

# Analytical Customer Relationship Management for Garage Services Recommendation Using the Generalized Sequential Pattern Method

(A Study Case: PT. Armada International Motor)

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## ABSTRACT

Analytical CRM refers to CRM's component needed by PT. Armada International Motor ( PT. AIM ) Indonesia in achieving customer knowledge that consists of customer behavior and profile from PT. AIM's garage database. Using data mining exploration held on garage data in order to find possible pattern as management' precise decision making base. Generalized Sequential Pattern (GSP) Algorithm refers to sequential data mining algorithm which able in exploring data that able solving any time and taxonomy constraints. GSP Algorithm implemented in this study in order to find customer service pattern both sequentially and simultaneously. One advantage of service type pater founded that taken simultaneously is as service type recommendations base that can be run simultaneously at one service period. Furthermore, it may be used as promotion planning base, e.g. product bundling.

**Keywords:** Analytical CRM, Data mining, GSP, Garage.

## 1. INTRODUCTION

PT. Armada International Motor (PT. AIM) is one of the automotive distributor companies in Indonesia which has selling division and garage division to provide services for customers' vehicles.

According to the data, the growth of Indonesia's car market has always experienced a rising trend from 2010 [1]. This fact makes the competition in the market more competitive, so that every automotive distributor company is competing for the market. According to Ross [2], a key factor to gain market share is to build customers' loyalty and develop a sustainable competitive advantage.

Keeping the customers and increasing their loyalty is two very important financial activities within a company. Based on the fact that attracting new customers is much more costly [3][4]; therefore, studying the factors that support the growth of the loyalty of the customers

becomes a crucial management issue. This has encouraged PT. AIM to improve the strength of the relationship with customers for the company's development process and increasing the profits by implementing CRM (Customer Relationship Management). However, only the new operational CRM system is applied in PT.AIM. This has led to the company's superficial knowledge of the consumers' profile and behavior, resulting at the company cannot predict future actions. Therefore, it is necessary to have an analytical CRM system that focuses on the processing and interpretation of the data collection that has been stored in order to create meaningful and beneficial interactions with customers [5]. Analytical CRM is the most critical component in CRM [6] because it determines the ability of the CRM system to acquire knowledge of customers [7] and allows to effectively manage relationships with customers [5].

From the database of PT. AIM's garage we can obtain database, customer data, service transactions, and the types of services performed. However, it is still unknown how the behaviors of customers are in choosing the types of service in each scheduled service. This will result in the random selection types of service. Types of service and the schedule of service is an important factor in taking care of the vehicle. There are several types of services that are related to each other, and the schedule of service is an important factor in determining the type of service that is performed in a sequential manner. Therefore, it is necessary to apply the data mining techniques to explore patterns of the service done by the customer.

The implementation of data mining techniques to identify opportunities and optimize customers' interactions [8] is an analytical CRM step which is a process associated with the use of data effectively, efficiently, and strategically, so as to enable the right decisions for the management [9]. Data mining can also search for the compatibility between the product and the customers and provide better targeting

of promotional products. In other words, it can be said that data mining helps CRM in their responsibility to obtain, develop and maintain customer's loyalty [10].

One method of data mining is generalized sequential pattern (GSP), which is a method that can look for relationships between different items in a dataset where different data are on a transaction that results in a different grouping. The data of what kind of service transactions that already exist in the database will be excavated and grouped to find a distribution pattern of the entire dataset; and there will be a result of a service relationship pattern that is performed simultaneously and also a type of service pattern that is performed sequentially.

Based on the description above, this study will apply the algorithm of generalized sequential pattern to the data of PT. AIM's garage in order to determine the pattern of relationship of the types of services that are performed simultaneously or sequentially, which is used as the basis for service recommendations and basic managerial decision making in improving relationships with customers.

## 2. RELATED WORK, RESEARCH PURPOSE AND CONTRIBUTION

### 2.1 Related Work

A study entitled "Implementation of Data Mining Techniques in The Concept of Customer Relationship Management (CRM)" explains that there are three major types of CRM, one of which is an analytical CRM that enables an accurate decision-making action for the management because it involves the process of analysis, modeling, and evaluation of the data stored in the database to generate a mutually beneficial relationship between the company and its customers. In this study, the data mining applied in CRM concept uses the association rule method to obtain the association between one product and another product as the basis of marketing strategies for cross selling in retail companies [11].

