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RESEARCH ARTICLE OPEN ACCESS

Reverse Logistics and Sustainability in the Armor Division, Philippine Army

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Abstract:

This study investigates reverse logistics and sustainability in the Armor Division, Philippine Army, focusing on profiles of respondents in terms of age, sex, educational attainment, length of service, and unit assignment. The study aimed to assess their reverse logistics practices or disposition options and perspectives regarding the reuse, repair, remanufacture, recycling, and disposal of armor assets/materiel and to evaluate sustainability in terms of environmental, economic, and social aspects. The study used quantitative, descriptive, and correlational design, employing a researcher-made survey questionnaire using Google Forms and distributed to a sample population of 152 active logistics and maintenance military armor personnel. The data were analyzed using different statistical tools such as frequency, percentage, weighted mean, t-tests, one-way ANOVA, and Pearson's correlation through Statistical Package for the Social Sciences (SPSS) software. Findings revealed that logistics and maintenance personnel of the Armor Division, Philippine Army highly valued reverse logistics practices and support the adherence to standard operating procedures for maintaining armor assets. They emphasized the importance of preventive maintenance, recycling, and remanufacturing as essential to waste reduction and prolonging the lifespan of armor assets/materiel. The respondents also recognized the importance of a strong commitment to environmental sustainability, supporting energy conservation, responsible resource management, and advocating waste reduction. Economically, they also recognized the importance of repairs, preventive maintenance, and efficient resource management to minimize costs. Socially, they highlighted equality and fairness, health and safety, and community support as key principles in their roles. Based on the statistics result, there were significant differences in reverse logistics practices based on sex and length of service, particularly in the areas of recycling, reuse, and disposal. Likewise, there was a strong positive correlation between reverse logistics practices and sustainability, with very high correlations found in the environmental and economic aspects. The study concludes that reverse logistics plays a vital role in promoting sustainability within the Armor Division organization, with strong implications for improving both operational efficiency and environmental responsibility.

Keywords — **Reverse Logistics, Environmental Sustainability, Economic Sustainability, Social Sustainability**

I. INTRODUCTION

In today's world, where resource scarcity and environmental concerns like climate change and global warming are growing, it is crucial to focus on reducing waste and promoting the recovery and reuse of products and materials. This shift towards sustainable consumption is essential to support the needs of our expanding population. Waste reduction has become a global issue, not only for developed nations but also for developing countries. The concept of material cycles, which involves the continuous reuse of materials to reduce the need for new resources, is gaining traction as a viable alternative to the traditional linear economy. This

approach not only conserves natural resources but also minimizes environmental damage caused by waste disposal. Embracing reverse logistics and material cycles is vital for ensuring a sustainable future.

Reverse logistics, which involves managing the return and reuse of products, plays a key role in minimizing waste through practices such as reuse, repair, remanufacturing, recycling, and disposal.

In both commercial and military settings, reverse logistics helps reduce environmental impacts and supports sustainability by recovering value from returned items and byproducts. For example, the U.S. Army uses reverse logistics to manage materials returned from the battlefield, mitigating environmental effects and conserving resources.
The process also aids in reducing waste disposal costs and recovering value from equipment.

In the Philippine Army, reverse logistics is crucial for managing military supplies throughout their lifecycle, ensuring equipment is repaired, reused, or recycled. This process helps extend the life of military assets and conserves resources. During peacetime, reverse logistics prepares equipment for potential conflict, while in wartime, it supports the repair and maintenance of damaged equipment. Post-conflict, reverse logistics is essential for retrieving and properly disposing of equipment and materials, preventing environmental harm.

In the Armor Division, reverse logistics is particularly vital for ensuring that armored vehicles and other specialized equipment remain operational. Even with wear and tear, reverse logistics extends the lifespan of these assets, contributing to waste reduction and supporting sustainability efforts within the Armed Forces of the Philippines (AFP). The shift in military sustainability towards considering environmental, social, and economic factors reflects broader global concerns. The Philippine government's National Security Policy 2023-2028 emphasizes the need to mitigate the effects of climate change and encourages all agencies, including the AFP, to preserve resources for future generations.

Thus, understanding reverse logistics and its role in sustainability within the Philippine Army, particularly in the Armor Division, is essential. This research aims to explore the division's reverse logistics practices, including reuse, repair, remanufacturing, recycling, and disposal, and assess their impact on environmental, economic, and social sustainability. By examining these practices, the study will highlight their importance in minimizing waste, preserving resources, and addressing sustainability concerns within the military context.

