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RESEARCH PAPER

Analysis on strategic and environmental issues of remanufacturing in India

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Abstract. Environmental awareness among masses has created tremendous pressure on government and corporates to preserve our natural resources. Globally, many companies have successfully initiated product recovery operations in their business plans. Remanufacturing is one of the highly profitable and sustainable product recovery options. Many Western countries successfully adopted remanufacturing as an alternate source of revenue generation model. But in India, it is still in nascent stage. In this research, we tried to identify the critical factors in the area of "Strategy & Environment" for the viability of remanufacturing business in India. For this, a questionnaire survey was conducted among Indian manufacturing companies and their responses were analyzed. The sample size of the study consists of 72 responses. Afterwards, the identified factors were ranked based on their criticality in initiating remanufacturing activity. The findings may help Indian government and manufacturing firms to frame proper strategy related to environmental aspect of remanufacturing operations in India.

Keywords: remanufacturing; environment; empirical study; India

1. Introduction

In today's world, the increasing rate of environmental pollution and depletion of natural resources create tremendous pressure on corporate and government to adopt sustainable practices for economic development (Lieder & Rashid, 2016). These sustainable practices provide alternatives for preserving our resources and ecosystem. There are several methods practiced today viz; repair, refurbish, reconditioning, recycle, remanufacturing, etc., to divert materials from landfill (Pigosso et al., 2010). Out of these methods, remanufacturing is considered to be very effective as it produces products with comparable quality to new ones at a fraction of the cost (Guide et al., 1997).

Remanufacturing is not the same as recycling, reconditioning, refurbishing, reusing or repairing, but can include some or all of these activities. Remanufacturing is a value recovery process where used and discarded products/components/parts are subjected to a sequence of value addition activities to convert them into reusable ones (Lund, 1996). Remanufacturing retains more of the energy associated with the original conversion of raw materials to finished products (Nasr & Thurston, 2006). The main drivers of remanufacturing are take-back obligations, disposal bans, economic benefits, creation of stock of components/parts from disassembly and demand for spare parts during post product life cycle period. Remanufacturing is currently

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practiced in numerous industrial sectors, namely the automotive, aerospace sector, photo copiers, surgical equipment, earth moving machinery and so on. Companies like Xerox, IBM, Fuji film, Caterpillar, Flextronics, BMW, and Ford motors are actively engaged in remanufacturing activities for more than a decade (Apec Remanufacturing Resource Guide, 2013).

Although remanufacturing has been successfully accepted as a profitable business option in many countries like the US, the UK, Japan, Denmark, etc., this practice still remains in adolescence stage in India (Sinha et al., 2017). Most of the research papers in the area of remanufacturing have been published by the Western countries in leading journals (e.g.: Thierry et al., 1995; Doppelt et al., 2001). However, very limited researches have been done in Indian context, especially, focusing on "Strategic and Environmental" issues of remanufacturing.

The growth of remanufacturing business has tremendous potential if we consider the huge population base of India. The basic factor for considering the demand for remanufactured products consists of rapidly growing middle class, market oriented stable economy, availability of trained manpower at competitive cost, fairly well-developed credit and financing facilities, and local availability of almost all the raw materials at a competitive cost. The Indian customers are keen on low running cost and low cost of ownership (Sinha, 2013). These are the influential purchase decisions for most of Indian customers.

As per the facts mentioned above, India has all the favorable conditions like enormous market growth, demand for remanufactured products, and price sensitive market, (Sinha, 2013) for initiating remanufacturing business. With this backdrop, we propose to seek the answer to the following questions. First question, what are the Strategic and Environmental factors considered critical for the viability of remanufacturing business in India? Second question is prioritizing these factors as per their importance in taking up remanufacturing business in India.

2. Literature review

Among all the product recovery options, remanufacturing is the most sustainable and economical one (Sharma et al., 2010). It extends the life of a product by multiple usage and prevents the environment from being polluted through land filling, incineration, and disposal (Seitz & Peattie, 2004; Steinhilper, 2006). Companies like Xerox, Caterpillar, and Fujifilm, are extremely benefited by remanufacturing activities (Gray & Charter, 2006).

There are several rules and laws in many European countries as well as in several states of the US which compel the companies to adopt product recovery activities (Doppelt & Nelson, 2001). The End-of-Life vehicles (ELV) directives of Denmark, Germany, Netherlands, and France compel the auto manufacturers to collect the used cars for remanufacturing purpose (Environmental Protection Agency, 1998). Restriction of hazardous waste substances (RoHS) directives of the UK ban the use of hazardous materials from electronics products and reduces their environmental impacts (Gray & Charter, 2006). In the US, 95% of cars and trucks that are retired each year go to the recycler, and for each of those cars, 75% by weight is recovered for reuse (Steinhilper et al., 2001). In the European Union (EU) countries, the End-of-life vehicles (ELVs) regulation has passed laws requiring member countries to reuse and recover around 95% by weight of the average vehicle coming for recycle (Gerrard & Kandlikar, 2007).

