

Time and Cost optimization of Business Process Distribution Company using Goal Programming

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Abstract— *Often when a company is growing and just starting out the management team tend to make all the internal decisions, As the company reaches a certain size Standard operational procedure (SOP) is the important aspect to help the company to evaluate more than what they do now but also help the company to decide how to move forward. Having a standard operating procedure in place streamlines the process and management can accomplish more in optimizing time and cost, on business process of Return Material Authorization (RMA) which may not time and cost effective for the company which was about 2880 minutes with cost IDR. 348,242. In this research, the authors use Goal Programming to optimize time and cost. This approach improves the business process using analysis of multi objective problems. The results show that the time is reduced about 40% and the cost is reduced about 37%, which show improvement in the performance of the business process.*

Keywords—*optimization; time; cost; standard operational procedure; goal programming;*

I. INTRODUCTION

As competition increases and transactions become more complex it is important company's constantly compile data and readjust programs in order to explain and facilitate the work procedure. This will result in increased communication and coordination within all departments of the company. In a company, there must be certain procedures that guide to perform a process [1, 5]. On this paper PT. XYZ is engaged in trading and purchase of wireless devices that great affect the business performance of the company, Therefore it is necessary to analyze the business process to know the existence of non-conformity in the process that is planned with actual performance. While time and cost optimization can be described as a process capable of identifying various activities to obtain minimum duration and minimum cost in a process itself [5, 7, 9].

Establishing SOPs throughout for the company makes it easier to conduct employee performance appraisals. There are some activities in business process of RMA that explore. In

business process RMA, the company will replace new goods while it's still under warranty but the company has special rules, if the warranty period passed from less one month, the goods can still be replaced. This special rule likes this often occurs to daily events which have never been described in a previous business process and non-free choice activity drawn to describe this special rule. This paper will contribute to optimizing time and cost for this business process, especially with non-free choice activity.

The model process and simulation will be drawn by Yet Another Workflow Language (YAWL). YAWL is an application used to create and simulate a business process of a company. An event logs of business process simulation is the result of YAWL, which it can use process mining against it [2, 3]. YAWL is used to create a business model process that can be used as a reference or standard in a business process where YAWL can explore the history of every activity that has been done.

Process mining (ProM) helps to analyze business process which include event logs and automatically describes the actual daily process. The goal of process mining analysis is to improve process, not to analyze data from event log [7].

By utilizing the event logs, the business process will be easier to obtain. An event log includes specific records on when and by whom the business activities which support business process [3]. For optimizing cost, the methods used to solve this problem are Goal Programming [9, 8, 13].

II. RESEARCH METHODS

A. Drawing the SOP by YAWL

From the results of interviews and observations, The first step is to describe the SOP in the process business by using Microsoft Visio and drawing it again with YAWL for simulating it, for SOP RMA as for Business process depiction at YAWL and sett time and cost are as follow.

