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# The Role Of Sustainability In Reverse Logistics For Returns And Recycling

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**ABSTRACT**

**The purpose of this research is to measure the impact of reverse logistics performance indicators namely; cost, recycling efficiency, time, quality and waste on sustainability performances (Economic, Environmental and Social) in in Fast Moving Consumer Goods (FMCG) industries. To reach this aim primary data was collected through 116 online survey, to test the hypothesized relationship between reverse logistics performance indicators and sustainability. For the purpose of this research the questionnaire was distributed to key personnel in reverse logistics processes working at FMCG industry. The results concluded that reverse logistics performance indicators have a significant positive impact on environmental performance, except for waste. In addition, economic performance is positively influenced by only recycling efficiency and quality. Finally, it was found that only recycling efficiency can positively influence social performance. These findings includes implications for the development of implementing sustainability in revers logistics, in addition it provide companies with the guidance to apply sustainability in revers logistics. Finally, This paper adds value to the industries by measuring the role of sustainability in revers logistics.**

**Keywords:** FMCG (Fast Moving Consumer Goods), product return processes, recycling, waste, reverse logistics, Sustainability.

## INTRODUCTION

Recently, in the globalized and fast-moving economy, competition can be seen in every field including manufacturing industry. Competition is driving companies to address the importance of reverse logistics processes on firm performance. Customers are expecting efficient return policies from manufacturers, retailers and service providers. However, companies are also aiming to gain as much value out of any returned product as possible. Although forward and reverse logistics are identical in functionalities, the reverse flow of products is not merely the mirror image of forward distribution flow [1].

The reverse logistics is basically a movement of goods/materials/products from the point of consumption to the point of origin [2]. In forward supply chain, inventory is consistent and uniform, on the other hand, backward supply chain is dynamic and unpredictable. Items return back to its origin produced place in a variety of conditions such as; new, open box, used (damaged/Good) etc. however, manufacturer also has a very little information regarding the condition in which items will be returned [3]. This supports the idea that manufacturers should be prepared and taking in to account different aspect of sustainability while products are returning.

Sustainable development is an all-embracing term which recognizes the inter-relationships between economic success, environmental protection and social well-being. In order for companies to obtain sustainability, reverse logistics needs to be used. [4]

In the last decade, Sustainability and reverse logistics literature give significance on the optimization of return flow of products and wastes, especially that Products which have a quick turnover and relatively low cost are known as Fast Moving Consumer Goods (FMCGs) or Consumer Packaged Goods (CPG). FMCG generally include a wide range of frequently purchased consumer products such as toiletries, soap, cosmetics, tooth cleaning products, shaving products and detergents, as well as other non-durables such as glassware, bulbs, batteries, paper products, and plastic goods. FMCG may also include pharmaceuticals, packaged food products, soft drinks, tissue paper, and chocolate bars etc., [5].

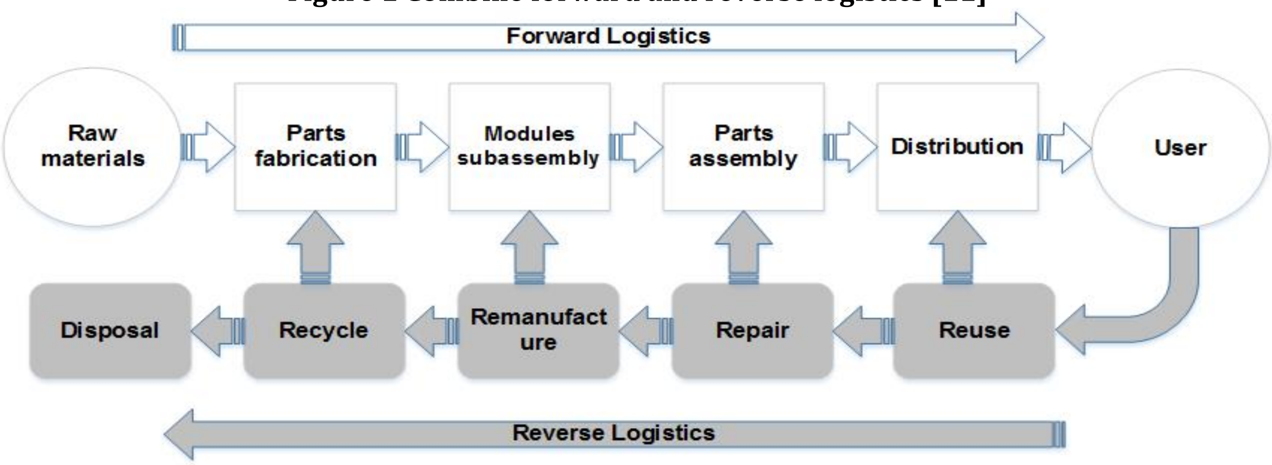
The importance of reverse logistics strategy and sustainability comes from the fact that it enhances effeciency [6], manufacturing companies and/or retailers have to take steps towards a sustainable development as packaging of these products leads to more waste.

## LITERATURE REVIEW

### Forward and reverse logistics

Traditionally, forward logistics is the process of supplying finished goods to customers [7, 8]. The Council of Logistics Management declares that logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements [9]. These activities are also included in reverse logistics, however they are performed in reverse, it is defined as follows "*The process of planning, implementing, and controlling the efficient, cost effective flow of raw 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*." [10] from this definition, it can be seen that reverse logistics is actually the movement of materials or products from customer side to the manufacturer or supplier side as shown is figure 1.

**Figure 1 Combine forward and reverse logistics [11]**



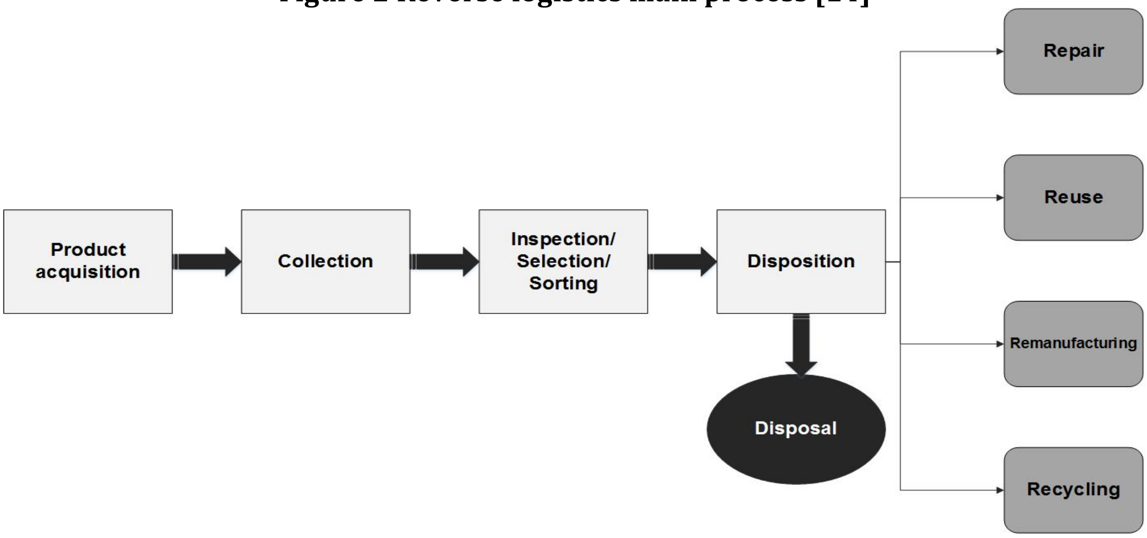
## Product return reasons

Products are returned or abandoned because of two main reasons, either they do not function properly or their function are no longer needed. These reasons can be categorized under supply chain stages; manufacturing, wholesaler, retailers and consumers/customers. Consequently, there are three types of returns manufacturing returns (raw material surplus, quality-control returns, product leftovers), distribution returns (product recalls, commercial returns “wrong/damaged deliveries and unsold products”, stock adjustments and functional returns “Distribution items/carriers/packaging” and customer/user returns (refund guarantees, warranty returns, service returns “repairs and spare parts”, end of use and end of life) [12].

