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OLAP Cube Processing of Production Planning Real-life Event Log: A Case Study

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***Abstract*— Business process modeling in an application log can be done by using process mining technique. To analyze the process flow in more detail in several dimensions needs cube process. The multidimensional depiction in star schema to perform Online Analytical Processing (OLAP) can be done by drill-down, roll-up, slice, and dice method. This research was conducted to analyze log characteristic in the production planning module by performing the cube process. The analysis was done by performing process cube on a set of log module of production planning. In this study the dimensions used in process cube are event class, timestamp and activity. Data that had been processed with the cube was modeled by using Heuristic miner algorithm. The results obtained from this study are those for the three parts of data that have been processed with the cube, the best measurement value for fitness was obtained by female of 1 while the best precision in male is at 0.56, and the value of each structure is at 1 for each data. The result of measurement also shows that the number of transitions and places in a process model influences the measurement of conformance value. Overall, the existence of the cube process performed has influenced the process model and the resulting measurement.**

Keywords—process mining, OLAP, heuristic miner, production planning

I. INTRODUCTION

Identifying the process recorded on an application can be done by modeling logs that have been stored therein. There are many popular applications that have logs to learn and analyze. One of them is the application of Enterprise Resource Planning (ERP). This application is a type of application that is widely used in large companies in the world. Based on the research results conducted by Gartner in 2017 [1], it is obtained the result that SAP is at the top position of ERP application provider company. There are several modules in SAP application, one of which is the production planning. This module is an important module in SAP application that serves to handle the whole business process related to the production conducted by the enterprise. Therefore, in this research, a business process modeling on production planning module of SAP application was performed.

Business process modeling in an application can be done by using process mining technique. To analyze the process flow in more detail in several dimensions, a cube process needs to be done. The cube process is a way of modeling a process using several different dimensions [2]. Cube is a method previously known and widely used in data warehouse. In the data warehouse, multidimensional cube is a representation of a star schema [3]. The multidimensional depiction of the star schema allows users to perform data analysis by online. This technique is called Online Analytical Processing (OLAP). There are several analyzes that can be done, for example, drill-down, roll-up, slice, and dice [4].

Referring to the previous research [2], this study was conducted to analyze the log characteristics in the production planning module by performing the cube process first. The analysis was done by slicing a set of log module production planning. Data that has been processed with cube will be modeled by using algorithm that is compatible with the mining process techniques. Based on the research [5] it is stated that the most appropriate and robust algorithm for real-life event logs is the Heuristic miner algorithm. In addition, it is mentioned in [6] that the Heuristic miner algorithm has a high performance, good handling of control-flow and short modeling time. The expected result is to know the different characteristics of each log sliced so that it will get an analysis of the flow of its business processes.

II. METHODOLOGY

In performing event log analysis from the production planning process, stages were performed for data processing.

2.1 Downloading ERP application logs

This stage is the beginning part of model making process from the application log of ERP production planning module. To download application logs, the important thing to note is the compatibility of activity on the logs with the actual activity running in real life.

2.2 Processing logs with OLAP cube

To perform the log processing by using OLAP, the first thing to do is to make star schema from data obtained. Cube is a multidimensional representation of a data to measure value and to perform analysis based on certain criteria [4]

2.3 Performing data conversion

This activity was done by converting previously the downloaded data from ERP application. In this case, the data from ERP application is a .csv file. The data will then be filtered first and converted into event log with .mxml format using Disco application. This application is not only capable of converting but also capable of analyzing and simulating a process.

2.4 Modeling the event log with the Heuristic miner algorithm

A pre-processed log event can be directly used as an input to create a process model. To create a process model is done by entering the event log on the application developed by TU Eindhoven, that is ProM. Furthermore, an algorithm can be selected according to the event log type, and in this case the real-life event log is more suitable to use the Heuristic miner algorithm. For event logs that have been processed into process models of Heuristic net, the conformation will be further measured. The process model and the result of the measurement are the representations of the process model flow that can be analyzed in accordance with the production planning flow.

2.5 Calculation of process model conformity

According to the research of "Conformance Checking of Processes Based on Monitoring Real Behavior" there are four dimensions of process model evaluation currently used [7] namely: fitness, precision, generalization, and structure. The fitness dimension calculates how many occurrences of the records that are recorded in the business process model. The precision dimension (Advanced Behavioral Appropriateness) describes how many events that may be formed but it is not based on the event log. Dimension generalization is a dimension in the contrast to the precision dimension, and it is more flexible to the possible model generated from other event log data. The structure dimension shows the model's ability to handle XOR and AND processes.