The process of reverse flow of materials complicates remanufacturing operations due to a lack of proper reverse logistics system. The rate of flow return (used products) is very uncertain in terms of quality, quantity and timing (Guide & Jayaraman, 2000). Hence, the designing of reverse distribution network is a very complicated process.

There are various cost associated with remanufacturing operations which impose challenge for the companies to estimate accurately. These includes, cost of reverse logistics, collection cost of used product, storage and inventory cost, inspection cost, disassembly operation cost, cost of cleaning and sorting, and technology and capital cost (Guide & Jayaraman, 2000; Teunter & Van der Laan, 2002; Hammond et al., 1998; Thierry et al., 1995).

The market demand for remanufactured products could be increased by changing the perception of the customer (Steinhilper, 2006; Yang & Zhao, 2010; Rathore et al., 2011). They need to be educated about the benefits associated with the remanufactured products (Steinhilper, 2006). Furthermore, the selling price of the remanufactured products should be kept comparatively low. Several incentives and discounts could be offered on remanufactured products for its easy penetration into the market (Morley, 2006; Choi, 2017). Other strategies like superior quality product with warranty and green product promotions could also be adopted (Gungor & Gupta, 1999; Alqahtani & Gupta, 2017; Matsumoto et al., 2018). This will help in attracting environmental conscious customers (Guide, 2000; Debo et al., 2005; Ferguson, 2009). All important factors found from literature survey in the areas of strategy and environment are listed in Table 1.

These factors will be considered for developing a questionnaire for survey research in the subsequent section. The description about these factors are given below. Cost of reverse logistics (V1) is cost incurred in transportation of cores (used products) from customer base to the manufacturing center. Collection cost of used product/cores (V2) is cost incurred in procurement of cores from the customers. Storage and inventory cost (V3) is cost related to holding and stocking of used products near manufacturing center. Inspection cost (V4) is cost related to quality check of the used products to ensure its condition. Disassembly operation cost (V5) is cost related to disassembly operations of the cores up to component level to segregate good and bad parts. Cost of product and process design (V6) is cost related to the design of the product and process for multiple lives (usage). Cost of cleaning and sorting (V7) is cost incurred in cleaning and sorting operations of the cores for quality assurance before remanufacturing operations. Technology and capital cost (V8) is cost related to purchase and installation of new equipment and machinery. Disposal cost (V9) is cost related to disposing the waste part of used products underground after disassembly and inspection operations.

Take-back policies (V10) are rules and regulations imposed by government related to product take back after its useful life. Landfill and incineration restrictions (V11) are rules and regulations imposed by government related to underground dumping and burning of waste products. Laws related to environmental protection (V12) are rules and regulations imposed by government related to conserving our environment from pollution. Restriction on the use of hazardous substances (V13) is government policy related to prohibiting the use of hazardous materials in components used for final assembly of the product. Prevention and control of pollution (V14) are measures taken by the government for prevention and control of environmental pollution. Price of remanufactured product (V15) determines the selling price of the remanufactured product. Customer's attitude towards remanufactured product (V16) is the customer's perception of the remanufactured product about its quality. Existence of disorganized business sector (V17) is the existance of disorganized (local) markets that are selling repaired, refurbished and reused products. Companies' perception about remanufacturing (V18) is the perception of the companies about the quality of remanufactured products. Companies' fear of losing market share (V19) is companies thinking about losing market share of original product once they switch to remanufacturing business. Relatively few customers in the market (V20) means that there are not many buyers existing in the market for remanufactured products. Second hand market is thriving (V21) is local market for second hand products are already existing and operating successfully. Trade barriers (V22) are barriers on import/export of remanufactured products imposed by the government. Identification of potential customers (V23) is difficulty in identifying the potential customer for remanufactured products. Green image as marketing element (V24) is advertising about the remanufactured products as eco-friendly products which are available at cheaper cost with the same quality as the new ones. Remanufactured product promotion through offers (V25) is providing offers and incentives on the purchase of remanufactured products to improve its sale.