The study "Data Mining with Fuzzy Method for Customer Relationship Management (CRM) in Retail Company" [12] discusses about the data mining process from the sales data of UD. Fenny, a retailer of baking materials and equipment located in Denpasar, Bali, looks for potential customers to conduct consumer segmentation which is the process to determine consumers' behavior and implement appropriate marketing strategies to be profitable for the company. The data mining process begins with the process of clustering using Fuzzy C-Means (FCM) algorithm and Fuzzy Subtractive (FS) Clustering. The clustering results of each of the methods are used for segmentation using Fuzzy RFM model to find the consumer class.

### 2.2 Research Purpose

In this study, extracting the data of the service transactions in the garage is conducted to obtain customer transaction patterns either simultaneously or sequentially using the GSP algorithm as an CRM analytical step which is used as the basis for giving recommendations of service and the basis for managerial decision making in improving relationships with customers.

### 2.3 Research Contribution

For the company, the use of analytical CRM can give knowledge in the form of customer transaction patterns that can be used by the management as a basis for decision-making actions in maintaining customers' loyalty, such as promotions of product building or product affinity, and the company's CRM application development which is based on the knowledge found. This will give a positive effect not only for the garage division, but also for the sales division.

In the future, this study is expected to contribute to the learning of analytical CRM and development of CRM applications.

## 3. GENERALIZED SEQUENTIAL PATTERN ALGORITHM

Generalized Sequential Pattern (GSP) is a sequential data mining algorithm that can overcome the limitations of time and taxonomy introduced by R. Srikant and R. Agrawal on EDBT'96. GSP algorithms perform several processes of the data to dig deeper into the data in order to find knowledge, as illustrated in the process of extraction on Knowledge Discovery in Databases in Figure 1.

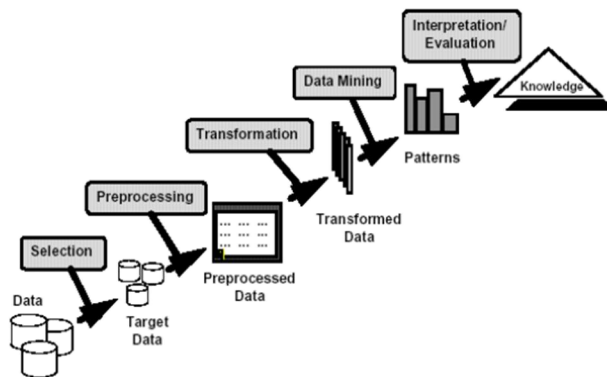


Fig. 1. Knowledge Discovery in Database Process [13]

Based on the process of knowledge discovery in database in Figure 1, before the process of extracting the data, data preparation is performed. The purpose of the

data preparation process is to prepare the data into an effective and efficient form to be extracted. The data preparation process in this study is divided into three main stages, which are:

1. *Data selection*

Data selection is a process of selecting the data from the garage of PT. AIM in the year of 2009 to 2014 which consists of 5070 customers, 10610 transactions and 59400 detailed transactions. The relevant data are selected to obtain the target data, such as transaction data, the data of spare parts, the data of the type of service, and the dates of service.

2. *Preprocessing*

Preprocessing is the process of consolidating the data targets with a special structure to make it more efficient. The table attributes that are not used will be omitted to make them more efficient and form a new relationship of tables that have been established. The data of spare parts and the data of the types of services are included in one table.

3. *Transformation*

In this process, the results of the preprocessing will be transformed into an appropriate form of database to be extracted. The results of this transformation process are item table, transaction table, transaction\_detail table, and time table.

4. **Result and Discussion**

After the data passed the preparation process, then it will proceed to the data mining process which is the process of extracting data to find patterns in the data set that has been established. In this study, the data collection was done by using the GSP algorithm. Before carrying out the GSP algorithm, predetermination of the time constraint was conducted to limit the time gap between the series of transactions that contained sequential elements on the data sequence [14]. Table 1 shows the time constraint in this study.