## Product return and value recovery processes

The following key processes of reverse logistics are identifying like (1) Product acquisition; (2) Collection; (3) Inspection/Selection/Sorting; (4) Disposition; (5) Re-distribution [10, 12, 13], See figure 2

**Figure 2 Reverse logistics main process [14]**




### *Product acquisition*

Product acquisition is a critical process for obtaining profitable reverse logistics flow. It is the process of acquisition of used products, components and materials from end customer/user or markets for additional processes. Acquisition is important in reverse logistics because the time at which consumers will return the product is uncertain, in addition, its quality and quantity cannot be determined [13].

### *Collection*

The product collection aims at gathering discarded products from customers to the recovery point [12]. Collection is the process of bringing returns products back from retailers or customers to the manufacturer or seller. This process is generally managed by intermediaries like third-party service providers. This third-party service providers collects and transports returns [15].

### *Inspection/selection/sorting*

After the collection process, the condition of discarded products must be evaluated and the suitable form of treatment has to be determined. Separate inspection process for each item or products is required for sorting because each product might have different conditions [12]. It is necessary for companies to implement the inspection process when the return product or item arrive to the recovery location. This process starts with disassembly, testing, sorting and rating the returned product, which will help in the determination of the product characteristics and quality level. Companies can then easily identify the most profitable and appropriate strategy for each product or item [16].

### *Disposition*

It is important for the company to ensure that the total cost of recovery product does not exceed the cost of a new product. The disposition options for the returned products are divided into three groups; direct recovery, product recovery management and final disposal, which is arranged according to the product disassembly degree. Direct recovery is usually implemented when the state of the returns is evaluated to be "as-good-as-new" or when their condition is satisfactory enough. Most of return product, which cannot perform their function or which have reached to the end of their useful life period, are moving toward the reconditioning process to be useable and profitable again. The product recovery processes includes repair, refurbishment, remanufacturing, cannibalization/retrieval of parts and recycling. When the returned products and materials could not be recovered any more, they should be disposed. The final disposal can be carried out by either incineration or landfill [14].

### *Redistribution*

The final key processes of reverse logistics is redistribution, the reconditioned and recovered product, materials and components are distributed again to the market where it can attract new customers. Moreover, the redistribution process pushes the recovered product from the reverse flow system to the forward supply chain. There are many potential possibilities for a redistributed product such as; return to vendor, sell as new, sell via outlet or discount, sell to a secondary market and donate to charity [10].

### Recycling

Recycling is one of the best way to have a positive impact on the environment in which we live. The amount of waste is constantly increasing, which calls for an immediate action [17]. Recycling is defined as "*any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations*" [18].

Recycling reduces the amount of waste that ends up in landfill sites while decreasing the amount of material needed from the natural environment. Recycling importance comes from the fact that it decreases imports as it provides industries the required supplies recovered from waste like paper, glass, plastic metals as well as valuable metals from used electronics appliances [19].

### *Waste*

The European union's approach to waste management is based on "waste hierarchy" which sets priority order when shaping waste policy and managing waste at operational level: prevention, reuse, recycling, recovery and disposal which includes, landfilling and incineration without energy recovery. Priority objectives for the waste policy in the EU are as follows [20]:

- To reduce the amount of waste generated;
- To maximize recycling and re-use;
- To limit incineration to non-recyclable materials;
- To phase out landfilling to non-recyclable and non-recoverable waste;
- To ensure full implementation of the waste policy targets in all Member States.

## Sustainability

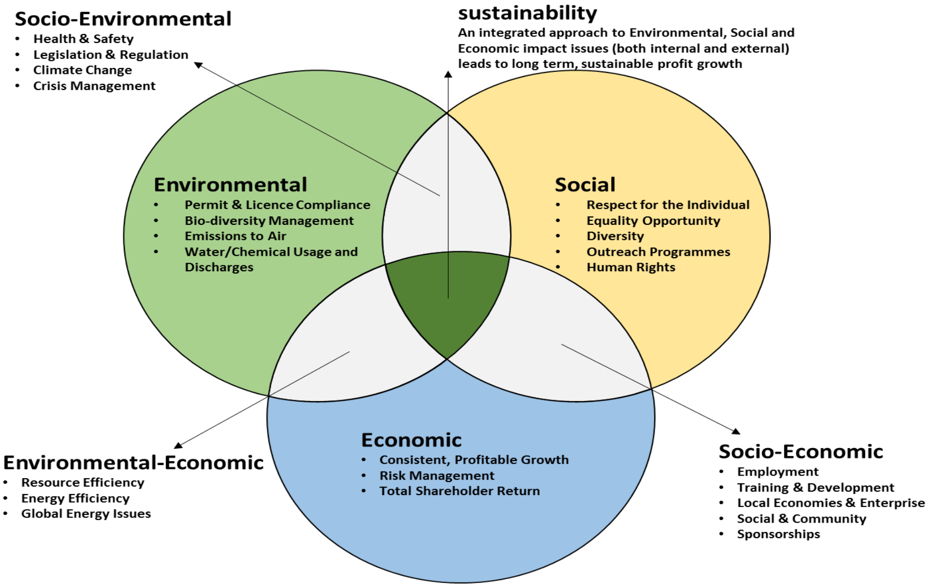
Nowadays, companies are becoming more aware of the choice they made of how to handle the products and processes can affect the environment [6]. As more companies aiming to enhance efficiency in their processes, they pursued sustainable practices such as; recycling, reuse, waste reduction, product return management etc. The concern of sustainability has constantly been gaining importance in the business world. Sustainability or sustainable development is defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*"[21]. Thus, from this definition it can be concluded that in order to save the earth and our children, resources must be preserved by protecting the environment.

## Triple Bottom Line (TBL)

The triple bottom line (TBL) also referred as three pillars of sustainability is an accounting framework of that incorporates three dimensions of performance: Economic, Environmental and Social. The TBL dimensions are also called the three Ps: People, Planet, and Profits. The TBL defines as "…captures the essence of sustainability by measuring the impact of an organization's activities on the world. A positive TBL reflects an increase in the company's value, including both its profitability and shareholder value and its economic, environmental, and social capital" [22]. This definition was supported by academics as well as practitioners as the most general definition for TBL [23].

As shown in figure 3, TBL captures the essence of sustanability by measuring the impact of an organizations' activities on the world. A positive TBL reflects an increase in the companys' value, which enhances its profitability and shareholder value, in addition to, its economic, environmental and social capital.

