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IMPLEMENTATION OF THE FP-GROWTH ALGORITHM ON SPARE PARTS SUPPLY REQUESTS

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Abstract

Manufacturing companies rely on machines for operational activities to produce finished goods. Common factors constraining the demand and supply of spare parts are the high number of spare parts managed and irregular patterns of demand for spare parts. These varying quantities also require investment in spare parts inventory and longer response times than predicted. The research aims to apply the FP-Growth algorithm approach to find association rules and produce patterns of demand and supply of spare parts in lightweight brick manufacturing companies based on transaction data on demand and supply of spare parts from January – March 2023. The approach used is associated with the applied algorithm. In this research, the primary process of the FP-Growth algorithm is to create a combination of each item until no more combinations are formed using minimum support and minimum confidence parameters. Based on the results of making association rules using spare parts demand data from the machine maintenance department, it is stated that the regulations formed from processing the RapidMiner application with a confidence value of 100% recommend FD Regular Bolt spare parts, then the next rating with a confidence value of 94% is Steel Nuts, seven rules recommend Nuts. Steel. Therefore, it is recommended that FD Regular Bolts and Steel Nuts carry out safety stock to maintain stock availability and place them on shelves included in the fast-moving inventory category.

Keywords: Inventory; Spare parts; Association; FP-Growth;

Abstrak

Perusahaan manufaktur dalam kegiatan memproduksi barang jadi mengandalkan sebuah mesin dalam kegiatan operasional. Faktor umum yang menjadi kendala permintaan dan persediaan sparepart yaitu tingginya jumlah sparepart yang dikelola dan pola permintaan sparepart yang tidak teratur, kuantitas yang bervariasi juga memerlukan investasi dalam persediaan sparepart dan waktu respon yang lama daripada yang sudah diperdiksi. Tujuan penelitian yaitu menerapkan pendekatan algoritma FP-Growth untuk mencari aturan asosiasi dan menghasilkan pola permintaan dan persedian sparepart pada perusahaan manufaktur bata ringan berdasarkan data transaksi permintaan dan persediaan sparepart yang terjadi pada periode Januari – Maret 2023. Pendekatan yang digunakan adalah asosiasi dengan algoritma yang diterapkan pada penelitian ini adalah algoritma FP-Growth proses utamanya adalah membuat kombinasi setiap item hingga tidak terbentuk kombinasi lagi menggunakan parameter minimum support dan minimum confidence . Berdasarkan hasil pembuatan aturan asosiasi menggunakan data permintaan sparepart departemen maintenance mesin menyatakan bahwa aturan yang terbentuk dari pengolahan aplikasi RapidMiner dengan nilai confidence 100% merekomendasikan sparepart Baut Biasa FD, kemudian rating selanjutnya dengan nilai confidence 94% adalah Mur Baja terdapat sebanyak 7 aturan yang merekomendasikan Mur Baja. Oleh sebab itu di rekomendasikan Baut Biasa FD dan Mur Baja melakukan safety stock guna menjaga ketersedian stock dan juga meletakan di rak yang termaksud kedalam kategori persediaan yang fast moving.

Kata kunci: Persediaan; Sparepart; Asosiasi; FP-Growth;

INTRODUCTION

Manufacturing companies rely on machines in their operational activities to produce finished goods (Junaidi, Rahman, & Yunita, 2021). Production machines in their activities have a long operational duration and can even exceed their working time limits(Ramadhani & Nugroho, 2022). To maintain machine performance, the company performs maintenance to check performance and machine maintenance and provides spare parts as a backup for machine parts in case of damage(Oktarini & Agustiningrum, 2022).

Running out of stock of spare parts in a company has a terrible impact on the smooth running of production machines, causing production results to decrease because the machines are not operating optimally. (Nurhidayanti & Kurniawati, 2022).

A common obstacle in the demand and management of spare part inventory is the high number of spare parts managed. The demand pattern for spare parts continues to change, making it difficult to predict the stock of spare parts that must be provided so that there is no lengthy production stoppage (Yansi, Fellisiana, Toding, & Mongan, 2023). Spare parts demand has an irregular pattern and varying quantities, requiring investment in spare parts inventory and longer response times than predicted. Therefore, stock availability is needed to anticipate this (Trisnawati, W, & Pujotomo, 2018).

