Product Segmentation of Wooden Handicraft Micro, Small and Medium Enterprises (MSMEs) in Indonesia

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Abstract. The intense competition between wooden handicraft Micro, Small and Medium Enterprises (MSMEs) in Indonesia has encouraged business owners to generate creative innovation in order to maintain the sustainability of the company. This study aims to develop the new product development strategy based on the product segment characteristics from wooden handicraft MSMEs in the Special Region of Yogyakarta, Indonesia. The segmentation of products was done by applying the combination of K-Means Algorithm and Frequency, Monetary, Customer Variety (FMC) variables to the customer transaction data. The results showed five different types of product sales characteristics in three wooden handicraft MSMEs. It will encourage business owners to gain valuable insights about useful product sales characteristics for building business strategies to face increasingly fierce competition in this era.

1. Introduction
Micro, Small and Medium Enterprises (MSMEs) perform a significant role in the Indonesian economy. In 2017, MSMEs absorb 97.02% of the total labor and contribute 60% of Gross Domestic Product (GDP) at current prices[1]. The excessive spread of this type of business is still centered on Java Island with a percentage of 58.28% of the total number of MSMEs in Indonesia[2].

The wooden handicraft is one of the fastest growing MSME sectors in Java, especially in the Special Region of Yogyakarta. The development of the wooden handicraft MSMEs in the Special Region of Yogyakarta is supported by the great availability of natural resources and high creativity from the surrounding community [3][4]. However, this business sector also experienced various obstacles in its development process. One of the obstacles is the intense competition which naturally occurred as a result of the increasing number of wooden handicraft MSMEs in the Special Region of Yogyakarta. This phenomenon encourages business owners to develop innovative strategies to win the competition and maintain the company's sustainability.

Information technology is one of the factors that contribute significantly to the development of a company's business processes[5]. The application of information technology in an organization can reduce costs and processing time because it integrates all systems automatically [4]. One type of information technology that has been widely applied to various companies is Customer Relationship Management (CRM), which defined as a system that utilizes historical data from customers to find out information related to customer behavior patterns[7]. The main purpose of the implementation of CRM is to increase customer loyalty and company profitability[8].

Customer segmentation is one example of CRM applications widely used in various types of industries, such as retail [9] and veterinary[10]. It is defined as the customer classification process based
on the similarity of the characteristics or features of the customer[11]. By segmenting customers, companies can find out customer behavior patterns and build strategies tailored to the characteristics of the targeted customer segments. Contrary to customer segmentation, research that discusses product segmentation is very rare, especially in the wooden handicraft sector.

This study aims to develop the new product development strategy based on the characteristics of the product segment of three wooden handicraft MSMEs in the Special Region of Yogyakarta, Indonesia. This research is used to provide MSMEs owners with an overview of the characteristics of their product base to build a competitive advantage of their business.

2. Research Methodology

The methodology of this research was conducted by integrating the Frequency, Monetary, and Customer Variety (FMC) variables with the K-Means algorithm method for product segmentation based on the customer transaction data from three different wooden handicraft MSMEs in the Special Region of Yogyakarta, Indonesia.

2.1. Frequency, Monetary, Customer Variety (FMC) Variables

The first step that must be done before starting product segmentation is determining which variables will be used for segmenting products. Recency, Frequency, and Monetary (RFM) variables are features that are widely used in various studies as a reference for segmenting customers[12]. Recency is defined as the time gap since the last transaction of a customer. Frequency indicates the total number of purchase transactions. Monetary denotes the amount of money that customers spend for a certain period of time. The purpose of the RFM analysis is to classify customers based on their RFM measure from the customer transaction data[13].

Based on the main idea of RFM model, Peker, Kocyigit, and Eren introduce a new approach for product segmentation by using a modification of the RFM variables called FMC variables[14]. The FMC variables are defined as:

- Frequency (F) : the total number of times the product has been purchased by the customer for a certain period. This variable is measured by calculating the number of transaction dates of a product on customer transaction data.
- Monetary (M) : the total amount of money spent by customers to buy a product for a certain period. This variable is measured by summing the total expenditure of a product on customer transaction data.
- Customer Variety (C) : the number of unique customers who buy a product for a certain period. This variable is measured by calculating the number of unique (non-recurring) customers who buy a product on customer transaction data.

