The Influence of Product Specification and Customer Behavior to Reverse Logistics System

Farida Pulansari[1,2], Suparno[2], and Sri Gunani Partiwi[2 *]
[1,2]*Department of Industrial Engineering, Faculty of Industrial Engineering*
[1,2]*Sepuluh Nopember Institute of Technology, Indonesia*
[1]*University of Pembangunan Nasional "Veteran" Jawa Timur, Indonesia*
[*]*pulansari@yahoo.com, pulansari@gmail.com; suparno@its.ac.id; srigunani@its.ac.id*

Abstract

Purpose – purpose of this study, the influence of factor product specifications and customer behavior factors for the design of reverse logistics system.

Methodology/approach – to determine product specifications, used questionnaires to identify the voice of the customer. From the questionnaire results will be obtained the largest percentage of defective products. And for customer behavior, researchers used a statistical test of 2 & 4 cluster methods and the ANOVA test.

Practical implications – This research will contribute greatly to the R & D Development, to understand and study the product that has the largest percentage in particular parts which are often damaged and can produce products with high quality and performance. And for customer behavior, the benefits that can be taken in this study were researchers can collect data about consumers' habits that have implications for reverse logistics system, ranging from lifestyle, how to use a product until the behavior is carried out if the product is damaged.

Originality – previous research has been discussed about Manufacturing return, Commercial return (B2B and B2C), Product recall, Warranty return, Service return, End-of-use return and End-of-life return, and this paper introduce the new factors namely product specification and customer behavior.

Keywords: reverse logistics system, customer behavior, product specification

1. Introduction

Global warming issues go green, sustainable and the limitation numbers of natural resources are now being encouraged because every individual should have a high awareness. This is no exception with a company that is doing the exploitation of natural resources to meet human needs. Therefore the company is expected to perform legislation, social responsibility, environmental concern, corporate imaging, economic benefit and customer awareness [1]. And promote processes such as product reuse and recycling of materials as well as research from [2].

One of the methods or approaches to address the above challenges is the method of reverse logistics system. There are so many benefits from the implementation of reverse logistics system among others the use of recycled iron providing about 74% profit impact for energy savings, 90% for the use of natural materials, 97% reduction from mining wastes, 88% reduction for water emission, and 76% for water reduction, according to research from [3], and [4] declare that The result of the survey of 125 manufacturing companies, showed that about 50-70% of total potential revenue gained from remanufacturing product that has run out of useful life. While [5] stated that the reverse logistics supply chain system and integrated information system will provide the benefits of collaboration and coordination between all actors along the supply chain. And research by [6] analyze that Reverse logistics will be one way to reduce costs, increase revenues and customer service levels and help to obtain market advantage. There are a number of benefits to implement an effective reverse logistics operation by [7] , are effective waste management, costs, carbon impact and health and safety/ site efficiency.

This paper will introduce two new factors that have a significant impact on reverse logistics system that is factor product specifications and consumer behavior. A simple product design, quality materials and high production process and the use appropriate products will make the product durable and rarely damaged. This is as done by [8], which is then reviewed by [9] and [10], but all researchers were just talking about end-of-life factors to predict when the product is out of useful life. But the factor of product specifications to be discussed will analyze the level of damage to the product after being use by consumers. Meanwhile, for the problems affecting the behavior of customers is to see the extent to which consumer behavior that causes a defective product and what to do at the time of damage.

2. Reverse Logistics Concepts

According to [11], Reverse Logistics System definition or concepts as quoted also by [12] is *"Process of planning, implementing and controlling the efficient, cost-effective flow of materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal".* From [6] has different definition about reverse logistics, ""*... the term most often used to refer to the role of*

logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair and remanufacturing." But the researchers [13] have the own definition about reverse logistics system, *"reverse logistics as the process or return the product (finished goods) or material from consumers as end user because of many factors like reject product, damaged, government or company policy, warranty, end of life/use and customer services with good planning, controlling, and information to support the system".* The conclusion to be drawn from the above two concepts, shows how a good information and control can support the smooth process of reverse logistics system. An interesting definition of the latter is damaged goods here not only from the end user alone but at the time of distribution and storage process can also trigger it. As an example is the material handling process, pickup and delivery process and warehouse layout.