**Figure 3 Triple bottom line [24]**



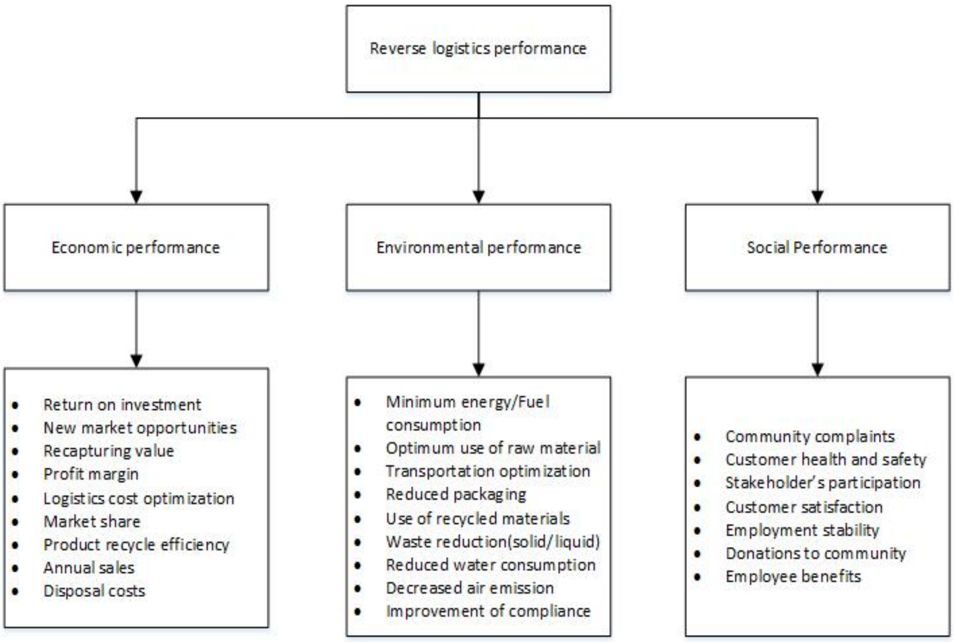

The objectives favoring social, environmental and economic aspects can be in conflict with organization' goals that are more biased towards corporate social responsibility. This is because the efforts of these organizations towards social and environmental aspects are not proving productive because they are falling apart from TBL. Even though the initiatives towards social and environmental are executed but tending to fragmentation and disconnected, in addition it lacks strategic planning. The TBL is an accounting framework aimed at moving beyond traditional profit measures or reporting corporate performance to incorporate social and environmental measures. The major challenge is that while economic performance is easily measured in dollars, environmental and social performances are not easily quantifiable in these terms. In addition, the inclusion of all three dimensions is necessary since stakeholder's demand sustainability in all three dimensions [25].

### Sustainable Reverse Logistics

Sustainable supply chain network design that consists of manufacturing, logistics, and reverse logistics are key to achieving sustainable development. The main goal of sustainable development is to draw attention to environmental, social and economic aspects. The term sustainable development is being used in logistics, due to the fact that Logistics is originally a human activities like transport, storage and packaging management processes which give companies competitive advantages, nevertheless, they have some negative impacts on the environmental and economical performances [10]. According Zeng, Chen [26] achieving sustainable development in supply chain, sustainable supply chain network design must have a perfect manufacturing, logistics, and reverse logistics activities.

The term of sustainable reverse logistics is so called (sustainable waste management) has grown up after the appearance of sustainable Logistics especially after the strict regulations for environmental protection [27]. Sustainable reverse logistics is aiming to solve environmental problems in the areas of reverse logistics by reducing the overall negative influence of logistics on the environment and also taking into considerations the economical part that represents cost of recycling and waste [28]. The key criteria for selecting the sustainable reverse logistics performances can usually include cost, time, recycling efficiency, quality, and waste. Reverse logistics outsourcing should clearly be economically, environmentally and socially applied. The sustainability criteria and sub-criteria has been shown in Figure 4 [29].

**Figure 4 Sustainable Reverse logistics performance criteria and sub-criteria [29]**




### Fast Moving Consumer Goods (FMCG)

Fast Moving Consumer Goods (FMCG), alternatively called Consumer Packaged Goods (CPG) refers to retail goods that are consumed relatively quickly, many of them within a short time period of just a few days. Examples comprise non-durable goods like cold drinks, toiletries, and grocery items such as vegetables, fruits, meat or dairy products. "FMCG are products that are classified as being sold quickly and that have a short shelf life, either as a result of high consumer demand or because the product breakdown rapidly." Generally, the profit per item is relatively small but since they sell in large quantities the cumulative profit can be large [30].

Fast Moving Consumer Goods (FMCG) industries have recently been one of the developing industries in regions around the globe. The FMCG industry is a quick, active industry with a wide range of products. Retailing is an ancient art that has been practiced from the early years of mankind. Retailing includes the companies which basically deal with the activity of purchasing products from other firms with the purpose of reselling them to final customers, totally without transformation, and transferring incidental services to sales department. The retailing process is the last step regarding distributing the goods; thus, retailers are arranged to sell products in small quantities to the public [31].

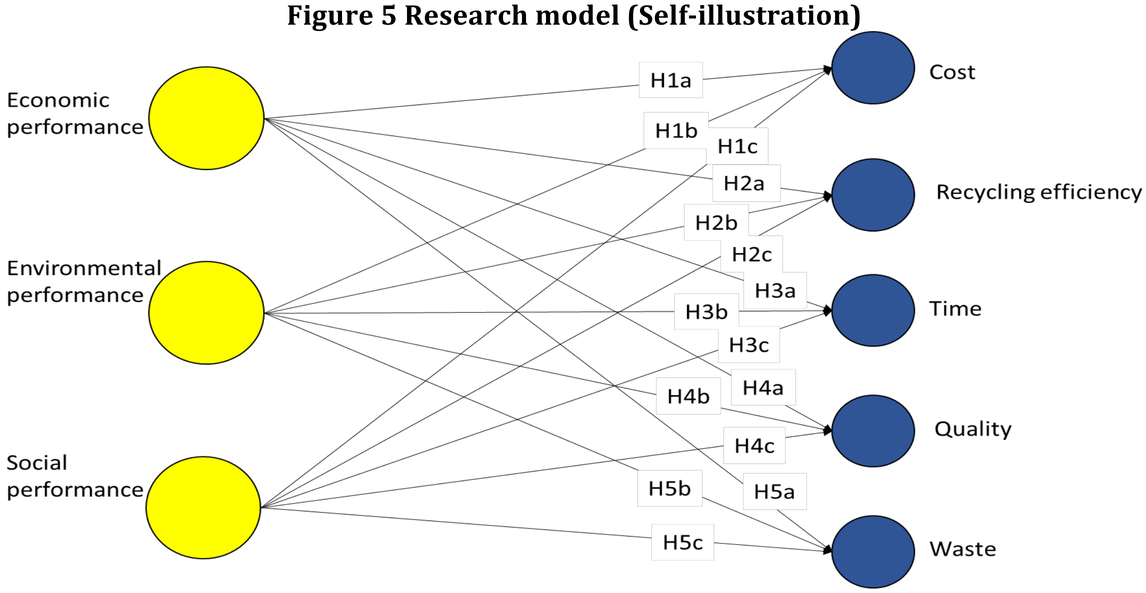
## RESEARCH METHODOLOGY

Research methodology is defined as the types of qualitative and quantitative designs that gives specific guidance for the procedures in the research approach. In other words, research methodology is all about the steps taken on how to answer a set of research questions and research objectives. The selection of methodology is very important as it can guide the conduct of the research and affect the quality of research results [32].

### Development of model and hypothesis

The research model shown in figure 5 will be used to test the research hypotheses. The model shows interrelations of sustainability TBL performances i.e. economic performance, environmental performance, and social performance with reverse logistics key performance indicators i.e. cost, recycling efficiency, time, quality and waste. Three hypothesis were derived for each logistics performance indicator.

