Emerging Green Technologies to Establish Green Reverse Logistics in the Printing and Packaging Industry in Sri Lanka: Case Study of PrintCare Group Single Case Study.

Chathurini Methmali Karunawardhana[1]*, Amiya Bhaumik [2], Chandana Kasturi Arachchi [3]

[1]Faculty of Business and Accountancy, Lincoln University College, Malaysia.

[2]Lincoln University College, Malaysia.

[3]Department of Postgraduate Studies, Lincoln Institute of Graduate Studies, Sri Lanka.

***Corresponding Author**

DOI: https://doi.org/10.47772/IJRISS.2025.91200130

Received: 15 December 2025; Accepted: 22 December 2025; Published: 03 January 2026

ABSTRACT

Technological modifications and Global sustainability standards are coupled with the printing and packaging industry due to its immense pressure raised from society for its persisting environmental footprint. Green reverse logistics practices act as a green initiative in representing environmental sustainability. Green technology has now become a pivotal field in achieving carbon neutrality that in turn equalizes the green initiatives. Due to the limited literature and in bridging the empirical gap the study focuses on probing the relationship between green technology and its impact on the green practices in the printing and packaging industry in Sri Lanka. The research employed a single case study, adopted a deductive approach with a quantitative approach under pragmatism research philosophy It involved a questionnaire that was distributed among the supply chain operations in the PrintCare group-being one of the main organizations in the printing and packaging industry. The use of SPSS software for the statistical analysis revealed that there is a strong positive relationship between the adaptation of green technology and its effect on green reverse logistics practices. In enhancing the originality of the study, the practical and impactful insights showed new paths that could be followed by the PrintCare Group and the same could be followed in the Sri Lankan industry and thereby move forward with the global sustainability levels.

Keywords: Green Technology, Green Reverse Logistics Practices, PrintCare Group, Printing and Packaging Industry.

INTRODUCTION

There is no doubt that the beginning of the 20th century has opened doors in the field of information technology in terms of expansion and transition. Thus, the effect on human life is tremendous within the elements of the production of goods and services along with products and services too (Shahzad et al., 2022). Alongside these innovations, there is an enhancement in including these digital technologies in the printing industry due to the environmental challenges (Zhang et al., 2022). One of the significant problems the world has faced today is all about climate changes, global warming, reduction of ground water level and food supplies. Many scholars over the decades have researched many sustainable contributions due to the threats it has created upon humans, plants and animals (Lipiak and Salwin, 2019). Concerning health care issues, international obligations, environmental policies among the government administrations have led to the development of technological innovation in the printing industry. Globally, the concerns within the printing industry mainly fall into paper production, energy consumption, water usage and pollution, generating waste and disposal, carbon footprint and e-waste among the equipment (The Enterprise World, 2022).

In relation to the Sri Lankan printing industry (SLPI), currently the export market within the commercial printing

and packaging (P&P) has increased tremendously. Tea cartons, garment tags and labels are the major export markets. Despite the lack of skilled and knowledgeable labour and import duties, the growth of the printing industry is high and expected to grow further by 2030 (Wresearch, 2020). The contribution towards Sri Lankan (SL) exports in P&P has significantly positively impacted on sales. The revenue earned by printers in 2024 is US $11.3m and is expected to grow at the rate of 1.6% (EDB Sri Lanka, 2025) . However, the major question of the sustainability of this industry is still unknown. As per the Sri Lankan National Environmental Act NO.47 of 1980 it was the obligation of the top management in the respective organization to ensure that they have adhered to all the required conservations, protection and rehabilitation of the natural environment of Sri Lanka (Pathmanandakumar, 2024). However, even after many decades of passing these laws, there are very limited approaches considered by the printing organizations in SL to mitigate these negative externalities. There is less or nearly no attention provided to protecting the environment from these activities. In addition to the above, there is very limited literature pertaining to the application of the Environmental Protection Act in Sri Lanka and how the industry is aiming to protect while gaining economic benefits.

PrintCare Group (PCG), founded in 1979 has evolved into one of the most respected P&P companies in the South Asian region. The company is running technological innovations and has created success stories in Asia with customers on five continents. Sri Lanka being a developing country, PCG, is the colonist for the tea bag industry in Sri Lanka. Currently PCG is catering to P&P and digital media, with a customer portfolio of apparel, tea, telecommunication, fast moving consumer goods (FMCG), publishing, education and the lottery industry too. Building a new green factory completely running on renewable energy is one strategy PCG has taken in creating value in sustainability (PrintCare, 2025). These steps are needed in saving mother earth while building up for long-term survival in the industry. Balancing economic performance while being responsible for social and environmental considerations is a must. In achieving sustainability, the presence of innovation is needed (Alamandi, 2025). Therefore, the PCG needs more green initiatives in their overall operational strategies in a way of a survival strategy. Since PCG caters more towards P&P, they would encounter adverse effects with the environment in terms of emissions, resource depletion, waste and changes in the SL regulations. Thus, actioning upon sustainable developments among green technology and green practices are needed.

In understanding the significance of the study, it was observed that there is a gap existing within the P&P industry in terms of understanding the impact of green technology (GT) towards the green reverse logistics practices (GRLP). This would be a new research area in the industry concerned. When PCG identifies the relationship between GT and the GRPL towards sustainable developments, PCG would be able to improve its operation's efficiencies through quality and better formulated mechanisms. Thus, the benefit of the papers will bring multifaceted benefits to the PGC as well as the overall P&P industry.

The application of GT has contributed majorly to enhancing quality and value while reducing the time of production Shi et al. (2023). These innovations have positively impacted the efficiency of resources in the P&P Industry and are focused on meeting the economic compliances, reducing the harm towards the environment and increasing the effectiveness (Skare & Soriano, 2021). With the last decade the establishment of the GRLP that initiated in reverse flow of the products returned by the end customer to the original producer, it has opened doors in understanding the importance in the capability of remanufacturing, recycling, reusing, reducing and waste disposal. In the view of Adesoga et al. (2024), these adaptations could enhance the overall efficiency of the industry. However, there are very limited studies that specifically or empirically tested the relationship between the GT and GRLP. Therefore, the need to understand the relation between these two variables extends by analyzing the objective of the study. Therefore, the objectives of the study are:

1. To understand the key attributes of GT pertaining to the Printing and Packaging industry in Sri Lanka.

2. To recognize the key elements in the GRLP in the Printing and Packaging industry in Sri Lanka.

3. To understand the impact of GT adaptation on the GRLP in the Printing and Packaging industry in Sri Lanka.

4. To evaluate the GT strategies adopted in PCG in Sri Lanka to establish effective GRLP.

The aim of this study is to probe the relationship of the emerging green technologies and its impact of green reverse logistics in the printing and packaging industry in Sri Lanka: the Case study of PrintCare Group. The current study also aids in contributing to understanding the initiatives taken by the PrintCare Group in resolving or minimizing the negative externalities while proposing other mechanisms to be adopted by the P&P industry in Sri Lanka. However, the contributions of the study could be aimed at utilizing these proposed mechanisms in other industries too. Thus, the outcome of the study would contribute to many industries in order to save the environment. In answering the research questions and pursuing the research objectives, the study is outlined by understanding the theoretical background and the literature in terms of the existing knowledge among the elements of GT and GRLP, followed by the methodology and the data sources and subsequently it discusses the results, limitations, implications and the conclusion.

