Joint Replenishment Problem for Multi Supplier One Regional

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Abstract: PT XYZ is a company that produces various bags with leather as its basic material. Request for bag accessories as supporting raw material is uncertain (probabilistic). In view of accessories requests in the monthly report of 2017 until 2018, there was out of stock to the value of 44%. Accessories request is not performed in the unit, but only several accessories needed at that time. In consequence, after order is submitted, request for additional accessories is added and makes the total request and order imbalance. The order which is submitted several times in one month may increase inventory cost. Moreover, this research uses the Joint Replenishment Order Method, which aims to control accessories stock. This method tries to design control for the stock by taking into account request (Di), service level, and company's expense. The first step of this method is determining the time between the order of each accessory(Ti), and then determining the interval of basic order (T) in order to specify order optimal time (T*). After the optimal time is specified, the quantity (Q), which will be ordered to the supplier, also safety stock and inventory level for each item can be known. Stock control design will obtain the result of minimal inventory total cost. Result of Joint Replenishment Order Method Calculation shows obtained order optimal time (T*) of 0,3558 years with the total cost to the value of Rp50.863.488; thus, in one year the obtained total cost is Rp152.590.465 per year, while expenses with company method are to the value of Rp198.411.763. The company can save cost up to Rp45.821.297 or 23% with this method.

1 INTRODUCTION

Inventories are idle resources, so their existence can be seen as a waste due to the existence of embedded capital that cannot be used. Inventory is also the capital or assets of the company that is important for the smooth production process in the company. If the supply is insufficient, or there is a shortage of inventory, the company will be faced with the cessation of the production process, not achieving the production target and the loss of consumer confidence. Conversely, if there is too much inventory, the company will bear the costs due to the goods stored, the risk of damage to the goods, or even the goods become out of date. Thus, the company is faced with a dilemma that is one side of the company wants to increase service level by providing enough goods, and the other side is to provide goods as minimal as possible to avoid losses due to the risk of storing too many goods. Clearly, the ability to satisfy consumers and simultaneously reduce losses requires the application of good inventory management principles.

PT XYZ is a company in Yogyakarta that manufactures various types of leather-based bags. One of the supporting raw materials in bag making is accessories. This company has a diverse catalog of bag models, where each bag model requires accessories that can differ (vary) from one model to another. There are 56 types of accessories managed by companies that support the production of various models of bags. All were ordered from 4 suppliers, namely Prima Jakarta, 88 Buckle, Mitra Buckle, and Beautiful Pattern. The four suppliers are located in Jakarta. Each supplier orders several different items (multi items).

The variety of bags produced and the uncertain number of bag requests make it difficult for companies to determine the stock of each item of accessories that must be provided in the accessories warehouse. Based on monthly reports on the need for accessories in the last two years, there was an out of stock of 44%. So ordering often happens several times a month. As a result, the costs of messaging and transportation costs are quite high. If this continues, it will certainly make the company lose, because it will hamper the smooth production of

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bags, the target is not achieved, and the level of consumer confidence in the company decreases.

The more accessories that are provided, the more embedded capital that cannot be used for other purposes that are more profitable, and the greater the risk of the product being damaged. The fewer accessories available, the greater the likelihood that a shortage will occur. As a result, the greater the loss of opportunities for profit.

Based on the above problems, it is necessary to have a design in the ordering system to control the supply of accessories that demand is probabilistic, so that these accessories when needed are available in the right amount in such a way that the costs incurred are minimal and the production process is realized.

The Joint Replenishment Model approach can be used to help design the ordering system in such cases. When a company located in Yogyakarta orders several suppliers located in Jakarta, the company needs to develop a shipping strategy in order to minimize transportation costs arising from ordering items from some of these suppliers. One way is to consolidate all items designed for ordering using the joint replenishment model approach from several suppliers to be sent together to Yogyakarta. The solution method used in determining the ordering interval together that minimizes the costs incurred is the heuristic method. While the ABC method can be used to classify groups of accessories according to the level of importance or priority of each of these accessories.

The purpose of this research is to set an appropriate time interval for multi-item accessories that are ordered together from multi suppliers in order to minimize transportation costs and message costs and at the same time, minimize out of stock.