2.2. K-Means Algorithm

K-Means algorithm is one of the most popular clustering methods due to its easiness to implement and has a relatively small complexity of time and space[15]. This method starts with a random, initial partition and continues reassigning the samples to clusters based on similarities between the samples and the cluster centers until a convergence criterion is met, which is characterized by the discontinuation of reassignment of any sample from one cluster to another[16]. The steps in implementing the K-Means algorithm are as follows[17]:

- Step 1: select the initial cluster number k containing randomly chosen samples and compute the centroids of the clusters;
- Step 2: the distance between each data point and the centroid is calculated, and data points are assigned to the centroid with the minimum distance;
- Step 3: new centroids are calculated;
- Step 4: the distance between each data point and the new centroid is recalculated, assigning data points to their new nearest cluster;
- Step 5: repeat steps 3-5 until no further changes.
3. Data Analysis

The data used in this study was customer transaction datasets from three wooden handicraft MSMEs which domiciled in the Special Region of Yogyakarta and had been operating for a minimum of two years (Company X, Company Y, and Company Z). Each data set contained records of customer transaction data for 17 months consisting of transaction ID, transaction date, customer ID, product ID, shipping address, quantity purchased, unit price, shipping and other expenses, and net income. Example of transaction datasets used in this study can be seen in Table 1.

### Table 1. Example of customer transaction data set from Company X.

| Trans. ID | Transaction Date | Customer ID | Product ID | Shipping Address | Quantity | Unit Price (Rp) | Shipping and Other Expenses (Rp) | Nett Income (Rp) |
|-----------|------------------|-------------|------------|------------------|----------|----------------|-------------------------------|-----------------|
| 1         | 1/12/2017        | CUST 01 X1 | Self pickup | 5                | 250,000 | 0              | 1,250,000                     |
| 2         | 1/14/2017        | CUST 02 X2 | Jakarta    | 100              | 35,000  | 175,000        | 3,325,000                     |
| 3         | 1/14/2017        | CUST 02 X3 | Self pickup | 100              | 42,000  | 0              | 4,200,000                     |
| 4         | 1/14/2017        | CUST 02 X4 | Self pickup | 100              | 33,000  | 0              | 3,300,000                     |
| 5         | 1/18/2017        | CUST 03 X5 | Tangerang  | 30               | 194,500 | 115,000        | 5,720,000                     |
| ...       |                  |             |            |                  |         |                |                               |
| 295       | 5/30/2018        | CUST 51 X80| Jakarta    | 1                | 125,000 | 25,000         | 100,000                       |

3.1. Data extracting process

The massive number of customer transaction data sets must be integrated into one database to facilitate the process of extracting information. The database management system (DBMS) in this study was carried out using Microsoft Access. The information required for this research was Frequency, Monetary and Customer Variety (FMC) variables. To extract this information from the customer transaction database, the query design was used in Microsoft Access. Example of the result of FMC variables extraction from database transactions was presented in Table 2.

### Table 2. Examples of FMC variable extraction in Company X.

| Product ID | Frequency | Monetary   | Customer Variety |
|------------|-----------|------------|------------------|
| X1         | 1         | 1,250,000  | 1                |
| X10        | 2         | 6,664,000  | 1                |
| X100       | 1         | 3,204,500  | 1                |
| X101       | 1         | 1,125,000  | 1                |
| X102       | 1         | 97,500     | 1                |
| ...        |           |            |                  |
| X99        | 3         | 1,170,000  | 1                |

3.2. Determination of the number of clusters

Before classifying the products, the optimal number of clusters must be determined beforehand. Determination of the number of clusters was carried out by the Elbow Method. The key concept of this method was to find a turning point on the curve from the total Within-cluster Sum of Square (WSS) to the number of clusters[18]. In this study, the number of clusters used was 2 to 10 (k = 2 to k = 10). The results of the Elbow Method analysis showed that the optimal number of clusters for Company X, Y, and Z database was k = 5. The graphics result of the Elbow Method analysis was shown in Figure 1.

3.3. Product segmentation

Product segmentation was done by combining FMC variables obtained from query extraction with the K-Means algorithm. Table 3 shows the results of product segmentation that describe the sample size, the average value of the FMC variable, and FMC Scores of each product segment. Determination of FMC scores referred to research from Ha and Park[19]. The average value of FMC variables in each cluster was compared to the total average value of FMC variables from all clusters. If the average value of variables in a cluster was greater than the total average value, then the arrow sign upwards (↑) added to the variable. Conversely, if the average value of variables in a cluster was smaller than the total...
average value, then the sign of the arrow down (↓) added to the variable. In addition, Table 4 shows the sample products in each segment of Company X, Y, and Z as a reference in analyzing the characteristics of each product segment.