Data mining is the application of various mathematical, statistical, machine learning, and artificial intelligence techniques to extract and identify things that help dig up hidden information in big data. (Silvanie, 2020). Association rules are one of the data mining techniques used to find relationships or association rules between a combination of items. This method can also be applied to view spare part demand patterns in manufacturing companies (Wibowo & Jananto, 2020).

Algoritma FP-Growth merupakan pengembangan dari algoritma apriori yang dapat di implementasikan dalam permasalahan permintaan suku cadang (Suhada, Ratag, Gunawan, Wintana, & Hidayatulloh, 2020). The frequent pattern growth algorithm is an alternative algorithm for determining data sets that often appear in spare part stock demand data sets (Anas, 2020). FP-Growth applies a tree-building concept called FP-Tree to search for frequent item sets and does not use candidates like the a priori algorithm (Setyorini, Mustakim, Adhiva, & Putri, 2020). The FP-Growth method consists of three main stages: the conditional pattern base generation stage, the conditional FP-Tree generation stage, and the frequent itemset search stage. (Ardianto & Fitrianah, 2019).

The manufacturing company produces lightweight bricks for building needs, be it houses, office buildings, apartments, etc. This company has a machine maintenance department manages machine maintenance and spare parts supplies. Based on the results of an interview with one of the machine maintenance department staff, they are currently not using specific methods to manage machine spare parts inventory. In managing spare parts supplies, the maintenance department uses an intuitive process, namely ordering for the current period based on demand for spare parts in the previous period, thus causing a stock out of spare parts when there is a sudden increase in demand.

Spare parts inventory management is a complex problem that needs to be handled quickly if production machine downtime occurs due to damage to spare parts or outdated spare parts. (Istiqomah, Yuli Astuti, & Siti Nurjanah, 2022). The spare part storage layout issue is also an obstacle because it is currently not regulated according to the pattern of spare part demand. The problem of spare part storage layout is also an obstacle because it is presently not regulated according to the pattern of spare part demand.

Based on the problems that occur in spare part inventory management, a solution is needed to determine the pattern of spare part demand, analyze the ongoing transaction data to find out which spare parts are often requested simultaneously to maintain the availability of spare part stock, can formulate safety stock to maintain the availability of spare parts and arrange the layout of spare part storage to facilitate the entry and exit of spare parts.

RESEARCH METHODS

This research uses data mining methods to analyze existing spare parts supply transaction patterns in light brick industrial manufacturing companies using the association method with the FP-growth algorithm (frequent pattern growth) (Munanda & Monalisa, 2021). This algorithm forms a frequent item set, which becomes a reference for formulating association rules (Suryati, 2022).

Types of research

This research uses spare parts inventory transaction data in manufacturing companies, including spare parts demand and inventory

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transactions. This research aims to examine patterns of demand and supply of spare parts.

Time and Place of Research

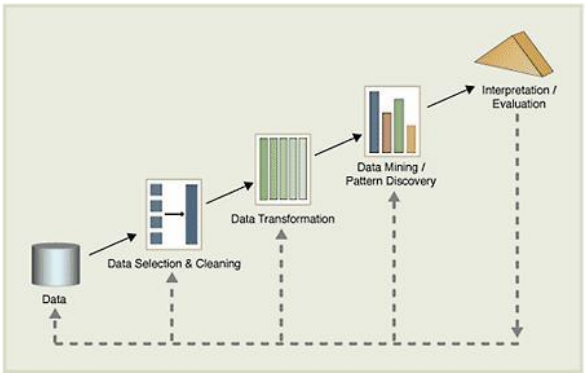
The research was conducted at a lightweight brick manufacturing company to obtain a history of spare parts supply and demand transactions from January to March 2023. The research period was three months.

Research Target / Subject

The research aims to apply the FP-Growth algorithm approach to find association rules and produce patterns of demand and supply of spare parts in lightweight brick manufacturing companies based on transaction data on demand and supply of spare parts from January - March 2023.

Procedure

The framework implemented uses the stages and procedures of Knowledge Discovery in the Database research process (KDD) (Ependi & Putra, 2019).