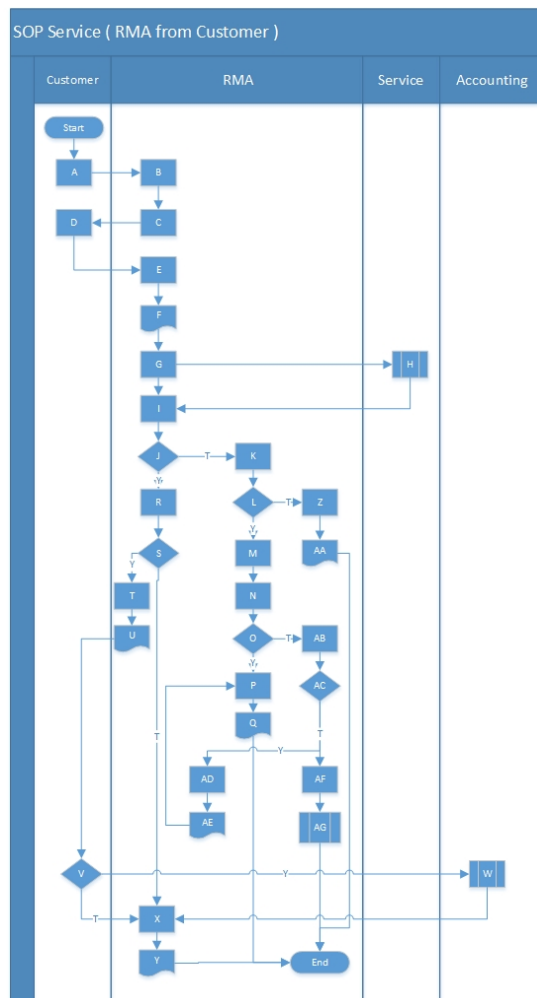


Fig. 1. SOP RMA drawn by Visio

Fig 1 is SOP RMA drawn by Microsoft Visio base of observation and interview. There are 4 departments involved in this procedure. What exactly that they do Table 1 will describe above activities.

TABLE 1. NOTIFICATION OF RMA ACTIVITY

Activities	Note
A	Damaged Goods Information
B	Check Mc.add / Serial Number
C	Info to customer for product warranty
D	Sending damaged goods
E	Create a service receipt
F	RMA Registration Form
G	Submit Goods to Technician
H	Refer To SOP Service
I	Check Service Results from technician via web RMA
J	Results OK?
K	Check Warranty
L	Still guaranteed?
M	Replacement
N	Check RMA Stock
O	RMA Stock Available?
P	Create Job Costing
Q	Job costing form
R	Check if it Is Charge?
S	Is Charge?
T	Create Service Quote
U	Form Repair Service Quote
V	Agree with Quotation?
W	Refer to SOP Billing
X	Create Delivery order RMA (DO)
Y	Form Delivery order RMA (DO)
Z	Create Form Letter notification of damaged goods
AA	Form Letter notification of damaged goods
AB	Check Warehouse Stock
AC	Warehouse Stock Available?
AD	Create form request outgoing
AE	Form Request outgoing
AF	Email Approval purchase
AG	Refer to SOP Purchasing

After drawing using Visio, there are some activities that can be described completely by YAWL. Fig 2 is SOP RMA level 0 where this is the main process of RMA, there are 8 traces and 1 non-free choice activity.

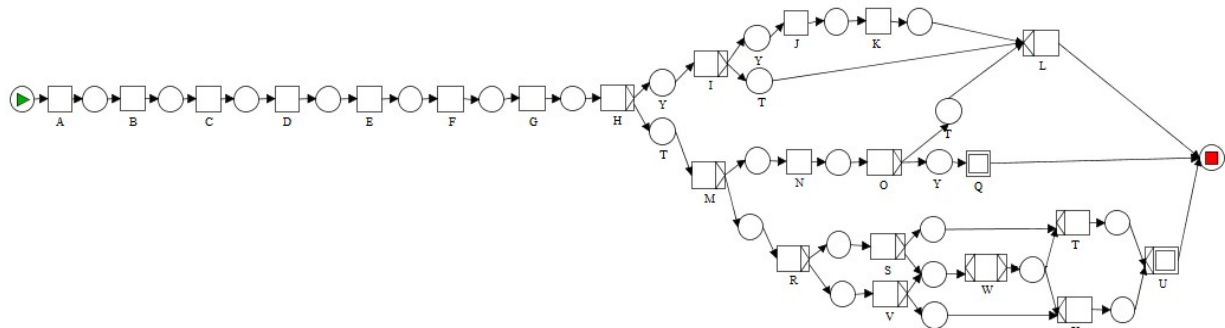


Fig. 2. SOP RMA level 0 drawn by YAWL

As the seen on Fig 2 is SOP RMA level 0 and drawn by YAWL, table 2 will describe the notification of each activity