**Figure 1.** Total Within Sum of Square values from k=2 to k=10 for Company X (a), Company Y (b) and Company Z (c).

**Table 3.** Results of product segmentation of each company.

(a) Company X

| Segment | Sample Size | Average F | Average M       | Average C | FMC Scores |
|---------|-------------|-----------|-----------------|-----------|------------|
| 1       | 115         | 1.47      | 1,636,713.04    | 1.11      | F↑M↑C↑     |
| 2       | 1           | 26        | 2,443,750       | 8         | F↑M↑C↑     |
| 3       | 3           | 8         | 919,333.33      | 7         | F↑M↑C↑     |
| 4       | 1           | 20        | 1,688,400       | 1         | F↑M↑C↑     |
| 5       | 41          | 1.37      | 9,332,182.93    | 1.02      | F↑M↑C↑     |
| **Total Average** |           | **1.83**  | **3,588,395.34** | **1.24**     |

(b) Company Y

| Segment | Sample Size | Average F | Average M       | Average C | FMC Scores |
|---------|-------------|-----------|-----------------|-----------|------------|
| 1       | 13          | 5.08      | 1,629,692.31    | 4.69      | F↑M↑C↑     |
| 2       | 1           | 12        | 2,880,000       | 12        | F↑M↑C↑     |
| 3       | 86          | 1.74      | 409,843.81      | 1.23      | F↑M↑C↑     |
| 4       | 11          | 1.36      | 2,327,727.27    | 1.36      | F↑M↑C↑     |
| 5       | 3           | 9.67      | 2,655,151.51    | 2.33      | F↑M↑C↑     |
| **Total Average** |           | **2.39**  | **814,763.35**  | **1.76**     |
(c) Company Z

| Segment | Sample Size | Average F | Average M     | Average C     | FMC Scores |
|---------|-------------|-----------|---------------|---------------|------------|
| 1       | 71          | 15.58     | 7,975,020.38  | 15.35         | F↑M↑C↑     |
| 2       | 484         | 2.03      | 975,941.83    | 2.01          | F↓M↓C↓     |
| 3       | 9           | 62.56     | 19,195,702.09 | 61.11         | F↑M↑C↑     |
| 4       | 4           | 108.50    | 18,022,843.69 | 106.00        | F↑M↑C↑     |
| 5       | 3           | 133.00    | 39,959,495.11 | 130.00        | F↑M↑C↑     |

Total Average | 6.11 | 2,457,641.81 | 6.00 |

Table 4. The sample products in each segment of Company X, Y, and Z.

(a) Company X

| Segment | Samples |
|---------|---------|
| 1       | Photo album, stationery case, fridge magnet, keychain, tissue box |
| 2       | Name card holder 1 |
| 3       | Name card holder 2, wedding ring box, desk organizer |
| 4       | Name card holder 3 |
| 5       | Bible verse placemats, candle container, wooden cross |

(b) Company Y

| Segment | Samples |
|---------|---------|
| 1       | Small cutting board 1, long bread board 1, snack platter and glass tray 1, large cutting board, round bread board, rectangular tray, glass tray set 1 |
| 2       | Snack platter and glass tray 2 |
| 3       | Small cutting board 2, round cake stand 1, long bread board 2, eggy bread board, long serving board 1, square dessert plate, medium cutting board |
| 4       | Long serving board 2, rectangular platter, small chopping board, extra large round serving plate, snack platter and glass tray 3 |
| 5       | Round cake stand 2, glass tray set 2 |

(c) Company Z

| Segment | Samples |
|---------|---------|
| 1       | Bread box, interphone box, storage box, square tissue box 1, hanger |
| 2       | Decorative lights, placemats, wooden board, signboard |
| 3       | Wood letter 1, multifunction box, robo tissue box, snack box |
| 4       | Slide box 1, wood letter 2, square tissue box 2, tissue holder |
| 5       | Slide box 2, folding shelf, single hook |

4. Result and Discussion

In this section, the analysis of the product segmentation results for the three companies will be elaborated. Moreover, advice will also be given to the business owners based on the characteristics of the product segment of each company.
4.1. Company X

Products sold by Company X were divided into five segments (see Table 3). Segment 1 was characterized by the lower average value of all FMC variables compared to the total average value. It indicated that the products in Segment 1 were the least sold and did not make a large contribution to the company's income. This segment also had the largest number of the sample size compared to other segments. It showed that most of the products sold by Company X provide low values for the company. Therefore, Company X needs to take into account the product classification results in this segment to improve the efficiency of the company by focusing the production activities on the company's pillar products.