Objectives

The research aims to explore the reverse logistics disposition options in the Armor Division, Philippine Army in terms of reuse; repair; remanufacture; recycling; and disposal; and its relationship to sustainability in terms of environmental; economic; and social aspects. Also, this is to alleviate the effects of waste on the environment, economy, and society and to create a proposed policy regarding reverse logistics and sustainability. Likewise, the researcher intends to conduct this study to address the Armor Division's problems related to the maintenance of materiel, such as armored vehicles, weapons, and other specialized machines to prolong its lifespan and mitigate the effects of waste disposal.

II. MATERIALS AND METHOD

Research Design

The researcher employed the quantitative method and used descriptive and correlational design to explore the reverse logistics practices and sustainability of the Armor Division Philippine Army. Reverse Logistics practices in terms of: reuse; repair; remanufacture; recycle; and disposal, and sustainability in terms of; Environment, Economic and Social aspects. This method and design were used to gather data from the respondents through the conduct of surveys using researcher made questionnaires. Quantitative method of research is the process of gathering and evaluating numerical data. Finding trends and averages, generating hypotheses, examining causality, and extrapolating findings to larger populations are all possible with this method (Bhandari 2020).

A descriptive correlational design is a research design that examines the relationship between variables without changing them. It seeks to answer the question, "How are things related?" Data for descriptive and correlational research is typically collected through surveys or observational approaches. Surveys are effective for acquiring

information about people's experiences, beliefs, and attitudes, whereas observation entails seeing participants in a variety of scenarios, such as video recordings or the experience sampling method (ESM). Descriptive studies describe the features of a sample without a comparable group and generate hypotheses; however, they cannot determine associations or test hypotheses. In contrast, correlational investigations investigate the relationship between variables.

Respondents of the study

The respondents for this study are active military personnel from the Armor Division of the Philippine Army, specifically those assigned to the logistics section/department and the Armor Maintenance Battalion. The total population consists of 250 eligible active personnel. To determine the sample size, the researcher used the Raosoft Sample Size Calculator, which yielded a sample size of 152 respondents based on a 5% margin of error and a 95% confidence level. These 152 individuals are eligible to participate in the survey. For sampling, the researcher employed simple random sampling to ensure that every eligible individual had an equal chance of being selected. The survey was administered through Google Forms, where the selected respondents were invited to complete the questionnaire.

Data Gathering Instrument

The researcher utilized a survey tool that is a researcher-made questionnaire designed to measure and explore reverse logistics practices and sustainability. Reverse Logistics in terms of reuse; repair; recycle; and disposal and sustainability in terms of environment, economics and social aspects. It has three parts, the first part is the survey about the demographic profile of the respondents such as age, sex, length of service, educational attainment, and unit assignment. The second part is the survey about reverse logistics and the third part is about sustainability. The researcher-made questionnaire was validated by the research adviser and experts in the field of research to determine its clarity, relevance and appropriateness. The validated questionnaire was run through pilot testing to ensure reliability. Permission to conduct the survey on the target respondents also obtained and ensured the confidentiality of all the data gathered. A seven-point Likert Scale was utilized to measure the respondent's level of agreement for the researcher to gain a deeper understanding and to interpret the response of the chosen population. Below is the scoring and interpretation used for the questionnaire.

TABLE I
SCORING AND INTERPRETATION

Options	Scale Range	Verbal Interpretation
7	6.50 – 7.00	Strongly Agree
6	5.50 – 6.49	Agree
5	4.50 – 5.49	Slightly Agree
4	3.50 – 3.49	Neutral
3	2.50 – 3.49	Slightly Disagree
2	1.50 – 2.49	Disagree
1	1.00 – 1.49	Strongly Disagree

Data Gathering Procedure

The researcher followed the step by step process in gathering the data needed in this study. First is the asking of permission from the units/department involved to conduct the survey by giving a letter request approved by the thesis adviser. Approval of the different unit commanders were the signal of the distribution of the formulated questionnaire through an online platform. Ample time was given to the respondents to answer all the questionnaires. The researcher monitored all the distributed questionnaires and collected and consolidated all the gathered data and information. Likewise, the utmost confidentiality of all the gathered data was assured to the respondents. The gathered data was tallied and directly forwarded to statisticians for statistical treatment. The result was interpreted and analyzed by the researcher to determine the possible recommendations based on the objective of the study.

