

Prioritizing of Reverse Logistic Implementation Factor: A Case Study on Electronics Industries

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Abstract

The reverse logistics (RL) try to discover to assist the return of consumer supplies or its ingredient materials in the production phase. Nowadays reversed logistics has been achieved more attention in supply chain management. Political, economic, green image and social responsibility etc. influence firms to develop strategies to their current systems because, substitute uses of resources must be promoted that may be cost- effective and ecology friendly by extending products? routine life cycles in the turbulent business environment. Reverse logistics activities i.e. storing, transporting and handling of used products poses a great challenge to reverse logistics managers as there is always chances of uncertainty in terms of quantity, quality and timing of return of end of life (EOL) products. This approach intends to investigate the going-over dynamics of reversed logistics implementation based on survey opinion polls for Walton electronics industry by a real life case study. Fuzzy Analytic Hierarchy Process (FAHP) was selected for identify the vital gauges from different companies? professionals of confirmation and electronics firms to do the related eco-friendly management work. The priortization of each factor has been obtained. The overall weights and performance ranking of the evaluation criteria have been shown by the result of this study with respect to the reverse logistics implementation.

Index terms—

1 Prioritizing of Reverse Logistic Implementation Factor: A Case Study on Electronics Industries

Nusrat Hossain Zerin ? & Dewan Maisha Zaman ? I. Introduction lectronics industry is introduced in Bangladesh during the post liberalization era. Due to extension of information technology, many Bangladeshi companies start to produce electronics goods and Walton is the first local electronics industry in Bangladesh. Electronics waste or e-waste is the result of this. . E-waste can be made profitable and useful by establishing RL system. Reverse logistics means the reuse of products and materials. In reverse logistics system, the source goes at least one step back in the supply chain. Normally in supply chain products move manufacturers to distributors or customers. Any process or management which maintain or continue after the sale of the product called reverse logistics. Defective product can be returned by customer. The manufacturing firm would then have to organize shipping of the defective product, testing the product, dismantling, repairing, recycling or disposing the product. The product would move in reverse through the supply chain network in order to retain any use from the defective product. The logistics for such matters is Author ? ? : Dept. of Industrial Engineering and Management, Khulna University of Engineering & Technology, Bangladesh. e-mails: nus Rathossain.zerin@gmail.com, dewanmaisha23@gmail.com

Reverse logistics [4] found that effective RL focuses on the back-ward flow of materials to maximize value from returned items and guarantee their proper disposal [1,5,6]. However, many companies are not yet ready to

42 implement RL including Walton. Walton Hi-Tech Industries Ltd. has been selected for the study because it has
43 a high consumption volume, and major source of waste generation. Also, this is one of the few sectors which
44 come under e-waste regulations [1, 5, and 6]. A thorough study of CSFs and their ordered implementation is
45 essential for successful RL implementation. The major intention of this study is to understand various CSFs
46 for RL implementation in Walton Hi-Tech Industries Ltd. The identification and prioritization of these factors
47 will help the researchers and the managers in strategic decision making for RL implementation. After review of
48 literature on RL and the opinion of experts, 11 CSFs factors of RL implementation were identified. The experts
49 were asked to rate each of these 11 factors in terms of their importance. A decision matrix was developed from
50 these responses which are used in the application of fuzzy-TOPSIS methodology for prioritizing CSFs [1, 5 and
51 6].

52 2 II. Methodology

53 Fuzzy TOPSIS algorithm is used for Prioritizing Reverse Logistics Implementation Factors. This algorithm
54 consists of 8 steps. These steps are presented in detail as follows: (0.5,0.7,0.9) High (0.7,0.9,1.0)

55 Step 2: The TOPSIS method evaluates the following fuzzy decision matrix.

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57 Abstract-The reverse logistics (RL) try to discover to assist the return of consumer supplies or its ingredient
58 materials in the production phase. Nowadays reversed logistics has been achieved more attention in supply
59 chain management. Political, economic, green image and social responsibility etc. influence firms to develop
60 strategies to their current systems because, substitute uses of resources must be promoted that may be cost-
61 effective and ecology friendly by extending products' routine life cycles in the turbulent business environment.
62 Reverse logistics activities i.e. storing, transporting and handling of used products poses a great challenge to
63 reverse logistics managers as there is always chances of uncertainty in terms of quantity, quality and timing
64 of return of end of life (EOL) products. This approach intends to investigate the going-over dynamics of
65 reversed logistics implementation based on survey opinion polls for Walton electronics industry by a real life
66 case study. Fuzzy Analytic Hierarchy Process (FAHP) was selected for identify the vital gauges from different
67 companies' professionals of confirmation and electronics firms to do the related ecofriendly management work.
68 The prioritization of each factor has been obtained. The overall weights and performance ranking of the evaluation
69 criteria have been shown by the result of this study with respect to the reverse logistics implementation.