Table 1. List of important factors under strategy and environment

SL. No.	Factors	Variable	Reference
1	Cost of reverse logistics	V1	Savaskan et al. (2004); Wei et al. (2015)
2	Collection cost of used product/cores	V2	Guide (2000); Wei et al. (2015)
3	Storage and inventory cost	V3	Teunter & Van der Laan (2002); Wei et al. (2015)
4	Inspection cost	V4	Hammond et al. (1998); Vercraene et al. (2014)
5	Disassembly operation cost	V5	Hammond et al. (1998); Vercraene et al. (2014)
6	Cost of product and process design	V6	Hammond et al. (1998); Wu (2013)
7	Cost of cleaning and sorting	V7	Hammond et al. (1998); Wei et al. (2015)
8	Technology and capital cost	V8	Thierry et al. (1995); Hammond et al. (1998)
9	Disposal cost	V9	Gray & Charter (2006); Subramoniam et al. (2013)
10	Take-back policies	V10	Guide (2000); Atasu & Wassenhove (2010)
11	Landfill and incineration restrictions	V11	Gray & Charter (2006); Li et al. (2018)
12	Laws related to environmental protection	V12	Thierry et al. (1995); Li et al. (2018)
13	Restriction on the use of hazardous substances	V13	Gray & Charter (2006); ; Li et al. (2018)
14	Prevention and control of pollution	V14	Gray & Charter (2006); ; Li et al. (2018)
15	Price of remanufactured product	V15	Morley (2006); Bhattacharya et al. (2018)
16	Customer's attitude towards remanufactured product	V16	Steinhilper (2006); Bai et al. (2018)
17	Existence of disorganized business sector	V17	Gray & Charter (2006); Atasu & Wassenhove (2010)
18	Companies' perception about remanufacturing	V18	Gray & Charter (2006); Sharma et al. (2010)
19	Companies' fear of losing market share	V19	Gray & Charter (2006); Zhao & Zhu (2018)
20	Relatively few customers in the market	V20	Thierry et al. (1995); Bai et al. (2018)
21	Second hand market is thriving	V21	Gray & Charter (2006); Alqahtani & Gupta (2017)
22	Trade barriers	V22	Gray & Charter (2006); Bhattacharya et al. (2018)
23	Identification of potential customers	V23	Thierry et al. (1995); Bai et al. (2018)
24	Green image as marketing element	V24	Gungor & Gupta (1999); Matsumoto et al. (2018)
25	Remanufactured product promotion through offers	V25	Morley (2006); Alqahtani & Gupta (2017)

3. Methodology

To answer the research objectives, and more specifically, to identify the probable factors under "Strategic and Environmental" category which possibly are the roadblocks for initiating remanufacturing in India, we adopted a questionnaire as the survey method. The survey instrument consists of a set of questions related to the factors that may be considered important while initiating remanufacturing business in India. Based on the literature survey, a questionnaire is prepared to conduct a survey among Indian manufacturing companies. Companies include both OEMs as well as component suppliers. A total of 25 closed ended questions (refer to Table.1) were framed under the questionnaire set. The respondents were asked to rate each question in the 5-point Likert scale, (1 with least important and 5 with most important) based on their criticality in taking up remanufacturing business in India.

A questionnaire survey was conducted online (using Google Forms) to 456 manufacturing companies which comprise our population. The designation of the respondents were ranging from manager to the supervisor level. A total of 72 responses were obtained which represent our sample size. In these, 30 are OEMs and 42 component supplier based out of eastern and western part of India. They are mostly involved in white goods appliances and automobile manufacturing.

For data analysis, SPSS software (version-23) and Microsoft Office Excel-2010 were used. One-sample t-test was conducted to identify about the criticality of the factors.

4. Result and discussion

4.1. Data analysis

The descriptive statistics of all 25 factors taken from the questionnaire were computed and one sample *t*-test was conducted to know the *t*-statistics values from the data for testing whether an issue is considered significantly important or not, i.e., the mean value being greater than or equal to 3.

The descriptive statistics of the 25 factors considered in this study are shown in Table 1. Highest mean value occurred with factor V8 and lowest with V4 whereas the highest standard deviation occurred with V20 and lowest with V18. Using t-statistics, we only consider significantly important factors with mean values being at least 3. Thus, seventeen significantly critical factors were sorted out and are depicted in the last column of the table with asterisk sign. These factors could be seen in Table 2. These seventeen factors are taken for further analysis for ranking as per their frequencies using MS-Excel software. Plots in Figure 1 show the frequencies of different ratings (1 to 5) against the factors. The distribution of rating of each factor is varied.

Afterwards, weighted score was calculated by using the above table values and ranking is provided to prioritize the factors. Table 3 shows the factors weighted value with their corresponding ranks. Based on the weighted score, a rank chart was plotted to depict and prioritize the factors as per their importance in initiating remanufacturing business. The rank is depicted in Figure 2.