2.6 Previewing the modeling process using cube process

Based on the previous research [2], it was found that the cube process is a way of modeling the process with different dimensions. Each part of the cube is an event that is used as input in the process model making. As described earlier, the OLAP cube includes slice, dice, roll-up, and drill-down operations although in this study, not overall OLAP cube operation was used to form the event logs.

III. Data Collection

Modeling process was done by creating event log from the ERP application data first. Before the event log was made, it was necessary to identify the dimensions for the cube creation first. In this study the dimensions used are event class, activity, and timestamp, as shown in Figure 1.

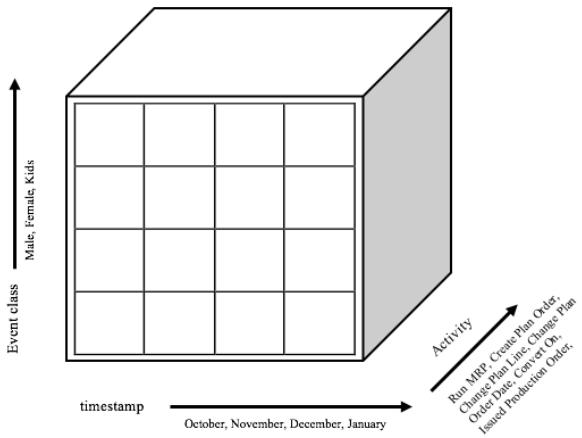

Fig. 1. Production Planning Cube Design

Furthermore, the following is a piece resulting from the creation of the event log module production planning (Table I).

TABLE I. PRODUCTION PLANNING EVENT LOG

ID	Case	Timestamp
31539965	Start	12/27/12 16:00
31539966	Start	12/27/12 16:00
31539966	Run MRP	12/27/12 16:30
31539966	Create Plan Order	12/28/12 6:00
31539966	Change Plan Order Date	1/2/13 11:00
31539966	Run MRP	1/3/13 16:30
31539966	Create Plan Order	1/4/13 6:00
31539966	Change Plan Order Date	1/9/13 11:00
31539966	Run MRP	1/10/13 16:30
31539966	Create Plan Order	1/11/13 6:00
31539966	Change Plan Order Date	1/16/13 11:00
31539966	Run MRP	1/17/13 16:30
31539966	Create Plan Order	1/18/13 6:00

As an illustration, here is the statistical data of activity for each class. (Table II).
First, the data is sliced to separate based on the type of goods produced in accordance with the target consumers. Generally, the grouping of goods is divided into three, male, female and kids. The table shows that most data is the data for female type with average of 50% for each activity. This indicates that the products processed through SAP applications are mostly intended for female.

TABLE II. PRODUCTION PLANNING EVENT LOG

No	Activity	Sum All	Male	Female	Kids
1	Start	582	115	317	150

2	Run MRP	1756	377	912	467
3	Create Plan Order	1756	377	912	467
4	Issued Production Order	449	77	243	129
5	Change Plan Order Date	641	186	297	158
6	Change Plan Line	35	7	19	9
7	Convert On	449	77	243	129
8	Start Production	449	77	243	129

IV. Result and Discussion

The result of business process modeling of production planning based on cube operation which has been done can be seen in figure 2 - 7 below. Each type (male, female, and kids) is depicted in two types of diagrams, ie. fuzzy net processed from Disco and Heuristic net applications.