Table 1: Time Constraint

Time Gap	Start Time	End Time
1	2009-01-01	2009-03-31
2	2009-04-01	2009-06-30
3	2009-07-01	2009-08-31
...	...	...

The following GSP algorithm process in this study are:

A. **Finding Individual Item with minSupport (1-Sequence)**

Before finding individual item, minimum support must be determined first, which in this study is 0.5. Will be founded the candidate from data sequence or database that fulfilled the minimum support. After candidate 1-sequence founded, system will calculate the number of candidate have been obtained from sequence data. This process named as counting candidate thus resulted frequent 1-sequence as shown at Table 2 (Process shown with item id number in database).

Table 2: Frequent 1-Sequence

Frequent 1-sequence	Number of Item
51383	7109
46472	3733
47072	7412
41006	7410
40956	7625
50259	6387
40957	7622
48633	5973
...	...

B. **Using The Individual Item in Finding 2-Sequence**

From individual item at frequent 1-sequence, merging and pruning processes held which are the part of candidate generation process. Candidate generation results in this phase shown at Table 3.

Table 3: Candidate Generation 2-Sequence

Frequent 1-sequences	Candidate 2-sequence	
	after join	after pruning
51383	(6472, 8633)	(6472, 8633)
46472	(0956, 6472)	(0956, 6472)
47072	(0957) (1006)	(0957) (1006)
41006	(0259) (1006)	(0956) (8633)
40956	(0956) (8633)	(1006) (0259)
50259	(1006) (0259)	(0957) (0259)
40957	(0957) (0259)	(1006) (8633)
48633	(1006) (8633)	(1006, 8633)
	(1006, 8633)	...
...	...	...

After candidate generation process, then will be held counting candidate process. Counting candidate results in this phase are shown at Table 4.



Table 4: Frequent 2-Sequence

Frequent 2-sequence	Number of Item
(46472, 48633)	4553
(50956, 46472)	4816
(40957) (41006)	4940
(40956) (48633)	4559
(41006) (50259)	4681
(40957) (50259)	4559
(41006) (48633)	...
(41006, 48633)	
...	

**C. Using K-Sequence to Find (K+1)-Sequence**

After frequent 2-sequence founded, then candidate generation 3-sequence is held. Candidate 3-sequence results shown at Table 5.

Table 5: Candidate Generation 3-Sequence

Frequent 2-sequences	Candidate 3-sequence			
	after join		after pruning	
(46472,48633)	(40957) (41006, 48633)	(41006, 48633)	(40957) (41006, 48633)	(41006, 48633)
(40956, 46472)	(40956, 46472, 48633)	(46472, 48633)	(40956, 46472, 48633)	(46472, 48633)
(40957) (41006)	(40957) (50259) (41006)	(41006) (50259)	(40957) (50259) (41006)	(41006) (50259)

(40956) (8633)	(40957) (41006) (48633)	(40957) (41006) (48633)
(41006) (50259)	...	...
(40957) (50259)		
(41006) (48633)		
(41006, 48633)		
...		

Candidate 3-sequence will be calculated in resulting frequent 3-sequence. Frequent 3-sequence shown at Table 6.

Table 6: Frequent 3-Sequence

Frequent 3-sequence	Number of Item
(40957) (41006, 48633)	4811
(40956, 46472, 48633)	4810
(40957) (41006) (50259)	4553
(40957) (41006) (48633)	4558
...	...

This process will retain. Itemsets at frequent 3-sequence used in resulting candidate 4-sequence.

**D. Finding The Last Frequent Sequence**

In this study, process will be ended up after frequent 8-sequence found. Frequent 8-sequence results on application are shown at Figure 2.