LITERATURE REVIEW

Theoretical Overview of Green Technology

Adopting GT is one of the options to reduce the adverse effects towards the environment while having a competitive advantage (Awan et al., 2022). It enables developing mechanisms in the P&P industry that results in very much less negative externalities towards the eco system (Khan et al., 2021). In the view of Ma et al. (2021), GT is the application, production and exploitation of the process of goods and services, that enables the organization to level up and be firm upon the results in the reduction of the risk of the environment. However, Hilkenmeier et al. (2021), argued that these definitions are carried out in different forms in the innovations in GT as of innovation among the process of the products and non-technological innovations in terms of the organisational structure and change management. Nevertheless, the aim of adopting GT is enriched with reduction of energy consumption, saving natural resources and preventing pollution, and adopting restructuring of the organization as green supply chain management, green RL or green marketing (Liao et al., 2020). The literature of Wang et al. (2019), introduced GT as a process innovation in terms of software or hardware that contributes positively towards the waste recycling, energy saving and preventing pollution. However, several studies have pointed out the main reason behind these adaptations have an economic value. The pressure from the concerned stakeholders, demands of the consumers, legislative pressure from the government, taxations, and having the competitive advantage (Klein, 2025). Nevertheless, GT improves in environmental performance and finally towards the excellence in the business and the industry itself (Wu et al., 2020). With the increased deterioration of the environment and changes in the climate due to enhancing hazardous emission among sustainability, it has been vitally important in adopting GT and to be answerable to the policies put forward by authorities (Khan et al., 2021). However, transforming into these adaptations is quite challenging and sometimes remains very difficult due to uncertainties and financial complexities (Shahzad et al., 2022). From the available literature, adaptation of GT has been developed in the TAM model theory. As per Davis (1989), the model is about how far an individual would accept certain technology. The perceived usefulness and perceived ease of use are the factors as one individual's subjective capability in performing and one's ease and the capability in adopting these applications respectively. However, there are several literatures argued that these factors are influenced mainly due to cultural, political and social factors (Anser et al., 2020; Schorr, 2023). On the other hand, Venkatesh and Bala (2008), have developed the TAM model by introducing other components towards the main factors. Despite these amendments, the highlighted need to integrate GT into the P&P is associated with the TAM model. GT would lead to green products and the intention and the attitude of going for green initiatives would definitely increase the revenue of the company (Anser et al., 2020). Thus, the usage of TAM provides more wisdom of polices of sustainable developments in the global scale. However, it is quite surprising that the adaptation of GT does not carry any weight on hedonic characteristics. There are no risks associated with these adaptations. On the flip side, Yoon and Han (2016), argued that it is the norms towards the responsibility of the environment that would play the vital role in influencing one individual in accepting information technology in the form of GT.

Key Attributions of Green Technology

The current desires of printing materials have been changed, and it is the requirement of the P&P industry to understand these changes and cater accordingly. With the introduction of these innovative technologies, the industry consists of material technological advancements, process technological advancements, facility

technological advancements and system technological advancements (Amri et al., 2022). Thus, technology keeps on advancing nimbly and becoming more popular. Most of the printing inks are comprised of volatile solvents which make the environment hazardous. It was proved that synthetic resins and emissions of volatile organic compounds (VOC) are not biodegradable (Sabturo & Othman, 2023). Among all with the fluctuations of the price within that petroleum, the PI has looked at new resources as ink with the formulation of soy protein. In view of this fact, it was proved that soy ink could be competitively priced and could be used as an alternative for petroleum-based ink. Due to the reduction of environmental pollution, being more stable at printing and the low number of VOCs presented, the demand has increased drastically (Sabturo & Othman, 2022). Given its environmental friendliness, renewable resources, and biodegradability has enhanced the demand tremendously (Jiang et al., 2015). However, the literature of Benitez et al. (2024), stated that these materials have their own challenges. Water instability of cellulose paper, limiting the mechanical properties of the materials have limited this usage. Nevertheless, much research is carried out in improving these challenges (Wang et al., 2019). Among all biodegradable paper is another substrate used in the P&P industry. These substrates are made from postconsumer waste. Due to its significant low environmental footprint, reduction in the virgin pulp has enhanced the demand for these substrates. Another substrate is bio-based paper made from agricultural residues. It also aids in a circular economy where the materials are recycled and reused (Qualprint, 2025). However, these mechanisms are often complex or might require expensive pretreatments. This would weaken the cost efficiency (Jiang et al., 2015).

The P&P industry is known to be grouped as a water intensive industry (Esmaeeli & Sarrafzadeh, 2023). Moreover, it creates massive amounts of wastewater. Thus, the adaptation of waterless printing has significantly positively impacted the PI (Park Lane Press Environmentally wise, 2024). This mechanism aids in keeping the color constant and delivering exceptional accuracy constantly. As per Park Lane Press Environmentally wise (2024), the environmental impact is very low doe to less water, less energy and the reduction of greenhouse gases. However, in the literature of Grande-Acosta and Islas-Samperio (2020), it was stated that the expenses of setting up the process along with the strict temperature tolerance have bought in many questions in the usage of this process. On the flip side, PrintWiki (2023), stated that this process is still on the infancy stage and yet the new developments are still in the process of overcoming these challenges. The P&P industry is capable of harnessing the advantages among these innovative technologies. UV printing and LED UV Curing provide significant advantages among the traditional ink methods (Zheng et al., 2023). Extremely high-quality printing and quick turnaround times are some of the advantages of UV printing. In terms of understanding the environmental progress, it is using less energy than the traditional printing machines. However, one of the biggest drawbacks is the limited materials. The article of Mendes-Felipe et al. (2023), stated that these expensive mechanisms would overcome the benefits that occurred through thermal based 3D printing practices. In view of Eslamian and Eslamian (2021), rainwater harvesting is about a particular technology used in collecting and storing them with the use of complex techniques such as underwater check dams. In an article of The Green Lines (2024), it was proved that on average the printing of one paper consumes 1g of ink, 0.011 liters of water and 1.5 liters of natural gas Therefore one of the technological solutions would be rainwater harvesting, wastewater usage that aids in as a potential practice to overcome the water scarcity. It is proven that this method is a long-lasting practice that is simple to install and operate on the P&P industry. Printing companies could have their own dams or underground tanks to store the rainwater (Abdulla and Al-Shareef 2009). On the other hand, rainwater harvesting has its own disadvantages, where the quantity of water and the availability depend on rainfall, storing excessive water could be quite expensive, The P&P industry might have to go through an initial high cost in providing necessary storage facilities. Therefore, the question of how far the P&P industry is able to stand up with these expenses is still unanswerable. It is no doubt that the gradual decrease of natural resources has created a path in finding new materials. Using recycled papers, recycling waste, are some of those inventions (Yilmaz et al., 2021). However, Kasmani et al. (2012), argue that using recycled paper is somewhat a challenge since the quality of the print would be negatively affected in terms of the brightness. The increased price on the energy market and scarcity of resources had compelled the P&P industry in using more energy efficient equipment and renewable energy use while reducing the emission of CO2 and greenhouse gases (Tan et al., 2019). The ultimate goal of integrating green technology is to reduce pollution and enhance energy efficiency.

However, as per the literature of Iravani et al. (2017), some challenges in implementing GT are known to be as high costs in relation to implementations, lack of knowledge and expertise along with human resource, less

alternative process technology has been lined up. Despite these challenges, the industries are compelled to embrace GT in avoiding the negative consequences.