TABLE 2. NOTIFICATION OF RMA BY YAWL

Activities	Note
A	RMA Request from Customer
B	Check status of goods
C	Info to customer for product warranty
D	Create a service receipt
E	Create RMA Registration Form
F	Submit Goods to Technician
G	Services
H	Check Service Results from technician via web RMA
I	Calculate the charge
J	Create Service Quote
K	Create Billing statement
L	Create Delivery order RMA (DO)
M	Check Warranty
N	Form Letter notification of damaged goods
O	Send Email information to Customer
Q	Send RMA to Vendor
R	Replacement
S	Check RMA Stock
T	Create form request outgoing RMA
U	Create Job Costing
V	Check Warehouse Stock

There are 8 traces and 1 non-free choice activity where on SOP RMA level 0, start from activity *Check RMA stock* then *approval replacement* next activity is non-free choice to *Create form request outgoing RMA* and for activity *Check Warehouse stock* then *approval replacement* next activity is non-free choice to *Create form request outgoing goods*.

Trace 1

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Calculate the charge- Create Service Quote- Create Billing statement- Create Delivery order RMA (DO).

Trace 2

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA - Create Delivery order RMA (DO)

Trace 3

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Form Letter notification of damaged goods- Send Email information to Customer- Create Delivery order RMA (DO)

Trace 4

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Form Letter notification of damaged goods- Send RMA to Vendor

Trace 5

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Replacement- Check RMA Stock- Create form request outgoing RMA- Create Job Costing

Trace 6 and non-free choice

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Replacement- Check RMA Stock - Approval Replacement- Create form request outgoing RMA- Create Job Costing

Trace 7

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Replacement- Check Warehouse Stock- Create form request outgoing goods- Create Job Costing

Trace 8 and non-free choice

RMA Request from Customer- Check status of goods-warranty-reate a service receipt- Create RMA Registration Form- Submit Goods to Technician- Services- Check Service Results from technician via web RMA- Check Warranty- Replacement- Check Warehouse Stock - Approval Replacement- Create form request outgoing goods- Create Job Costing

Fig 3 is the level 1 of the create job costing activity, and this process has 1 trace1.

Level 1

Create new form from database – input data customer – choose items – input mc.add – entry data warranty – approve / not approve – print form – request approval – closed job.

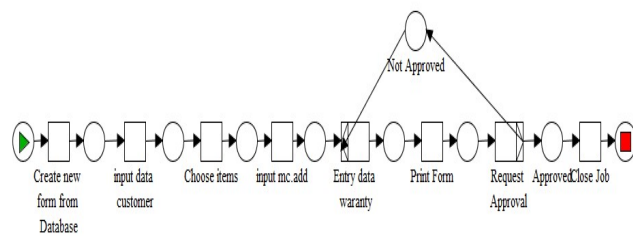


Fig. 3. SOP RMA level 1 Create Job Costing

Fig 4, is the level 1 of Mikrotik Activity, and this process has 2 traces.

Trace 1

Send email to support@mikrotik.com – receive confirmation email – get RMA number – login to mikrotik.com/rma – classification of rejected goods – closing database.

Trace 2

Send email to support@mikrotik.com – receive confirmation email – get RMA number – login to mikrotik.com/rma – Classification of compensation – credit note calculation – closing database

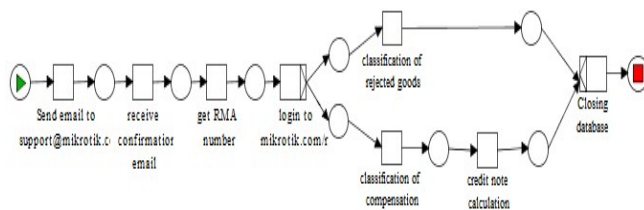


Fig. 4. SOP RMA level 1 of Mikrotik

Fig 5, is the level 1 of Ubiquity, and this process has 1 trace.

Trace 1

Recap items from vendors – login in RMA ubiquity – Entry data – log out.

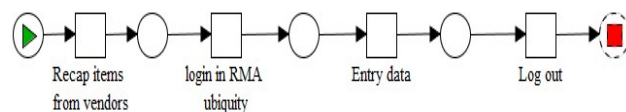


Fig. 5. SOP RMA level 1 of Ubiquity

B. Discovering business process model from even log

The daily routine or daily activities would be written manually based on observation and exporting from the database we can see it on Table 3. There are 4 information Case, Activities, Start Timestamp and resources.