Statistical Treatment of Data

To come up with an accurate and reliable result the researcher with the aid of thesis adviser,

statistician and other expert in the field of research the following statistical tools were used: Relative frequency, percentage, weighted mean, T-test, analysis of variance, and Pearson's r test of correlation.

III. RESULTS AND DISCUSSION

This consists of the data of the study which was presented, analyzed, and interpreted by the researcher. The data were derived from the answers to the questionnaire issued by the researchers to the respondents. It also included the presentation of the data in tabular form along with the corresponding interpretation.

Profile of the Respondents

The respondents are active military logistics and maintenance personnel assigned to the different units of the Armor Division, Philippine Army composed of 152. The factors considered in their profile are age, sex, educational attainment, length of service, and unit assignment.

TABLE II
AGE OF THE RESPONDENTS RANGED FROM 18-55 YEARS OLD

Age	Frequency	Percentage
18-25 yrs old	10	6.58
26-40 yrs old	105	69.08
41-55 yrs old	37	24.34
Total	**152**	**100**

The data shows that the majority, 105 (69.08%) of the respondents belong to the age group of 26 to 40 years old. Likewise, 37 (24.34%) of them belong to 41 to 55 years old. The lowest age range is from 18 to 25 years old with a total of 10 (6.58%).

TABLE III
SEX OF THE RESPONDENTS

Sex	Frequency	Percentage
Male	140	92.11
Female	12	7.89
Total	**152**	**100**

The data reveals that the majority of respondents, 140 (92.11%), are male, while 12 (7.89%) are female, out of a total of 152 respondents. This reflects the predominant male representation in the military. However, it also highlights that the organization remains inclusive, offering opportunities for women to contribute to and be part of this traditionally male-dominated institution.

TABLE IV
EDUCTIONAL ATTAINMENT OF THE RESPONDENTS

Educational Attainment	Frequency	Percentage
High School Graduate	86	56.58
College Graduate	66	43.42
Total	**152**	**100**

The data shows that the majority of respondents, 86 (56.58%), are high school graduates, while 66 (43.42%) have completed college. These figures are based on a total of 152 respondents from the logistics and maintenance personnel of the Armor Division.

TABLE V
LENGTH OF SERVICE OF THE RESPONDENTS

Length of Service	Frequency	Percentage
5yrs and below	40	26.32
6 to 10 yrs	32	21.05
11 to 15 yrs	31	20.39
16 to 20 yrs	15	9.87
More than 20 yrs	34	22.37
Total	**152**	**100**

The table above presents the distribution of respondents by length of service, showing that the highest category is 5 years or less, with 40 respondents, representing 26.32%. This is followed by those with more than 20 years of service, totaling 34 respondents (22.37%). The third category is 6 to 10 years of service, with 32 respondents (21.05%), followed by 11 to 15 years, which includes 31 respondents (20.39%). The smallest group consists of 15 respondents in the 16 to 20 years of service category, accounting for 9.87%.

TABLE VI

UNIT ASSIGNMENT OF THE RESPONDENTS

Unit Assignment	Frequency	Percentage
Mechanized	20	13.16
Cavalry	17	11.18
Tank	6	3.95
AmBn	109	71.71
Total	**152**	**100**

The table above displays the results of the respondents' unit assignments, indicating that most were from the Armor Maintenance Battalion, comprising one hundred nine (109) individuals or 71.71% of the total sample population. This was followed by the Mechanized units with twenty (20) respondents (13.16%), the Cavalry units with seventeen (17) respondents (11.18%), and the Tank Battalion unit with six (6) respondents, representing 3.95%.

Assessment on Reverse Logistics Practices

To gain a comprehensive understanding of the respondents' perspectives on reverse logistics practices, a series of questions were posed covering key aspects such as reuse, repair, remanufacture, recycling, and disposal.