Source: (Amsury, Kurniawati, & Rizki Fahdia, 2023)
Figur 1. Knowledge Discovery in Database

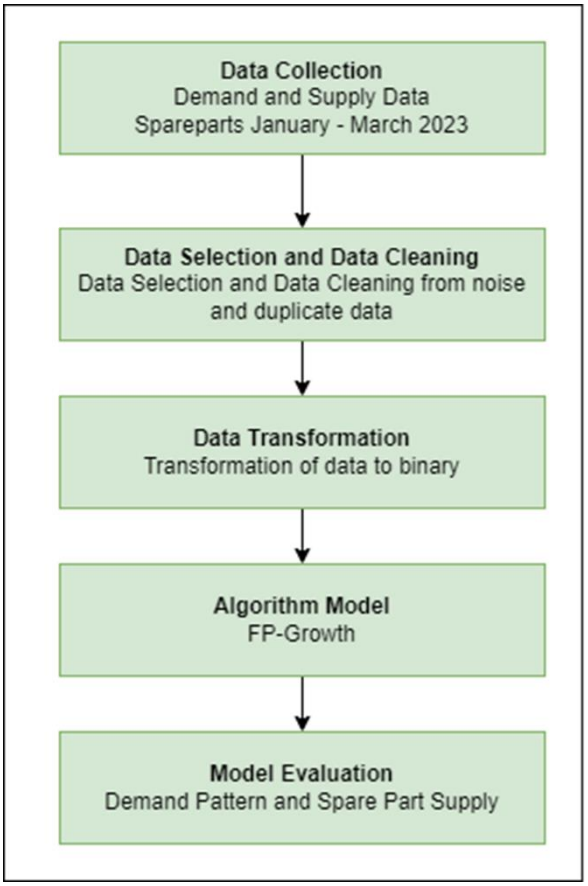
Figure 1 explains the steps in the KDD process used to search for and identify a pattern in the data. The data source for this research comes from spare parts supply and demand transaction data from January - March 2023. Then, data selection is carried out, and noise data is removed. The selected data is transformed so that the data mining process can be carried out, and the data mining process is carried out by searching for patterns or information from the data using the FP-Growth algorithm approach (Pranata & Utomo, 2020). Evaluation is translating patterns generated from data mining and presenting them in a form that interested parties easily understand.

Data, Instruments, and Data Collection Techniques

This research uses primary data from interviews and transaction data on demand and supply of spare parts for January - March 2023. Secondary data comes from journals and books related to the research carried out. Direct observations of the company were also carried out to find out information related to the existing spare parts supply and demand information system to help analyze patterns of spare parts demand and supply in the maintenance department, and interviews were conducted with staff regarding the spare parts demand and supply transaction process to understand the workflow and obtain the data needed in research.

Data analysis technique

The framework applied during the research process.



Figur 2. Resarch Stages

Figure 2 describes the research framework carried out as follows:

1. Identify the Problem

The research begins by identifying the problems that occur in the company, namely having

a lot of spare part request transaction data but only storing it in a database and not knowing how to use the data, even though the spare part request transaction data can be analyzed to obtain important information contained therein to determine the pattern of spare part requests to determine safety stock and rearrange the layout of goods.

2. Preprocessing

The spare part request transaction data that has been obtained must be processed first before data mining techniques can be applied, such as cleaning the data and removing noise in the data, selecting data, and transforming data so that it can be processed using data mining techniques. Then, the data is converted into binary data.

3. Method

This research applies the association method using the FP-Growth algorithm to discover the relationships and links between products requested simultaneously in a spare parts request transaction based on spare parts demand data for January - March 2023.

4. Algorithm

The approach used is associated with the algorithm applied in this study, namely the FP-Growth algorithm. The primary process is to combine each item until no more combinations are formed using the minimum support parameter (Junaidi, 2019). The support and confidence value parameters tested are 10% support value and 90% confidence, 20% support value and 80% confidence, 30% support value and 70% confidence, 40% support value and 60% confidence, and 50% support value and 50% confidence. Testing is carried out to find the best value of the support and confidence parameters of the FP-Growth algorithm.