TABLE 3. DATAL OF RMA

Case	Activities	Start Timestamp	Resources
1	RMA Request from Customer	1/31/18 8:00 AM	Requester/Customer
1	Check status of goods	1/31/18 8:04 AM	Admin RMA
1	Info to customer for product warranty	1/31/18 8:06 AM	Admin RMA
1	Create a service receipt	1/31/18 8:10 AM	Admin RMA
1	Create RMA Registration Form	1/31/18 8:18 AM	Admin RMA
1	Submit Goods to Technician	1/31/18 8:23 AM	Admin RMA
1	Services	1/31/18 8:30 AM	Technical
1	Check Service Results from technician via web RMA	1/31/18 10:30 AM	Admin RMA
1	Calculate the charge	1/31/18 10:40 AM	Manager RMA
1	Create Service Quote	1/31/18 11:00 AM	Admin RMA
1	Create Billing statement	1/31/18 11:13 AM	Accounting
1	Create Delivery order RMA (DO)	1/31/18 11:13 AM	Admin RMA
2	RMA Request from Customer	2/1/18 2:00 PM	Requester/Customer
2	Check status of goods	2/1/18 2:04 PM	Admin RMA
2	Info to customer for product warranty	2/1/18 2:10 PM	Admin RMA
2	Create a service receipt	2/1/18 2:13 PM	Admin RMA
2	Create RMA Registration Form	2/1/18 2:17 PM	Admin RMA
2	Submit Goods to Technician	2/1/18 2:23 PM	Admin RMA
2	Services	2/1/18 3:40 PM	Technical
2	Check Service Results from technician via web RMA	2/1/18 4:10 PM	Admin RMA
2	Calculate the charge	2/1/18 4:15 PM	Manager RMA
2	RMA Request from Customer	2/1/18 4:17 PM	Admin RMA
2	Check status of goods	2/1/18 4:30 PM	Admin RMA
2	Create Delivery order RMA (DO)	2/1/18 4:34 PM	Admin RMA

C. Optimizing business process using Goal Programming

Goal Programming is a method used to minimize errors or deviations in doing a goal by considering the priority of the objective [5, 9,10]. Goal programming models are very similar to linear programming models but whereas linear programs have one objective goal programs can have several objectives [8]. A preferred solution is then defined as the one which minimizes the deviations from the set goals. The Goal Programming can be formulated as the following achievement function [13].

$$\text{Min} = \sum_{i=1}^k (d_i^+ + d_i^-) \quad (1)$$

$$f(x) + d_i^- - d_i^+ = b_i \quad i = 1, \dots, k, \quad (2)$$

$$x \in X, \quad i = 1, \dots, k,$$

$$d_i^-, d_i^+ = 0 \quad i = 1, \dots, k,$$

$$d_i^-, d_i^+ \geq 0 \quad i = 1, \dots, k,$$

Where :

x = Number of i in Production

b_i = Level demand for the product i

d_i^- = Deviation of below b_i

d_i^+ = Deviation of above b_i

The purpose of goal programming is to minimize the deviation between the achievement goals (1)(2), $f(x)$ and these acceptable aspiration levels, b_i ($i = 1, \dots, k$). Also, d_i^- , d_i^+ , are respectively, under- and over- achievement of the i goal.

III. RESULT AND ANALYSIS

A. Analyzing the event log with ProM

The result of YAWL simulate are in .xes format, the next step is re-extraction into .mxml form before those are analyzed by ProM. The processes are analyzed at b on ProM application using alpha++. The information attributes of event log are Case , Activity, Resource and complete timestamp.