2 LITERATURE REVIEW

Inventories are materials or products or assets from an association that is put away that will be utilized to meet certain targets. Each component in an organization must have stock in different structures and capacities. In light of the physical structure, the stock can be as crude materials, work in the procedure, completed merchandise, save parts, and supplies. While dependent on its capacity, the stock is delegated a great deal size stock, variance stock, and expectation stock.

Despite the fact that stock is an inactive asset, it tends to be said that no organization works without stock. Without provisions, business visionaries will be looked at with the hazard that their organization will, at one time, not have the option to satisfy the wants of their clients. The level of stock of the complete resources of the organization is moderately high. For instance, at the manufacturing plant level, around 25 - 35% of the absolute resources claimed. While at the wholesaler level, 15 - 90% of the absolute expense of items oversaw. Thusly, the current stock in the organization should be overseen just as conceivable, and the stock must be arranged and controlled successfully and productively.

Stock control intends to keep up stock at an ideal level with the goal that reserve funds are gotten from expenses brought about. Assurance of stock strategy or model that suits the genuine issue will deliver a powerful stock control framework for the organization. Stock models are partitioned into deterministic models and probabilistic models. In the deterministic stock model, the parameters that influence the inventory framework (request, lead time) are known with sureness. Though in the probabilistic stock model, the parameters that impact are not known with conviction. So there are three explanations behind the significance of stock for organizations, to be specific: the nearness of a component of interest vulnerability, a component of stockpile vulnerability from providers, and a component of the vulnerability of the elegance time frame among requesting and sending.

Regularly an association or organization is looked at with issues of capacity and support of various supplies, both crude materials, parts, and completed products. In these conditions, the executives must give exacting control need to kinds of stock that have high esteem, though for inventories with low-esteem control should be possible rather freely, in light of the fact that too tight power over this sort of control expenses might be higher than the estimation of stock. For proficient control, the stock must be grouped first. The arrangement is normally isolated into three, generally called ABC groupings. This idea was presented by HF. Dickie during the 1950s. The order depends on stock worth. With the information of this grouping, the control will be done all the more seriously on specific things, which are the most significant things of every single existing thing contrasted with different things.

Stock control by the ABC strategy is a stock control method by considering gatherings of merchandise as per the degree of significance of each gathering of products. This strategy was found by Pareto. In view of the Pareto standard, merchandise is arranged into three gatherings, to be specific Class A, Class B, and Class C. Class A will be a gathering of products that ingests about 80% of the all-out capital gave and comprises of about 20% of all merchandise oversaw. Class B is a gathering of products that ingests about 15% of the all-out capital gave (after class B) and comprised about 30% of all merchandise oversaw. Though class C is the gathering of products that retain reserves, just about 5% of all capital gave (outside classes An and B) and comprised of about half of all merchandise oversaw. At the point when an organization is dealing with a multi-thing stock, and they arrange recharging requests of things provided by a similar provider. The related issue is known as the joint renewal issue (JRP). The model is a joint recharging model (JRM).

The fundamental idea of JRM is that few things are requested from one provider utilizing similar methods for transportation. The benefit of this JRM is that it can limit the expense of messages and transportation expenses acquired contrasted with when requesting products separately. Requesting and dispatching that is done all the while with bigger parts and done once in a specific period for a wide range of things required will surely have the option to save money on message expenses and transportation costs. Alternately, if a request is made independently to a similar provider, there will be rehashed orders. This, obviously, will make the message expenses and transportation costs higher. By deciding the ideal request time interim, the correct request recurrence will be acquired with the end goal that the expenses brought about can be limited.

Research on joint recharging issues has been done by a few scientists. Salameh et al., has looked into JRM by thinking about item substitution. At the point when the item requested at the provider level isn't accessible, it is conceivable to supplant the arranged thing. The examination centers around quick-moving shopper products that have the moderately deterministic interest are sold rapidly, and with generally low costs, for example, toiletries, and everyday necessities. Constrained work has been done on stock-out based substitution under deterministic interest inside the EOQ model setting. Nagasawa et al. have been investigated about the utilization of Genetic Algorithms for Can-Order Policy on JRM. Research on JRP, where the item under thought is an item that has weakening properties, has been done by Li et al. In this examination, the Joint recharging issue (JRP) model with an exponential appropriation crumbling rate was proposed. The target capacity of the JRP model was to limit the arrangement costs, stock holding expenses, and decay costs. Hereditary calculation (GA) was utilized for tackling this issue and inquired about were likewise made in angles, for example, chromosome coding, wellness work, determination, hybrid and transformation activities, and so forth. The critical thinking arrangement offered in this exploration is to utilize hereditary calculations.

