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BENEFITS OF REMANUFACTURING THE ECONOMY AS A TRANSITION INTO A GREEN ECONOMY

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Remanufacturing is the restoration of end of life products to almost new. It is a form of sustainability. The research set out to identify the benefits of remanufacturing to the Nigerian economy which could aid with the transition to green economy. A questionnaire survey was used to establish the benefits of remanufacturing to the Nigerian economy. Data analysis involving mean item score revealed development of an Industrial base, industrialisation to rural areas, boosting of export trade, conservation of natural resources are seen as important benefits of remanufacturing to the Nigerian economy. Factor analysis made known four clusters titled in the order of importance as benefits of remanufacturing environmentally, benefits of remanufacturing to trade, benefits of remanufacturing socially, benefits of remanufacturing to entrepreneurs as this clusters signify the benefits of remanufacturing to the Nigerian economy. Further discussed is the implication of the findings, firstly is the development of an industrial base, which will benefit Nigeria, as Nigeria is an under-industrialised nation. Furthermore, the entrenchment of the development of an industrial base would lead to a boosting of export trade in the form of exporting capital equipment to other countries as well as an inflow of foreign exchange. Lastly revealed is the industrialisation to the rural areas, which will stop the social scourge of rural and urban migration.

Keywords: Sustainability, Nigeria

1 INTRODUCTION

Remanufacturing is defined as an industrialized process where parts described as cores, which have reached the end of its lifecycle, are restored to useful life or almost new (Lund 1983). The steps associated with the restoration to useful life are inspection, disassembly, part replacement/refurbishment, cleaning, reassembly and testing to ensure the desired product standard is met (Sundin 2004). Lund (1998) developed seven conditions for remanufacturing. Lund (1983) in his research on remanufacturing identified the following benefits of remanufacturing to countries. Development of an indigenous industrial base through training of a workforce, acquisition of capital goods, and direct technology transfer; Augmentation of foreign exchange by export of remanufactured goods; Development of a service and repair infrastructure to keep industrial and commercial equipment operating; and opportunity for bringing industrialization to rural areas. These benefits enjoyed by countries who develop their remanufacturing industry would also lead to benefits to the remanufacturers, which

include the government lowering the entry in terms of capital requirements, leading to more individuals participating in it and increasing the employment rate, labour skills and an increase in the technical expertise and profitability (Ijomah *et al.* 2004). Added benefits to the remanufacturers include broader market appeal. The aim of this study is to identify the benefits of remanufacturing to the Nigeria economy.

2 RESEARCH METHODOLOGY

A quantitative survey was used for this study, whereby Respondents were requested to specify the level of significance of each of the benefits of remanufacturing that play a role in the transition of green economy based on a five-point Likert scale (strongly agree = 5, agree = 4, neutral, = 3, disagree = 2, strongly disagree = 1). Mean item score was used to present the findings for the Likert scale. EFA was performed to gather information about the un-dimensionality of the factors to yield their factor analyzability (Pallant 2010). The EFA was used to confirm the reliability and validity of the factors affecting benefits of remanufacturing the maximum likelihood with an eigenvalue over one, together with Varimax rotation, was specified as the analysis method for this study. The EFA was conducted using SPSS version 21.

2.1 Data Analysis

Two statistical analyses were carried out that is descriptive statistics in the mold of mean item score and factor analysis. The mean item score was used to find the rank of the variables. At the same time as factor analysis was used in instituting which of the variables could be measuring the same underlying effect (Ahadzie *et al.* 2008).

2.2 Mean Item Score

The mean ranking of individual variable was presented to make available a vivid image of the agreement reached by the respondents. A result for the test is revealed in Table 1. The mean for each variable included the standard deviation.

Table 1. Results of mean item score for the benefits of remanufacturing to the Nigerian Economy.