Theoretical Aspects of Green Reverse Logistic Practices

Sustainability has become a vital issue in any industry due to environmental awareness, legislation and globalization of the markets. Therefore, reverse logistics act as a significant contribution in providing sustainable initiatives. The literature of Nanayakkara et al. (2022), stated that RL could manage the return products more effectively and aid in achieving the sustainability goals. RL is about collection of used or EOL products and segregating them into different categories and finally disposing them in an environmentally friendly manner (Agrawal and Singh, 2019). In the analysis of sustainability Triple Bottom Line Theory of people, planet and profits (Elkington 1997) is considered as an evaluation of social, economic and environmental performances (Budak, 2020). These dimensions are ecological as to conserving the natural resources, economical as in driven towards technological advancements, and enhancing the effectiveness and finally social as in improving the living conditions of the people. In the literature of Kurbatova et al. (2020), it was proved that GRL could be known as a tool in managing the issues within the organization and balancing the economy, environment and social aspects. Thus, it is evident that the GL elements are strengthening the efficiency of the industry. When the organizations do not use the virgin materials in producing the products that in turn reduces the operational costs. This provides a positive impact upon the financial performance of the organization (Jayarathna & Lasantha, 2018). When GRL practices are employed within the organization more job opportunities are found. In addition, when GRLP are practiced, less waste management is recurring the harm created upon the natural environment (Tundys & Wiśniewski, 2023). Thus, the three elements of profit, people and planet is considered and when practicing GRLP the organizations can gain more reliability. These environmentally friendly industries are contributing to the enhancements of the economy by being cost effective, in the environment by being a no polluter, furthermore, in relation to social aspects by being stable in providing environmentally friendly products (Rakhmangulov et al., 2017).

Key attributions of Green Reverse Logistics Practices

Researchers emphasized the elements in the RL as reuse, repair, remanufacture, recycle and disposal (Pushpamali et al., 2019). In understanding reuse, it is directly reusing the same product with no repair, and takes only what is in good condition (Samarasinhe & Haijun, 2019). In the element of repair, it is that when the customer returns the product due to some breakage, the producer would repair the product. This would involve some cost, and this method is very operational effective (Ali et al., 2021). However, it is argued, that the product will be of a lesser quality than the original product (Akdoğan & Coşkun, 2012). Nevertheless, Samarasinghe and Haijun (2019), stated that yet the product could be for the same purpose. The next function is remanufacture. The ultimate purpose of remanufacture is to enhance the quality of the product. Once the producer gets the returned product, the manufacturer will examine and remove the broken parts and replace them with new parts. On the flip side Fancello et al. (2017), argue that this process is very complex, and this method is subjected to the product type. However, Samarasinghe and Haijun (2019), stated that even though some parts are taken out, those individual parts could be repaired and used for other returned products. Yet the question of quality arises. The fourth element is recycling. This is where the products or parts are processed in terms of materials and could be reused in new products (Khor and Udin, 2013). This process would preserve the functionality of the product, and the original materials would be changed to the prior product. In view of Sun et al. (2022), the literature stated that in this process the materials go through different stages such as shredding, reprocessing and burning. Finally, in the element of disposal, this is known to be the last method and once a returned product comes to this stage, the product or any part of the product cannot be reused. Akdoğan and Coşkun (2012), stated that this process is mainly a cost to the organization and only goes under landfilling.

However, in the literature of Pushpamali et al. (2019), it was observed that an organization cannot move forward with the RL practices at the mere benefit of competitive advantage. Considering the PI, the elements depend on the particular product. The time, quality and the cost of applying any of these functions should be considered.

Therefore, the authors argue that the adoption of the options should be considered wisely. If not, RL would be a cost center than a cost benefit. The following figure indicates the cost in line with the different RL options.

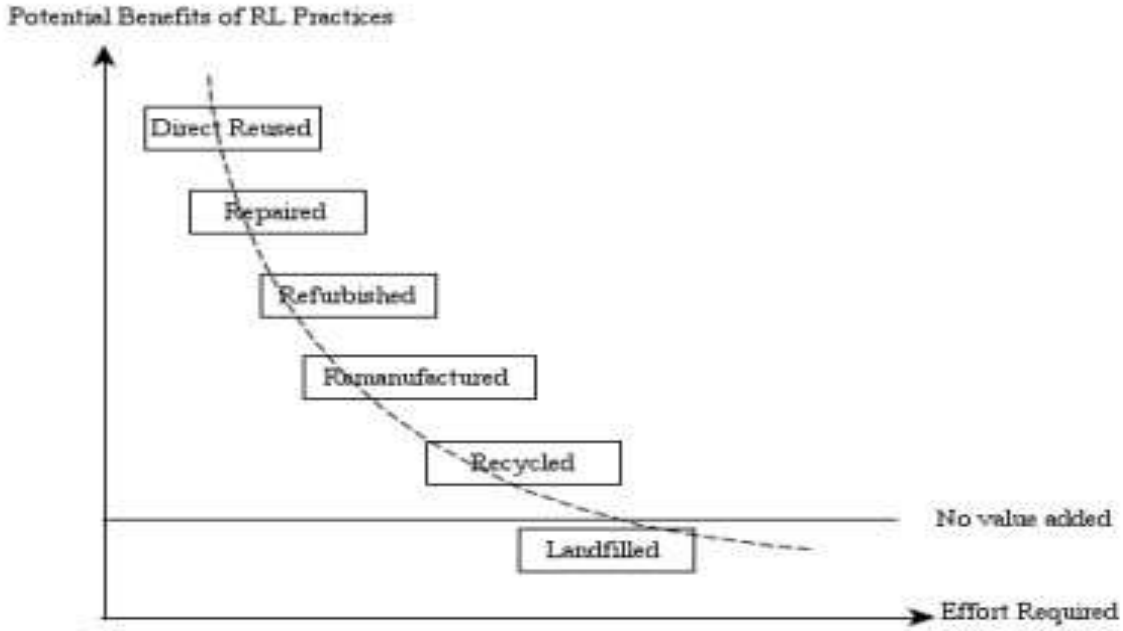

Figure 1: Reverse Logistics Strategies

Source: (Pushpamali et al., 2019).

Being a machinery intensive industry it is important to adopt this green initiative. Nevertheless, RL practices should be adopted according to the individual product and process. RL is merely a process of economic, social and environmental benefits, yet managing the waste effectively would bring positivity within RL implementations. With the available literature thus, the authors developed the below theoretical framework.