Wang et al. have been built up an Improved Fruit Fly streamlining calculation (IFOA) to discover answers for taking care of issues in JRP. The outcome is IFOA can likewise be used to explain the commonplace JRPs that have been demonstrated as non-deterministic polynomial difficult issues. Similar models uncover that the proposed IFOA can discover preferred arrangements over the present best calculation; consequently, it is a potential device for different complex improvement issues. While Tynan dan Kropp thinks about occasional audit frameworks and joint recharging under stochastic requests condition. To begin with, they study the single item intermittent survey issue and propose a basic arrangement method that is close ideal. At that point, given the presence of this basic system, they study the joint renewal issue for various things under stochastic requests and propose basic heuristics, which generally give excellent outcomes. This examination finds the straightforward strategies joined with the vigor of the cost capacity to be appealing in different applications that require coordination of process durations under stochastic requests.

In view of a few past investigations, there has not been much inquired about on the issue of the joint recharged issue of multi-provider one locale. In this examination, the JRP case will talk about where a request is made by an organization to a few providers in a similar region under stochastic requests. Requesting a few things to every provider depends on probabilistic requests with the JRM approach. At that point, all requesting things from every provider are solidified in a specific distribution center to be sent together from Jakarta to Yogyakarta. The arrangement strategy utilized in deciding the requesting interim together that limits the expenses brought about is the heuristic technique.

3 EXPERIMENTS

This research is performed in PT XYZ Yogyakarta. The research object is bag accessories in the number of 56 items from January 2017 until December 2018. Required research data involve data of request, inventory costs, and lead time.

Table 1: Cost Data Collection

No	Parameter		Data
1	Request Data (*D*)		
2	Purchase Price Data		
3	Supplier Data		
4	Order Cost	Minor (Administration, telephone) (a)	Rp 20.000
		Major (transportation) (A)	Rp250.000
5	Storage Cost, Rp/*item* (h)		Rp 2,663
6	Service level (z)		99%
7	Lead time, day (LT)		4

Table 2: Data of Request

No	Code	Request		No	Code	Request		No	Code	Request	
		2017	2018			2017	2018			2017	2018
1	A01	15166	28878	20	A20	7000	1660	39	A39	6469	1680
2	A02	5327	20320	21	A21	7620	5878	40	A40	3000	996
3	A03	25186	34938	22	A22	19934	12713	41	A41	13655	12708
4	A04	21434	42796	23	A23	7169	3951	42	A42	15155	11701
5	A05	17649	15896	24	A24	4883	3321	43	A43	8328	14790
6	A06	15550	14382	25	A25	63490	49419	44	A44	2778	13456
7	A07	13541	13266	26	A26	3298	1147	45	A45	2618	1330
8	A08	15130	15207	27	A27	1624	1542	46	A46	21963	8945
9	A09	29118	51925	28	A28	27206	9186	47	A47	6218	2815
10	A10	6401	3423	29	A29	1603	1715	48	A48	4668	1638
11	A11	7206	6739	30	A30	6574	4356	49	A49	33000	29403
12	A12	7567	6773	31	A31	8000	2291	50	A50	39000	21326
13	A13	65425	52951	32	A32	7705	2625	51	A51	13516	8668
14	A14	5438	2978	33	A33	8513	3825	52	A52	11728	7768
15	A15	24200	19091	34	A34	5381	6658	53	A53	12923	10199
16	A16	2725	15274	35	A35	31600	21038	54	A54	13477	8281
17	A17	14067	15875	36	A36	1313	2321	55	A55	8829	7386
18	A18	13669	16393	37	A37	3255	1424	56	A56	3100	8953
19	A19	12741	16244	38	A38	3653	2310				