70 Step 1: Collecting the required data containing linguistics terms. A proper scale must be chosen to represent
71 the data. Respondents must be asked to choose the best alternative among the linguistics terms for a given
72 question. Fuzzy numbers for the selected linguistics terms are presented in Table 1. (1)

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76 i n j n j

77 Where is a fuzzy number corresponding to the linguistic term assigned by the I the Decision Maker (DM) to
78 the j th factor. $i=1, 2, \dots, m$ are the number of DMs and $j = 1, 2, \dots, n$ are the number of factors (CSFs).

79 Step 3: This step includes neutralizing the weight of decision matrix and generating fuzzy un-weighted matrix
80 (R). $R = [r_{ij}]_{m \times n}$, $r_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$, $r_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$, $r_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$, $r_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$ (2)

81 Where $r_{ij} = \max_i r_{ij}$

82 Step 4: Calculate the weighted normalized decision matrix $V = [v_{ij}]_{m \times n}$ $i = 1, 2, 3 \dots m$ and $j = 1, 2$
83 n (3)

84 The weighted normalized value v_{ij} is calculated as $v_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$ (4)

85 Where w_i is the weight given to each decision maker? $w_i = (1, 1, 1, 1, 1) / 5$, because all the DMs
86 are considered to have same weight for this study. $w_i = (1, 1, 1, 1, 1) / 5$ (5) $w_i = (1, 1, 1, 1, 1) / 5$
87 $w_i = (1, 1, 1, 1, 1) / 5$ (6)

88 Since the positive and negative ideas introduced by Chen (1997) are used for the research. The following terms
89 are used for ideal and negative ideal? $w_i = (1, 1, 1) / 3$ (7)

90 $w_i = (0, 0, 0)$ (8)

91 Step 6: Calculate the sum of distances from positive and negative ideal solution for each factor. $d_i = \frac{1}{n} \sum_{j=1}^n (d_{ij}^+ + d_{ij}^-)$
92 $d_i = \frac{1}{n} \sum_{j=1}^n (d_{ij}^+ + d_{ij}^-)$, $j = 1, 2, \dots, n$ (9) $d_i = \frac{1}{n} \sum_{j=1}^n (d_{ij}^+ + d_{ij}^-)$

93) is the distance between two fuzzy numbers which can be calculated using the vector algebra. For example
94 distance between two numbers $A_1 = (1, 3, 2)$ and $A_2 = (2, 1, 2)$ is $d(A_1, A_2) = \frac{1}{3} \sqrt{(1-2)^2 + (3-1)^2 + (2-2)^2} = \frac{1}{3} \sqrt{1 + 4 + 0} = \frac{1}{3} \sqrt{5}$
95 (10)

96 Similarly, the separation from the negative ideal solution is given as $d_i^- = \frac{1}{n} \sum_{j=1}^n (d_{ij}^-)$
97 $d_i^- = \frac{1}{n} \sum_{j=1}^n (d_{ij}^-)$, $j = 1, 2, \dots, n$ (11) $d_i^- = \frac{1}{n} \sum_{j=1}^n (d_{ij}^-)$, $i=1, 2, \dots, m$ (12)

98 Step 8: Prioritize the preference order based on the order of the values of d_i .

5 III. Numerical Analysis a) Analysis of Critical Factors

Many CSFs are common to all of these studies and these factors can be utilized as base for discussion with expert from Walton Hi-tech Industries ltd. Eleven CSFs were identified after pertinent literature review including studies discussed in "Introduction" and discussion with the number of experts from the Walton Hi-tech Industries ltd. These factors are Total manufacturing cost (C1), Recycling (C2), Environment concern (C3), Recycled volume (C4), Economic Need (C5), Pressure with stakeholders (C6), Reverse logistics management information syst (C7), Top management awareness (C8), capabilities & skilled workers (C9), Increase of sales volume for new product (C10), Consumer awareness & Social acceptability (C11).