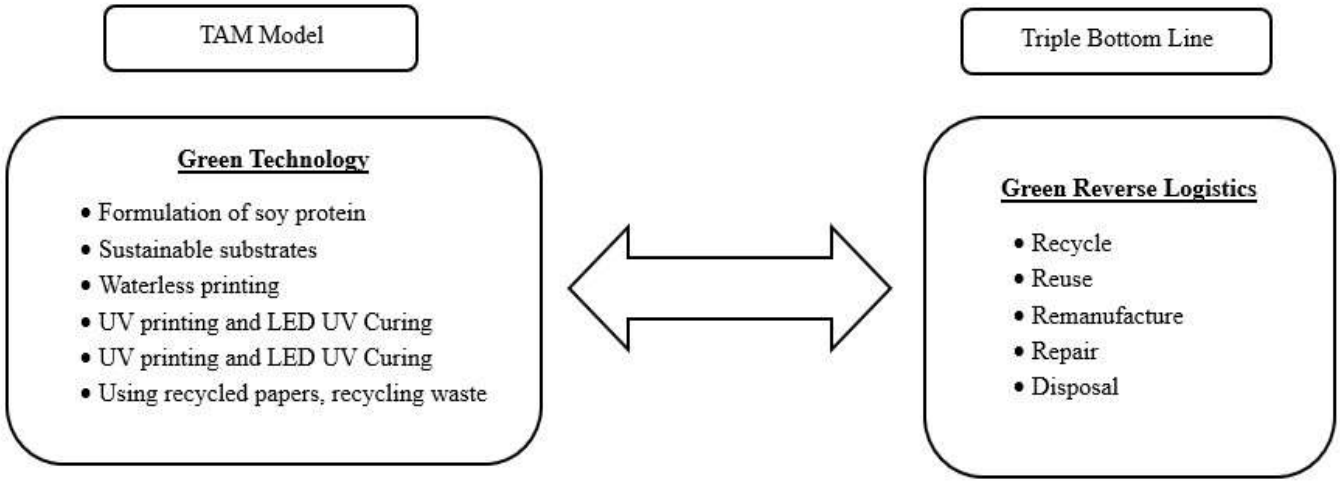

Figure 2: Theoretical Framework

Sustainable development of any organization is stimulated by GT (Ghisetti & Quatraro, 2016). Thus, it is about identifying the sources which are environmentally friendly and are aiding in industries while creating jobs and innovative technologies. Therefore, in order to achieve green growth within the P&P industry, it is essential in investing in innovative GT that becomes the strong foundation for sustainable development. Existing literature found that RL is an advanced economic, social and environmental strategic decision in achieving sustainable development. (Alnoor et al., 2019). Remanufacturing is a vital component in sustainable development where is includes process efficiency and strategic planning. When the goods are recovered from the final customer, a closed loop supply chain is created. This process is about retrieving the products, replacing the damaged parts, and recycling them. This process is achieving investment returns. Thus, achieving the closed loop chain is about reaching sustainable strategy (Shekarian, 2019). Through RL the three issues of sustainability are achieved. Focusing from the environmental aspect, the industry is able to reduce the harmful substances, while reducing

the air and water pollution. When the recycling approach is in practice it reduces waste and energy consumption, in the literature of Meherishi et al. (2019), it has been proved that adopting RL would enable us to move away from environmental concerns. In the aspect of the social element, more and more job opportunities are created which is a social issue, thus creating awareness of the moral and social responsibilities in terms of the environment conservativeness (Aryee & Adaku, 2023). As for economic factors, the performances of RL would result in enhancing the value recovered from the products, having less investment in inventory while enhancing sustainability. The results of the literature show that RL has a great input in improving the sustainability of the P&P industry (Banihashemi et al., 2019). Thus, it is essential in introducing RLP along with the GT and thus conserve the environment. Therefore, the current study hypothesizes that;

H1: There is a significance effect upon the green reverse logistics practices on the adaptation of green technology in the printing and packaging industry in Sri Lanka.

H0: There is no significant effect upon the green reverse logistics practices on the adaptation of green technology in the printing and packaging industry in Sri Lanka.

With the proposed hypotheses the authors derived the conceptual framework shown below.

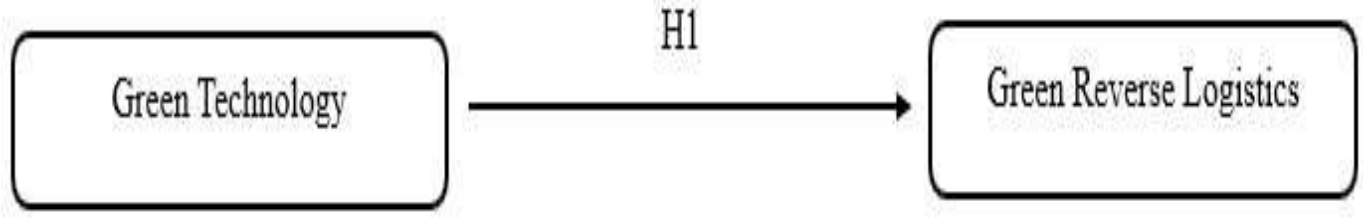

Figure 3: Conceptual Framework METHODOLOGY

This chapter shows how the current study is conducted along with the theoretical framework of the research. Thus, the scientific approach of the study is convinced. In view of Saunders et al. (2019), the research design is about the overall plan that the author expands in relation to the research questions in laying out the empirical research. The developed framework consists of philosophy, design or the method of analysis, approach and data collection along with the approved ethical considerations of the participants.

The reality of the study is to understand the impact of GT adaptation on the GRLP in the P&P industry. The study starts with the problem of the way the P&P industry has negatively contributed towards the natural environment and the involvement of GT in reducing the negative externalities. Providing practical and impactful insights would enhance environmental sustainability of the P&P industry. Therefore, the study follows a pragmatism philosophy with a deductive approach in which the research is developing the theoretical frameworks at the beginning of the research while examining the pertaining literature and afterwards formulating the test in validating the same. Thus, the deductive approach is known to be theory to data approach or top-down reasoning. Understanding the theoretical framework of the GT and GRL practices with the already established theories and the test on the available data collected from the PrintCare Group. This is in line with the pragmatism research philosophy. The developed questionnaire is based upon the above theoretical underpinning (Kaushik & Walsh, 2019).

The Methodological choice is about how the data is collected in research (Haq & Yasin, 2025). The study employed mono-method quantitative research in examining the relationship between the GT and GRLP, that are measured numerically and analyzed through statistical techniques. The questionnaire was built with the applicable theories to enhance the validity and reliability and would be pre-tested. The participants would use the Likert number between 1-5 where the level of importance is high in 5 and 1- no importance level. The questionnaire along with the consent form was divided into four main sections. The demographic section, the adaptation of GT in the PCG, the applicability of GRLP in the PCG, and the impact of GT on the GRLP in the PCG. The questionnaire was physically distributed in the office premises among the employees of the supply chain operations in the PrintCare Group. The census method was adopted where the authors are covering the entire population of the employees under supply chain operations. Thus, all the employees amounting to 20 are of the target population are incorporated in the study (Stratton, 2023). The single case study strategy was adopted

while highlighting the supply chain operations in the PCG. The in-depth inquiry of the GT and its impact of the GRLP enabled the authors in understanding the actual setting (Dźwigoł, 2023). The study selected PrintCare Group purposively since it provides the opportunity in observing and analyzing variables while defining the actual scenario. The authors ensure that the chosen approach is suitable for nature in the current research questions and objectives.

The employees of the supply chain operations have different designations and belong to different departments. They have their own different levels of experience. The demographic details of the respondents are shown below.

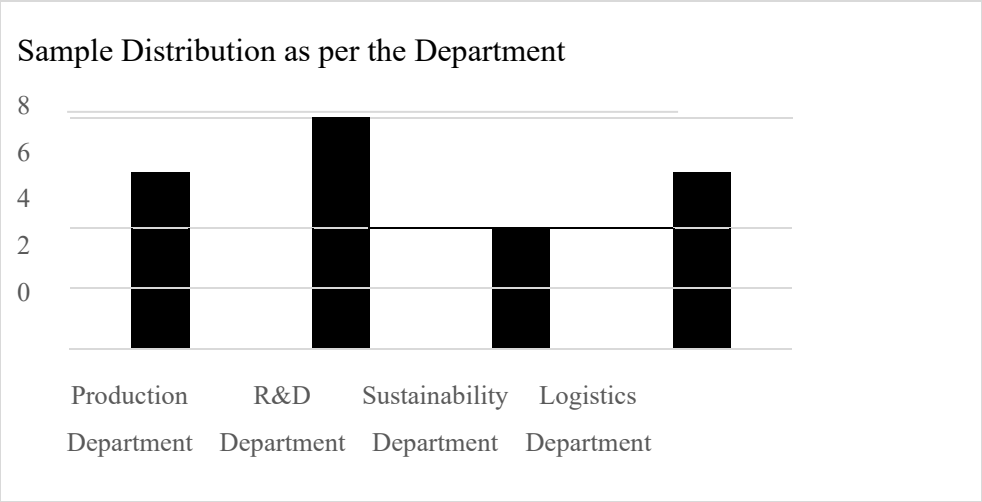

Figure 4: Demographic Distribution -Department wise.