Table 3: Purchase Price Data

No	Code	Price (Rp)	No	Code	Price (Rp)	No	Code	Price (Rp)
1	A01	1120	20	A20	360	39	A39	625
2	A02	750	21	A21	380	40	A40	632
3	A03	500	22	A22	395	41	A41	1050
4	A04	200	23	A23	410	42	A42	1150
5	A05	350	24	A24	425	43	A43	1190
6	A06	350	25	A25	175	44	A44	1205
7	A07	780	26	A26	210	45	A45	240
8	A08	507	27	A27	375	46	A46	495
9	A09	550	28	A28	425	47	A47	507
10	A10	820	29	A29	500	48	A48	550
11	A11	750	30	A30	675	49	A49	450
12	A12	450	31	A31	513	50	A50	180
13	A13	420	32	A32	575	51	A51	450
14	A14	300	33	A33	620	52	A52	180
15	A15	540	34	A34	650	53	A53	450
16	A16	300	35	A35	450	54	A54	500
17	A17	300	36	A36	500	55	A55	1350
18	A18	1150	37	A37	500	56	A56	750
19	A19	850	38	A38	619			

Table 4: Supplier Data

Code	Accessory Name	Supplier	Code	Accessory Name	Supplier
A01	Big Zipper		A35	Horse Buckle 1 cm	
A02	Medium Zipper		A36	Horse Buckle 1,5 cm A	
A05	Plastic YKK Zipper 05		A37	Horse Buckle 1,5 cm B	
A06	Plastic YKK Zipper 03		A38	Horse Buckle 2,5 cm	
A07	Metal YKK Zipper		A39	Horse Buckle 3,2 cm	Gesper
A08	Jacket YKK Zipper	Prima	A40	Horse Buckle 3,8 cm	88
A13	Zipper Head	Jakarta	A45	Buckle 1,5 cm	

A14	Small Zipper Head		A46	Buckle 2,5 cm	
A15	Leaf Zipper Head		A47	Buckle 3,5 cm	
A16	Small Leaf Zipper Head 1		A48	Buckle 3,8 cm	
A17	Small Leaf Zipper Head 2		A03	Button	
A18	Metal Zipper Head NK		A04	Button Bearing	
A19	Jacket Head Zipper		A10	Eyelet 1 cm	
A20	Square Buckle 1,5 cm		A49	Solid Rivet T255	Mitra
A21	Square Buckle 2 cm		A50	Rivet Hole T255	Gesper
A22	Square Buckle 2,5 cm		A51	Solid Rivet T266	
A23	Square Buckle 3 cm		A52	Rivet Hole T266	
A24	Square Buckle 3,8 cm		A53	Short Rivet 277	
A25	Ring D 1 cm		A54	Long Rivet 277	
A26	Ring D 1,5 cm	Gesper	A09	Horse Chain	
A27	Ring D 2 cm	88	A11	Ipod Rag	
A28	Ring D 2,5 cm		A12	Ipod Rag Bearing	
A29	Ring D 3 cm		A41	Roll Buckle 2 cm	Pola
A30	Ring D 3,8 cm		A42	Roll Buckle 2,5 cm	Indah
A31	Ring O 2 cm		A43	Roll Buckle 3,2 cm	
A32	Ring O 2,5 cm		A44	Roll Buckle 3,8 cm	
A33	Ring O 3,2 cm		A55	Magnet JP	
A34	Ring O 3,8 cm		A56	Magnet HB	

4 RESULTS

4.1 ABC Calculation

Step 1: Calculate the total cost per item
Step 2: Sorting out the total cost of each item from the biggest until the smallest.
Step 3: Calculate the percentage of the total cost
Step 4: Classify each item into category A to the value of 0-80%, category B to the value of 81%-90%, and category C to the value of 91%-100%.

4.2 Distribution Test

The distribution test of request data is performed by using *Kolmogorov-Smirnov Method* with SPSS. An example of the calculation result can be seen in Table 5.