TABLE VII
ASSESSMENT ON REVERSE LOGISTICS PRACTICES IN TERMS OF REUSE

Reuse ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
conduct inspection of armor assets/materiel to check its serviceability every week.	6.30	Agree
conduct cleaning and maintenance of all armor assets/materiel to prolong its lifespan every week.	6.38	Agree
Determine armor assets/materiel that are subject for exchange property every year.	6.26	Agree
determine armor assets/materiel that are subject for donation for scientific and educational purposes every year.	5.94	Agree
identify armor assets/materiel which are intended for redistribution to other newly created units every six (6) months.	6.11	Agree
determine which armor assets/materiel that are still serviceable and suitable for operation every month.	6.41	Agree
transfer property accountability of armor assets/materiel to the receiving unit.	6.46	Agree
encourage our peers to maintain the serviceability status of armor assets/materiel for further use and maximize its value.	6.59	Strongly Agree
check the completeness of parts of armor assets/materiel before the turnover of property accountability to the receiving unit.	6.59	Strongly Agree
follow the standing operating procedure in maintaining of all armor assets/materiel of the unit.	6.61	Strongly Agree
Composite Mean	**6.36**	**Agree**

The result indicates that reuse is being practiced and valued disposition option in reverse logistics within the organization. This is reflected in Table 8, which shows a composite mean of 6.36. Logistics and maintenance personnel across the various units of the Armor Division highly practice adherence to standard operating procedures for maintaining all armor assets and materials, which is crucial for effective reuse, with a mean of 6.61. This was followed by checking the completeness of parts of armor assets/materiel before the turnover of property accountability to the receiving unit and encouraging their peers to maintain the serviceability status of armor assets/materiel for further use and maximize its value with the mean of 6.59 respectively. However, determining armor assets/materiel that are subject for donation for scientific and educational purposes every year got the lowest mean of 5.94.

TABLE VIII
ASSESSMENT ON REVERSE LOGISTICS PRACTICES IN TERMS OF REPAIR

Repair ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
identify defects of malfunctioning armor assets/materiel of the unit every week.	6.35	Agree
assess the repair costs of malfunctioning armor assets/materiel.	6.41	Agree
disassemble at product level the malfunctioning armor assets/materiel.	6.28	Agree
restore immediately a damaged armor assets/materiel to maintain a working condition if spare parts are available.	6.48	Agree
replace broken parts of armor asset's/materiel to prolong its life cycle or extend its lifespan.	6.51	Strongly Agree
encourage our colleagues to conduct preventive maintenance check and servicing (PMCS) of armor assets/materiel to avoid total malfunction every week.	6.61	Strongly Agree

replace damaged spare parts or elements of armor assets/materiel that has reached its extended lifespan.	6.51	Strongly Agree
fix the damaged armor assets/materiel immediately to restore its functions and operation.	6.57	Strongly Agree
fix damaged items or spare parts of armor assets/materiel to save money and avoid disposal.	6.47	Agree
adhere in the standard operating procedure in the conduct of repair and maintenance of all armor assets/materiel of the unit.	6.54	Strongly Agree
Composite Mean	**6.47**	**Agree**

As shown in Table 8, repair is a vital option in reverse logistics, as reflected in the responses from the Armor Division's logistics and maintenance personnel with a composite mean of 6.47. They strongly agree on the importance of encouraging their colleagues to perform PMCS to prevent total malfunctions of armor assets and materials, as demonstrated by a weighted mean of 6.61. This was followed by fixing the damaged armor assets/materiel immediately to restore its functions and operation with a computed mean of 6.57 and then adhering to the standard operating procedure in the conduct of repair and maintenance of all armor assets/materiel of the unit with a mean of 6.54. However, the disassemble at the product level the malfunctioning armor assets/materiel got a lowest score mean of 6.28.

TABLE IX
ASSESSMENT ON REVERSE LOGISTICS PRACTICES IN TERMS OF REMANUFACTURE

Remanufacture ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
recover materials from high value products like armor assets/materiel of the unit.	6.45	Agree
replace obsolete or faulty parts with new or refurbished ones while preserving the original product's identity and functionality.	6.39	Agree
refurbish/recondition products, armor assets/materiel to extend their lifecycle or prolong its lifespan.	6.53	Strongly Agree
determine which materiel is subject for refurbishment, prototype, or fabrication every week.	6.32	Agree
restore/refurbish the functionality of a part of armor assets/materiel to manage waste from defective items and save resources.	6.45	Agree
cannibalize/recover interchangeable parts, reusable parts or materials of armor assets to have alternative and cost-effective new source of spare parts.		
rebuild/fabricate items of armor assets/materiel or spare parts to lower the operational cost and minimize energy, resource and raw material expenses.	6.47	Agree
remanufacture/fabricate items, armor assets/materiel or spare parts to avoid delay in the operation.	6.37	Agree
remanufacture/fabricate items, armor assets/materiel or spare parts if the new product are not commercially available.	6.41	Agree
adhere to the standing operating procedure in the implementation of materiel development in the aspects of fabrication, prototyping, or remanufacturing of the Philippine Army.	6.39	Agree
Composite Mean	**6.41**	**Agree**