From the analysis, it is clear that technology/machine/capital cost (V8) is ranked first whereas restriction on the use of hazardous substances (V13) is ranked seventeenth in terms of their importance in remanufacturing activity. The other factors are lying in between these two.

4.2. Discussion

A total of seventeen factors are identified as critical in the data analysis. These factors are then ranked as per their importance in starting remanufacturing business.

Technology and capital cost (V8), take-back policies (V10), and green image as marketing element (V24) are considered to be at the first level. These are the major stumbling blocks in initiating remanufacturing business. The reason behind it may be the companies think that huge capital investment will be required to start remanufacturing activity. Furthermore, there is a lack

of government policies related to product take-back in India, which makes manufacturing companies hesitant to think about product recovery options. Moreover, Indian customers are generally unaware of the environmental issues related to product disposal (Sinha, 2013). This may be due to a lack of higher education and understanding about the impact of pollution on environment.

Table 2. Descriptive statistics of factors under strategic and environmental category

SL. No	Factors	Notation	Mean	Std. Dev.	t-values
1	Cost of reverse logistics	V1	3.611	0.683	7.593*
2	Collection cost of used product/cores	V2	3.292	0.638	3.881*
3	Storage and inventory cost	V3	2.778	0.716	-2.632
4	Inspection cost	V4	2.014	0.796	-10.512
5	Disassembly operation cost	V5	2.097	0.825	-9.286
6	Cost of product and process design	V6	3.264	0.787	2.845*
7	Cost of cleaning and sorting	V7	2.056	0.902	-8.884
8	Technology and capital cost	V8	4.375	0.740	15.768*
9	Disposal cost	V9	3.611	0.742	6.987*
10	Take-back policies	V10	4.292	0.971	11.293*
11	Landfill and incineration restrictions	V11	3.917	0.727	10.703*
12	Laws related to environmental protection	V12	2.667	0.650	-4.351
13	Restriction on the use of hazardous substances	V13	2.944	0.669	-0.705*
14	Prevention and control of pollution	V14	3.292	0.895	2.765*
15	Price of remanufactured product	V15	4.167	0.692	14.305*
16	Customer's attitude towards remanufactured product	V16	3.056	0.669	0.705*
17	Existence of disorganized business sector	V17	2.750	0.783	-2.710
18	Companies' perception about remanufacturing	V18	3.542	0.627	7.335*
19	Companies' fear of losing market share	V19	2.236	0.760	-8.531
20	Relatively few customers in the market	V20	3.833	1.101	6.425*
21	Second hand market is thriving	V21	2.792	0.804	-2.199
22	Trade barriers	V22	2.944	0.690	-0.683*
23	Identification of potential customers	V23	4.153	0.799	12.243*
24	Green image as marketing element	V24	4.208	0.838	12.233*
25	Remanufactured product promotion through offers	V25	3.028	0.919	0.257*

*Decision criteria: If $t \geq -1.667$ (at 5% significance level) then the factors have mean significantly greater than or equal to 3 (at 5% level of significance).

On the second level, Price of remanufactured product (V15) and Identification of potential customers (V23) are identified. These are also considered critical factors in starting remanufacturing business. Identification of potential customers for remanufactured products is very difficult as this sector is existing in much disorganized form in the market. Additionally, the price of remanufactured product should be kept significantly lower so that it could penetrate into the market easily.