**Figure 5 Research model (Self-illustration)**




*Cost indicators:* cost indicators that affects sustainability in reverse logistics are; greening cost which is the overall cost acquired by the company to make sure that every operation that performed in the company are environmentally sustainable. Cost associated with environmental compliance, energy consumption, environmental friendly materials are example of greening cost. Recycling cost related to costs that affect company's financial account by processing the product return operations like product recovery, processing,

disassembly, disposal etc. cost associated with returning of EOL (End of Life) products, processing of recyclables, cost of sorting and segregation of recyclables, cost of disposal for hazardous and unprocessed waste are example of recycling cost. Reverse supply chain cost which is related to costs of customer service labor cost, transaction cost, transportation and shipping cost, warehouse and storage cost that mainly affect customers and company image. Finally return operational cost which is related to product return operations like testing the product, inspection, handling, repair and repackaging. This type of cost influences company environmentally and economically [33]. The hypothesis are as follows
**H1a**: Cost has a positive influence on economic performance.
**H1b**: Cost has a positive influence on environmental performance.
**H1c**: Cost has a positive influence on social performance.

*Recycling efficiency indicators:* The entire effectiveness of the recycling processes measured by recycling efficiency. Recycling process in green supply chain management indicates higher recycling efficiency. Recycling efficiency can be measured through; decrease in recycling time: a time of product arrive at collection center until finally reprocessed. Availability of recycling standards: for measuring of the existing standards formed for every recycling processes. It is difficult to know without standards, whether recycling is effective or not. So, this is an important indicator. Availability of standard operating procedures: this shows that if there is any standard procedure for recycling process. By using this procedure, it saves cost arising from waste because of errors and carelessness in the recycling processes. Decrease in utility usage during recycling: volume of power consumption, water consumption, gas consumption is measured by this indicator during the recycling of a product. Efficiency of shredders and dismantlers: these are two main attributes within recycling process. The overall time of recycling processes will increase, if these two do not execute their task smoothly and at the same time there will be more generation of waste. Reduction in emission and waste generation, which is considered during every recycling operations, the emission and waste generated has been decreased. The main aim of recycling is waste reduction so, for efficient recycling process generation of waste and emission must be lower [33]. The hypothesis are as follows
**H2a**: Recycling efficiency has a positive influence on economic performance.
**H2b**: Recycling efficiency has a positive influence on environmental performance.
**H2c**: Recycling efficiency has a positive influence on social performance

*Time indicators:* researchers acknowledge order cycle time and manufacturing lead time as a significant performance. There are lot of ways for product returns to define time. Manufacturers are continuously attempting for decrease of product returns and improvement of cycle time. The time from product returns finally deliver the usable product to the customer treated as lead time [34] Time indicators that affects the sustainability in reverse logistics are; order fill rate, transit time, customer order promised cycle time, time to process credit, time to process warranty claim, replacement of inventory time, remanufacturing cycle time (Receipt to refurbishment) [35]. The hypothesis are as follows
**H3a**: Time has a positive influence on economic performance.
**H3b**: Time has a positive influence on environmental performance.
**H3c**: Time has a positive influence on social performance

*Quality indicators:* this attribute measure the standard of the product. It has a considerable influence on supply chain performance that's why has been examined by many researchers. Product quality is a very significant performance matrix [34] Manufacturing processes may be impacted by the abrupt quality of products. The product returns which have an extended life may have important quality concerns. In addition, customer requirements and customer satisfaction are more important in long product return lifecycle. For decreasing product return and landfill or incineration, a superior strategy is to account improper product returns but functionality, characteristics, and features should be met because it's basic need for product return [36]. There are some quality indicators that affects reverse logistics namely; recycled material in returned products, product to be disposed to landfill or incineration, availability of eco-labelling, biodegradable content in returned products. level of usage of design for assembly in products, level of market share controlled by green products, quality of packaging material, quality and completeness of returned products, quality of information [37]. The hypothesis are as follows

**H4a**: Quality has a positive influence on economic performance.
**H4b**: Quality has a positive influence on environmental performance
**H4c**: Quality has a positive influence on social performance.

**Waste indicators:** unexpected product returns may cause unpredictable results like poor remanufacturing, recover, wrong implementation, improper recycle, reuse processes may rise product disposal to landfill. There are two types of product waste. Direct waste and indirect waste. Number of non-usable of returned products are direct waste and natural resource depletion like energy consumption, water consumption, and man power allocation for further processing of product that is reusable after remanufacturing. The waste indicators that affects sustainability in reverse logistics are, poor remanufacturing, improper recycle or recover, reuse processes increases product disposal to landfills, number of non-usable of returned products, natural resource depletion. disposal of unprocessed and hazardous waste [36]. The hypothesis are as follows:

**H5a**: Waste has a positive influence on economic performance.
**H5b**: Waste has a positive influence on environmental performance.
**H5c**: Waste has a positive influence on social performance.

## Quantitative method

"*Quantitative research is an approach for testing objective theories by examining the relationship among variables*."[38]. Using statistical procedures by coding variables in to numbers, these variables can be measured. A known issue that can be standardize and tested is usually well matched with a quantitative approach. "Quantitative research is frequently referred to as hypothesis testing research." Quantitative studies start with theory from which hypotheses are derived and then an experimental design is established to measure the dependent variables and determine their effect on the independent variables [39]. Typically, the deductive approach is used in quantitative research. A deductive approach is related to "developing a hypothesis and then designing a research strategy to test the hypothesis." The researchers tests and verifies a theory by considering hypotheses or questions. These hypotheses or questions contain variable that needs to be defined. Then testing the hypothesis with the use of relevant method and then evaluate the outcome of the test and so adopting or rejecting the hypotheses or theory [38].

## Questionnaire design

A questionnaire is commonly used to conduct descriptive or explanatory research. Considering that the targeted respondents were located in different countries, a self-administered questionnaire were used and distributed electronically via message in LinkedIn. There are few disadvantages of the questionnaire based survey strategy. The poor response rate and the non-responses to certain questions. If the respondent doesn't understand question, or feels uncomfortable answering a particular question, they will most likely leave it blank or else directly leave the survey. The survey consists of 18 questions designed to gather information regarding the reverse logistics operations in FMCG industries.

The questionnaire consists of 3 sections. The first section of the questionnaire contains demographic information. Respondent is also asked to provide his/her position in company, and contact details like E-mail or phone number. The second section contains questions regarding reverse logistics practices in FMCG industries. Each one was measured using 5-point Likert scale (1=strongly disagree to 5=strongly agree). The third and final section was concerned with indicators of reverse logistics that affect sustainability.

**Data collection**
Primary data are collected to answer the research questions and to test the research hypotheses. The data were collected through a google form survey link, which was sent to the individuals working in the industry under investigation. Originally 1369 participants consisted of logisticians from a large service organizations and practitioners in FMCG industry. For the purpose of this study only 116 were selected as these questionnaire were the valid responses received. The selection was based on those individuals that have some knowledge, role, or control within the reverse logistics process as the levels and degrees of logistics operations varying throughout the organization.

**Data analysis**
The examination and analysis of data was carried out using Microsoft Excel, IBM SPSS software, SmartPLS software and descriptive statistics was employed to structure and analyze the data of the questionnaires. The frequency table and cross tabulation method were employed to further analyze and interpret the demographic data of the respondents.

The hypotheses were tested using Partial Least Square structural equation modeling method (PLS-SEM). PLS path models are usually defined using two sets of linear equations known as the measurement model and structural model. The measurement model specifies the relationship between unobserved or latent variables whereas outer model specifies the relationship between a latent variable and its manifest variables. The inner and outer model are sometimes referred to as the structural and measurement model [40].

The evaluation of the measurement model was performed to evaluate the validity and reliability of the constructs. A reflective measurement model can be validated by testing its internal consistency, convergent validity and discriminant validity. The validity guidelines to evaluate a reflective measurement model are shown in **Error! Reference source not found.**.

Validating the structural model can help the researchers to assess systematically whether the hypotheses expressed by the structural model are supported by the data. The structural model can only be analyzed after the measurement model has been validated successfully. In PLS, a structural model can be evaluated using coefficient of determination (R2), and path coefficients (β) and t values [40] The guidelines to evaluate structural model is shown in Table 2.