This stage is carried out by searching for a combination of items that meet the minimum requirements of the support value stated in Equation 1 and the confidence indicated in Equation 2.

$$support(A \cap B) = \frac{\sum trans\ contain\ A\ and\ B}{Total\ transaction} \quad \text{.....(1)}$$

Equation 1 is a formula for finding the support value of two items.

$$confidence\ P(B|A) = \frac{\sum trans\ contain\ A\ and\ B}{Total\ transaction\ A} \quad \text{.....(2)}$$

Equation 2 is a formula for finding confidence values by calculating the A – B association rules.

5. Research results

The results of this research are to obtain transaction patterns for requests for spare parts so that companies know which spare parts are often needed to maintain stock availability and keep production machines running well. It also helps in the spare parts inventory layout process to make managing the spare parts stock layout easier.

RESULTS AND DISCUSSION

As a result of the observation and interview process carried out at lightweight brick manufacturing companies, spare parts demand transaction data was obtained for the period January - March 2023. Based on this data, data mining techniques will be implemented using the association method to determine spare parts demand patterns using the FP-Growth algorithm approach. The table below is a list of spare part codes and spare part names.

Table 1. List of Item Code and Description Item

No	Item Code	Description Item
1	S-16338	Adapter Actuator Valve
2	S-16674	Air Cylinder
3	S-16752	Air Cylinder AIRTAC
4	S-10196	Air Cylinder STNC
5	S-18083	Air Filter
6	S-12961	Air Oil Separator
7	S-12573	As Roda Hoist Packing
8	S-17918	As Stainless Steel 304
9	S-10927	Back Cover Pompa Slurry
10	S-10026	Bahan Nilon Bening
11	S-15226	Ball Valve Steam
12	S-13236	Band Pipe / Elbow
13	S-10457	Baut Baja FD
14	S-18104	Baut Baja NFD
15	S-11934	Baut Biasa FD
16	S-12613	Baut Biasa Kepala + JP FD
17	S-11358	Baut Biasa Kepala JP FD
18	S-12261	Baut Biasa NFD
19	S-10641	Baut Coupling Pump Slurry
20	S-18057	Bearing

Table 1 explains the spare part codes and detailed spare part descriptions for existing products.

The testing stage is carried out using data, namely the date of the transaction request and the spare part code requested by the machine maintenance department.

Tabel 2. Example spare parts demand data

January	Sparepart Name	February	Sparepart Name	March	Sparepart Name
01-01-23	Double Neple Hydrolic	01-02-23	Mur Baja	01-03-23	Besi As VCN
01-01-23	Baut Baja FD	01-02-23	Ring Per Baja	01-03-23	Bearing KOYO
01-01-23	Roll Convayer	01-02-23	Kawat Seling Biasa China	01-03-23	Air Cylinder STNC
01-01-23	Mur Biasa	01-02-23	Neple Selang Solenoid (L)	01-03-23	Motor + Gear Box Omiter
01-01-23	Mur Baja	01-02-23	Neple Selang Solenoid Drat	01-03-23	Baut Baja FD
01-01-23	Packing Asbes	01-02-23	Vanbelt BANDO	01-03-23	Mur Baja
01-01-23	Mur Baja	01-02-23	Bearing FAG	01-03-23	Roda PU 90 merah
01-01-23	Steam Valve	01-02-23	Rantai + Sambungan (FBJ)	01-03-23	Butterfly Valve+Penumatic
01-01-23	Baut Baja FD	01-02-23	Baut Biasa FD	01-03-23	Buttrerflay Valve Manual
01-01-23	Mur Baja	01-02-23	Mur Biasa	01-03-23	Fellure Clamp Hose
01-01-23	Ring Per Biasa	01-02-23	Ring Per Biasa	01-03-23	Mur Baja
01-01-23	Kawat Seling JermanBLUE STRAND	01-02-23	Air Filter	01-03-23	Bearing KOYO
01-01-23	Bearing FYH / Pillow Block	01-02-23	Oil Filter	01-03-23	Bearing ASB
01-01-23	Bearing ASB	01-02-23	Oil Fine Sparator	01-03-23	Bearing NACHI
01-01-23	Baut Biasa FD	01-02-23	Oil LubriCANT	01-03-23	Besi As VCN
01-01-23	Mur Biasa	01-02-23	Sutle Valve	01-03-23	Baut Baja FD
02-01-23	Bearing NACHI	01-02-23	Cleaning Coller	01-03-23	Baut Baja FD
02-01-23	Air Cylinder AIRTAC	01-02-23	Buttrerflay Valve Manual	01-03-23	Mur Baja
02-01-23	Pneumatic Cylinder Accessory	01-02-23	Neple Selang Solenoid Drat	02-03-23	Bearing NACHI
02-01-23	Vanbelt BANDO	01-02-23	Neple Selang Solenoid Drat	02-03-23	Baut Biasa FD
02-01-23	Baut Baja FD	01-02-23	Mur Baja	02-03-23	Mur Biasa
02-01-23	Mur Biasa	01-02-23	Bearing NACHI	02-03-23	Bearing NACHI
02-01-23	Buttrerflay Valve Manual	01-02-23	Pressure Gauge Webrock Uk:2,5"	02-03-23	Bearing NACHI
03-01-23	Mur Baja	02-02-23	Bearing FAG	02-03-23	Oil Seal
03-01-23	Air Cylinder	02-02-23	Bearing ASB	02-03-23	Bearing FAG
03-01-23	Neple Selang Solenoid Drat	02-02-23	Bearing KOYO	02-03-23	Bearing Nachi
03-01-23	Karakter Angka	02-02-23	Bearing NACHI	02-03-23	Pulley A3
03-01-23	Besi AS VCN	02-02-23	Ring Plat Baja	02-03-23	Neple Joint Fitting lurus
03-01-23	Buttrerflay Valve Manual	02-02-23	Mur Baja	02-03-23	Bearing NTN
03-01-23	Sambungan Rantai	02-02-23	Bearing NACHI	02-03-23	Baut Baja FD