Benefits of remanufacturing to the Nigerian Economy	Mean	Standard deviation	Ranking
Development of an industrial base	4.81	0.397	1
Industrialization to rural areas	4.78	0.438	2
Boosting of export trades	4.65	0.501	3
Conservation of natural resources	4.65	0.500	3
Landfills reduction	4.64	0.598	5
Carbon footprint is reduced	4.64	0.664	5
Inflow of foreign exchange	4.62	0.584	7
Waste reduction	4.62	0.567	7
Less pollution of environment	4.60	0.677	9
Enhance standard of living	4.58	0.745	10
Increased level of technical skills	4.57	0.497	11
Job creation	4.47	0.502	12
Halt urban migration	4.35	0.863	13
Better ways to recovery product	4.32	0.827	14
Better product knowledge	4.18	1.090	15
Manufacturers become responsible for their actions	4.11	1.275	16
Product diversity	3.92	1.181	17
Energy efficiency	3.91	1.026	18

2.3 Factor Analysis

Factor analysis was used to determine which of the variables could be quantifying phases of the same principal dimensions. Factor analysis is suitable for grouping groups of linked variables and thus idyllic for reducing a large sum of variables into a more simply understood framework (Norusis 2006). Tables 1-5 and Fig.1 present the result. The Kaizer-Meyer-Olkin (KMO) measure of sampling adequacy attained a high value of 0,718 (Table 2); the Bartlett test of sphericity was also important which suggests that the population matrix was not an identity matrix (Table 3). Thus, the required tests in respect to adequacy of the sample size were approving for the factor analysis to continue. Cronbach's alpha of 0.714 advocated the reliability of the study instrument used was good.

Table 2: KMO and Bartlett's test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.718**
Bartlett's Test of Sphericity	Approx. Chi -Square	309.999
	Df	91
	Sig.	0.000

The data was subjected to principal component analysis (with varimax rotation). The eigenvalue and factor loading were set at values of 1.0 and 0.5 individually. As shown in table 5, six components with eigenvalues greater than 1.00 were extracted using the factor loading of 0,5 as the cut-off point (see also scree plot in Fig 1). The total variance (see table 6) described by each component extracted is as follows; component 1 (23.13), component 2 (18.72), component 3 (8.67), component 4 (7.24). Thus, the results of the principal component analysis and the components extracted accounted for approximately 57.76% of the total cumulative variance.

Table 3. Rotated component matrix.

Rotated Factor Matrix[a] for benefits of remanufacturing to the Nigerian Economy				
	Factor			
	1	**2**	**3**	**4**
Landfill reduction	.734			.364
Carbon footprint is reduced	.666			
Conservation of natural resources	.536			
Waste reduce	.470			
Development of an industrial base	.376		.305	
Industrialization to rural area	.357			
Product diversity		.799		
Better product knowledge		.688		
Better ways to recovery of products		.447	.363	
Technology transfer	-.261	.350	.666	
Manufacturers become responsible			.606	
Halt urban migration	.321		.473	
Enhance standard of living			.305	
Inflow of foreign exchange	.258			.796

Table 4. Total variance explained.

Total Variance Explained									
Factor	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	3.23	23.13	23.13	2.69	19.22	19.22	2.05	14.65	14.65
2	2.62	18.72	41.85	2.15	15.37	34.59	1.60	11.44	26.09
3	1.21	8.67	50.53	.67	4.80	39.39	1.49	10.64	36.73
4	1.01	7.22	57.75	.54	3.89	43.27	.92	6.54	43.27
5	.968	6.91	64.67						
6	.873	6.23	70.91						
7	.765	5.46	76.37						
8	.683	4.87	81.25						
9	.643	4.59	85.85						
10	.552	3.94	89.79						
11	.447	3.19	92.98						
12	.356	2.545	95.52						
13	.328	2.340	97.863						
14	.299	2.137	100.000						

Based on the examination of the inherent relationships among the variables under each component, the following interpretation was made component one was termed benefits of remanufacturing environmentally; component 2 was termed benefits of remanufacturing to manufacturers; component 3 was termed benefits of remanufacturing socially; and component 4 was termed benefits of remanufacturing to trade. These names were derived from the components by observation of the components. Also, how closely related the variables are using the highest loading factor.

3 DISCUSSION OF RESULTS

3.1 Compared 1: Benefits of Remanufacturing Environmentally

The six extracted variables for the benefits of remanufacturing to the Nigerian economy for component 1 were landfill reduction with (73.4%), carbon footprint is reduced with (66.6), conservation of natural resources with (53.6%), waste reduction with (47.0), development of an industrial base with (37.6%) and industrialization to rural areas with (35.7%). This cluster accounted for 23.13% of the variance. In order *to reduce waste*, the life cycle and efficient use of resources must be extended. Products m be remanufactured to achieve better sustainability. *Reduction of carbon footprint* is another benefit of remanufacturing. In 2005 Caterpillar Global Remanufacturing Operation collected and reused 43 million tons of core material, thereby preventing 52 million tonnes of CO_2 emission into the ecosystem (Caterpillar Sustainability Report 2006). Another benefit for remanufacturing is the *reduction of land fill*. Fuji Xerox is an example of a company which achieved zero landfill after Xerox adopted remanufacturing in the 1980s. Xerox achieved zero landfill in Japan in 2000. By employing a closed loop supply chain whereby, the products are recovered via customer take back policy which is then sent to the remanufacturing plant (Maslennikova and Foley 2000). Lund (1983) in his research on remanufacturing identified the following benefits of remanufacturing to countries identified