3. Reverse Logistics Perspective

According to [14] there are 4 perspectives in the reverse logistics system, namely RL Input, RL Process, RL Structure and RL Process. The content of RL Input are raw material , recycled material, used parts/new parts, supplier, forecasting, inventory system & how to collection product/parts as has been done by [15] and [16]. And then for RL Process, research by [17],[18],[19],[20],[21],[22], [23] and [24] have been analyzed that the RL Process consists of the problems concerning like disassembly process, coordination, supply chain, inventory systems , repair and after-sales service, remanufacturing, recycle, refurbishing, reuse, production planning. RL Structure discuses about location-allocation, inspection & consolidation, integrating manufacturing and remanufacturing, product modularity, network, hazardous waste management [25],[26],[27],[28],[29],[30]. And the last is RL Output from research by [31],[10],[32],[33] and [34], a lot of researching on the subject like *pricing, product competition* or *customer relation* and *service information.*

Based on [14] analyze about 4 perspective and discussed about policy, innovation, resource based view, SWOT, system approach, stakeholder theory, organizational slack, strategic posture, operations/marketing interface, customer service, information system and leasing such studies have been completed by [3],[35],[36],[37], [38], [39] and [40]. Or from research by [41] which reported a reverse logistics relationship like deposit fee, take back, fee, and trade in.[42].

4. Product Specification and Customer Behavior Factor

Many reverse logistics system research topic have been done by many researchers in the world as quoted by [43] discuss issues concerning manufacturing returns, commercial returns (B2B and B2C), product recalls, warranty returns, service returns, end-of-use returns, and end-of-life returns. In these paper researchers wants to introduce the 2 new factors which have influence in the reverse logistics system namely product specification and customer behavior. Product design should be simple, have a good quality both in terms of material and process as well as having a long durability. The complexity of product and how to use the wrong cause the product more easily damaged and require repair process. Reverse logistics systems research related to product specifications resulting from the use by the consumer is still very rare and few.

Based on research by [8],[44],[36] and [45] discussed about product specification has relationship with end-of-life, recycle, network design and pricing, production and inventory. But for relationship with product damaged after used by customers were not discussed.

While research on consumer behavior that have been there, usually talking about the factors associated with the prestige of consumer knowledge and the paradigm of customer behavior [46], [47] and internet marketing was discussed by [48] and [49]. From [50] discussed about review of customer behavior with motivation topic along with psychological and sociological consumers factors before buy some product. While the strategy and marketing innovation to be developed by the company to attract buyers expressed by [51].

5. Case Study

The object of this study is an electronics company that is PT.PCB located in Sidoarjo, East Java, Indonesia. The company is engaged in the color TVs, audio cassette, TV Stand, plastic injection, and CD replication. In relation to this paper, researchers will analyze the extent to which the implementation of reverse logistics based on product specifications and customer characteristics especially TV Akari brand, which is one of product of PT.PCB. Figure 2 describe about supply chain flow at PT.PCB. This company has two suppliers, one from domestic supplier and the others from foreign suppliers (many countries in ASIA). From 2 different suppliers, all raw materials produced in PT.PCB. Finished goods produced will be marketed by distributors to retailers. From the retailer directly sold to consumers as end users. If the product is defective then the consumer can return the product to service stations. There are 2 kinds of service stations, (Repairs & Information Centre) PRI is an authorized service station owned by PT.PCB and the second is the ASC (Authorized Service Station) is a service station partners.