Table 9 shows that respondents generally view remanufacturing as a key element of reverse logistics practices, with a composite mean of 6.41. They strongly agree on the importance of refurbishing or reconditioning armor assets to extend their lifespan, reflected in the highest mean score of 6.53. This is closely followed by the need to rebuild or fabricate armor parts to reduce operational costs and minimize the use of energy, raw materials, and resources, with a mean score of 6.47. The third-highest score, 6.45, is given to restoring the functionality of parts to manage waste and recover materials from high-value assets. However, cannibalizing parts for reusable components received the lowest mean score of 6.27.

TABLE X
ASSESSMENT ON REVERSE LOGISTICS PRACTICES IN TERMS OF RECYCLING

Recycling ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
focus on material recovery from low-value products to extract reusable materials from used products, armor assets and materiel.	6.22	Agree
recover used products of armor assets/materiel and converting them into recycled products.	6.28	Agree
recover items or materials, organize and separate into their categories as part of waste management program of the institution.	6.32	Agree
cannibalize/remove usable parts from unserviceable equipment to	6.28	Agree

restore other equipment to serviceability.		
recover used products/materiel to minimize the accumulation of wastes in the junkyard.	6.38	Agree
recover used products, armor assets/materiel to maintain inventory and to avoid unnecessary use of resources.	6.38	Agree
recover unserviceable products, armor assets/materiel or property that can no longer be repaired and be subjected for appraisal or junk value.	6.26	Agree
recover unserviceable products, armor assets/materiel or property that can no longer be repaired and be made available for public bidding.	6.16	Agree
recover used products, armor assets/materiel to generate additional funds for the institution	6.10	Agree
adhere to the AFP's standing operating procedure in the implementation of materiel recovery of unserviceable products, armor assets/materiel or property.	6.33	Agree
Composite Mean	**6.27**	**Agree**

Table 10 shows that logistics and maintenance personnel in the Armor Division of the Philippine Army generally recognize recycling as an important practice within reverse logistics, as reflected in a composite mean of 6.27. The highest mean score of 6.38 was given to recovering used products or materiel to reduce waste accumulation and to maintain inventory, preventing unnecessary resource use. This was followed by adhering to the AFP's standing operating procedures for recovering unserviceable products, armor assets, or property, with a mean score of 6.33. In contrast, recovering used products or armor assets to generate additional funds received the lowest mean of 6.10, followed by recovering unserviceable items for public bidding (mean of 6.16). Lastly, focusing on material recovery from low-value products to extract reusable materials ranked third-to-last with a mean of 6.22.

TABLE XI
ASSESSMENT ON REVERSE LOGISTICS PRACTICES IN TERMS OF DISPOSAL

Disposal *As logistics and maintenance personnel of our organization, I/we…*	**Mean**	**Interpretation**
identify products, armor assets/materiel which are cannot be sold or reused and be subjected for incineration or landfill.	6.18	Agree
observe the process of getting rid of an armor assets/materiel that are considered excessive, harmful, or outdated in an environmentally safe manner.	6.30	Agree
determine the materials that are obsolete or cannot be useful and appraised for junk value.	6.20	Agree
conduct thorough inspection of hazardous materials or components that cannot be recycled and be disposed of in accordance with environmental rules to reduce their environmental impact	6.30	Agree
determine properties, armor assets/materiel which are unserviceable and deemed unsafe or pose a risk to public health.	6.35	Agree
evaluate each armor asset/materiel and property to determine its condition and usefulness.	6.38	Agree
determine obsolete properties, armor assets/materiel that may no longer be useful because they are outdated or no longer meet the needs of the unit.	6.38	Agree
determine excess properties that may be surplus to requirements and no longer needed for the operations.	6.34	Agree
identify and dispose excess and outdated properties, armor assets/materiel to ensure that the unit is making best possible use of its resources.	6.32	Agree
apply and consider the complex and detailed process of disposing government properties in accordance with the AFP Handbook for Disposal.	6.32	Agree
Composite Mean	**6.31**	**Agree**