TABLE 4. EVENLOG SIMULATE BY YAWL

Case	Activities	Resource	Complete Timestamp
50	RMA Request from Customer	Customer	00:47.1
50	Check status of goods	Nancy	04:13.2
50	Info to customer for product warranty	Nancy	06:19.9
50	Create a service receipt	Nancy	10:41.4
50	Create RMA Registration Form	Nancy	18:09.2
50	Submit Goods to	Nancy	23:14.4

	Technician		
50	Services	Didik	30:14.4
50	Check Service Results from technician via web RMA	Nancy	30:48.8
50	Calculate the charge	Nancy	40:46.6
50	Create Service Quote	Nancy	00:40.3
50	Create Billing statement	Nikita	13:52.5
50	Create Delivery order RMA (DO)	Nancy	13:52.5
51	RMA Request from Customer	Customer	08:47.1
51	Check status of goods	Nancy	11:13.2
51	Info to customer for product warranty	Nancy	16:19.9
51	Create a service receipt	Nancy	20:41.4
51	Create RMA Registration Form	Nancy	28:09.2
51	Submit Goods to Technician	Nancy	33:14.4
51	Services	Didik	40:14.4
51	Check Service Results from technician via web RMA	Nancy	30:48.8
51	Calculate the charge	Nancy	45:46.6
51	RMA Request from Customer	Nancy	05:40.3
51	Check status of goods	Nikita	15:52.5
51	Create Delivery order RMA (DO)	Nancy	17:31.9

B. Analyzing time and cost

The result of optimizing time using ProM analyze by Performance analysis with Petrinet can see in table 5 event log of RMA per log trace

TABLE 5. THROUGHPUT TIME PER LOG TRACE

Log Trace	Throughput time (minutes)	Cost (IDR)
50	193.09	33,660
51	188.75	41,140
52	158.75	37,400
53	158.75	89,760
54	158.75	89,760
55	398.75	119,760
56	151.99	29,920
57	1166.89	41,140
58	1166.89	44,880
59	1165.93	56,100
60	1165.93	41,140
61	1165.93	137,240
62	1159.93	129,760
63	1159.93	129,760
64	1159.93	129,760
65	1159.93	140,980
66	1519.93	129,760

In case 61 until 66 for optimizing time and cost because those case has the longest trace with 20 events than others and also has non-free choice activity.

C. Optimize time and cost using Goal Programming

After analyze optimal of time and choose the traces, the next step is optimizing the cost based on the optimal time. As described above, the optimization of cost will use goal programming method where the longest traces are on case 61 until 66, optimizing cost will also focus on those traces.

Source code of Goal programming

```
min = d1plus+d2minus;
137240*C61+129760*C62+129760*C63+129760*C64+140
980*C65+129760*C66+d1plus+d2minus=1000000;
C61>=1;
C62>=1;
C63>=1;
C64>=1;
C65>=1;
C66>=1;
```

Fig. 6. Source code of goal programming

TABLE 6. RESULT OF GOAL PROGRAMMING

Variable	Value	Reduced Cost	Slack or Surplus	Dual Cost
D1Plus	0.0	1.0	0.0	-1.0
D2Minus	0.0	1.0	0.0	0.0
C61	1.0	0.0	0.0	0.0
C62	1.0	0.0	0.0	0.0
C63	1.0	0.0	0.0	0.0
C64	1.0	0.0	0.0	0.0
C65	1.0	0.0	0.0	0.0
C66	2.5	0.0	1.5	0.0

The optimal time and cost on this research are on case 62 (trace 5) with cost IDR129,760 and total time is 1159 minutes also 63 (trace 6) with cost IDR129,760 with total time 1159 minutes. For trace 7, case 65 the optimal time is 1159 minutes with cost IDR140,980 and for trace 8 case 66 the optimal time is 1519 minutes with cost IDR 129,760, as we can see case 66 has value 2.5 with slack or surplus 1.5 it means there are advantages of resource constraints.

IV CONCLUSION

This Paper presented the results of optimizing the business process of a Distribution Company. The optimal traces follow the case number 62 with total time 1159 minute or 19 hours (include office hours) with cost IDR129,760 and case number

63 with total time 1159 minute or 19 hours (include office hours) and cost IDR 129,760. The result shows the improvement of the time and cost before, 40% for time reduced and 37% for cost reduced. It will help companies in improving productivity, as well as cost and time reduction.

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