development of an indigenous industrial base through training of a workforce, acquisition of capital goods, and direct technology transfer and also Lund (1983) added opportunity to bring industrialization to the rural areas as one of the benefits. Conservation of resources is another benefit of remanufacturing to the Nigerian economy, which recaptures value of energy, labour and capital equipment going into the original manufacture of a product and it maintains the product of materials in a high value state (Lund 1983).

3.2 Component 2: Benefits of Remanufacturing to Manufacturers

The three extracted benefits of remanufacturing to the Nigerian economy for component 2 were product diversity (79,9%), better product knowledge (68.8%), better ways to recovery of products with (47.7%). This cluster accounted for (18.72%). Subsequently this component was labelled *benefits of remanufacturing to manufacturers.* In comparison to other forms of product recovery management, remanufacturing of products will retain all the value (Kim *et al*. 2008). That's why it remains the better of other product recovery of products.

3.3 Component 3: Benefits of Remanufacturing Socially

The four extracted benefits of remanufacturing to the Nigerian economy for component 3 were technology transfer (66.6%), conservation of natural resources with (60.6%), halt urban migration (47.3%), enhance standard of living (30.5%). This cluster accounted for (8.68%). Subsequently this component was labelled *benefits of remanufacturing socially.* Lund (1983) in his study on remanufacturing identified the following benefits of remanufacturing; the transfer of technology, opportunity for brings industrialisation to rural area which brings about the halting of urban migration.

3.4 Component 4: Benefits of Remanufacturing to Trade

For benefits of remanufacturing to trade, one variable was extracted that are Inflow of foreign exchange (79.65%) with a cluster which accounted for 7.22%.

4 IMPLICATION OF FINDINGS

From the findings above it was revealed that development of an industrial base is a very important benefit that remanufacturing would bring to Nigeria as opined by the respondents. This is so because Nigeria is an under-industrialized nation. Studies have shown that remanufacturing can bring about industrialization in the form of better product knowledge of products remanufactured, thereby leading to improvement and innovative ideas to better the products remanufactured. Additional benefits are an increased level of technical skills and the creation of jobs. This development of an industrial base once established would give rise to industrialisation to the rural areas, thereby stemming the social scourge of rural-urban migration and leading to an enhanced standard of living. Furthermore, the entrenchment of the development of an industrial base would lead to the boosting of export trade in the form of exporting of capital equipment to other countries as well as an inflow of foreign exchange. This would also lead to the conservation of natural resources as revealed in the above discussion. The carbon footprint is reduced as Nigeria seeks to transition to a green economy which is one of the benefits of remanufacturing activities.

5 CONCLUSIONS

From the primary data, results revealed that the development of an industrial base, Industrialization to rural areas, boosting of export trade, conservation of natural resources, landfills reduction. The development of an industrial base as revealed by the respondents as the main benefits of remanufacturing to the Nigeria economy is so because the Nigeria economy is currently under-industrialised in nature with the development of remanufacturing it would lead to the Nigeria economy a highly-industrialised economy. With the development of an industrialised base this would lead to development of industrial bases in rural areas which could be due to cheap labour or closer to parts to be used. Boosting of exporting trade will arise once the industrial base is fully developed. Presently Nigeria is currently grappling with the issue of landfill reduction as equipment's are abandoned after end of life but with the development of remanufacturing will benefit the economy as landfill will be reduced. The benefits of remanufacturing to the Nigerian economy can be classified into four clusters, namely; benefits of remanufacturing environmentally, benefits of remanufacturing to manufacturers, benefits of remanufacturing socially, benefits of remanufacturing to trade these findings lend support to the benefits of remanufacturing to the Nigeria economy. Lastly remanufacturing would be beneficial to Nigeria, as it is going to bring about the development of technically skilled workers which would be beneficial to the Nigerian economy.

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