The next stage is that the spare parts demand data will be converted into a tabulation form, which will be saved in an Excel file. Then, an analysis process will be carried out using the association method.

Table 3. Example of tabulated data

Dates	Adapter Actuator Valve	Air Cylinder	Air Cylinder AIRTAC	Air Cylinder STNC
01-01-23	-	-	-	-
02-01-23	-	-	1.00	-
03-01-23	-	1.00	-	-
04-01-23	-	-	-	-
05-01-23	-	-	-	-
06-01-23	-	1.00	1.00	-
07-01-23	-		-	-
09-01-23	-	-	-	-
10-01-23	-	-	-	-
11-01-23	-	-	-	-
12-01-23	-	-	-	-
13-01-23	-	-	-	-
14-01-23	-	-	-	-

Table 3 explains the results of changing the data into a tabulation in binary numbers 0 and 1. The next stage is that the data that has become a tabulation is imported using the read excel operator in the RapidMiner application. Then, the analysis model was created using the RapidMiner application.

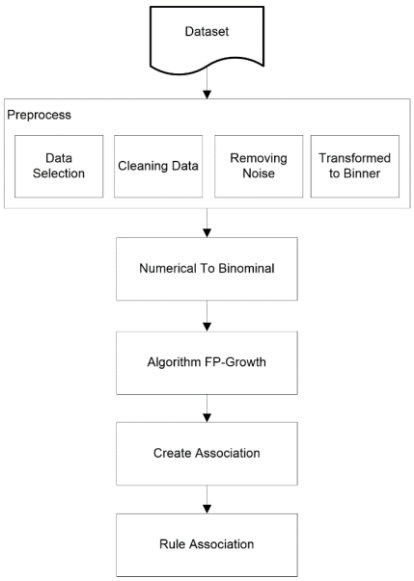


Figure 3. Proposed Method

Figure 3 is a model created in the rapid miner application, starting with data preprocessing by selecting data, cleaning data, removing noise, and transforming data into binary. Then, the data import process is carried out using the read Excel operator. Then, the data is converted using the numeric to a binomial operator to change the data into a binominal format, continued with the algorithm approach process using the FP-Growth operator and creating association rules using the create association rules operator and producing an association rule.