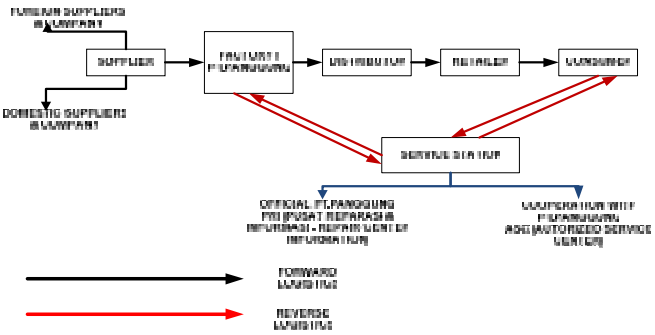

Figure1. Supply Chain of PT.PCB

5.1 Product Specification Factor

Of the 207 questionnaires that have been deployed for 7 months, in seven different places namely Malang, Pasuruan, Sidoarjo, Surabaya, Jombang, Mojokerto and Kediri, has tested the validity and reliability testing to determine the uniformity of voice of the customer. Here are the results of reliability test are:

```
****** Method 2 (covariance matrix) will be used for this analysis ******

RELIABILITY ANALYSIS - SCALE (SPLIT)
N of Cases = 207.0

Statistics for      Mean     Variance   Std Dev   N of Variables
Part 1           48.8213    40.8077    6.3881        13
Part 2           46.0000    35.4078    5.9504        12
Scale            94.8213   133.8854   11.5709        25

Correlations      Mean       Minimum    Maximum    Range     Max/Min   Inter-item Variance
Part 1            .3237      .0661      .5818      .5157     8.7991    .0144
Part 2            .3601      .1193      .6438      .5245     5.3957    .0118
Scale             .3180     -.0066      .6438      .6504   -97.1696    .0133

Reliability Coefficients  25 items

Correlation between forms = .7586  Equal-length Spearman-Brown = .8627
Reliability Coefficients  25 items

Correlation between forms = .7586  Equal-length Spearman-Brown = .8627
Guttman Split-half = .8615         Unequal-length Spearman-Brown = .8629
Alpha for part 1 = .8598           Alpha for part 2 = .8668
13 items in part 1                 12 items in part 2
```

Figure2. Reliability Test Result

From reliability test result found that all the data reliable and can be used for further model development. From model development by [52] and [30], then it can be concluded that the model for the total reverse logistics costs consist of:

$$TRLC = proces\sin g\cos ts + \log isti\csc osts + creditorreplacement\cos t + assetdepreciation\cos ts + collection\cos ts \quad (1)$$

Because PT.PCB service station consists of two places, namely the PRI (Repairs & Information Center) which is an authorized service station PT.PCB own and ASC (Authorized Service Station) which is a service station where the ownership is collaboration with third parties.

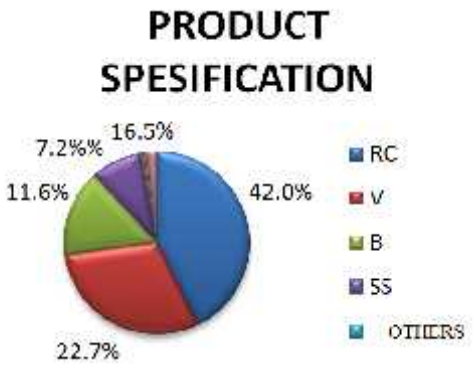

Figure3. The Percentage of Product Specifications That Are Often Damaged

In the questionnaire that has been processed obtained two different groups namely the specification of the remote control group and the tube, visual and sound system group. The group was separated because of some limiting conditions, namely:

1. If the remote control, causing serious damage and cannot be repaired by service station, then the company has a policy to subcontract the manufacture of remote control in an electronics company in Jakarta.
2. While the tube, visual and sound system group that suffered damage then the service station will fix it and if there is damage which is not unusual then the task of R & D Development Company handle it.

Of the two kinds of these conditions then there is a difference in:

a. Service is performed on the PRI and the ASC which is different, because the ASC includes technical services cost to PT.PRI as the claim over servicing a product that is still within the warranty period
b. From the transportation cost factor is also different because the process of collection for damaged products from a variety of service station areas that are affected by distance and the amount of product
c. For groups of tubes, visual and sound system because the repair processes itself is done in the service station it is necessary the addition of some variable costs and include maintenance costs, set up cost, and storage costs.