Table 5: Distribution test result

		Rit.Besar	Rit.Sedang	Kancing	Bantalan. Kancing	Rit.YKK. Plastik.05
N		24	24	24	24	24
Normal Parameters[a]	Mean	1835.17	1153.12	2505.17	2676.25	1397.71
	Std. Deviation	943.642	920.339	762.709	1323.386	270.862
Most Extreme Differences	Absolute	.246	.258	.106	.224	.122
	Positive	.246	.258	.091	.224	.122
	Negative	-.145	-.128	-.106	-.130	-.100
Kolmogorov-Smirnov Z		1.203	1.265	.519	1.099	.598
Asymp. Sig. (2-tailed)		.110	.081	.950	.178	.866

a. Test distribution is Normal.

Note: Rit Besar = Big Zipper, Rit Sedang = Medium Zipper, Kancing = Button, Bantalan Kancing = Button Bearing, Rit YKK Plastik 05 = Plastic YKK Zipper 05

4.3 Calculation of *Joint Replenishment Order*

Iteration 1 for supplier 1

Step 1: Determining the value of T_i^*

$$T_0 = \sqrt{\frac{2a}{h\,D}}$$

$$= \sqrt{\frac{2(20000)}{(31{,}96)(22022)}} = 0{,}2383 \text{ year.}$$

$$T_i^* = \sqrt{\frac{2a_i}{h_i(D_i+\frac{z_i\sigma_i}{\sqrt{T_0+L_i}})}}$$

$$= \sqrt{\frac{2(20000)}{31{,}96\left(22022+\left(\frac{(2{,}327)(471{,}821)}{\sqrt{0{,}2383+0{,}0125}}\right)\right)}}$$

$$= 0{,}2773 \text{ year}$$

Step 2: Identification of the smallest T_i^* value is notated as item 1, with value of $k_1 = 1$ and other items are notated as item 2,3,4,..,n. the smallest T_i^* value is A13 so that it is notated $k_1 = 1$

Step 3: Determining T Value

$$T_0 = \sqrt{\frac{2(A+a_i)}{h_1 D_1}}$$

$$= \sqrt{\frac{2(250000+20000)}{(31{,}96)(59188)}} = 0{,}5343 \text{ year}$$

$$T = \sqrt{\frac{2(A+a_i)}{h_i(D_i+\frac{z_i\sigma_i}{\sqrt{T_0+L_i}})}}$$

$$= \sqrt{\frac{\mathbf{2(270000)}}{\mathbf{31{,}96}\left(\mathbf{59188}+\left(\frac{\mathbf{(2{,}327)(1605{,}451)}}{\sqrt{\mathbf{0{,}5343+0{,}0{,}125}}}\right)\right)}} = 0{,}5059 \text{ year}$$

Step 4: Determining value of other k items in which $k_2, k_3, k_4, , k_n$ with *trial and error*

$\sqrt{(k-1)k} \le \frac{Ti^*}{T} \le \sqrt{(k+1)k}$, $k_i = q$

(k = 1) $= \sqrt{(1-1)1} \le \frac{0{,}2273}{0{,}5059} \le 1\sqrt{(1+1)1}$

$= 0 \le 0{,}4493 \le 1{,}4142$ (fulfilled)

Step 5: Determining T* value

$$T_0 = \sqrt{\frac{2(A+\sum_{i=1}^{n}\frac{a_i}{k_i})}{\sum_{i=1}^{n} h_1 k_1 D_1}} \quad (2)$$

$$= \sqrt{\frac{2(250000+260000)}{(7468870{,}952)}} = 0{,}3695 \text{ year}$$

Step 6: Determining Total Cost (OT)

$$T = \sqrt{\frac{2(A+\sum_{i=1}^{n}\frac{a_i}{k_i})}{\sum_{i=1}^{n} h_1 k_1 (D_1+\frac{z_i\sigma_i}{\sqrt{k_i T_0+L_i}})}}$$

$$= \sqrt{\frac{2(250000+260000)}{(8055050{,}324)}} = 0{,}3558 \text{ year} \quad (3)$$

(4)

Table 6: Input of data OT supplier 1 (iteration 1)