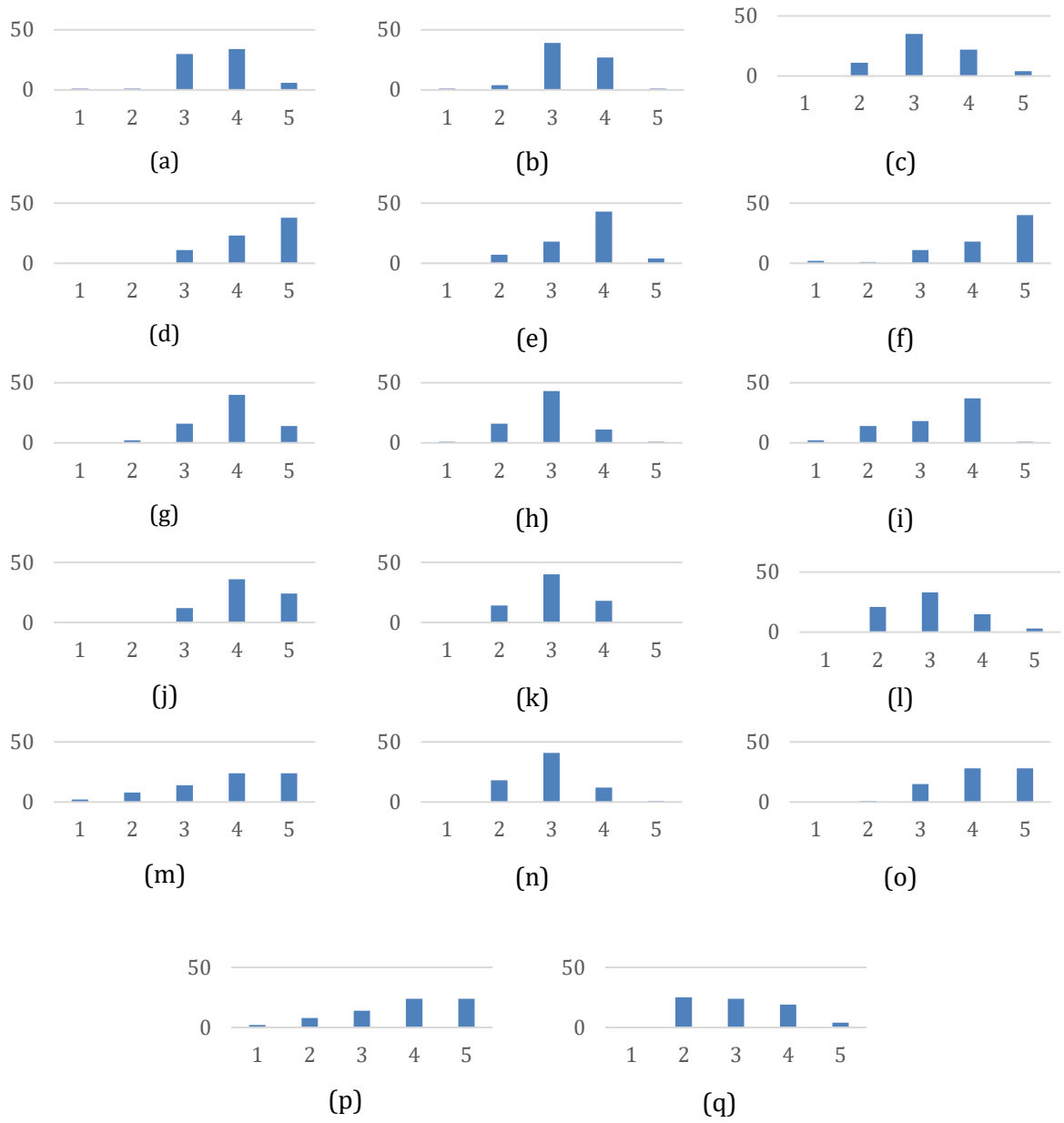

Figure1. Frequency distribution of critical factors a. Cost of reverse logistics (V1), b. Collection cost of used product/cores (V2), c. Cost of product and process design (V6), d. Technology and capital cost (V8), e. Disposal cost (V9), f. Take-back policies (V10), g. Landfill and incineration restrictions (V11), h. Restriction on the use of hazardous substances (V13), i. Prevention and control of pollution (V14), j. Price of remanufactured product (V15), k. Customer's attitude towards remanufactured product (V16), l. Companies' perception about remanufacturing (V18), m. Relatively few customers in the market (V20), n. Trade barriers (V22), o. Identification of potential customers (V23), p. Green image as marketing element (V24), q. Remanufactured product promotion through offers (V25).

At third level, Landfill and incineration restrictions (V11) and relatively few customers in the market (V20) are considered important. Because Indian customers are less aware of environmental issues, they may be reluctant to purchase remanufactured products (Sinha, 2013). They may perceive remanufactured as a secondhand product. The lack of government regulations

pertaining to landfill, disposal and incineration of used products hinders in product take-back and recovery process.

Table 3 Composite score of factors and their ranks

Variable	Total	Rank	Level
V8	315	1	I
V10	309	2	
V24	303	3	
V15	300	4	II
V23	299	5	
V11	282	6	III
V20	276	7	
V9	260	8	IV
V1	259	9	
V2	239	10	V
V14	237	11	
V6	235	12	
V16	220	13	VI
V25	218	14	
V18	216	15	
V22	212	16	
V13	211	17	