Mathematical model for a product that is still in warranty period for Remote Control in PRI and ASC

From model (1) the processing costs in PT.PCB are:

$$Pc = \left(\sum RC_c \times d\right) \quad (2)$$

And for logistics costs consist of:

$$L_c = L_{cjp} + L_{pPRI} + WH_c + S_c \quad (3)$$

If the model (2) and (3) are combined, then the final model to PT.PCB for PRI is:

$$TRLC = \left(\sum RC_c \times d\right) + \left(L_{cjp} + L_{pPRI} + WH_c + S_c\right) + O_c + CR_c + AD_c + \left(\sum_{k=1}^{K}\sum_{i=1}^{I} t_i^c \times l_i^c\right) \quad (4)$$

Where:

TRLC	: Total Reverse Logistics Costs
RC_o	: remote control costs / piece
d	: demand
L_{cjp}	: logistics costs from Jakarta to PT.PCB
L_{pPRI}	: logistics costs from PT.PCB to PRI
L_{FCp}	: logistics costs from foreign company to PT.PCB
WH_c	: warehouse costs
S_c	: storage costs
O_c	: overhead costs (telephone, internet ext)
CR_c	: credit or replacement costs
AD_c	: asset depreciation costs
TS_c	: technical service costs
RM	: raw material
RM_c	: raw material costs / piece/kg
L	: labor

L_c : labor costs
SU_c : set up costs
M_c : maintenance costs
10% FOB : tax for logistics costs with sea transportation
A_c : assurance cost
RM_{os} : raw material order shipment
l_t : lead time
t_i^c : The unit cost in terms of transportation collected part from PRI or ASC to PT.PCB
l_i^c : The total transportation distance to collected part from PRI or ASC to PT.PCB

$$TRLC = \left(\sum RC_c \times d\right) + \left(L_{cjp} + L_{pPRI} + WH_c + S_c\right) + O_c + CR_c + AD_c + \left(\sum_{k=1}^{K}\sum_{i=1}^{I} t_i^c \times l_i^c\right) + TS_c \quad (5)$$

The different model (4) and (5) is model which has technical service costs. The company must pay the costs of technical service for all products serviced at ASC including replacing the damaged part.

Mathematical model for a product that is still in warranty period for Visual (Tube), Button and Sound System in PRI and ASC

Under the terms of Customs and Excise of Indonesia, the determination of import goods tax is

- 15% FOB are the goods imported from European countries, America and Africa
- 10% FOB are the goods imported from Non-ASEAN Asian countries and Australia
- 5% FOB are the goods imported from ASEAN countries

The following is a model for total processing costs and total logistics costs in PT.PCB:

$$P_c = \left(\sum RM \times RM_c\right) + \left(\sum L + L_c\right) + SU_c + M_c \quad (6)$$

$$L_c = L_{FCP} + L_{pPRI} + WH_c + S_c + 10\%FOB + A_c \quad (7)$$

And the final model total reverse logistics cost in PRI is:

$$TRLC = \left\{\left(\sum RM \times RM_c\right) + \left(\sum L + L_c\right) + SU_c + MC_c\right\} + \left\{\left(L_{FCP} + L_{pPRI} + WH_c + S_c + 10\%FOB + A_c\right)\right\} + O_c + CR_c + AD_c + \left(\sum_{k=1}^{K}\sum_{i=1}^{I} t_i^c \times l_i^c\right) \quad (8)$$

And for model in ASC is:

$$TRLC = \left\{\left(\sum RM \times RM_c\right) + \left(\sum L + L_c\right) + SU_c + MC_c\right\} + \left\{\left(L_{FCP} + L_{pPRI} + WH_c + S_c + 10\%FOB + A_c\right)\right\} + O_c + CR_c + AD_c + \left(\sum_{k=1}^{K}\sum_{i=1}^{I} t_i^c \times l_i^c\right) + TS_c \quad (9)$$

5.2 Customer Behavior Factor

From the reliability test has been done then the next step is perform an ANOVA test and cluster test to determine the extent of reliability of this result is the voice of customers.

Table 1: Anova 2 cluster

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df	Mean Square	df
Q1	9.099	1	.571	205	15.948	.000
Q2	16.702	1	.559	205	29.873	.000
Q3	15.129	1	.578	205	26.165	.000
Q4	20.186	1	.362	205	55.733	.000
Q5	34.538	1	.549	205	62.943	.000
Q6	90.062	1	.537	205	167.790	.000
Q7	56.700	1	.391	205	144.985	.000
Q8	38.070	1	.570	205	66.830	.000
Q9	25.569	1	.438	205	58.350	.000
Q10	29.913	1	.717	205	41.728	.000
Q11	29.705	1	.394	205	75.477	.000
Q12	29.530	1	.408	205	72.335	.000
Q13	18.327	1	.373	205	49.172	.000
Q14	29.259	1	.831	205	35.212	.000
Q15	10.935	1	.311	205	35.120	.000
Q16	20.048	1	.468	205	42.871	.000
Q17	57.597	1	.478	205	120.417	.000
Q18	32.920	1	.489	205	67.286	.000
Q19	16.161	1	.360	205	44.920	.000
Q20	21.709	1	.394	205	55.142	.000
Q21	37.808	1	.339	205	111.667	.000
Q22	39.136	1	.428	205	91.466	.000
Q23	21.873	1	.550	205	39.761	.000
Q24	43.430	1	.478	205	90.848	.000
Q25	31.571	1	.415	205	76.109	.000