**Table 1 Validity Guidelines to Evaluate Reflective Measurement Model[40]**

| ` | Validity type | Criterion | Guidelines |
|---|---|---|---|
| 1 | Internal consistency | Composite reliability (CR), Cronbach's alpha (CA) | CR, CA > 0.7 (Satisfactory) |
| | | | CR, CA < 0.6 (lack of reliability) |
| 2 | Convergent validity | Indicator reliability | Item's loading > 0.7 and significant at least at the 0.05 level |
| | | AVE | AVE > 0.5 |
| 4 | Discriminant validity | Cross loading | Item's loading of each indicator is highest for its designated construct. |
| | | Fornell-Larcker's criterion | The square root of the AVE of a construct should be greater than the correlations between the construct and other constructs in the mode |

**Table 1 Validity guidelines to evaluate structural model [40]**

| | Validity type | Criterion | Guidelines |
|---|---|---|---|
| 1 | Model Validity | Coefficient of determination (R2) | The Values of R2 ranges between 0 and 1. |
| 2 | | Path coefficients | Path coefficients must be lie between +1 and -1 at significance level at least 0.05 |
| 3 | | T value | 1.65 at significant level 10% |
| | | | 1.95 at significant level 5% |
| | | | 2.57 at significant level 1% |

## RESULTS AND DISCUSSION

### Demographic composition

From table 3, it can be found that the majority of the respondents' company location were from Europe, Asia, North America, Africa and Australia with a percentage of 34%, 22%, 11%, 8% and 8% respectively. However, 8% of the respondents did not specify their company location. In terms of employees' strength, 36% companies have more than 5000 employees followed by 26% and 20% that have 101-1000 and 1001-5000 employees respectively. Additionally, 18% of the respondents were from small size companies. In terms of position of respondent, majority of respondents are managers and directors representing 55% and 16% of the population respectively. A total of 16% of the respondents are CEOs and head of their company, while assistant, consultant, engineer, project analyst, supervisor and vice president represent 9%. Furthermore, 5% of respondents did not specifies their positions in the company. The majority of participants are manufactures and service providers representing 62%, followed by retailers with 16% and wholesalers with only 7%. However, 5% of participants did not specified company business.

**Table 2 Respondents demographic information (Self-illustration)**

| Demographic construct | Frequency (n=116) | Percentage |
|---|---|---|
| **Location** | | |
| Africa | 9 | 8% |
| Asia | 25 | 22% |
| Australia | 9 | 8% |
| Europe | 39 | 34% |
| Middle East | 7 | 6% |
| North America | 13 | 11% |
| South America | 5 | 4% |
| Not specified | 9 | 8% |
| **Company size** | | |
| up to 100 | 21 | 18% |
| 101-1000 | 30 | 26% |
| 1001-5000 | 23 | 20% |
| above 5000 | 42 | 36% |
| **Position in Company** | | |
| Assistant | 1 | 1% |
| CEO | 9 | 8% |
| Consultant | 3 | 3% |
| Director | 19 | 16% |
| Engineer | 1 | 1% |
| Head | 9 | 8% |
| Manager | 64 | 55% |
| Project analyst | 1 | 1% |
| Supervisor | 2 | 2% |
| Vice President | 1 | 1% |
| Not specified | 6 | 5% |
| **Company business** | | |
| 3PL | 2 | 2% |
| Consultancy | 8 | 7% |
| Distribution | 2 | 2% |
| Manufacturer | 36 | 31% |
| Retailer | 18 | 16% |
| Service provider | 36 | 31% |
| Wholesaler | 8 | 7% |
| Not specified | 6 | 5% |

## Observation of survey about reverse logistics practices in FMCG

### *Related reasons for a company to adopt reverse logistics*

In this research the questionnaire covered reasons for companies to adapt reverse logistics, benefits of adapting reverse logistics, barriers implementing reverse logistics and the reasons of product returns. The results of the respondents regarding these issues is shown in Figure 6, figure 7, figure 8 and figure 9 respectively. However, table 4 shows a summary of all the results.

**Table 4 summary results**

| | Highest | Mean | Lowest | Mean |
|---|---|---|---|---|
| reasons adapting reverse logistics | Customer satisfaction | 4.48 | Decreased resources investment level | 3.32 |
| | Quality and warranty of products | 4.03 | Social pressure | 3.31 |
| | Profitable business opportunities | 3.84 | customer reluctance to handle hazardous substances in EOL (end-of-life) products | 2.98 |
| benefits of adapting reverse logistics | customer service | 4.41 | Low working capital requirement | 3.31 |
| | improved relation with customers | 4.31 | resources reduction | 3.24 |
| | increase in corporate image | 4.18 | alternative uses of products | 3.17 |
| barriers implementing reverse logistics | lack of information and technological systems | 3.57 | Lack of training | 3.25 |
| | lack of strategic planning related to reverse logistics | 3.50 | lack of awareness about reverse logistics | 3.22 |
| | policies of company | 3.49 | lack of commitment by top management | 3.06 |
| reasons of product returns | damaged | 4.1 | repairs needed | 3.44 |
| | customer return/dissatisfaction | 3.83 | recycling | 3.36 |
| | units unsold | 3.70 | reconditioning | 3.27 |

**Figure 6 Reasons for the adoption of reverse logistics (Self-illustration)**

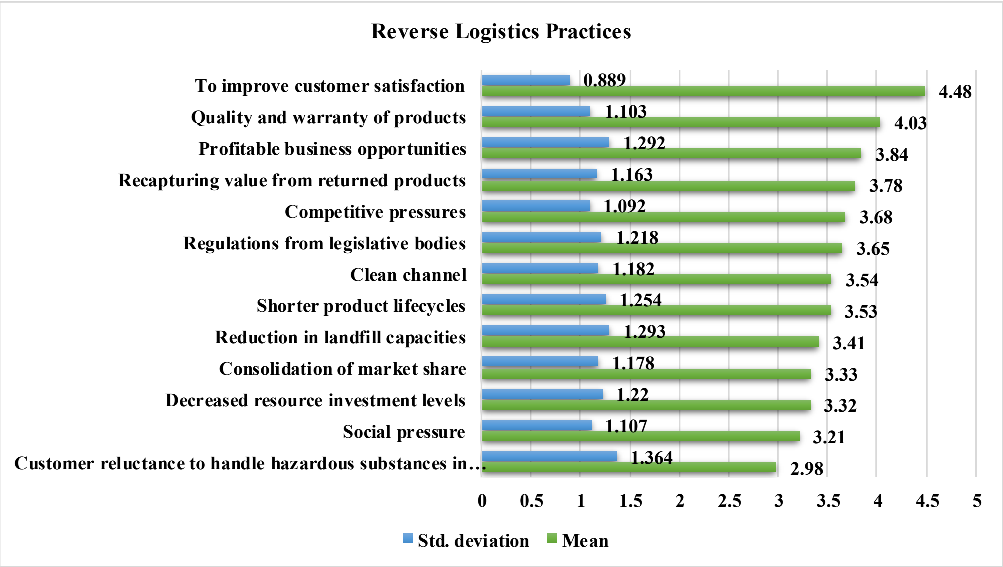


Figure 7 Benefits for the adoption of reverse logistics (Self-illustration)