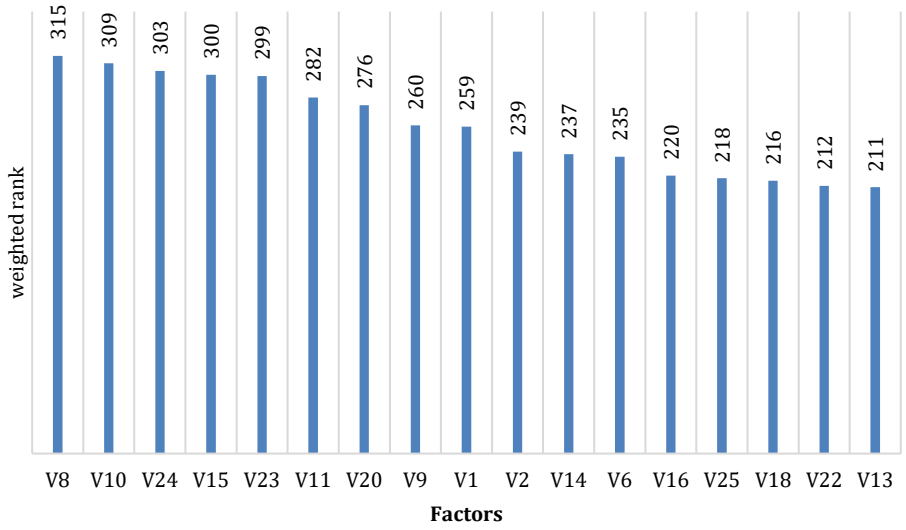

Figure 2. Rank Chart

Disposal cost (V9) and Cost of reverse logistics (V1) are considered as important factors at the fourth level. In Western countries, product disposal costs are very much prevalent forcing companies to engage in product take-back (Nagel & Meyer, 1999). However, in India, such rules are lacking, hence no effort was made in this direction. Furthermore, the rate of return (used product) is highly uncertain which creates difficulty in establishing reverse network distribution channels and also deciding about its operational cost.

At the fifth level, Collection cost of used product/cores (V2), Prevention and control of pollution (V14), and Cost of product and process design (V6) are identified as important. The basic raw material for remanufacturing operation is core/used products, and as we know, the quality and rate of return is very uncertain (Guide et al., 1999), hence its collection is very challenging. Moreover, the lack of government rules and regulations related to prevention and control of pollution make product recovery operations very difficult. In addition, the product and process should be designed for multiple life uses, hence it is challenging to determine the cost of such process.

At last, Customer's attitude towards remanufactured product (V16), Remanufactured product promotion through offers (V25), Companies' perception about remanufacturing (V18), trade barriers (V22), and Restriction on the use of hazardous substances (V13) are the factors identified at the sixth level. The main reason behind the non-existence of remanufacturing business in India is the lack of knowledge and benefits related to remanufacturing among companies as well as customers (Sinha, 2013). Also, there is no existing trade policy related to remanufactured product business in India. At last, the compliance related to RoHS (Restriction of Hazardous Substances) in the manufacture of electrical and electronic equipment should be strictly followed.

5. Conclusion

There are enormous benefits associated with remanufacturing activity. Many European countries are highly benefited by it. However, in India, it still exists in nascent stage. In this research, we tried to identify the critical factors, especially in the area of strategy and environment, for the viability of remanufacturing business in India. A total of seventeen critical factors have been identified and ranked as per their importance in remanufacturing activity. The essence of the research shows that there is a lack of government rules and regulations related to product take-back, disposal, landfill and incineration. There is a lack of awareness among Indian customers about remanufactured products. They perceive it as a secondhand product or a product of low quality. Even Indian manufacturing companies are not much interested in remanufacturing activities. The reason may be the lack of policies pertaining to product take-back, the capital cost associated with remanufacturing operations, and inadequate demand for remanufactured products. Measures like low price ownership, superior quality, and green image of remanufactured product should be adopted to increase their market penetration. In summary, proper strategy needs to be framed based on the above identified factors by the Indian government and manufacturing firms for starting remanufacturing business in India.

References

Alqahtani, A. Y., & Gupta, S. M. (2017). Warranty as a Marketing Strategy for Remanufactured Products. *Journal of Cleaner Production*, *161*, 1294–1307. https://doi.org/10.1016/j.jclepro.2017.06.193

APEC Remanufacturing Resource Guide, Sep – 2013.

Atasu, A., Guide, V. D. R., &Wassenhove, L. N. V. (2010). So What if Remanufacturing Cannibalizes My New Product Sales?.*California Management Review*, *52*(2), 56–76.https://doi.org/10.1525/cmr.2010.52.2.56

Bai, H., Wang, J., & Zeng, A. Z. (2018). Exploring Chinese Consumers' Attitude and Behavior Toward Smartphone Recycling. *Journal of Cleaner Production*, *188*, 227–236. https://doi.org/10.1016/j.jclepro.2018.03.253

Bhattacharya, R., Kaur, A., & Amit, R. K. (2018). Price Optimization of Multi-Stage Remanufacturing in a Closed Loop Supply Chain. *Journal of Cleaner Production*, *186*, 943–962. https://doi.org/10.1016/j.jclepro.2018.02.222