The clue:

- if the significance value> 0.05 then there is no significant difference between cluster 1 and cluster 2, which is associated with the variable
- if the significance value <0.05 then there is a difference between cluster 1 and cluster 2, which is associated with the variable

Based on [53], value of reliability test>0.6 that means all questioners are reliable. In figure 1 show from 3 methods from Cronbach-alpha, spearman-brown and Guttman split-half, each value is: 0.7586, 0.83 and 0.8615. The next step is all data will be conducted by using cluster test, and ANOVA test. For cluster test, this paper use 2 cluster tests and 4 cluster tests.

From anova test for 2 clusters and result from 4 clusters, it can be concluded that Voice of Customer especially Akari consumers have positive and negative perspective for TV Akari. Negative perspective, it means that consumers fulfill the questioner with value of Likert scale<3. The connection between anova test result and customer behavior are based

on consumer dissatisfaction after using the product and how their behavior in the purchase, use and care of TV Akari.

Table 1: Anova 4 cluster

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df	Mean Square	df
Q1	4.704	3	.551	203	8.530	.000
Q2	10.513	3	.491	203	21.391	.000
Q3	7.406	3	.549	203	13.491	.000
Q4	8.135	3	.345	203	23.581	.000
Q5	17.009	3	.473	203	35.968	.000
Q6	30.356	3	.537	203	56.521	.000
Q7	21.751	3	.353	203	61.654	.000
Q8	17.324	3	.507	203	34.183	.000
Q9	11.442	3	.399	203	28.650	.000
Q10	11.712	3	.698	203	16.775	.000
Q11	10.847	3	.383	203	28.288	.000
Q12	11.369	3	.390	203	29.174	.000
Q13	10.270	3	.315	203	32.615	.000
Q14	20.871	3	.675	203	30.927	.000
Q15	5.780	3	.283	203	20.432	.000
Q16	9.812	3	.426	203	23.033	.000
Q17	19.177	3	.483	203	39.675	.000
Q18	11.231	3	.490	203	22.907	.000
Q19	8.906	3	.311	203	28.609	.000
Q20	9.648	3	.362	203	26.657	.000
Q21	17.763	3	.266	203	66.864	.000
Q22	17.598	3	.365	203	48.237	.000
Q23	10.450	3	.509	203	20.537	.000
Q24	21.924	3	.373	203	58.826	.000
Q25	13.652	3	.373	203	36.633	.000

From table 1 and table 2, the conclusions both of two tables are:

Table 3: final result from 2 cluster tests and 4 cluster tests

Dominant factor	2 cluster	4 cluster
Ranking 1	Q1 (15.94)	Q1 (8.53)
Ranking 2	Q3 (26.16)	Q3 (13.49)
Ranking 3	Q2 (29.87)	Q10 (16.77)
Ranking 4	Q15 (35.12)	Q15 (20.43)
Ranking 5	Q14 (35.21)	Q23 (20.53)
Ranking 6	Q23 (39.76)	Q2 (21.39)
Ranking 7	Q10 (41.72)	Q18 (22.90)
Ranking 8	Q16 (42.87)	Q16 (23.03)
Ranking 9	Q19 (44.92)	Q4 (23.58)
Ranking 10	Q13 (49.17)	Q20 (26.65)

Table 3 shows that there are 7 factors compared between 2 cluster tests and 4 cluster tests. There are Q1, Q3, Q15, Q2, Q23, Q10, and Q16, whereas the content of these questions is:

Q1 : From this brand TV, I can expect high quality results (images/visual, sound)