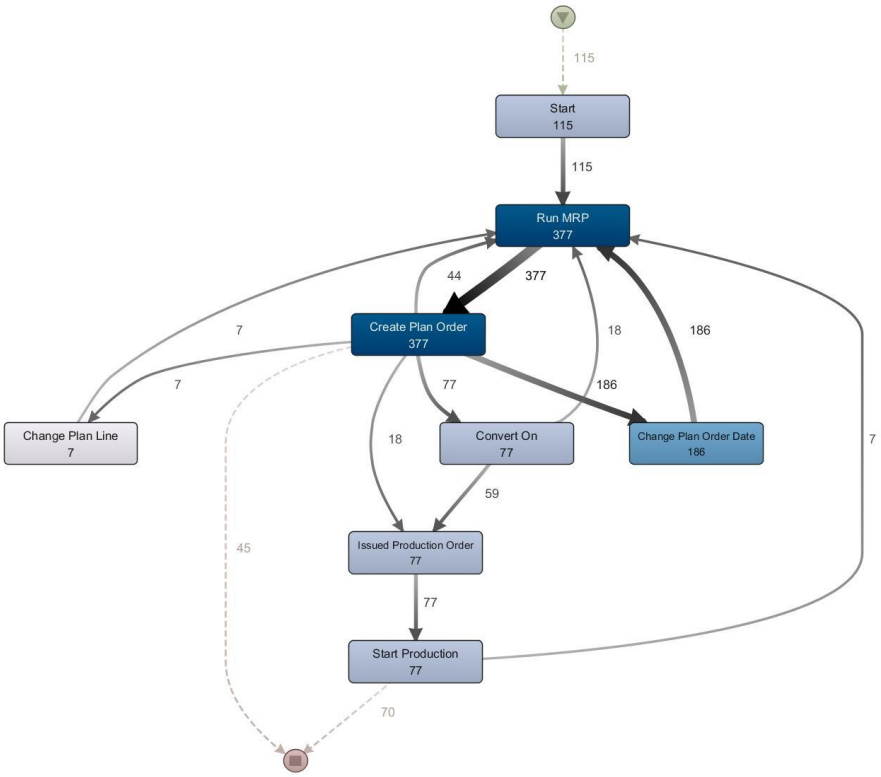

Fig. 2. Male Fuzzy Net

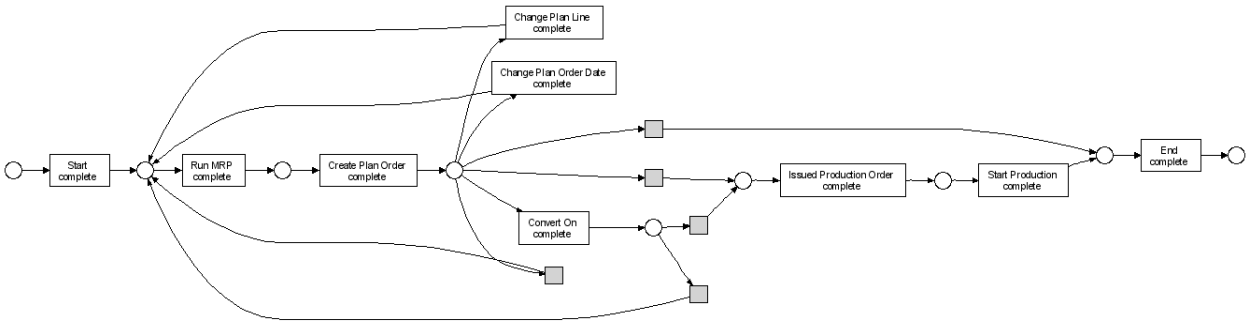

Fig. 3. Male Heuristic Net

Based on the flow of production planning in Figure 2, there are more repetitions on the activity of "Run MRP → Create Plan Order → Change Plan Order Date". The incident shows that in the phase of plan order a change in production planning still often occurs. Unlike male, the fuzzy net for female and kids also happens to loop more on the same flow. Different results were obtained on Heuristic net modeling in which the log event for male type had 5 transitions of hidden task and 9 places. Female type had 7 transitions and 10 places while kids had 7 transitions and 11 places. These results show that the model produced for the type of kids is more complicated than the male and female types, so the results of the conformance calculation will show in accordance with the flow conditions that have been modeled with the Heuristic miner. The conformance calculation for the three models can be seen in Table III. The data shows the statistics and conformance value of each event log. The results obtained from the fitness, precision, and structure values for the three types were that the highest fitness was in the female log event while the highest presicion for the male type and for the value of the structure had the same value of 1 for all three types. On the other hand, in the type of kids in which the modeling was more complicated (there were more transitions of hidden task and there were places), the conformance calculation obtained was also lower than the other two types, both for fitness and precision.