Table 11 indicates that disposal, as the final option in reverse logistics practices, received a consolidated response from the participants, with a composite mean of 6.31. Evaluate each armor asset/materiel and property to determine its condition and usefulness and determine obsolete properties, armor assets/materiel that may no longer be useful because they are outdated or no longer meet the needs of the unit got the highest mean score of 6.38 for both. It was followed by a mean score of 6.35 in determining properties armor assets/materiel that are unserviceable and deemed unsafe or pose a risk to public health. On the other hand, identifying products, armor assets/materiel which are cannot be sold or reused and be subjected for incineration or

landfill got the lowest mean score of 6.18. Then, it was followed by determining the materials that are obsolete or cannot be useful and appraised for junk value with a mean of 6.20. And the third to the last was observing the process of getting rid of armor assets/materiel that are considered excessive, harmful, or outdated in an environmentally safe manner with a mean score of 6.30.

Assessment on the Sustainability

TABLE XII
ASSESSMENT ON SUSTAINABILITY IN TERMS OF THE ENVIRONMENT

Environment ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
reduce the amount of waste by 10% every year.	6.20	Agree
adhere on the policy of waste segregation and recycling	6.33	Agree
implement proper disposal of used and hazardous defense materiel.	6.39	Agree
conduct consistent information drives to protect environment every quarter.	6.39	Agree
reduce carbon emission/footprint by conducting preventive maintenance and servicing of all vehicles of the unit every week.	6.43	Agree
encourage responsible resource management which reduces wasteful spending.	6.41	Agree
conduct tree planting activities every quarter.	6.41	Agree
conduct clean-up drive every month.	6.39	Agree
continue to pursue to mitigate and adapt to climate change by continuous education.	6.44	Agree
adhere to the policy of the unit in ENERCON	6.47	Agree
Composite Mean	**6.39**	**Agree**

The table above indicates that logistics and maintenance personnel from the Armor Division agree that environmental sustainability is a key consideration, reflected in their responses with an average composite mean of 6.39. They strongly support the policy of energy conservation, which received the highest weighted mean of 6.47 among the survey questions. Participants also reached an average weighted mean of 6.44, emphasizing the importance of ongoing education to mitigate and adapt to climate change. The third one is reducing carbon emission/footprint by conducting preventive maintenance and servicing of all vehicles of the unit every week, with a mean score of 6.43. On the other hand, the lowest mean of 6.20 was reducing the amount of waste by 10% every year. Followed by adhering on the policy of waste segregation and recycling with a mean score of 6.33, and lastly, conducting consistent information drives to protect the environment every quarter with a weighted mean of 6.39.

TABLE XIII
ASSESSMENT ON SUSTAINABILITY IN TERMS OF THE ECONOMIC

Economic ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
promote economic growth and prevent exploitation of natural resources.	6.43	Agree
recapture value from products, items or materiel practices to help produce additional source of funds for the unit.	6.32	Agree
practice proper utilization of resources in the conduct of operation.	6.50	Strongly Agree
conduct repair to prolong the lifespan of materiel and prevent costly replacement.	6.52	Strongly Agree
conduct fabrication/refurbishment of materiel /armor assets to reduce cost in purchasing new materials.	6.47	Agree
conduct proper inventory of materiel to minimize cost every month.	6.48	Agree
should conduct regular preventive maintenance check and servicing of armor assets/materiel to avoid early damaged of its parts and prevent purchasing cost	6.47	Agree
involve in training to enhance labor productivity to meet customer/enduser demand and satisfaction.	6.40	Agree
educate ourself in the aspects of economic sustainability for the good of the institution.	6.44	Agree
adhere to the standing operating procedure in the conduct proper waste disposal and energy consumption.	6.44	Agree
Composite Mean	**6.45**	**Agree**

In the assessment of sustainability from an economic perspective, a composite mean of 6.45

shows that the majority of respondents have a positive outlook on economic sustainability. Logistics and maintenance personnel strongly agree that conducting repairs to extend the lifespan of materials helps avoid costly replacements, reflected in the highest weighted mean of 6.52. They also emphasize the importance of properly utilizing resources during operations, which garnered a weighted mean of 6.50. Also, the conduct proper inventory of materiel to minimize cost every month got a mean score of 6.48. On the other hand, recapturing value from products, items or materiel practices to help produce additional source of funds for the unit got the lowest mean score of 6.32. It was followed by a mean of 6.40 in involvement in training to enhance labor productivity to meet customer/end-user demand and satisfaction. And lastly, promote economic growth and prevent exploitation of natural resources with a weighted mean of 6.43.