Q3 : This TV is made in such a way that is free from error operation

Q15 : Operation of this TV is easier

Q2 : During use, the TV is relatively distant from damage or disturbance

Q23 : This TV has a service places scattered everywhere making it easier in case of disruption or damage

Q10 : I have this TV due to have its features more than any other TV brands

Q16 : I am sure the company and the employees who work for this TV Company are very reliable (especially in PRI and ASC)

6. CONSCLUSION

There are some conclusions from this study, namely:

1. In relation with the product specification, the results of the questionnaires revealed that the products of PT PCB, especially Akari TVs have four types of components that very often damages. The components are Remote Control, Visual (tubes), Buttons and Sound Systems. This information is very important and can be used to improve the quality of the product.
2. For the customer behavior, the questionnaires showed that there are many negatives perspectives from the customers. This indication may be seen from the Q1, Q3, Q15, Q2, Q23, Q10 and Q16.
3. Two optimization models for determining the lot sizes which minimize the total costs of reverse logistics activities have been developed. The cost consists of several costs related to the activities of reverse logistics.

REFERENCE

[1] A. Mutha and S. Pokharel, "Strategic network design for reverse logistics and remanufacturing using new and old product modules," *Computers & Industrial Engineering* Vol. 56, 2009, pp. 334-346.

[2] P. Panousopoulou, E.-M. Papadopoulou, and V. Manthou, "Reverse Logistics Performance Indicators: A Conceptual Framework for Evaluating Reverse Logistics Services," *Annual Conference on Innovations in Business & Management,* 2011.

[3] S. Kumar and V. Putnam, "Crandle to crandle : Reverse logistics strategies and opportunities across three industry sectors," *Int. J. Production Economics* Vol. 115, 2008, pp. 305-315.

[4] R. Moore, "Reverse Logistics-the least used," 2005.

[5] M. Chouinarda, S. D'Amoursa, and D. Aı¨t-Kadia, "Integration of reverse logistics activities within a supply chain information system," *Computers in Industry* Vol. 56, 2004, pp. 105–124. doi: 10.1016/j.compind.2004.07.005.

[6] J. R. Stock, "Reverse Logistics in the Supply Chain," University of South Florida, Florida

[7] Wrap, "Case study: Reverse logistics for plasterboard A unique operation to manage the delivery of plasterboard and backhaul the off-cuts and wastage," www.wrap.org.uk/construction, Oxon.

[8] C. M. Rose, K. Ishii, and K. Masui, "How product Characteristics Determine End-Of-Life Strategies," *Manufacturing Modeling Lab. Department of Mechanical Engineering Stanford University, Stanford CA* pp. 94305-94321.

[9] B. Witcher and R. Butterworth, "Hoshin Kanri : How Xerox

Manages," *Long Range Planning* Vol. 32, No. 2, 1999, pp. 323-332.

[10] X. Qu and J. A. S. Williams, "An analytical model for reverse automotive production planning and pricing," *European Journal of Operational Research* Vol. 190, 2008, pp. 756–767. doi: 10.1016/j.ejor.2007.06.041.

[11] D. S. Rogers and R. S. L. Tibben, *Going Backwards: Reverse Logistics Trends and Practices*: University of Nevada, Reno Center for Logistics Management, 1998.

[12] CSCMP. *The Council of Supply Chain Management Professionals*.

[13] F. Pulansari, Suparno, and S. Partiwi, "The Key Success Factor to Implementation of Reverse Logistics System," in *The 1st International Conference on Industrial Engineering and Service Science (IESS)*, Solo (Surakarta)-Indonesia, 2011.

[14] S. Pokharel and A. Mutha, "Perspectives in reverse logistics: A review," *Resources, Conservation and Recycling* Vol. 53, 2009, pp. 175–182. doi: 0.1016/j.resconrec.2008.11.006.

[15] R. K. Pati, P. Vrat, and P. Kumar, "Economic analysis of paper recycling vis-a‘ -vis wood as raw material," *Int. J. Production Economics* Vol. 103, 2006, pp. 489–508. doi: 10.1016/j.ijpe.2005.08.006.

[16] S. Minner, "Strategic safety stocks in reverse logistics supply chains," *Int. J. Production Economics,* Vol. 71, 2001, pp. 417-428.