The years of experience against the number of employees.

Years of Experience	No of Employees	Cumulative %
1	5	25%
2	6	30%
3	4	20%
4	5	25%
Total	**20**	**100%**

Table 1: Demographic Distribution-Years of Experience wise.

Data Analysis

The study generated numerical data and is analyzed in obtaining results and deriving towards the conclusions. The relevant statistical methods were employed in analyzing the data.

In understanding the green technologies and the adaptation of GRL practices, the following tables provides a clear picture of the perceptions of the employees in the PCG in relation to the elements of the study. It was revealed that 80% of the employees having have a perceived knowledge of the GT and it was also identified that only 35% of employees are well aware of the GRL practices where as 55% have not fully apprehended in terms of GRL practices and finally 10% is aware of GRL yet not fully aware of the benefits it carries towards the environmental sustainability. This concludes that still the knowledge about GRL practices in Sri Lanka is at the infancy level and it is the responsibility of the management in highlighting the importance and adopting these green integrations for the P&P industry in Sri Lanka.

Perceived knowledge of green reverse logistics practices			Perceived knowledge of green technologies		
Less Knowledge	11	55%	Less Knowledge	4	20%
Moderate	2	10%	Moderate	0	0%
High Knowledge	7	35%	High Knowledge	16	80%
	20	100%		20	100%

Table 2: Perceived knowledge of green revere logistics practices and green technology.

Reliability and Validity.

Reliability analysis is a vital statistical procedure that aids in evaluating stability, consistency and dependability among the datasets. With internal consistency it ensures that the set of questions consistently measures the fundamental concept (Izah et al., 2023). Each factor was measured and evaluated in checking reliability and validity through Cronbach's Alpha (Kennedy, 2022). The Table shows that the Cronbach's alpha was =0.962. which proved that there is internal consistency since the alpha value is above 0.70, that is acceptable in the research field.

Scale Reliability Statistics	
	Cronbach's α
scale	0.962

Table 3:Cronbach's Alpha Internal consistency among the items was also calculated.

Item Reliability Statistics	
	If item dropped
	Cronbach's α
Awareness	0.987
Adoption Level	0.943
Reverse Effectiveness	0.943
Impact Agreement	0.938
Experience Years	0.938

Table 4:Cronbach's Alpha Element wise

This was further illustrated by Learning (2019), that the coefficient α below .60 is poor reliability, coefficient α between .60 and .070 as fair reliability and whereas the coefficient α of .70 and .80 is a good reliability.

Omnibus ANOVA test

Omnibus ANOVA Test					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Adoption Level	17.85	1	17.847	169	<.001
Residuals	1.90	18	0.106		
Note. Type 3 sum of squares					

Table 5: Omnibus ANOVA Test

The output in the table ANOVA model, showed that adaptation of GT, was statistically significant with (F=169, p-value= <0.001). Therefore, this was suitable in predicting that adaptation of green technology is significantly influencing the GRL practices in the printing and packaging industry in Sri Lanka. This was confirmed through the F value. The calculated F value is 169, which is greater than the critical F =4.41 (1,18), at α=0.05. Therefore, the model is fit to predict the relationship of green technologies and green reverse logistics practices of the printing and packaging industry in Sri Lanka. Hence the study null hypothesis is rejected. Furthermore, it was concluded that the adaptation of green technology has a significant impact upon the green reverse logistics practices in the printing and packaging industry in Sri Lanka.

Regression Analysis

Linear regression examination was used in establishing the impact of green technologies upon the green reverse logistics practices. In view of Cheng 2014, it was observed that the variable being predicted would be the standard variable, while the variable utilized in the prediction for standard variable are known to be explanatory variables. This was applied in the study of Daodu and Bhaumik (2024), affiliated with Lincoln University College while employing the regression analysis. Their methodology supports the regression analysis in the current study. Thus, the simple linear regression model was employed in determining the effect of GRLP upon the adaptation GT in the P&P industry in Sri Lanka.

Model Coefficients - Reverse Effectiveness									
			95% Confidence Interval					**95% Confidence Interval**	
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**t**	**P**	**Stand. Estimate**	**Lower**	**Upper**
Intercept	1.211	0.2085	0.773	1.649	5.81	<.001			
Adoption Level	0.736	0.0566	0.617	0.855	12.99	<.001	0.951	0.797	1.10

Table 6: Model Coefficients - Reverse Effectiveness

The test results indicated that the correlation coefficient is more than 0.5 which indicates that there is a strong relationship between GT and GRLP. The relationship is statistically significant. This showed that there is a strong positive relationship between the variables of adaptation of green technology and the green reverse logistics practices. Thus, the study rejects the null hypothesis. The standardized coefficient is nearly 1. That in

turn indicated that with the adaptation of GT, the effectiveness of the GRLP will significantly increase within the P&P industry in Sri Lanka. **Shapiro-Wilk Normality Test**

The authors employed the Shapiro-Wilk Normality Test in determining the distribution of the data set.

Normality Test (Shapiro-Wilk)	
Statistic	**p**
0.948	0.339

Table 7: Normality Test (Shapiro-Wilk)

As the tests indicated, the W static is nearly 1. When the value is closer to 1 it is suggested that the data is more normal. In addition, the p=0.339 (>0.05), thus the study fails to reject the H0, hence data is normally distributed.

In conclusion, the results indicated that there is a strong relationship between the adaptation of green technology and its impact of the effectiveness in the green reverse logistics practices in the printing and packaging industry in Sri Lanka. The reliability tests prove that the questionnaire is internally consistent whereas the ANOVA test along with the regression results indicated a statistically significant and positive impact of the two variables.

DISCUSSION

Based on the results of the tests it was observed that the adaptation of green technology has a significant positive relationship on the effectiveness of the green reverse logistics practices in the P&P industry in Sri Lanka. It was observed that when the P&P industry collaborates green technologies the effectiveness of GRLP and the outcome of those green initiatives is high. The P&P industry is known to be a permeant polluter (Aydemir et al., 2023), yet the adaptation of green technologies aids in conserving the natural resources and reducing the environmental degradation (Wang et al., 2019). PCG is not entirely running with solar energy, however, the company was able to install an industrial solar power system in one factory and was able to save the energy costs substantially. In view of Dassanayake et al. (2024), it was noted that the organizations have opportunities in utilizing more clearer and innovative technology in saving energy costs and reducing emissions.

Reverse logistics is aiming at logically solving the distribution of goods from the consumer and back to the producer. Among the trail of the events, recycling, reusing and managing waste substantially aids in reducing waste production. If the products of packages are not recycled or reused which are the elements of GRLP, the waste would be recovered, and the P&P industry is able to create value through waste. From the economic as well as ecological view, recycling is a major attribute (Zatrochová et al., 2021). However, effective operations of GRL practices are not possible without the adaptation of green technologies. PCG is currently recycling their waste at the rate of 86%, where there is still room for innovation. Wastepaper generated within the office premises, was recycled with the help of the environmental authorities. Further, the adaptation of water treatment plants and the relevant technologies have been considered as a mitigating step in minimizing the environmental damage the P&P company is creating through the wastewater (PrintCare, 2025). The acidity of the wastewater is high in the P&P industry (Aydemir et al., 2023). Thus, recycling contaminated wastewater will substantially provide positive outcome towards the natural environment.

One of the benefits of using technology in the PP& industry is to be cost effective and environmentally friendly. Creation of soy-based inks, UV curable inks and water-based inks are mostly used by the P&P industry due to the lesser emission of volatile organic compounds (VOCs). The adaptation of energy efficient techniques is coming through green technology (Batet et al., 2023). Safe disposal of these inks is essential in following the GRL practices. PCG is currently using eco-friendly ink that in turn reduces the environmental impact. Yet more environmentally friendly substrates, inks and other materials are designed with the use of green technologies that in turn positively impact the effectiveness of the GRLP.