TABLE XIV
ASSESSMENT ON SUSTAINABILITY IN TERMS OF THE SOCIAL ASPECTS

Social ***As logistics and maintenance personnel of our organization, I/we…***	**Mean**	**Interpretation**
involve in recycling, waste management, and product refurbishment training which boosts my/our skills and career opportunities.	6.43	Agree
ensure that hazardous materials and wastes are disposed to reduce environmental pollution and to protect the community health.	6.45	Agree
encourage participation in the conduct of educational initiatives that raise awareness about sustainability.	6.49	Agree
support the program and activities that promotes engagement with local communities to manage waste and recycling.	6.49	Agree
ensure that personnel treated fairly and work under safe conditions.	6.43	Agree
maintain the serviceability status of armor assets/materiel and equipment to avoid untoward incidents.	6.53	Strongly Agree
adhere in the existing standard operating procedure of the institution to prevent accident and ensure safety of personnel.	6.52	Strongly Agree
received fair treatment and equal opportunity from the institution in the performance of my/our job as armor personnel.	6.51	Strongly Agree
received proper wages and benefits from the institution where I/we belong in the conduct of operation.	6.43	Agree
respect the rights of my superiors and my subordinates in accordance with the rules and regulations of the institutions in the conduct of operation.	6.57	Strongly Agree
Composite Mean	**6.48**	**Agree**

Table 14 illustrates the perceptions of logistic and maintenance personnel in the Armor Division of the Philippine Army regarding sustainability in the social aspects. The majority expressed agreement, as reflected in a composite average mean score of 6.48. Notably, the respect for the rights of both superiors and subordinates, in alignment with institutional rules and regulations during operations, received the highest score of 6.57, which is interpreted as "strongly agree." Furthermore, respondents also strongly agreed on the importance of maintaining the serviceability of armor assets and equipment to prevent incidents with a mean of 6.53 and it was followed by adhering to established standard operating procedures to ensure personnel safety and receiving fair treatment and equal opportunities in their roles as armor personnel with a weighted mean of 6.52. However, ensuring that personnel are treated fairly and work under safe conditions received the lowest mean of 6.43. same with receiving proper wages and benefits from the institution where they belong in the conduct of operation and involvement in recycling, waste management, and product refurbishment training which boosts my/our skills and career opportunities are all have the same mean.

Significant difference on the assessed reverse logistics and sustainability when grouped according to profile

TABLE XV
ASSESSED REVERSE LOGISTICS AND SUSTAINABILITY WHEN GROUPED ACCORDING TO SEX

Variables	**Sex**	**Mean**	**Computed t-value**	**p-value**	**Decision on Ho**	**Interpreta-tion**
Reuse	Male	6.36	-0.015	0.988	Failed to Reject	Not Significant
	Female	6.37				
Repair	Male	6.48	0.083	0.934	Failed to Reject	Not Significant
	Female	6.46				
Remanufacture	Male	6.41	0.161	0.872	Failed to Reject	Not Significant
	Female	6.38				
Recycling	Male	6.31	2.092	0.038	Reject	Significant
	Female	5.84				
Disposal	Male	6.30	-0.290	0.773	Failed to Reject	Not Significant
	Female	6.37				
Environment	Male	6.38	-0.489	0.626	Failed to Reject	Not Significant
	Female	6.48				
Economic	Male	6.44	-0.534	0.594	Failed to Reject	Not Significant
	Female	6.55				
Social Aspect	Male	6.48	-0.551	0.583	Failed to Reject	Not Significant
	Female	6.59				

Social Aspect	0.818	<0.001	Reject	Very High Positive Correlation

Based on the table above and the statistical results, there were no significant differences in the assessed reverse logistics and sustainability when grouped according to sex, except in the case of recycling. This was shown using an independent t-test with a 95% confidence interval, a t-value of2.092, and a p-value of 0.038, which is less than 0.05. This indicates a significant difference regarding reverse logistics practices in terms of recycling and sustainability.