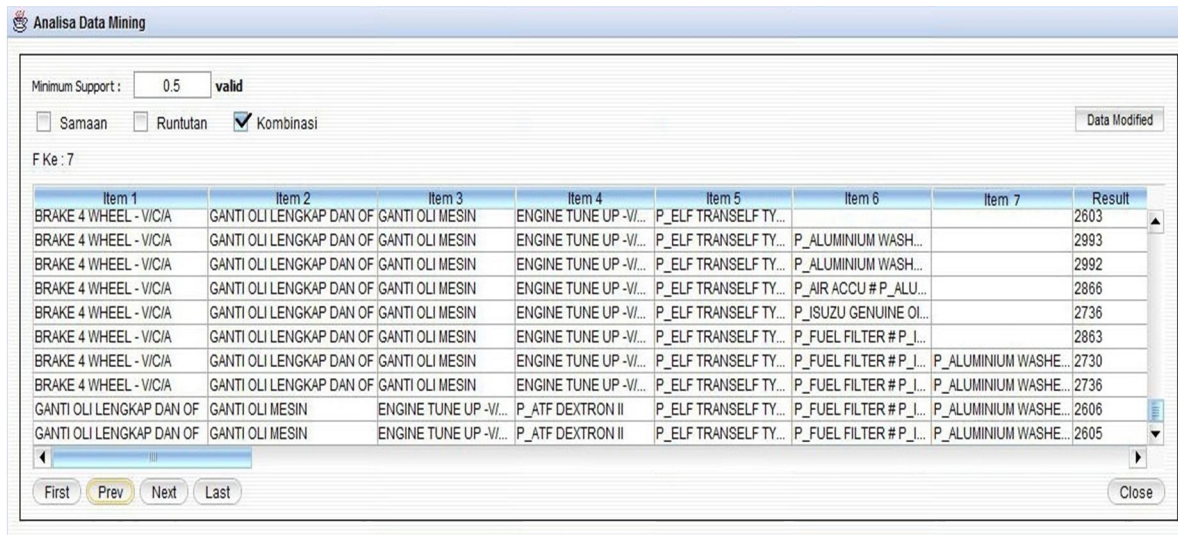


Fig. 2. Sequential Pattern of Data Mining Application Result

Figure 2 is sequential pattern of data mining result or in this study refers to itemset at frequent 8-sequence that including some sequential patterns. This are following half of sequential patterns found:

- {(Ganti oli lengkap dan of) (Ganti oli mesin) (Engine tune up - V/C/A) (ATF dextron II) (Elf tranself type B) (Fuel filter, Isuzu genuine oil) (Aluminium washer)}



- {(Brake 4 wheel – V/C/A) (Ganti oli lengkap dan of (Ganti oli mesin) (Engine tune up-V/C/A) (Elf tranself type B, Air accu, Kuras minyak kopling) (Fuel filter, Isuzu genuine oil) (Alumunium washer 14-22)}
- {(Brake 4 wheel – V/C/A) (Ganti oli lengkap dan of (Ganti oli mesin) (Engine Tune Up-V/C/A, Bleeding oli rem) (Elf tranself type B) (Air accu, Alumunium washer)}
- From several sequential patterns found, it can be seen that :
- Except Engine tune up - V/C/A , Ganti Oli mesin is type of service that always included in pattern.
- After doing Ganti oli mesin, Engine tune up - V/C/A will be taken on the next period.
- From 8 available pattern, Elf tranself type B spare part purchasing will be held, after Engine tune up - V/C/A done.

According to CRM dimension consists of customer identification, customer attraction, customer retention and customer development [8], sequential pattern of service type found may be used as the basic in performing one of CRM task in customer development dimension, which is sequential market based analysis or next sequential purchase that belong to analysis in forecasting what product or service that will be bought by customer in further [15]. In this study, the main aim of sequential pattern of service type that found is as the basis of providing type of service recommendation that must be taken in the next service. While the other advantage is as promotion base by making type of service package sequentially in a year supported with membership system thus customers will get discounts or cheaper price instead choose type of service by themselves at each visit. In addition to type of service pattern that taken sequentially, by GSP algorithm also found type of service pattern that taken simultaneously. Figure 3 shows type of service that taken simultaneously

Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Result
GANTI OLI LENGKAP DAN OF	ENGINE TUNE UP -V/C/A	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_AIR CLEANER	P_ISUZU GENUINE OIL	2604
GANTI OLI LENGKAP DAN OF	ENGINE TUNE UP -V/C/A	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_AIR CLEANER	P_AIR ACCU	2733
GANTI OLI LENGKAP DAN OF	ENGINE TUNE UP -V/C/A	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_ISUZU GENUINE OIL	P_AIR ACCU	3647
GANTI OLI LENGKAP DAN OF	ENGINE TUNE UP -V/C/A	P_ELF TRANSELF TYPE B	P_AIR CLEANER	P_ISUZU GENUINE OIL	P_AIR ACCU	2605
GANTI OLI LENGKAP DAN OF	ENGINE TUNE UP -V/C/A	P_FUEL FILTER	P_AIR CLEANER	P_ISUZU GENUINE OIL	P_AIR ACCU	2734
GANTI OLI LENGKAP DAN OF	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_AIR CLEANER	P_ISUZU GENUINE OIL	P_AIR ACCU	2867
GANTI OLI LENGKAP DAN OF	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_ISUZU GENUINE OIL	P_AIR ACCU	P_ALUMINIUM WASHER ...	2863
ENGINE TUNE UP -V/C/A	P_ELF TRANSELF TYPE B	P_FUEL FILTER	P_AIR CLEANER	P_ISUZU GENUINE OIL	P_AIR ACCU	2604

Fig. 3. Association Pattern of Data Mining Application Result

Figure 3 is association pattern or type of service pattern that often taken simultaneously. Association patterns that fulfilled the minimum support were found, some of which are:

- {(Engine tune up – V/C/A, Elf Tranself Type B, Fuel filter, Air cleaner, Isuzu genuine oil, Air accu)} with 2756 number of transactions.
- {(Ganti oli lengkap dan of, Engine tune up – V/C/A, Elf Tranself Type B, Fuel filter, Air cleaner, Isuzu genuine oil )} with 2604 number of transactions.

Of several association patterns found, can be seen that :

- Type of service Ganti oli mesin dan of is often taken simultaneously with Engine tune up - V/C/A.

- Type of service Engine tune up - V/C/A is often taken simultaneously with combination of Elf tranself type B Fuel filter, Air cleaner, Isuzu genuine oil, and Air accu.
  - Fuel filter, Air cleaner, Isuzu genuine oil, and Air accu are often purchased simultaneously.
  - Spare part combination that sold simultaneously has greater sale number than type of service combination that taken simultaneously.

Association pattern of type of service that found is the result of CRM analytical that may be used in performing one of the CRM’s task in customer development dimension, namely market based analysis [8], especially product bundling. The main aim of this study of association of service type that has been found is as the

basis of providing type of service recommendations that possible to be taken simultaneously by customer. Furthermore, another advantage is as the basic in (b) providing information to management as the basic of promotion making of type of service package, (c) providing information to management as the basic to create promotion of type of service package together with spare part, (d) providing information to management as the basic to create promotion of spare part purchasing package.

## 5. Conclusions

Based on the results of the study, it is concluded that the Generalized Sequential Pattern algorithm was able to excavate the data and determine the customers' behavior patterns in selecting the types of services conducted simultaneously and even sequentially. There were several sequential patterns of the datamining results that produced some knowledges, one of which was after doing the Ganti oli mesin, the Engine tune up - V/C/A would be the service type in the following periode. The main purpose of finding each sequential pattern was to be used as the basis of providing the service type recommendation that had to be done in the next service periode. Moreover, it can also be used as the basis of promotion, i.e. to make a service package for consecutively one-year periode using a membership system, so that customers could get discounts or lower prices compared to when they choose a service type by themselves in every visit.

Data mining with GSP algorithm also generated association patterns, one of which was the oil change service type that was frequently done along with Engine tune up - V/C/A. In addition, the main purpose of finding each association pattern was as the basis for providing recommendations on service types that could be simultaneously given to customers. Besides that, it could also provide information to the management as the basis of making promotions of the service type packages, the service package with spareparts, and the sparepart buying package.

For further studies, this study can hopefully be used as the source of application development, both web-based and mobile applications, so that customers can get the access in finding the recommendations of services that have to be done and the reminders of service schedules.

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