6 b) Decision Maker Choosing

The fuzzy TOPSIS methodology, presented in this research paper has been evaluated in context of Walton electronics industry. Four experts from electronic companies participated in this study. Profile of the decision makers and their respective organization is given as follows and their respective organization is given as follows:

First decision maker (DM1) is a supply chain manager in Walton electronic industry. Second decision maker (DM2) is a logistics manager in Walton electronic industry. Third decision maker (DM3) is a logistics manager in Walton electronic industry. Fourth decision maker (DM4) is vice president of operations management of same industry.

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Step 7: Calculate the relative closeness to the ideal solution. The relative closeness with respect to A_1^* is defined as

Step 5: Determine the ideal and negative-ideal solution for the CSFs (A_1, A_2, A_3) and $A_2(A_1, A_3)$ can be calculated as To generate R, following relationship can be applied solution. Here all decision maker weight is 1 and A_1^* is (1, 1, 1) and A_1^- is (0,0,0). So the table for Normalized fuzzy decision matrix for criteria and weighted normalized alternatives, FPIS and FNIS are same as table 2.

9 c) Data Analysis

10 IV. Result and Discussion

To prioritize the CSFs for RL implementation in Walton Electronic industry, 11 factor legislation, Total manufacturing cost (C1), Recycling cost (C2), Environment concern(C3), Recycled volume (C4), Economic Need(C5), Pressure with stakeholders (C6), Reverse logistics management information system(C7), Top management awareness(C8), Process capabilities & skilled workers(C9), Increase of sales volume for new product (C10), Consumer awareness & Social acceptability (C11), identified in section "Identification of CSFs for RL implementation" are considered for the prioritization. Four decision makers DM1, DM2, DM3, and DM4 were asked to rate the importance of the above mentioned each CSF on a 5-point scale having the linguistic terms low (L), fairly low (FL), medium (M), fairly high (FH), and high (H). The decision makers used the linguistic variables shown in table 2 to assess the importance of the CSFs. A decision matrix was prepared based on the responses received from the DMs shown in table 3. As mentioned in the fuzzy-TOPSIS methodology step 1, triangular fuzzy numbers were used to convert linguistics variable into the fuzzy numbers. By converting the fuzzy linguistic variables into triangular fuzzy numbers using table 1, the fuzzy decision matrix D was obtained. In the next step unweighted fuzzy decision matrix R was enumerated. Further steps were followed to obtain the weighted fuzzy normalized decision matrix, to find the ideal and negative-ideal solutions for the CSFs. The distance A_1^* and A_1^- of each CSF is derived, respectively, by using Eqs. (7), (8), (9), and (10). The A_1^* and A_1^- closeness coefficient C for each CSF is obtained by using Eq. (11) The findings of the research will help the managers and academicians in the development of RL strategies and practices in Bangladesh electronics industry. These CSFs can also be used for RL implementation in other sectors of Bangladesh industry. Like other studies, this study also has some limitations. This study is conducted using for experts from the Walton electronic industry. Future studies may consider larger sample size to assess the methodology and the effectiveness of the proposed solution to enable generalization. Furthermore, the wider rating of the 7 or 11-point linguistic scale could be used instead of using a 5-point linguistics scale. Researchers may utilize other methodologies including other MCDM methodologies and may compare the results. Future studies may be carried out to identify company-specific or productspecific identification of CSFs for RL implementation.

11 Nomenclature

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11 NOMENCLATURE

1

Linguistic term	Fuzzy number
Low	(0.0,0.1,0.3)
Fairly low	(0.1,0.3,0.5)
Medium	(0.3,0.5,0.7)
Fairly high	

Figure 1: Table 1 :

11	12	...	1	...	1
21	22	...	2	...	2
...
1	2
...
1	2

Figure 2:

2

Factor	D1	Decision Maker	D2	D3	D4
Total manufacturing cost (C1)	FH	M	FL		M
Recycling cost (C2)	FH	M	M		FH
Environment concern(C3)	M	FH	H		M
Recycled volume (C4)	FH	FH	FH		M
Economic Need(C5)	FH	FH	M		H
Pressure with stakeholders (C6)	L	M	L		FL
Reverse logistics management information system(C7)	M	L	M		FH
Top management awareness(C8)	H	H	FH		FH
Process capabilities & skilled workers(C9)	FL	FL	L		FL
Increase of sales volume for new product (C10)	M	M	FL		L
Consumer awareness & Social acceptability (C11)	M	H	M		M

Figure 3: Table 2 :

3

	Decision Makers			
	D1	D2	D3	D4
C1	(.5,.7,.9)	(.5,.7,.9)	(.1,.3,.5)	(.3,.5,.7)
C2	(.5,.7,.9)	(.3,.5,.7)	(.3,.5,.7)	(.5,.7,.9)
C3	(.5,.7,.9)	(.5,.7,.9)	(.7,.9,1)	(.3,.5,.7)
C4	(.5,.7,.9)	(.5,.7,.9)	(.5,.7,.9)	(.3,.5,.7)
C5	(.5,.7,.9)	(.5,.7,.9)	(.3,.5,.7)	(.7,.9,1)
C6	(0,.1,.3)	(.3,.5,.7)	(0,.1,.3)	(.1,.3,.5)
C7	(.3,.5,.7)	(0,.1,.3)	(.3,.5,.7)	(.5,.7,.9)
C8	(.7,.9,1)	(.7,.9,1)	(.5,.7,.9)	(.5,.7,.9)
C9	(.1,.3,.5)	(.1,.3,.5)	(0,.1,.3)	(.1,.3,.5)
C10	(.3,.5,.7)	(.3,.5,.7)	(.1,.3,.5)	(0,.1,.3)
C11	(.3,.5,.7)	(.7,.9,1)	(.3,.5,.7)	(.3,.5,.7)

Figure 4: Table 3 :

4

Factors	D1	Decision Maker D2	D3	D4	Average
C1	.342	.525	.719	.525	.528
C2	.342	.525	.525	.342	.434
C3	.525	.342	.183	.525	.394
C4	.342	.342	.342	.525	.388
C5	.342	.342	.525	.183	.348
C6	.876	.525	.876	.719	.749
C7	.525	.876	.525	.342	.567
C8	.183	.183	.342	.342	.262
C9	.719	.719	.876	.719	.758
C10	.525	.525	.719	.876	.661
C11	.525	.183	.525	.525	.440

Figure 5: Table 4 :

5

Factors	D1	D2	Decision Maker D3	D4	Average
C1	.719	.526	.342	.526	.528
C2	.719	.526	.526	.719	.622
C3	.526	.719	.879	.526	.662
C4	.719	.719	.719	.526	.670
C5	.719	.719	.526	.879	.710
C6	.183	.526	.183	.342	.309
C7	.526	.183	.526	.719	.89
C8	.879	.879	.719	.719	.796
C9	.342	.342	.183	.342	.302
C10	.526	.526	.342	.183	.397
C11	.526	.879	.526	.526	.614

Figure 6: Table 5 :

6

1	Total manufacturing cost (C1)	.528	.528	.500	7
2	Recycling cost (C2)	.434	.622	.590	5
3	Environment concern(C3)	.394	.662	.627	4
4	Recycled volume (C4)	.388	.6708	.634	3
5	Economic Need(C5)	.348	.710	.716	2
6	Pressure with stakeholders (C6)	.749	.309	.292	10
7	Reverse logistics management information system(C7)	.567	.489	.463	8
8	Top management awareness(C8)	.2623	.796	.752	1
9	Process capabilities & skilled workers(C9)	.758	.302	.284	11
10	Increase of sales volume for new product (C10)	.661	.394	.373	9
11	Consumer awareness & Social acceptability (C11)	.440	.614	.582	6

Figure 7: Table 6 :

shows that top four prioritized factors top management awareness, economic need, recycled volume, and environment concern are the most important among all 12 factors. Briefly, the contributions of this study are summarized as follows:

a) The study provides the insight into previous

b) Identifies the CSFs based on past literature review

c)

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Values of and closeness coefficient C for each CSF are shown in table 6. The prioritization of CSFs was obtained

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Prioritizing Of Reverse Logistic Implemen

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and experts opinion for successful reverse
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Figure 8:

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