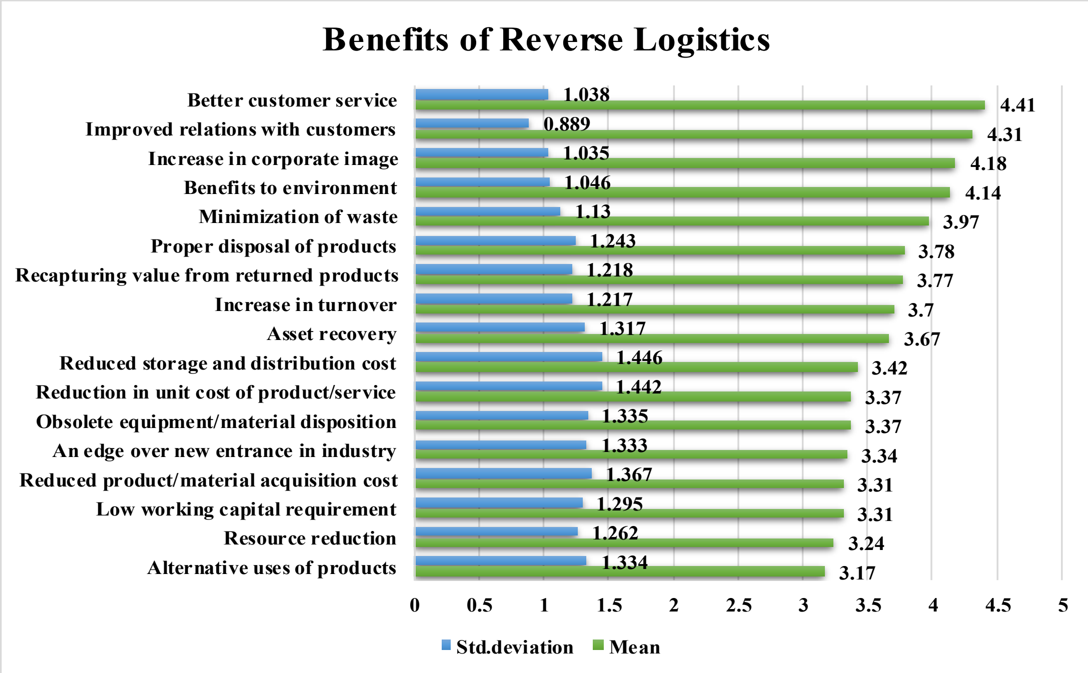



Figure 8 Barriers in implementing reverse logistics (Self-illustration)

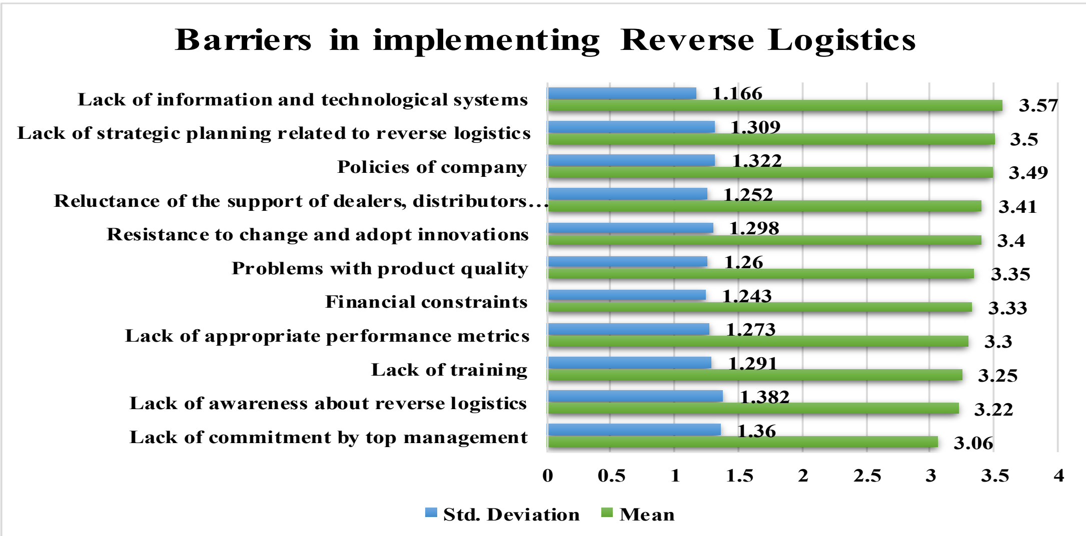
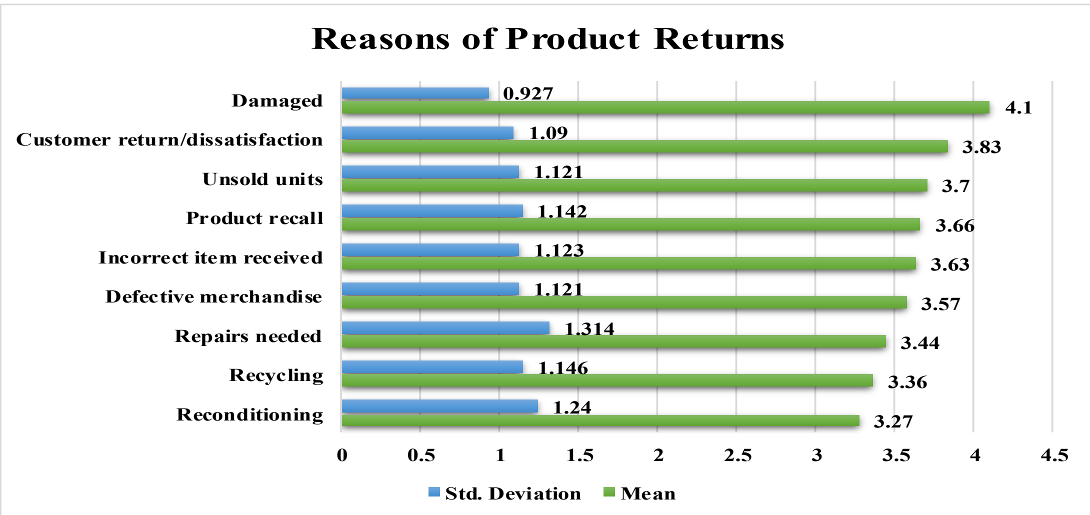



Figure 9 Reasons of product returns (Self-illustration)



## Model assessment and hypotheses testing

### *Measurement model reliability*

The research model for this study is tested using partial least square (PLS), SmartPLS software is used to evaluate measurement model and structural model. the validity and reliability of the measurement model for this study is evaluated using analysis like internal consistency reliability, convergent reliability, and discriminant validity [40].

The results in Table 3 shows that composite reliability of each construct for this study ranges from 0.850 to 0.902 since the recommended threshold is 0.7, the items used to represent the construct have satisfactory internal consistency reliability. Based on the analysis, all items in the measurement model exhibited loadings exceeding 0.7; ranging from a lower bound of 0.711 to an upper bound of 0.886. All items are significant at the level of 0.05. Table 3 shows the loading for each item and its T-statistic values on their respective constructs. Based on the results, all items used for this study have demonstrated satisfactory indicator reliability. And Table 3 also shows that all constructs have AVE ranging from 0.587 to 0.747, which exceeded the recommended threshold value of 0.5. This result shows that the study's measurement model has demonstrated an adequate convergent validity [40]. To determine the assessment of measurement model's discriminant validity, the AVE value of each construct is generated using the SmartPLS algorithm function. Then Fornell-Larcker's criterion table generated automatically. Based on the results, all square roots of AVE exceeded the off-diagonal elements in their corresponding row and column. The bolded elements in Table 4represent the square roots of the AVE and non-bolded values represent the intercorrelation value between constructs. Based on the results in Table 4, all off-diagonal elements are lower than square roots of AVE (bolded on the diagonal). Hence, it can be argued that the Fornell-Larcker's criterion is met [40].

Overall, the reliability and validity tests conducted on the measurement model are satisfactory. All reliability and validity tests are confirmed and this is an indicator that the measurement model for this study is valid and fit to be used to estimate parameters in the structural model.