Choi, T. M. (2017). Pricing and Branding for Remanufactured Fashion Products. *Journal of Cleaner Production*, *165*, 1385–1394. https://doi.org/10.1016/j.jclepro.2017.07.163

Debo, L. G., Toktay, L. B., & Van Wassenhove, L. N. (2005). Market Segmentation and Product Technology Selection for Remanufacturable Products. *Management Science*, *51*(8), 1193–1205.

https://doi.org/10.1287/mnsc.1050.0369
Doppelt, B., & Nelson, H**.,** (2001). Extended Producer Responsibility and Product Take-Back Application for Pacific Northwest. *The centre for watershed and community health,* Portland State University, Portland, Oregon.
Environmental Protection Agency. (1998). *Macroeconomic Importance of Recycling and Remanufacturing.* US Environmental Protection Agency Office of Solid Waste, October 28.
Ferguson, M. (2009). *Strategic Issues in Closed-Loop Supply Chains With Remanufacturing*.College of Management, Georgia Tech, Atlanta, GA 30332.
Gerrard, J., & Kandlikar, M. (2007). Is European End-of –Life Vehicle Legislation Living up to expectation? Assessing the impact of the ELV Directives on 'Green' Innovation and Vehicle Recovery, *Journal of Cleaner Production,* 15, 17-27. https://doi.org/10.1016/j.jclepro.2005.06.004
Gray, C., & Charter, M. (2006). Remanufacturing and Product Design. *International Journal of Product Development*, *6*(3–4), 375–392. https://doi.org/10.1504/IJPD.2008.020406
Guide, V., Jayaraman, V., & Srivastava, R. (1999). The Effect of Lead Time Variation on the Performance of Disassembly Release Mechanism. *Computers and Industrial Engineering*, 36, 759- 79. https://doi.org/10.1016/S0360-8352(99)00164-3
Guide, V. D. R. (2000). Production Planning and Control for Remanufacturing: Industry Practice and Research Needs. *Journal of Operations Management*, *18*(4), 467–483. http://linkinghub.elsevier.com/retrieve/pii/S0272696300000346%5Cnpapers3://publication/doi/10.1016/S0272-6963(00)00034-6
Guide, V. D.R., Srivastava, R., & Spencer, M. S. (1997). An Evaluation of Capacity Planning Techniques in a Remanufacturing Environment. *International Journal of Production Research*, *35*(1), 67–82. https://doi.org/10.1080/002075497195984
Guide, V. D. R., & Jayaraman, V. (2000). Product Acquisition Management: Current Industry Practice and a Proposed Framework. *International Journal of Production Research*, *38*(16), 3779–3800. https://doi.org/10.1080/00207540050176003
Gungor, A., & Gupta, S. M. (1999). Issues in Environmentally Conscious Manufacturing and Product Recovery: a survey. *Computers & Industrial Engineering*, *36*, 811–853. https://doi.org/10.1080/00207543.2018.1428774
Hammond, R., Amezquita, T., & Bras, B. (1998). Issues in Automotive Parts Remanufacturing Industry: Discussion of Results from Surveys Performed Among Remanufacturers. *Journal of Engineering Design and Automation, Special Issue on Environmentally Conscious Design and Manufacturing*, *4*(1), 27–46.
Li, Y., Kannan, D., Garg, K., Gupta, S., Gandhi, K., & Jha, P. C. (2018). Business Orientation Policy and Process Analysis Evaluation for Establishing Third Party Providers of Reverse Logistics Services. *Journal of Cleaner Production*, *182*, 1033–1047. https://doi.org/10.1016/j.jclepro.2017.12.241
Lieder, M., & Rashid, A. (2016). Towards Circular Economy Implementation: A Comprehensive Review in Context of Manufacturing Industry. *Journal of Cleaner Production*. 115, 36–51. https://doi.org/10.1016/j.jclepro.2015.12.042
Lund, R. T. (1996). *The Remanufacturing Industry: Hidden Giant.*Boston University
Matsumoto, M., Chinen, K., & Endo, H. (2018). Remanufactured Auto Parts Market in Japan: Historical Review and Factors Affecting Green Purchasing Behavior. *Journal of Cleaner Production*, *172*(1970), 4494–4505. https://doi.org/10.1016/j.jclepro.2017.10.266
Morley, N. (2006). *Presentation on "The Potential of Remanufacturing to Increase Resource Efficiency".* Japan
Nagel, C., & Meyer, P. (1999). Caught between Ecology and Economy-End-of-Life Aspects of Environmentally Conscious Manufacturing. *Computers and Industrial Engineering*, 36(4), 781-92. https://doi.org/10.1016/S0360-8352(99)00165-5
Nasr, N., & Thurston, M. (2006). Remanufacturing: A Key Enabler to Sustainable Product Systems. *Proceedings of the 13th CIRP International Conference on Life Cycle Engineering, LCE 2006*, 15–18.
Pigosso, D.C.A., Zanette, E.T., Filho, A.G., Ometto, A.R., & Rozenfeld, H. (2010). Ecodesign Methods Focused on Remanufacturing. Journal of Cleaner Production, 18 (1). https://doi.org/10.1016/j.jclepro.2009.09.005
Rathore, P., Kota, S., & Chakrabarti, A. (2011). Sustainability through Remanufacturing in India: A case study on mobile handsets. *Journal of Cleaner Production*, *19*(15), 1709–1722. https://doi.org/10.1016/j.jclepro.2011.06.016
Savaskan, R. C., Bhattacharya, S., & Van Wassenhove, L. N. (2004). Closed-Loop Supply Chain Models with Product Remanufacturing. *Management Science*, *50*(2), 239–252.