[17] A. Diaz and M. C. Fu, "Models for multi-echelon repairable item inventory systems with limited repair capacity," *European Journal of Operational Research* Vol. 97, 1997, pp. 480-492.

[18] Z. Wang, D.-Q. Yaob, and P. Huang, "A new location-inventory policy with reverse logistics applied to B2C e-markets of China," *Int. J. Production Economics* Vol. 107, 2007, pp. 350–363. doi: 10.1016/j.ijpe.2006.09.012.

[19] R. Kleber, S. Minnera, and G. K. uller, "A continuous time inventory model for a product recovery system with multiple options," *Int. J. Production Economics 79 (2002) 121–141,* Vol. 79, 2002, pp. 121–141.

[20] N. Aras, R. Gullu, and S. Yurulmez, "Optimal Inventory and Pricing Policies for Remanufacturable Leased Products," *International Journal Production Economics,* Vol. Article in Press, 2010, pp.] (]]]])]]]–]]]. doi: 10.1016.

[21] B. Yalabik, N. C. Petruzzi, and D. Chhajed, "An integrated product returns model with logistics and marketing coordination," *European Journal of Operational Research* Vol. 161, 2005, pp. 162-182. doi: 10.1016/j.ejor.2003.07.006.

[22] I. Dobos, "Optimal production–inventorystrategies for a HMMS-type reverse logistics system," *Int. J. Production Economics* Vol. 81-82, 2003, pp. 351–360.

[23] L.-H. Shih, "Reverse logistics system planning for recycling electrical appliances and computers in Taiwan," *Resources, Conservation and Recycling* Vol. 32, 2001, pp. 55–72.

[24] Z. P. Bayındır, N. Erkip, and R. Güllü, "Assessing the benefits of remanufacturing option under one-way substitution and capacity constraint," *Computers & Operations Research* Vol. 34, 2007, pp. 487–514. doi: 10.1016/j.cor.2005.03.010.

[25] S. Kara, F. Rugrungruang, and H. Kaebernick, "Simulation modelling of reverse logistics networks," *Int. J. Production Economics* Vol. 106, 2007, pp. 61–69. doi: 10.1016/j.ijpe.2006.04.009.

[26] M. I. G. Salema, A. P. Barbosa-Povoa, and A. Q. Novais, "An optimization model for the design of a capacitated multi-product reverse logistics network with uncertainty," *European Journal of Operational Research,* Vol. 179, 2007, pp. 1063–1077.

[27] D.-H. Lee and M. Dong, "Dynamic network design for reverse logistics operations under uncertainty," *Transportation Research,* Vol. Part E No. 45, 2009, pp. 61–71.

[28] H. Min, H. J. Ko, and C. S. Ko, "Agenetic algorithm approach to developing the multi-echelon reverse logistics network for product returns," *Omega* Vol. 34, 2006, pp. 56 – 69. doi: 10.1016/j.omega.2004.07.025.

[29] J. Q. F. Neto, J. M. Bloemhof-Ruwaard, J. A. E. E. v. Nunen, and E. v. Heck, "Designing and evaluating sustainable logistics networks," *Int. J. Production Economics,* Vol. 111, 2008, pp. 195–208.

[30] J.-B. S. Tung-Lai Hu, Kuan-Hsiung Huang, "A Reverse Logistics Cost Minimization Model For The Treatment of Hazardous Wastes," *Transportation Research,* Vol. Part E 38, 2002, pp. 457-473.

[31] M. M. Amini, D. R. Roberts, and C. C. Bienstock, "Designing a Reverse Logistics Operation for Short Cycle Time Repair Services," *International Journal Production Economics,* Vol. 96, 2005, pp. 367-380.

[32] Y. Liang, S. Pokharel, and G. H. Lim, "Pricing used products for remanufacturing," *European Journal of Operational Research* Vol. 193, 2009, pp. 390-395. doi: 10.1016/j.ejor.2007.11.029.

[33] S. Vadde, AbeZeid, and SagarV.Kamarthi, "Pricing decisions in a multi-criteria setting for product recovery facilities," *Omega,* Vol. 39, 2011, pp. 186-193. doi: 10.1016/j.omega.2010.06.005.