The products included in Segment 2 and Segment 3 had the same characteristics, which were often purchased by various customers, but less contributed to the company's revenue. Meanwhile, Segment 4, which only consisted of one product, had product characteristics with a large frequency of purchases, but only purchased by one type of customer and less contributed to the company's income. Table 4 shows that the same types of products with different variations, namely name card holders, are classified into three different segments (Segment 2, 3, and 4). It proves that the same type of product can have different sale characteristics depending on variations in product design, the type of targeted customer segment, the price of the product, etc. Thus, Company X needs to identify the factors that caused the differences to perform production planning accurately and in accordance with customer wishes.

Segment 5 of Company X was characterized by a combination of a low Frequency-Customer Variety values and a high Monetary value. In Table 4, it can be seen that Segment 5 is dominated by religious products, such as bible verse placemats, container candles, and wooden cross. Customers who buy these products were the owners of stores offering religious products, where Company X acted as a supplier for these stores. Although the shop owners only made several purchases of products in Segment 5, the number of purchased was quite large and contributed significantly to the company's revenue. Hence, it is important for Company X to maintain good relationships with these customers in order to maintain the profitability of the company.

4.2. Company Y

There were three combinations of FMC scores in Company Y. The first combination was FMC scores with the average value of the three FMC variables which higher than the total average value. This combination appeared in Segment 1, 2, and 5. Products with this kind of characters were defined as best-selling products of the company and contributed significantly to the company's revenue. Thus, for those kinds of product cluster, the recommendation that needs to be considered by business owners is ensuring that these products are always available to anticipate the high demand of the products [14].

The second combination was shown in Segment 4. This combination was found in products with low frequency and customer variation but contributed significantly to the company's income. The last combination was shown in Segment 3, which was indicated by the lower average value of all FMC variables than the total average value. The FMC scores in Segment 3 indicated that the products contained in this segment were rarely purchased by customers.

Company Y is a wooden handicraft MSME specializing in kitchenware products. This company only has a few types of products. It can be seen from the overall number of sample sizes from Company Y, which was smaller when compared to the other two companies. In addition, the emergence of the same type of product repeatedly in different segments shows that this company focuses its production planning on variations of existing product types. The differences in characteristics between one product with another caused one type of product to be included in a different segment. The results of segmentation on Company Y products are very useful as a reference for business owners to develop new product development strategies which accordance with the needs of customers.

4.3. Company Z

In general, product characteristics in Company Z can be classified into two major groups. The first group was the best-selling product group which characterized by the greater average value of all FMC variables
compared to the total average value. This characteristic appeared in Segment 1, 3, 4, and 5 of Company Z. Meanwhile, the second group, namely the least-selling products group, had the characteristics of the average value of all FMC variables that were smaller than the total average value. This characteristic appeared in Segment 2 of Company Z.

In Table 4, it can be seen that products with aesthetic functions, such as decorative light, placemats, wooden board, signboard, are included in Segment 2. It shows that products with practical functions, such as bread box, tissue box, and hanger, are more desired by customers from Company Z. Moreover, Company Z manufactured several products of the same type as the other two companies but has different characteristics of FMC scores. One of the examples was the tissue box. Both Company X and Company Z produced the tissue box. However, on the Company X product segmentation, the tissue box was included in the product segment that is less in demand. Meanwhile, on Company Z this product belonged to the best-selling product segment. It showed that the variation of the product results in the differences in the sales characteristics of the same product.

Although products with the best-selling product characteristics occupy four segments in the product classification in Table 3, there are still approximately 84.7% of products that have the least-selling product characteristics and occupy Segment 2. Therefore, Company Z needs to consider the results of product segmentation in this study as a basic idea in designing a product development strategy in the future.

5. Conclusion
This research was aimed to develop the new product development strategy based on the product segment characteristics of wooden handicraft MSMEs in the Special Region of Yogyakarta, Indonesia. Product segmentation was done by combining Frequency, Monetary, Customer Variety (FMC) variables with the K-Means algorithm clustering method. The results showed five different types of product sales characteristics in the three wooden handicraft MSMEs in the Special Region of Yogyakarta. Furthermore, the analysis of the sample products in each segment revealed that the variation of the same product caused the differences in product sales characteristics.

As further research, the product improvement factors which derived from product characteristics in each segment need to be identified. Other clustering techniques also can be used to segment products, especially those that take into account fuzzy factors in the process. In addition, future research can also be done by adding other variables besides FMC as a reference for segmenting products.

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