The research carried out trials to make observations. Several data tests were carried out to determine boundary parameters, with trials with a minimum support value of 10% and minimum confidence of 90%, trials with a minimum support value of 20% and minimum confidence of 80%, tests try a minimum support value of 30% and minimum confidence of 70%, try a minimum support value of 40% and minimum confidence of 60%, and try a minimum support value of 50% and minimum confidence of 50%, the limit values are adjusted to get the most optimal association rule results.

Association Rule Result

The results of data processing carried out using the RapidMiner application obtained several association rules that provide many regulations for spare parts request transaction data with the support and confidence value parameters tested are as follows:

Table 4. Test results for parameters with a support value of 10% and a confidence value of 90%.

No	Premises	Conclusion	Support	Confidence	Lift
1	Mur Baja, Baut Baja FD, Mur Biasa	Baut Biasa FD	0.11	1.00	2.37
2	Mur Baja, Mur Biasa	Baut Biasa FD	0.18	0.94	2.23

Table 4 explains the results of the association rules formed with the parameters of 10% support value and 90% confidence value, resulting in 2 rules with the highest confidence value of 1.00 and the highest lift value of 2.37. Rule 1: Mur Baja, Baut Baja FD, and Mur Biasa will be needed along with Baut Biasa FD, which has a confidence value 1. Rule 2: Mur Baja, Mur Biasa will be required along with Baut Biasa FD, having a confidence value of 0.94.

Table 5. Test results for parameters with a support value of 20% and a confidence value of 80%.

No	Premises	Conclusion	Support	Confidence	Lift
1	Mur Baja, Baut Baja FD, Mur Biasa	Baut Biasa FD	0.11	1.00	2.37
2	Bearing NACHI, Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.11	0.91	2.27
3	Mur Baja, Mur Biasa	Baut Biasa FD	0.18	0.94	2.23
4	Roda PU 90 merah	Baut Baja FD	0.11	0.83	1.47
5	Ring Plat Baja	Mur Baja	0.16	0.88	1.43
6	Baut Baja FD, Butterfly Valve Manual	Mur Baja	0.13	0.86	1.40

Table 5 explains the results of the association rules formed with parameters of a support value of 20% and a confidence value of 80%, resulting in 6 rules with the highest confidence value of 1.00 and the highest lift value of 2.36. Rule 1: Mur Baja, Baut Baja FD, and Mur Biasa will be needed along with Baut Biasa FD, which has a confidence value 1. Rule 2: Bearing NACHI, Kuku Macan/Clam Seling Biasa will be required, along with Kawat Seling Biasa China, having a confidence value of 0.91. Rule 3: Mur Baja, Mur Biasa will be needed along with Baut Biasa FD, having a confidence value of 0.94.

Table 6. Test results for parameters with a support value of 30% and a confidence value of 70%.

No	Premises	Conclusion	Support	Confidence	Lift
1	Mur Baja, Baut Baja FD, Mur Biasa	Baut Biasa FD	0.11	1.00	2.37
2	Bearing NACHI, Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.11	0.91	2.27
3	Mur Baja, Mur Biasa	Baut Biasa FD	0.18	0.94	2.23
4	Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.22	0.80	2.00
5	Mur Biasa, Bearing FAG	Baut Biasa FD	0.10	0.82	1.94
6	Mur Biasa	Baut Biasa FD	0.27	0.80	1.89
7	Baut Baja FD, Mur Biasa	Baut Biasa FD	0.17	0.79	1.87
8	Roda PU 90 merah	Baut Baja FD	0.11	0.83	1.47
9	Ring Plat Baja	Mur Baja	0.16	0.88	1.43
10	Baut Baja FD, Butterfly Valve Manual	Mur Baja	0.13	0.86	1.40
11	Bearing NACHI, Bearing KOYO	Mur Baja	0.10	0.82	1.34
12	Baut Biasa FD, Butterfly Valve Manual	Mur Baja	0.12	0.79	1.29
13	Butterfly Valve Manual	Mur Baja	0.20	0.78	1.28
14	Bearing KOYO	Mur Baja	0.14	0.76	1.25
15	Roda PU 90 merah	Mur Baja	0.10	0.75	1.23
16	Baut Baja FD, Bearing NTN	Mur Baja	0.10	0.75	1.23
17	Bearing NACHI, Oil Seal	Mur Baja	0.10	0.75	1.23

Table 6 explains the results of the association rules formed with parameters of a support value of 30% and a confidence value of 70%, resulting in 17 rules with the highest confidence value of 1.00 and the highest lift value of 2.37. Rule 1: Mur Baja, Baut Baja FD, and Mur Biasa

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will be needed along with Baut Biasa FD, which has a confidence value 1. Rule 2: Bearing NACHI, Kuku Macan/Clam Seling Biasa will be required, along with Kawat Seling Biasa China, having a confidence value of 0.91. Rule 3: Mur Baja, Mur Biasa will be needed along with Baut Biasa FD, having a confidence value of 0.94.