In contrast to the above, green technology has its own limitations. Despite the fact that, sustainable technological changes are impacting positively towards the natural environment yet overcoming the barriers are a must (Söderholm, 2020). However, overcoming these challenges involves societal, political. organizational, and

economic dimensions (Markard et al., 2012). Above all there is a vast knowledge gap among the employees in the P&P industry in terms of GRL. This is merely due to the fact that GRL is still at the infancy level in Sri Lanka. Reverse logistics is an inseparable part in green reverse logistics. This mainly deals with recycling, reusing, remanufacturing, repairing and proper disposal. Thus, sustainable development through green technology is essential toward environmental sustainability.

CONCLUSION

The study was carried out with the purpose of probing the relationship of emerging green technologies and its impact on GRL practices in the P&P industry in Sri Lanka. It was observed that green technology is essential in the P&P industry to gain the effectiveness of the GRL practices, in the years to come. This is about gaining a competitive advantage not only towards the economic aspect of the industry but towards the ecological and societal dimensions too. This in turn open doors in being ethical towards the employees and the community as well. Environmental sustainability is strategically achievable if the industry is willing to think and work ecologically. PCG is trying to move the business towards ecology not only due to the laws and regulations enforced, but to be in line with the corporate culture in terms of the code of ethics within the industry. With the above analyzed data it was derived that there is a significant positive relationship of GT on the effectiveness of GRL practices in the P&P industry in Sri Lanka. However, the knowledge about the GRL practices and how it contributes towards the environmental sustainability is still at the infancy level. The implementation of GRL is contributing positively towards the natural environment, yet the adaptation of GT is essential to grasp the best of GRL. The results presented in the study, can help the P&P industry and other industries at the national level. This can also move towards helping the Ministry of Environmental affairs in Sri Lanka in creating reports on the state as how industries could establish GRL practices and enhance its effectiveness through GT. It was observed that the knowledge in terms of GRL is yet to be perceived, where training should be conducted through the higher management in making sure the employees know the value of green implementations. Government intervention is needed in providing suitable schemes for loans and other financial incentives where the industry could adopt these GT in their premises. The organizations could also invest upon tracking devices on GRL systems and other conservational projects by following green technology.

Future directions in the area of GRL and GT, in exploring the practicality of deeper analysis in GRL and GT and how the industry has employed these mechanisms in large, small and medium P&P companies, is a must . There is currently lack of studies and publications in addressing the GRL and its impact upon the P&P industries and how GT enables in enhancing the effectiveness of GRL practices. The amalgamation of GT in the P&P industry would deliver consistent and excellent services while ensuring the precision at every stage of the company through an increasingly green technological driven world.

Data Availability

The primary data employed in this research was gathered via a structured questionnaire developed to obtain insights on emergent green technologies and reverse logistics practices. All participants provided informed consent prior completing the questionnaire, thus voluntary participation and compliance with ethical research norms. The data could be obtained upon reasonable request from the corresponding author, contingent upon confidentiality agreements and institutional regulations.

Ethical Consideration

After explaining the study's purpose, scope, and confidentiality rules, each participant gave their informed consent. Participants were assured that their responses would remain confidential and be employed solely for academic purposes. No private information that could be used against someone was collected, and the study posed very little risk to participants.

ACKNOWLEDGEMENT

The authors express profound appreciation to all persons and organizations that contributed to this research initiative. Special gratitude is extended to the management and personnel of PrintCare Group for their collaboration and assistance during the data collection process. The authors express their sincere gratitude to all

participants for allocating their valuable time and providing honest observations despite their busy professional commitments. Their contributions were important in attaining the aims of this study.

Conflict Of Interest

The authors declare that there are no conflicts of interests related to the article title of. The study was conducted independently with no financial, or personnel relationships that might influence the outcome of the article in terms of data collection and findings. The results drawn are exclusively founded on the acquired data and the writers' scholarly assessment.

REFERENCES

1. Abdulla, F. A., & Al-Shareef, A. (2009). Roof rainwater harvesting systems for household water supply in Jordan. Desalination, 243(1–3), 195–207. https://doi.org/10.1016/j.desal.2008.05.013
2. Adesoga, N. T. O., Olaiya, N. O. P., Onuma, N. E. P., Ajayi, N. O. O., & Olagunju, N. O. D. (2024). Review of reverse logistics practices and their impact on supply chain sustainability. International Journal of Science and Research Archive, 12(2), 162–168. https://doi.org/10.30574/ijsra.2024.12.2.1216
3. Agrawal, S., & Singh, R. K. (2019). Analyzing disposition decisions for sustainable reverse logistics: Triple Bottom Line approach. Resources Conservation and Recycling, 150, 104448. https://doi.org/10.1016/j.resconrec.2019.104448
4. Akdoğan, M., & Coşkun, A. (2012). Drivers of reverse Logistics Activities: An Empirical investigation. Procedia - Social and Behavioral Sciences, 58, 1640–1649. https://doi.org/10.1016/j.sbspro.2012.09.1130
5. Alamandi, M. (2025). Sustainable Innovation Management: balancing economic growth and environmental responsibility. Sustainability, 17(10), 4362. https://doi.org/10.3390/su17104362
6. Ali, Y., Zeb, K., Babar, A. H. K., & Awan, M. A. (2021). Identification of critical factors for the implementation of reverse logistics in the manufacturing industry of Pakistan. Journal of Defense Analytics and Logistics, 5(1), 95–112. https://doi.org/10.1108/jdal-07-2020-0013
7. Alnoor, A., Eneizan, B., Makhamreh, H. Z., & Rahoma, I. A. (2019). The effect of reverse logistics on sustainable manufacturing. International Journal of Academic Research in Accounting Finance and Management Sciences, 9(1). https://doi.org/10.6007/ijarafms/v9-i1/5768
8. Amri, L., Farani, D., Ali, N., & Anwar, R. (2022). The Challenges and Strategies of Printing Industry. In irst Jakarta International Conference on Multidisciplinary Studies Towards Creative Industries. https://doi.org/10.4108/eai.16-11-2022.2326107
9. Annual Report – PrintCare. (2025). https://printcare.lk/annual-report/
10. Anser, M. K., Yousaf, Z., & Zaman, K. (2020). Green Technology acceptance model and green logistics operations: “To see which way the wind is blowing.” Frontiers in Sustainability, 1. https://doi.org/10.3389/frsus.2020.00003
11. Aryee, R., & Adaku, E. (2023). A review of current trends and future directions in reverse logistics research. Flexible Services and Manufacturing Journal, 36(2), 379–408. https://doi.org/10.1007/s10696023-09493-y
12. Awan, F. H., Dunnan, L., Jamil, K., & Gul, R. F. (2022). Stimulating environmental performance via green human resource management, green transformational leadership, and green innovation: a mediationmoderation model. Environmental Science and Pollution Research, 30(2), 2958–2976. https://doi.org/10.1007/s11356-022-22424-y
13. Aydemir, C., Yenidogan, S., & Dogan, T. (2023). Sustainability in print and packaging indsutry. Cellulose Chemistry and Technology, 57(5–6), 565–577.
14. Banihashemi, T. A., Fei, J., & Chen, P. S. (2019). Exploring the relationship between reverse logistics and sustainability performance. Modern Supply Chain Research and Applications, 1(1), 2–27. https://doi.org/10.1108/mscra-03-2019-0009
15. Batet, D., Vilaseca, F., Ramon, E., Esquivel, J. P., & Gabriel, G. (2023). Experimental overview for green printed electronics: inks, substrates, and printing techniques. Flexible and Printed Electronics, 8(2), 024001. https://doi.org/10.1088/2058-8585/acd8cc
16. Benitez, I. B., Singh, J. G., & Repedro, K. I. (2024). Variable renewable Energy Forecasting in the Philippines: A review (International Conference on Sustainable Energy: Energy Transition and Net-Zero Climate Future, pp. 1–6). https://doi.org/10.1109/icue63019.2024.10795644