**Table 3 Results of internal consistency reliability and convergent validity (Self-illustration)**

| Construct | Variables | Indicator reliability | AVE | CR |
|---|---|---|---|---|
| **Economic performance** | **Market value** | **0.827** | 0.66 | 0.745 |
| | **Product recycle efficiency** | **0.813** | | |
| | **Annual sales** | **0.797** | | |
| **Environmental performance** | **Minimum energy fuel consumption** | **0.737** | 0.606 | 0.869 |
| | **Optimal use of raw materials** | **0.751** | | |
| | **Use of recycling materials** | **0.718** | | |
| | **Waste reduction (solid/liquid)** | **0.760** | | |
| | **Reduced water consumption** | **0.848** | | |
| | **Decreased air emission** | **0.846** | | |
| **Social performance** | **Community complaints** | **0.825** | 0.692 | 0.777 |
| | **Customer health and safety** | **0.873** | | |
| | **Customer satisfaction** | **0.797** | | |
| **Cost** | **Greening cost** | **0.840** | 0.594 | 0.742 |
| | **Recycling cost** | **0.825** | | |
| | **Reverse supply chain cost** | **0.767** | | |
| **Recycling efficiency** | **Availability of recycling standards** | **0.746** | 0.614 | 0.792 |
| | **Decrease in utility usage during recycling** | **0.795** | | |
| | **Efficiency of shredders and dismantles** | **0.872** | | |
| | **Reduction in emission and waste generated** | **0.713** | | |
| **Time** | **Return rate** | **0.847** | 0.747 | 0.831 |
| | **Order fill rate** | **0.886** | | |
| | **Transit time** | **0.859** | | |
| **Quality** | **Recycled materials in returned products** | **0.711** | 0.594 | 0.832 |
| | **Availability of eco-labelling** | **0.793** | | |
| | **Biodegradable content in returned products** | **0.798** | | |
| | **Level of usage of design for assembly in products** | **0.785** | | |
| | **Level of market share controlled by green products** | **0.746** | | |
| **Waste** | **Poor manufacturing** | **0.765** | 0.587 | 0.768 |
| | **Importer recycle or recover** | **0.818** | | |
| | **Reuse process increase products disposal to landfills** | **0.736** | | |
| | **Natural resource depletion** | **0.742** | | |

**Table 4 Inter-correlation Matrix (Self-illustration)**

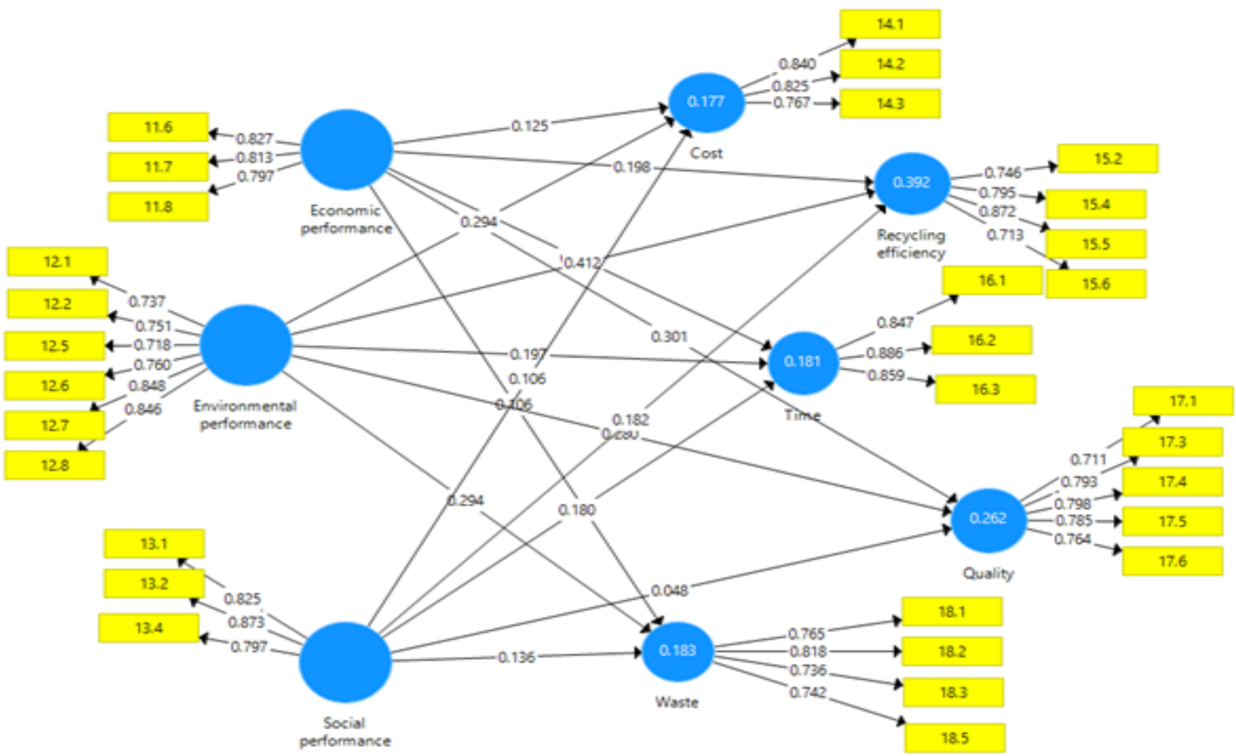
| | Cost | Economic performance | Environmental performance | Quality | Recycling efficiency | Social performance | Time | Waste |
|---|---|---|---|---|---|---|---|---|
| Cost | 0.812 | | | | | | | |
| Economic performance | 0.283 | 0.812 | | | | | | |
| Environmental performance | 0.387 | 0.412 | 0.778 | | | | | |
| Quality | 0.307 | 0.434 | 0.423 | 0.771 | | | | |
| Recycling efficiency | 0.397 | 0.431 | 0.564 | 0.662 | 0.784 | | | |
| Social performance | 0.263 | 0.350 | 0.387 | 0.262 | 0.411 | 0.832 | | |
| Time | 0.203 | 0.321 | 0.340 | 0.243 | 0.293 | 0.318 | 0.864 | |
| Waste | 0.297 | 0.275 | 0.391 | 0.431 | 0.633 | 0.287 | 0.234 | 0.766 |

### *Structural model reliability*

The validity of the structural model is assessed using the coefficient of determination (R2) and path coefficients. The R2 value indicates the amount of variance in dependent variables that is explained by the independent variables. Thus, a larger R2 value increases the predictive ability of the structural model. In this study, SmartPLS algorithm function is used to obtain the R2 values, while the SmartPLS bootstrapping function is used to generate the t-statistics values. The bootstrapping generated 5000 samples from 116 cases.

From figure 10 it can be argued that, economic performance, environmental performance and social performance are able to explain 17.7%, 39.2%, 18.1%, 26.2%, 18.3% of the variance in cost, recycling efficiency, time, quality and waste respectively. Within the structural model, each path connecting one latent variables represented a hypothesis. Based on the analysis conducted on the structural model, each hypothesis can be accepted or reject, as well as understand the strength of the relationship between the dependent and independent variables.

**Figure 10 Result of structural model (self-illustration)**



Using the SmartPLS algorithm output, the relationships between independent and dependent variables were examined. However, in SmartPLS in order to test the significant level, t-statistics for all paths are generated using the SmartPLS bootstrapping function. Based on the t-statistics output, the significant level of each relationship is determined. Using the results from the path assessment, the acceptance or rejection of the proposed hypotheses is determined. The testing of the proposed hypotheses is discussed in the next section.