Table 7. Test results for parameters with a support value of 40% and a confidence value of 60%.

No	Premises	Conclusion	Support	Confidence	Lift
1	Oil Seal	Kawat Seling Biasa China	0.16	0.67	1.67
2	Mur Baja, Oil Seal	Kawat Seling Biasa China	0.11	0.67	1.67
3	Bearing KOYO	Bearing NACHI	0.12	0.65	1.62
4	Bearing KOYO	Kawat Seling Biasa China	0.12	0.65	1.62
5	Roda PU 90 merah	Baut Baja FD	0.11	0.83	1.47
6	Ring Plat Baja	Mur Baja	0.16	0.88	1.43
7	Baut Baja FD, Butterfly Valve Manual	Mur Baja	0.13	0.86	1.40
8	Bearing NACHI, Bearing KOYO	Mur Baja	0.10	0.82	1.34
9	Baut Biasa FD, Butterfly Valve Manual	Mur Baja	0.12	0.79	1.29
10	Butterfly Valve Manual	Mur Baja	0.20	0.78	1.28
11	Bearing KOYO	Mur Baja	0.14	0.76	1.25
12	Roda PU 90 merah	Mur Baja	0.10	0.75	1.23
13	Baut Baja FD, Bearing NTN	Mur Baja	0.10	0.75	1.23
14	Bearing NACHI, Oil Seal	Mur Baja	0.10	0.75	1.23
15	Mur Baja, Bearing NTN	Baut Baja FD	0.10	0.69	1.22

Table 7 explains the results of the association rules formed with parameters of a support value of 40% and a confidence value of 60%, resulting in 29 rules with the highest confidence value of 0.67 and the highest lift value of 1.67. Rule 1: An oil seal and Kawat Seling Biasa China will be needed, with a confidence value of 0.67. Rule 2: Mur Baja, Oil Seal will be required along with Kawat Seling Biasa China, having a confidence value of 0.67. Rule 3: Bearing KOYO will be needed along with Bearing NACHI, having a confidence value of 0.65.

Table 8. Test results for parameters with a support value of 50% and a confidence value of 50%.

No	Premises	Conclusion	Support	Confidence	Lift
1	Mur Baja, Mur Biasa	Baut Baja FD, Baut Biasa FD	0.11	0.59	2.41
2	Mur Baja, Baut Baja FD, Mur Biasa	Baut Biasa FD	0.11	1.00	2.37
3	Bearing NACHI, Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.11	0.91	2.27
4	Mur Baja, Mur Biasa	Baut Biasa FD	0.18	0.94	2.23
5	Bearing NACHI, Kawat Seling Biasa China	Kuku Macan/Clam Seling Biasa	0.11	0.59	2.12
6	Baut Baja FD, Baut Biasa FD	Mur Biasa	0.17	0.68	2.05
7	Kawat Seling Biasa China	Kuku Macan/Clam Seling Biasa	0.22	0.56	2.00
8	Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.22	0.80	2.00
9	Baut Biasa FD	Mur Biasa	0.27	0.63	1.89
10	Mur Biasa	Baut Biasa FD	0.27	0.80	1.89
11	Mur Baja, Baut Baja FD, Baut Biasa FD	Mur Biasa	0.11	0.63	1.88
12	Baut Baja FD, Mur Biasa	Baut Biasa FD	0.17	0.79	1.87
13	Mur Baja, Baut Biasa FD	Mur Biasa	0.18	0.62	1.85
14	Baut Baja FD, Kuku Macan/Clam Seling Biasa	Kawat Seling Biasa China	0.11	0.71	1.79
15	Oil Seal	Kawat Seling Biasa China	0.16	0.67	1.67