https://doi.org/10.1287/mnsc.1030.0186
Seitz, M. A., & Peattie, M. A. (2004). Meeting the Closed-Loop Challenge: The Case of Remanufacturing. *California Management Review, 46*(2), 74-89. https://doi.org/10.2307%2F41166211.
Sharma, A., Iyer, G. R., Mehrotra, A., & Krishnan, R. (2010). Sustainability and Business-to-Business Marketing: A Framework and Implications. *Industrial Marketing Management*, *39*(2), 330–341. https://doi.org/10.1016/j.indmarman.2008.11.005
Sinha, A.K. (2013). Feasibility of Remanufacturing in India - A study of Automobile Sector. *Ph.D Thesis,* IIT (ISM) Dhanbad, India.
Sinha, A., Mondal, S., Boone, T., & Ganeshan, R. (2017). Analysis of Issues Controlling the Feasibility of Automobile Remanufacturing Business in India. *International Journal of Services and Operations Management*, *26*(4), 459–475. https://doi.org/10.1504/IJSOM.2017.082893
Steinhilper, R. (2006). *Interviewed by Gray, C. 22 Nov, 2006*.
Steinhilper, R., & Hieber, M. (2001). Remanufacturing the Key Solution for Transforming "Downcycling" into "Upcycling" of Electronics; P*roceedings of the IEEE International Symposium on Electronics and the Environment*, Denver, CO. https://doi.org/ 10.1109/ISEE.2001.924520
Subramoniam, R., Huisingh, D., Chinnam, R. B., & Subramoniam, S. (2013). Remanufacturing Decision-Making Framework (RDMF): Research Validation Using the Analytical Hierarchical Process. *Journal of Cleaner Production*, *40*, 212–220. https://doi.org/10.1016/j.jclepro.2011.09.004
Teunter, R., & Van der Laan, E. (2002). On the Non-Optimality of the Average Cost Approach for Inventory Models with Remanufacturing. *International Journal of Production Economics*, *79*(1), 67–73. https://doi.org/10.1016/S0925-5273(00)00085-2
Thierry, M., Salomon, M., van Nunen, J., & van Wassenhove, L. (1995). Strategic Issues in Product Recovery Management. *California Management Review*, *37*(2), 114–135. https://doi.org/10.2307/41165792
Vercraene, S., Gayon, J. P., & Flapper, S. D. (2014). Coordination of Manufacturing, Remanufacturing and Returns Acceptance in Hybrid Manufacturing/Remanufacturing Systems. *International Journal of Production Economics*, *148*, 62–70. https://doi.org/10.1016/j.ijpe.2013.11.001
Wei, S., Tang, O., & Sundin, E. (2015). Core (product) Acquisition Management for Remanufacturing: A Review. *Journal of Remanufacturing*, *5*(1). https://doi.org/10.1186/s13243-015-0014-7
Wu, C. H. (2013). OEM Product Design in a Price Competition with Remanufactured Product. *Omega (United Kingdom)*, *41*(2), 287–298. https://doi.org/10.1016/j.omega.2012.04.004
Yang, J. Y., & Zhao, W. (2010). Points Worth Re-consideration Concerning Product Life Cycle Management. *Proceedings - 2010 IEEE 17th International Conference on Industrial Engineering and Engineering Management, IE and EM2010*, 357–361. https://doi.org/10.1109/ICIEEM.2010.5646596
Zhao, S., & Zhu, Q. (2018). A Risk-Averse Marketing Strategy and its Effect on Coordination Activities in a Remanufacturing Supply Chain Under Market Fluctuation. *Journal of Cleaner Production*, *171*, 1290–1299. https://doi.org/10.1016/j.jclepro.2017.10.107