17. Budak, A. (2020). Sustainable reverse logistics optimization with triple bottom line approach: An integration of disassembly line balancing. Journal of Cleaner Production, 270, 122475. https://doi.org/10.1016/j.jclepro.2020.122475
18. Daodu, L., & Bhaumik, A. (2024). Impacts of innovation and business analytics on the performance of the service sector in Nigeria. *Future of Business Administration*, *3*(1), 1–15. https://doi.org/10.33422/fba.v3i1.555
19. Dassanayake, A., Gamaarachchi, T., Ranathunge, I., & Karunarathna, N. (2024). The role of green supply chain practices on environmental sustainability. SLIIT Business Review, 2(2), 47–76. https://doi.org/10.54389/srmi6001
20. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319. https://doi.org/10.2307/249008
21. Dźwigoł, H. (2023). Case studies as a research method in management science. Scientific Papers of Silesian University of Technology Organization and Management Series, 2023(180). https://doi.org/10.29119/1641-3466.2023.180.6
22. Elkington, J. (1997). Cannibals with Forks: The Triple Bottom Line of 21st Century Business. Oxford.
23. Environmental Prices Handbook 2024: EU27 version. (2020). In CE Delft.
24. Eslamian, S., & Eslamian, F. (2021). Handbook of Water Harvesting and Conservation: Case studies and application Examples. Wiley-Blackwell.
25. Esmaeeli, A., & Sarrafzadeh, M. (2023). Reducing freshwater consumption in pulp and paper industries using pinch analysis and mathematical optimization. Journal of Water Process Engineering, 53, 103646. https://doi.org/10.1016/j.jwpe.2023.103646
26. Fancello, G., Mola, F., Frigau, L., Serra, P., Mancini, S., & Fadda, P. (2017). A new management scheme to support reverse logistics processes in the agrifood distribution sector. Transportation Research Procedia, 25, 695–715. https://doi.org/10.1016/j.trpro.2017.05.452
27. Ghisetti, C., & Quatraro, F. (2016). Green Technologies and Environmental productivity: A cross-sectoral analysis of direct and indirect effects in Italian regions. Ecological Economics, 132, 1–13. https://doi.org/10.1016/j.ecolecon.2016.10.003
28. Grande-Acosta, G. K., & Islas-Samperio, J. M. (2020). Boosting Energy Efficiency and Solar Energy inside the Residential, Commercial, and Public Services Sectors in Mexico. Energies, 13(21), 5601. https://doi.org/10.3390/en13215601
29. Haq, M., & Yasin, N. (2025). Qualitative, quantitative, and mixed methodology paradigms. Journal of Practical Studies in Education, 6(6), 15–29. https://doi.org/10.46809/jpse.v6i6.144
30. Hilkenmeier, F., Goller, M., & Schaper, N. (2021). The differential influence of learner factors and learning context on different professional learning activities. Vocations and Learning, 14(3), 411–438. https://doi.org/10.1007/s12186-021-09266-4
31. Iravani, A., Akbari, M. H., & Zohoori, M. (2017). Advantages and Disadvantages of green technology; goals, challenges and strengths. International Journal of Science and Engineering Applications, 6(9), 272– 284. https://doi.org/10.7753/ijsea0609.1005
32. Izah, S. C., Sylva, L., & Hait, M. (2023). Cronbach's Alpha: a cornerstone in ensuring reliability and validity in environmental health assessment. ES Energy & Environments. https://doi.org/10.30919/esee1057
33. Jayarathna, B., & Lasantha, S. (2018). Impact of GSCM practices on Financial Performance: Special reference to manufacturing companies in Sri Lanka. Kelaniya Journal of Management, 7(1), 40–52. https://doi.org/10.4038/kjm.v7i1.7553
34. Jiang, X., Han, J., Han, Q., Zhou, X., & Ma, J. (2015). Preparation and characteristics of paper-based biodegradable plastics. BioResources, 10(2). https://doi.org/10.15376/biores.10.2.2982-2994
35. Kasmani, J., Mahdavi, S., Alizadeh, A., Nemati, M., & Samariha, A. (2012). Physical properties and printability Characteristics of mechanical printing paper with LWC. bioresources.com, 8(3), 3646–3656.
36. Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a Research Paradigm and Its Implications for Social Work Research. Social Sciences, 8(9), 255. https://doi.org/10.3390/socsci8090255
37. Kennedy, I. (2022). Sample size determination in Test-Retest and Cronbach Alpha Reliability Estimates. British Journal of Contemporary Education, 2(1), 17–29. https://doi.org/10.52589/bjce-fy266hk9
38. Khan, S. A., Koç, M., & Al-Ghamdi, S. G. (2021). Sustainability assessment, potentials and challenges of 3D printed concrete structures: A systematic review for built environmental applications. Journal of Cleaner Production, 303, 127027. https://doi.org/10.1016/j.jclepro.2021.127027