Table 8 explains the results of association rules formed with parameters of a support value of 50% and a confidence value of 50%, resulting in 60 rules with the highest confidence value of 0.59 and the highest lift value of 2.40. Rule 1: Mur Baja, Mur Biasa will be needed along with Baut Baja FD, Baut Biasa FD, having a confidence value of 0.59. Rule 2: Mur Baja, Baut Baja FD, and Mur Biasa will be needed along with Baut Biasa FD, which has a confidence value 1. Rule 3: Bearing NACHI, Kuku Macan/Clam Seling Biasa will be required, along with Kawat Seling Biasa China, having a confidence value of 0.91.

Based on the test results of several support and confidence value parameters, the support value parameters of 30% and 70% confidence have the

highest values, namely with the highest confidence value of 1.00 and the highest lift value of 2.37, with 17 rules formed. The results of these rules can be explained as follows.

- Rule 1: Mur Baja, Baut Baja FD, and Mur Biasa will be needed along with Baut Biasa FD, which has a confidence value 1.
- Rule 2: Bearing NACHI, Kuku Macan/Clam Seling Biasa will be needed along with Kawat Seling Biasa China, having a confidence value of 0.91
- Rule 3: Mur Baja, Mur Biasa will be needed along with Baut Biasa FD, having a confidence value of 0.94.
- Rule 4: Kuku Macan/Clam Seling Biasa will be needed along with Kawat Seling Biasa China, having a confidence value of 0.80.
- Rule 5: Mur Biasa, Bearing FAG will be needed along with Baut Biasa FD, having a confidence value of 0.82.
- Rule 6: Mur Biasa will be needed along with Baut Biasa FD, having a confidence value of 0.80.
- Rule 7: Baut Baja FD, Mur Biasa will be needed along with Baut Biasa FD, having a confidence value of 0.79.
- Rule 8: Roda PU 90 merah will be needed along with Baut Biasa FD, having a confidence value of 0.83.
- Rule 9: Ring Plat Baja will be needed along with Mur Baja, having a confidence value of 0.88.
- Rule 10: Baut Baja FD, Butterfly Valve Manual will be needed along with Mur Baja, having a confidence value of 0.86.
- Rule 11: Bearing NACHI, Bearing KOYO will be needed along with Mur Baja, having a confidence value of 0.82.
- Rule 12: Baut Biasa FD, Butterfly Valve Manual will be needed along with Mur Baja, having a confidence value of 0.79.

Based on the results of making association rules using spare parts demand data from the machine maintenance department, it is stated that the regulations formed from processing the RapidMiner application with a confidence value of 100% recommend Baut Biasa FD spare parts. The following rating with a confidence value of 94% is Mur Biasa. Seven rules recommend Mur Biasa. Therefore, it is recommended that Baut Biasa FD and Mur Biasa carry out safety stock to maintain stock availability, as well as create safety stock and place it on shelves that are included in the fast-moving inventory category.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Recommendations as consideration for company management to implement data mining methods can help decision-making by applying association methods to spare parts request transaction data. The company can direct the warehouse and machine maintenance department to provide recommendations for spare parts with safe stock and categorize spare parts in the fast-moving category to always be available in stock. The results of the observations state that spare parts request transaction data can be used as a basis for analysis for a data mining technique approach using the association method. The conclusion obtained from data processing using the RapidMiner application is that there are 17 recommendations with a support value parameter of 30% and a confidence value parameter of 70%, resulting in the best rule with the highest confidence value of 100%, which recommends the request for FD Regular Bolts and a confidence value of 94%, namely Steel Nuts. The company can recommend safety stock to the warehouse and machine maintenance department to maintain stock availability and categorize these spare parts as fast-moving stock.

Suggestion

The association method has a vital role in providing appropriate recommendations to find an association rule for the products/goods the company has, which helps the company formulate appropriate and accurate inventory strategies and spare parts planning. The analysis results can be developed using demand transaction data for the following year, such as 2024, to obtain more critical information from the resulting association rules. Research development can also be done by adding several support and confidence parameters and combining or comparing several other algorithms, such as priori algorithms, neural networks, support vector machines, linear regression, and others.

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