No	Code	Di	$\boldsymbol{\sigma}$	k_i	$\frac{\boldsymbol{a}}{\boldsymbol{k_i}}$	h k_i D_i	h k_i (D_i+$\frac{z\sigma}{\sqrt{k_i T_o + LT}}$)
1	A01	22022	471,8210	1	20000	703831,6589	760602,5719
2	A02	12824	472,0729	1	20000	409844,0322	466645,2515
3	A05	16773	135,4311	1	20000	536055,6034	552351,0749
4	A06	14966	114,1129	1	20000	478319,163	492049,5679
5	A07	13404	90,4434	1	20000	428381,0571	439263,4785
6	A08	15169	125,9936	1	20000	484791,1415	499951,0645
7	A13	59188	1605,4512	1	20000	1891671,43	2084844,1178
8	A14	4208	159,9435	1	20000	134489,3116	153734,1932
9	A15	21646	660,2407	1	20000	691798,5729	771240,7091
10	A16	9000	320,9006	1	20000	287627,5095	326239,2267
11	A17	14971	230,4744	1	20000	478478,9649	506210,3350
12	A18	15031	234,6681	1	20000	480396,5882	508632,5526
13	A19	14493	250,1622	1	20000	463185,9194	493286,1812
Total					127830,08	7468870,95	8055050,325

$$OT = \frac{A}{T} + \frac{a}{T} + \frac{\sum_{i=1}^{n}\frac{a}{k}}{T} + \frac{D(T+LT)h}{2} + z\sigma\sqrt{T+LT} + \sum_{i=1}^{n}\left[\frac{D(T+LT)h}{2} + z\sigma\sqrt{T+LT}\right]$$

$$= \frac{250000}{0{,}3558} + \frac{20000}{0{,}3558} + \frac{\frac{20000}{1}}{0{,}3558} + \frac{22202(0{,}3558+0{,}0125)31{,}96}{2} + (2{,}327)(471{,}821)\sqrt{0{,}3558+0{,}0125} + \left[\frac{22022(0{,}3558+0{,}0125)31{,}96}{2} + (2{,}327)(471{,}821)\sqrt{0{,}3558+0{,}0125}\right]$$

= Rp1.075.540

Based on the result of the calculation, it obtains the total cost for *supplier* 1 on iteration 1 is to the value of Rp13.359.289/year. The next stage is iteration 2 started with step 4. If the result of iteration 2 is smaller or the same with the previous iteration, then stop, but if the obtained result of iteration is bigger than the previous one, then it shall be continued to the next iteration. The calculation for *supplier* 2, *supplier* 3, and *supplier* 4 is using the same steps. In consequence, it obtains optimal time (T*) of 0,3558 years ≈ 4 months with a total cost of Rp50.863.488, and for 1 year, the obtained total cost is Rp152.590.465.

Table 7 Result of recapitulation

T*	Total cost (Rp)				TOTAL (Rp)
	Supplier 1	*Supplier* 2	*Supplier* 3	*Supplier* 4	
T^*_1 = 0,3558	13,359,289	20,982,163	9,034,423	7.487.613	50.863.488*
T^*_2 = 0,3962	13,483,820	21,159,823	9,198,838	7.348.389	51.190.870
T^*_3 = 0,3703	13,483,820	21,214,991	9,133,900	7.475.538	51.308.248
T^*_4 = 0,4229	13,694,912	20,992,152	9,214,931	7.732.542	51.634.537

4.4 Determining Order Quantity (Q)

Quantity obtains forecast result of 2019 and optimal time (T*) of 0,3558 years. Forecast Result in 2019 uses *Holt-Winters Additive Algorithm* (HWA) method and software WinQSB

Step 1: Determining the aggregate request.
Step 2: Determining the proportion of each item
Step 3: Calculating forecast by using software WinQSB
Step 4: Calculating disaggregation
Step 5: Determining order quantity (Q) for each item

$$Q_i = (k_i + T^*) \quad (9)$$

4.5 Determining Safety Stock and Inventory Level

Safety stock i = $z_i \sigma_i \sqrt{T_i + LT_i}$ (10)

Inventory level i = $\mathbf{D_i(K_i T + LT_i) + z_i \sigma_i \sqrt{T_i + LT_i}}$