[34] S. Mitra, "Revenue management for remanufactured products," *Omega* Vol. 35, 2007, pp. 553-562. doi: 10.1016/j.omega.2005.10.003.

[35] R. G. Richey, H. Chen, S. E. Genchev, and P. J. Daugherty, "Developing effective reverse logistics programs," *Industrial Marketing Management* Vol. 34, 2005, pp. 830–840. doi: 10.1016/j.indmarman.2005.01.003.

[36] Y.-H. Cheng and F. Lee, "Outsourching Reverse Logistics of Hightech Manufacturing Firms by Using a Systematic Decision-Making Approach:TFT-LCD Sector In Taiwan," *Industrial Marketing Management,* Vol. 39, 2010, pp. 1111-1119.

[37] S. E. Genchev, "Reverse logistics program design : A company study," *Business Horison* Vol. 52, 2009, pp. 139-148.

[38] P. O. d. Valle, J. Menezes, E. Reis, and E. Rebelo, "Reverse logistics for recycling: The customer service determinants," *Int. Journal of Business Science and Applied Management,* Vol. 4, No. 1, 2009.

[39] A. Kokkinaki, R. Zuidwijk, J. v. Nunen, and R. Dekker, *Chapter 16:Information and Communication Technology enabling Reverse Logistics*. Rotterdam: Econometrics Institute, Erasmus University Rotterdam, Rotterdam School of Management, Erasmus University Rotterdam, 2003.

[40] M. J. Álvarez-Gil, P. Berrone, F. J. Husillos, and N. Lado, "Reverse logistics, stakeholders' influence, organizational slack, and managers' posture," *Journal of Business Research,* Vol. 60, 2007, pp. 463–473.

[41] M. P. d. Brito, R. Dekker, and S. D. P. Flapper, *Reverse Logistics: A Review of Case Studies*, 2004.

[42] M. deBrito and R. Dekker, "Reverse logistics-a framework," *Econometric Institute Report El* 2002, pp. 2002-38.

[43] M. deBrito, F. P, D. P. Simme, and R. Dekker, "Reverse Logistics: a review of case study," *Econometrics Institute Report EI* No. May 2002, 2002, pp. 2002-21.

[44] D.-H. Kim and K.-J. Kim, "Robustness indices and robust prioritization in QFD," *Expert Systems with Applications* Vol. 36, 2009, pp. 2651–2658. doi: 10.1016/j.eswa.2008.01.067.

[45] R. Cruz-Rivera and J. Ertel, "Reverse logistics network design for the collection of End-of-Life Vehicles in Mexico," *European Journal of Operational Research* Vol. 196, 2009, pp. 930–939. doi: 10.1016/j.ejor.2008.04.041.

[46] F. Vigneron and L. W. Johnson, "A Review and a Conceptual Framework of Prestige-Seeking Consumer Behavior," *Academy of Marketing Science Review,* Vol. 1999, No. 1, 1999.

[47] S. McPartlin, L. F. Dugal, and M. B. Whitfield, "The New Consumer Behavior Paradigm: Permanent or Fleeting?," PricewaterhouseCoopers LLP and Kantar Retail.2010.

[48] Y. Liu, "Online interaction readiness:conceptualisation and measurement," *Journal of Customer Behavior,* Vol. 6, No. 3, 2007, pp. 283-299. doi: 10.1362/U7539207X251068.

[49] Albari, "Mengenal Perilaku Konsumen Melalui Penelitian Motivasi " *Siasat Bisnis,* Vol. 1, No. 7, 2002, pp. 65-79.

[50] S. Patel and A. Schlijper, "Title," unpublished|.

[51] L. Deswindi, "Kecepatan Tingkat Penerimaan dan Perilaku

Konsumen Terhadap Produk Lama yang Mengalami Perubahan dan Produk Inovasi Baru dalam Memasuki dan Merebut Pasar," *Business and Management Journal Bunda Mulia,* Vol. 3, No. 2, 2007.

[52] P. Rupnow. (2006) Increase Profits Using Reverse Logistics Costs Equation. *Reverse Logistics Magazine*. 30-32.

[53] S. Arikunto, *Prosedur Penelitian Suatu Pendekatan Praktek*. Jakarta: PT Rineka Cipta., 1998.