### *Hypothesis testing*

To validate the proposed hypotheses and the structural model, the path coefficient between two latent variables is assessed. Based on previous studies, the path coefficient value needs to be between +1 and -1 to account for a certain impact within the model [40]. Assessment of the path coefficient in Table 6 shows that proposed hypotheses H1b, H2a, H2b, H2c, H4a, H4b and H5b are accepted while the rest were rejected. From the analysis, in order to accept a hypotheses it must have t value at least 1.96 at significant level of 0.05, and an expected sign directions (i.e., positive) and consist of a path coefficient value (β) ranging from 0.182 to 0.412.

**Table 5 Path Coefficients, T-statistics for all Hypothesized Paths (Self-illustration)**

| | T Statistics | β |
|---|---|---|
| **Economic performance -> Cost** | 1.250 | 0.125 |
| **Economic performance -> Quality** | 3.802 | 0.301 |
| **Economic performance -> Recycling efficiency** | 2.512 | 0.198 |
| **Economic performance -> Time** | 1.603 | 0.176 |
| **Economic performance -> Waste** | 0.954 | 0.106 |
| **Environmental performance -> Cost** | 2.505 | 0.294 |
| **Environmental performance -> Quality** | 2.796 | 0.280 |
| **Environmental performance -> Recycling efficiency** | 4.559 | 0.412 |
| **Environmental performance -> Time** | 1.653 | 0.197 |
| **Environmental performance -> Waste** | 2.445 | 0.294 |
| **Social performance -> Cost** | 0.892 | 0.106 |
| **Social performance -> Quality** | 0.499 | 0.048 |
| **Social performance -> Recycling efficiency** | 2.294 | 0.182 |
| **Social performance -> Time** | 1.666 | 0.180 |
| **Social performance -> Waste** | 1.150 | 0.136 |

Based on analysis, the results in Table 6 shows that environmental performance is directly influence by cost (β=0.294, T=2.505). As a result, hypothesis H1b is supported and economic performance (β=0.125, T=1.250), and social performance (β=0.106, T=0.892) are not significant on cost. Hence, H1a and H1c hypotheses are not supported.

In addition, environment performance (β=0.412, T=4.559), economic performance (β=0.198, T=2.512), and social performance (β=0.182, T=2.294), which means they are significant and positively influencing recycling efficiency. Hence, hypothesis H2a, H2b and H2c are supported.
Further, environment performance (β=0.197, T=1.653), economic performance (β=0.176, T=1.603), and social performance (β=0.180, T=1.666) is not significant and not directly influenced by time. Hence, hypothesis H3a, H3b and H3c are supported.

Meanwhile, economic performance (β=0.301, T=3.802) and environment performance (β=0.280, T=2.796) is influenced directly by quality. As a result, hypotheses H4a and H4b are supported. And social performance (β=0.048, T=0.499) is not significant so, hypothesis H4c is not supported.

Finally, economic performance (β=0.106, T=0.954), and social performance (β=0.136, T=1.150) is not influenced by waste. As a result, H5a and H5c hypotheses are not supported while environmental performance (β=0.294, T=2.445) is directly influenced by waste. So, hypothesis H5b is supported.

**Table 6 Summary of Hypothesis Testing (Self-illustration)**

| Hypothesis | | Result |
|---|---|---|
| **H1a** | Cost has a positive influence on economic performance. | Not supported |
| **H1b** | Cost has a positive influence on environmental performance. | Supported |
| **H1c** | Cost has a positive influence on social performance. | Not supported |
| **H2a** | Recycling efficiency has a positive influence on economic performance. | Supported |
| **H2b** | Recycling efficiency has a positive influence on environmental performance. | Supported |
| **H2c** | Recycling efficiency has a positive influence on social performance. | Supported |
| **H3a** | Time has a positive influence on economic performance. | Not supported |
| **H3b** | Time has a positive influence on environmental performance. | Not supported |
| **H3c** | Time has a positive influence on social performance. | Not supported |
| **H4a** | Quality has a positive influence on economic performance. | Supported |
| **H4b** | Quality has a positive influence on environmental performance. | Supported |
| **H4c** | Quality has a positive influence on social performance. | Not supported |
| **H5a** | Waste has a positive influence on economic performance. | Not supported |
| **H5b** | Waste has a positive influence on environmental performance. | Supported |
| **H5c** | Waste has a positive influence on social performance. | Not supported |

## CONCLUSION

As explained through earlier chapters, the motive of this research was to understand the reverse logistics operations and sustainability concept in FMCG (Fast Moving Consumer Goods) industries and analysis of the three aspects of sustainability i.e. economic, environmental, and social for returns and recycling on reverse logistics performance indicators.

To achieve above objectives, a quantitative method is used. For this, both primary and secondary data were collected. A questionnaire is formulated based on literature review and an online survey was conducted. All questions are based on 5-point Likert scale. Secondary data have been collected through considerable literature research. The research method was to use library databases to search for interesting articles with the keywords like reverse logistics, sustainability and FMCG. The articles were searched through search engines like Google and Yahoo. Hypotheses are developed using literature review and for this the primary data have been collected through web survey method. A message that contains my background details, research work motive and google form survey link, was then sent to my contact list on social media for business websites like LinkedIn and Xing. In 2 weeks, I received 81 responses and then a few days after, I sent a reminder to them about filling up the survey which also included a deadline by which I expected the survey to be answered. At the end, I received 116 responses and that is enough to generate results. The survey was online for a period of 1 month.

With the help of google forms, data have been automatically gathered in a sheet. Then the data is coded in numerical value in Microsoft Excel with measurement values of '5-strongly agree to 1-strongly disagree', '5-substantial benefit to 1-no benefit' and '5-very important to 1-completely irrelevant'. After the data was coded, the validation of questions is analyzed using IBM SPSS software. The questionnaires regarding reverse logistics operations, product returns reasons, benefits of reverse logistics and barriers of implementing reverse logistics are evaluated using Mean and standard deviation of each questions and results were assessed by graphical representation. The questionnaires regarding sustainability and reverse logistics indicators are evaluated using SmartPLS software, a path model is generated and hypotheses are tested.

By results of survey, it is clear that customer satisfaction is more important factor than any other for adoption of reverse logistics in FMCG industries. It was followed by quality and warranty of products, and profitable business opportunities is the other major reasons for adoption of reverse logistics. Customer is the main target for any company so it is obvious that customer service and relation with customers are more important for any company and the results of my question i.e. benefits for adopting reverse logistics also suggested the same and was followed by profitable business opportunities. Regarding the barriers of implementing reverse logistics in company survey suggest that lack of information and technological system and lack of strategic planning relate to reverse logistics are the main obstacles. The main reasons for product returns are damaged product and customer dissatisfaction.

As per the results, it is concluded that cost, recycling efficiency, quality and waste have a positive effect on environmental performance but time has not. Economic performance is positively influenced by recycling efficiency and quality only and not positively influenced by cost, time and waste. At the end, only recycling efficiency has positive effect on social performance and all other considered indictors of reverse logistics like cost, time, quality and waste have no positive effect on social performance.

The study has several limitations; first, it considers only FMCG industries. It would be interesting to conduct a similar survey to examine the reverse logistics in other industries. Although current research questionnaire was focused only on few reverse logistics indicators, it would be good by finding more indicators that affects sustainability for future research. Since the time period is limited for conducting surveys, it would be better if one can get more responses and also use qualitative method by interviewing the experts to get deep idea about the research topic and analyze results by interpreting both data, qualitatively (Interview) and quantitatively (survey). Last but not least, due to the limitation of this research, only sustainability in reverse logistics has been studied. However, the forward logistics and reverse logistics are actually closely related to each other, more studies regarding the forward logistics indicators that affect sustainability would be sparkle in this area.

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