Table 8: Quantity, Safety stock and Inventory level

No	Code	$D_{forecast}$	Q	SS	IL	No	Code	$D_{forecast}$	Q	SS	IL
1	A01	21919	7800	784	8858	29	A29	1657	590	216	826
2	A02	12767	4544	683	5386	30	A30	5446	1938	290	2296
3	A03	29921	10648	629	11650	31	A31	5125	1824	279	2167
4	A04	31964	11375	707	12481	32	A32	5145	1831	268	2164
5	A05	16694	5941	356	6505	33	A33	6145	2187	190	2454
6	A06	14898	5302	181	5668	34	A34	5995	2134	227	2436
7	A07	13345	4749	273	5189	35	A35	26195	9322	918	10567
8	A08	15101	5374	293	5855	36	A36	1813	646	253	921
9	A09	40329	14352	1332	16187	37	A37	2334	831	274	1134
10	A10	4893	1742	268	2070	38	A38	2973	1058	224	1319
11	A11	6944	2472	161	2719	39	A39	4060	1445	297	1792
12	A12	7140	2541	175	2805	40	A40	1994	710	133	867
13	A13	58903	20961	3496	25193	41	A41	13123	4670	473	5307

14	A14	4194	1493	275	1820	42	A42	13369	4758	398	5323
15	A15	21545	7667	1353	9289	43	A43	11508	4096	299	4538
16	A16	8961	3189	378	3679	44	A44	8082	2876	363	3340
17	A17	14903	5304	394	5883	45	A45	1970	702	144	870
18	A18	14963	5325	469	5980	46	A46	15384	5475	535	6202
19	A19	14428	5135	504	5818	47	A47	4501	1602	218	1876
20	A20	4316	1536	167	1756	48	A48	3142	1119	211	1368
21	A21	6722	2393	280	2756	49	A49	31054	11051	2506	13944
22	A22	16249	5783	732	6718	50	A50	30020	10683	1048	12105
23	A23	5542	1973	310	2352	51	A51	11042	3930	346	4413
24	A24	4087	1455	184	1690	52	A52	9707	3455	281	3857
25	A25	56185	19994	1960	22656	53	A53	11510	4096	508	4748
26	A26	2217	789	201	1017	54	A54	10830	3854	483	4472
27	A27	1580	563	212	794	55	A55	8074	2874	525	3499
28	A28	18113	6446	2416	9088	56	A56	6002	2136	365	2576

4.6 Result Analysis

Based on data processing result, request data classification is obtained by *Activity-Based Costing* (ABC) in which Category A consists of 25 items and needs inventory cost to the value of 78,64%, category B consists of 9 items which need inventory cost to the value of 11,71%, and category C consists of 22 items which need inventory cost to the value of 10,34%. Request data which has been tested using *Kolmogorov-Smirnov* with SPSS are including as normal data, since the result of Asym. Sig is more than 0,05. Stock control uses a *joint replenishment method* to determine optimal order time. Stock control is performed based on order cost, storage cost, service level, and lead time. Accessory order cost consists of major cost to the value of Rp250.000 and minor cost to the value of Rp20.000, the storage cost of Rp31,96 per item per year, service level to the value of 99% and lead time for 4 days or 0,0125 years.

Based on recapitulation result, it obtains the smallest total cost of Rp50.863.488 with optimal time (T*) in which T^*_1 during 0,3558 year or 4 months. Total cost, which is obtained by the *joint replenishment order method* for 1 year, is to the value of Rp152.590.465, while the company method is to the value of Rp198.411.763. Stock control uses *a joint replenishment method* is aimed to determine the optimal time in performing the order so that it may save the total cost expelled by the company. The system of stock control uses this method, and the company can save Rp45.821.297 per year or 23%.

5 CONCLUSIONS AND FUTURE WORK

Based on the data processing result, it can be concluded that the company in performing accessories order is not considering order time and ordered quantity; thus, order by using *a joint replenishment order method* can determine the optimal time, quantity, safety stock, and inventory level, so it minimizes inventory cost. In this method, optimal order time (T*) of 0,3558 years or 4 months with the total cost of Rp50.863.488 and quantity (Q) are obtained. So that in one (1) year, there are 3 times of order, and the total cost is Rp152.590.465

per year cheaper than the total cost of the company method of Rp198.411.763, therefore there is saving cost up to Rp45.821.297 or 23 %.

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