39. Khor, K. S., & Udin, Z. M. (2013). Reverse logistics in Malaysia: Investigating the effect of green product design and resource commitment. Resources Conservation and Recycling, 81, 71–80. https://doi.org/10.1016/j.resconrec.2013.08.005
40. Klein, C. (2025). The scientific discussion of stakeholder involvement in social return on investment analysis? A systematic literature review. Evaluation and Program Planning, 113, 102678. https://doi.org/10.1016/j.evalprogplan.2025.102678
41. Kurbatova, S. M., Aisner, L. Y., & Mazurov, V. Y. (2020). Green logistics as an element of sustainable development. IOP Conference Series Earth and Environmental Science, 548(5), 052067. https://doi.org/10.1088/1755-1315/548/5/052067 Learning, C. (2019). Business Research Methods, 2nd Edition.
42. Liao, Y., Wu, W., & Pham, T. (2020). Examining the moderating effects of green marketing and green psychological benefits on customers' green attitude, value and purchase intention. Sustainability, 12(18), 7461. https://doi.org/10.3390/su12187461
43. Lipiak, J., & Salwin, M. (2019). The Improvement of Sustainability with Reference to the Printing Industry – Case Study. In Lecture notes in mechanical engineering (pp. 254–266). https://doi.org/10.1007/978-3030-17269-5_19
44. Ma, Y., Zhang, Q., & Yin, Q. (2021). Top management team faultlines, green technology innovation and firm financial performance. Journal of Environmental Management, 285, 112095. https://doi.org/10.1016/j.jenvman.2021.112095
45. Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955–967. https://doi.org/10.1016/j.respol.2012.02.013
46. Meherishi, L., Narayana, S. A., & Ranjani, K. (2019). Sustainable packaging for supply chain management in the circular economy: A review. Journal of Cleaner Production, 237, 117582. https://doi.org/10.1016/j.jclepro.2019.07.057
47. Mendes-Felipe, C., Cofano, R., Garcia, A., Sangermano, M., & Lanceros-Mendez, S. (2023). Photocurable 3D printed anisotropic electrically conductive materials based on bio-renewable composites. Additive Manufacturing, 78, 103867. https://doi.org/10.1016/j.addma.2023.103867
48. Nanayakkara, P. R., Jayalath, M. M., Thibbotuwawa, A., & Perera, H. N. (2022). A circular reverse logistics framework for handling e-commerce returns. Cleaner Logistics and Supply Chain, 5, 100080. https://doi.org/10.1016/j.clscn.2022.100080
49. Pathmanandakumar, V. (2024). From Policy to Practice: The Role of Sri Lankan Environmental Legislation on Sustainable Development Journey. Colombo Geographer, 2(1), 17–29.
50. Printing and packaging industry players weigh in on privatization plans | Enterprise. (2022, August 7). Enterprise.https://enterprise.press/industries/printing-packaging-industry-players-weigh-privatizationplans/
51. Printing, Prepress & Packaging Industry Trends – EDB Sri Lanka. (2025). Sri Lanka Export Development Board. https://www.srilankabusiness.com/printing-and-stationery/exporter-information/industrytrends.html
52. Printing, Prepress, and packaging services in Sri Lanka - EDB Sri Lanka. (2025). https://www.srilankabusiness.com/printing-prepress-packaging/ PrintWiki - the Free Encyclopedia of Print. (2023). https://printwiki.org/
53. Pushpamali, Agdas, D., & Rose, T. (2019a). A Review of Reverse Logistics: An Upstream Construction Supply Chain Perspective. Sustainability, 11(15), 1–14.
54. Pushpamali, N., Agdas, D., & Rose, T. M. (2019b). A Review of Reverse Logistics: An Upstream Construction Supply Chain perspective. Sustainability, 11(15), 4143. https://doi.org/10.3390/su11154143
55. Qualprint. (2025, July 14). Quality commercial printing - print that wins the moment. https://qualprint.com/
56. Rakhmangulov, A., Sladkowski, A., Osintsev, N., & Muravev, D. (2017). Green Logistics: Element of the Sustainable Development Concept. Part 1. Naše More, 64(3), 120–126. https://doi.org/10.17818/nm/2017/3.7
57. Sabturo, N. H., & Othman, S. A. (2023). Future of vegetable based ink-a review. AIP Conference Proceedings, 3013, 020010. https://doi.org/10.1063/5.0148506
58. Sabturo, N., & Othman, S. (2022). Preparation and characterisation of irradiated beans ink for offset lithography printing. Journal of Advanced Research in Fluid Mechanics and Thermal Sciences, 93(1), 167–185.

59. Samarasinhe, K., & Haijun, W. (2019). Challenges in implementing reverse logistics practices in Sri Lanka. International Journal of Information, Business and Management, 11(3), 113–124.
60. Saunders, M. N. K., Thornhill, A., & Lewis, P. (2019). Research methods for business students.
61. Schorr, A. (2023). The Technology Acceptance Model (TAM) and its Importance for Digitalization Research: A Review. Sciendo eBooks, 55–65. https://doi.org/10.2478/9788366675896-005
62. Shahzad, M., Qu, Y., Rehman, S. U., & Zafar, A. U. (2022a). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. Journal of Innovation & Knowledge, 7(4), 100231. https://doi.org/10.1016/j.jik.2022.100231
63. Shahzad, M., Qu, Y., Rehman, S. U., & Zafar, A. U. (2022b). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. Journal of Innovation & Knowledge, 7(4), 100231. https://doi.org/10.1016/j.jik.2022.100231
64. Shekarian, E. (2019). A review of factors affecting closed-loop supply chain models. Journal of Cleaner Production, 253, 119823. https://doi.org/10.1016/j.jclepro.2019.119823
65. Shi, X., Chen, X., Han, L., & Zhou, Z. (2023). RETRACTED ARTICLE: The mechanism and test of the impact of environmental regulation and technological innovation on high quality development. Journal of Combinatorial Optimization, 45(1). https://doi.org/10.1007/s10878-022-00984-6
66. Skare, M., & Soriano, D. R. (2021). How globalization is changing digital technology adoption: An international perspective. Journal of Innovation & Knowledge, 6(4), 222–233. https://doi.org/10.1016/j.jik.2021.04.001
67. Söderholm, P. (2020). The green economy transition: the challenges of technological change for sustainability. Sustainable Earth Reviews, 3(1). https://doi.org/10.1186/s42055-020-00029-y
68. Stratton, S. J. (2023). Population Sampling: Probability and Non-Probability Techniques. Prehospital and Disaster Medicine, 38(2), 147–148. https://doi.org/10.1017/s1049023x23000304
69. Sun, X., Yu, H., & Solvang, W. D. (2022). Towards the smart and sustainable transformation of Reverse Logistics 4.0: a conceptualization and research agenda. Environmental Science and Pollution Research, 29(46), 69275–69293. https://doi.org/10.1007/s11356-022-22473-3
70. Tan, L., Ge, Z., Zhou, X., Li, S., Li, X., & Tang, J. (2019). Conversion of coastal wetlands, riparian wetlands, and peatlands increases greenhouse gas emissions: A global meta-analysis. Global Change Biology, 26(3), 1638–1653. https://doi.org/10.1111/gcb.14933
71. The Environment - Doing things the right way. (2024, March 2). Park Lane. https://parklanepress.co.uk/environmental/
72. Tundys, B., & Wiśniewski, T. (2023). Triple bottom line aspects and sustainable supply chain resilience: A structural equation modelling approach. Frontiers in Environmental Science, 11. https://doi.org/10.3389/fenvs.2023.1161437
73. Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a research Agenda on interventions. Journal Compilation, 39(2), 273–315.
74. Wang, Q., Qu, J., Wang, B., Wang, P., & Yang, T. (2019a). Green technology innovation development in China in 1990–2015. The Science of the Total Environment, 696, 134008. https://doi.org/10.1016/j.scitotenv.2019.134008
75. Wang, Q., Qu, J., Wang, B., Wang, P., & Yang, T. (2019b). Green technology innovation development in China in 1990–2015. The Science of the Total Environment, 696, 134008. https://doi.org/10.1016/j.scitotenv.2019.134008
76. Wresearch. (2020). Sri Lanka Printing Market | Size, Share, Volume & Trends 2031. 6Wresearch. https://www.6wresearch.com/industry-report/sri-lanka-printing-market-2020-2026
77. Wu, H., Xu, L., Ren, S., Hao, Y., & Yan, G. (2020). How do energy consumption and environmental regulation affect carbon emissions in China? New evidence from a dynamic threshold panel model. Resources Policy, 67, 101678. https://doi.org/10.1016/j.resourpol.2020.101678
78. Yilmaz, U., Tutuş, A., & Sönmez, S. (2021). Investigation of color values of inkjet and laserjet prints on recycled papers. Journal of Graphic Engineering and Design, 12(3), 5–12. https://doi.org/10.24867/jged2021-3-005
79. Yoon, W., & Han, A. (2016). Does the potential for developing new technology lead to successful technology transfer commercialisation? The case of public R%D outputs in Korea. International Journal of Management Practice, 10(1), 93–108.
80. Zatrochová, M., Kuperová, M., & Golej, J. (2021). Analysis of the principles of reverse logistics in waste managment. Acta Logistica, 8(2), 95–106. https://doi.org/10.22306/al.v8i2.208

81. Zhang, W., Li, G., & Guo, F. (2022). Does carbon emissions trading promote green technology innovation in China? Applied Energy, 315, 119012. https://doi.org/10.1016/j.apenergy.2022.119012
82. Zheng, Q., Xie, B., Xu, Z., & Wu, H. (2023). A systematic printability study of direct ink writing towards high-resolution rapid manufacturing. International Journal of Extreme Manufacturing, 5(3), 035002. https://doi.org/10.1088/2631-7990/acd090