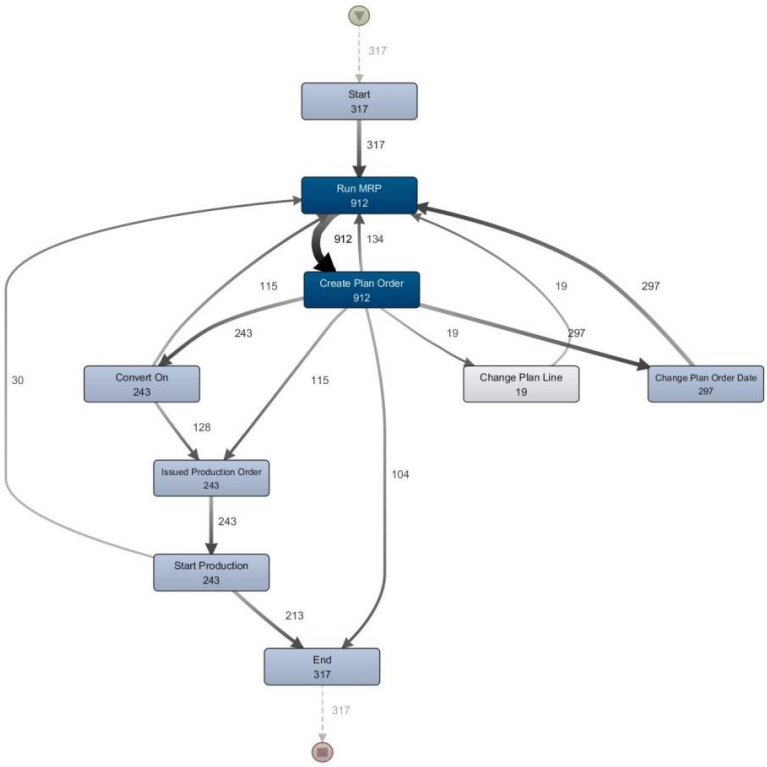

Fig. 4. Female Fuzzy Net

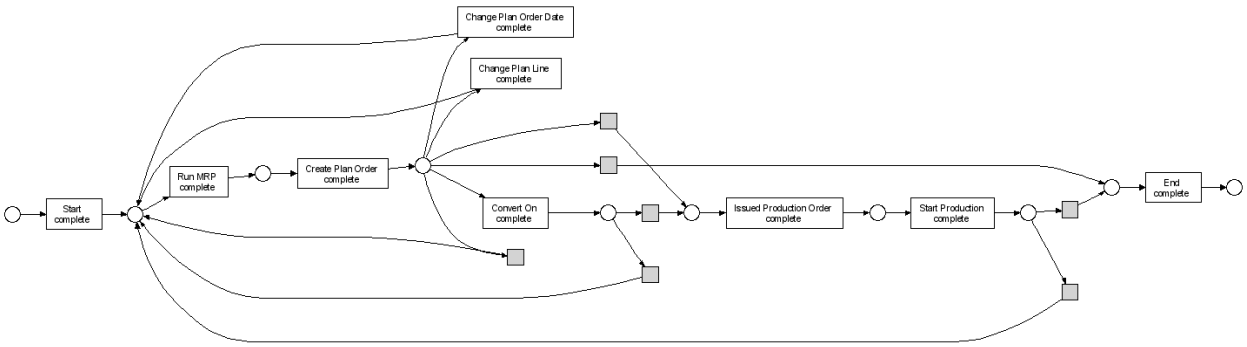

Fig. 5. Female Heuristic Net

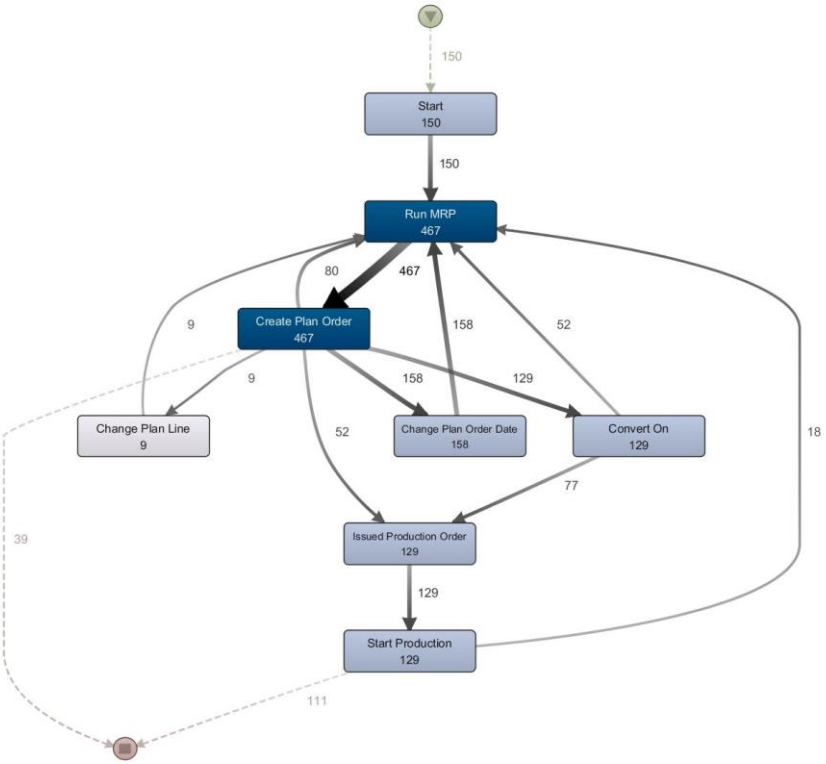

Fig. 6. Kids Fuzzy Net

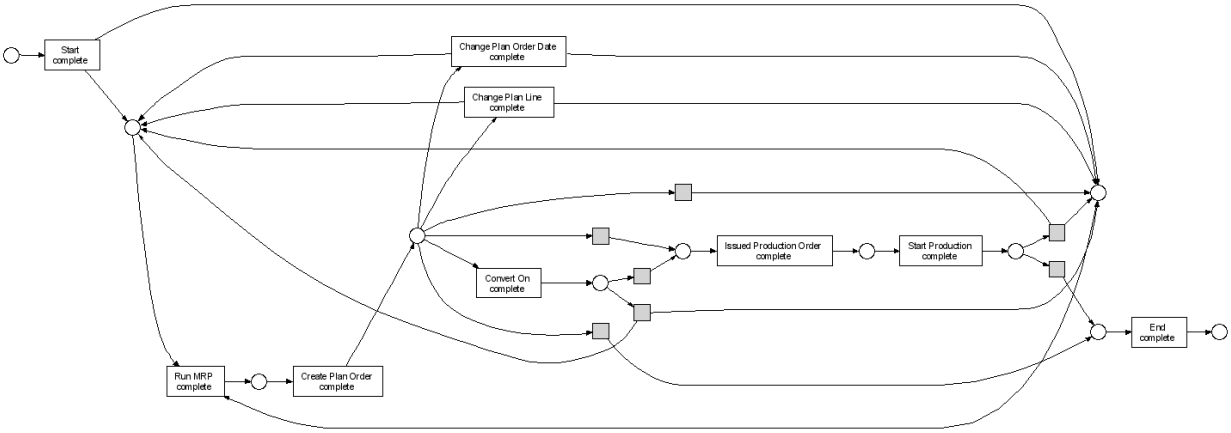

Fig. 7. Kids Heuristic Net

TABLE III. PRODUCTION PLANNING EVENT LOG

	Male	**Female**	**Kids**	**All**
Event	1293	3186	1638	6117
Case	115	317	150	582
Activity	8	8	8	8
Start Date	11 Desember 2012	15 October 2012	6 Desember 2012	15 October 2012
End Date	21 January 2013	26 January 2013	22 January 2013	26 January 2013
Fitness	0.996	1	0.956	1
Adv Behavioral App	0.56	0.495	0.495	0.495
Structure	1	1	1	1

V. CONCLUSION

In this research, the business process modeling was done by using the cube process for a case in the production planning module. Event logs that had been processed with OLAP cube were then processed with Heuristic miner algorithm. The measurement of modeling result was done by using conformance checking. The result of the measurement is that when it is closer to 1, will more represent the existing event log. The calculation of conformance checking performed shows that the best fitness value obtained by female was at 1, then male at 0.996 and kids at 0.956. On the other hand, for the precision measurement (advanced behavioral appropriateness) the best value was obtained by male type of 0.56, then female and kids values are each of 0.495. The measurement of the structure obtained the result of 1 for all types. The process modeling of kid type also obtained information that there were more places and transitions (in the form of hidden task). Based on the results of measurements, kids had lower value than others so that this indicated the number of transitions and places in a process model influences the measurement of conformance values. This study also confirmed that Heuristic miner algorithm is an algorithm which is capable of modeling the process in a short time with good quality. Overall, the existence of process cube performed has influenced the produced process model and its measurement, but the measurement results were not in line with the number of event logs of each data.

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