Significant relationship between reverse logistics and sustainability

TABLE XVI
REVERSE LOGISTICS PRACTICES IN TERMS OF REUSE AND ITS RELATIONSHIP TO SUSTAINABILITY IN TERMS OF ENVIRONMENTAL, ECONOMIC, AND SOCIAL ASPECTS

Reuse VS	Pearson's r	p-value	Decision on H_o	Interpretation
Environment	0.725	<0.001	Reject	High Positive Correlation
Economic	0.732	<0.001	Reject	High Positive Correlation
Social Aspect	0.719	<0.001	Reject	High Positive Correlation

The statistical result of the relationship between reverse logistics practices (in terms of reuse) and sustainability in terms of (environmental, economic, and social) with Pearson's r correlation result for environment-0.725, economic-0.732, social-0.719 and a p-value of <0.001 that also resulted to the rejection of the Ho indicates high positive correlation between the two key variables as shown in Table 16.

TABLE XVII
REVERSE LOGISTICS PRACTICES IN TERMS OF REPAIR AND ITS RELATIONSHIP TO SUSTAINABILITY IN TERMS OF ENVIRONMENTAL, ECONOMIC, AND SOCIAL ASPECTS.

Repair VS	Pearson's r	p-value	Decision on H_o	Interpretation
Environment	0.810	<0.001	Reject	Very High Positive Correlation
Economic	0.824	<0.001	Reject	Very High Positive Correlation

The table above presents the statistical results showing the relationship between reverse logistics practices, specifically repair, and sustainability across the environmental, economic, and social aspects with Pearson's r correlation result for environment-0.810, economic-0.824, social-0.818 and a p-value of <0.001, these results lead to the rejection of the null hypothesis (Ho), indicating a very high positive correlation between reverse logistics practices (repair) and sustainability across all three aspects.

TABLE XVIII
REVERSE LOGISTICS PRACTICES IN TERMS OF REMANUFACTURE AND ITS RELATIONSHIP TO SUSTAINABILITY IN TERMS OF ENVIRONMENTAL, ECONOMIC, AND SOCIAL ASPECTS.

Remanufacture VS	Pearson's r	p-value	Decision on H_o	Interpretation
Environment	0.764	<0.001	Reject	High Positive Correlation
Economic	0.820	<0.001	Reject	Very High Positive Correlation
Social Aspect	0.748	<0.001	Reject	High Positive Correlation

The table above presents the statistical results showing the relationship between reverse logistics practices, specifically remanufacture, and sustainability across the environmental, economic, and social dimensions. The Pearson's r correlation values are as follows: environment-0.764, economic-0.820, social0.748. With a p-value of <0.001, these results lead to the rejection of the null hypothesis (Ho), indicating a very high positive correlation between remanufacture as a reverse logistics practice and economic sustainability. Additionally, strong positive correlations were also observed in both the environmental and social aspects, further highlighting the significant impact of remanufacture on sustainability across all three areas.

TABLE XIX
REVERSE LOGISTICS PRACTICES IN TERMS OF RECYCLING AND ITS RELATIONSHIP TO SUSTAINABILITY IN TERMS OF ENVIRONMENTAL, ECONOMIC, AND SOCIAL ASPECTS.

Recycling VS	Pearson's r	p-value	Decision on H_o	Interpretation
Environment	0.687	<0.001	Reject	High Positive Correlation
Economic	0.731	<0.001	Reject	High Positive Correlation
Social Aspect	0.688	<0.001	Reject	High Positive Correlation

The table above illustrates the statistical results showing the relationship between reverse logistics practices, specifically recycling, and sustainability across the environmental, economic, and social dimensions. The Pearson's r correlation values are as follows: environment-0.687, economic-0.731, social-0.688. With a p-value of <0.001, these results lead to the rejection of the null hypothesis (Ho), indicating a high positive correlation between recycling as one of the reverse logistics practices and economic sustainability. Additionally, high positive correlations were also observed in these three aspects, further highlighting the significant impact of recycling on sustainability across all three areas.

TABLE XX
REVERSE LOGISTICS PRACTICES IN TERMS OF DISPOSAL AND ITS RELATIONSHIP TO SUSTAINABILITY IN TERMS OF ENVIRONMENTAL, ECONOMIC, AND SOCIAL ASPECTS.

Disposal VS	Pearson's r	p-value	Decision on H_o	Interpretation
Environment	0.804	<0.001	Reject	Very High Positive Correlation
Economic	0.859	<0.001	Reject	Very High Positive Correlation
Social Aspect	0.807	<0.001	Reject	Very High Positive Correlation

The statistical results indicate the relationship between reverse logistics practices, specifically disposal, and sustainability across the environmental, economic, and social dimensions. The Pearson's r correlation values are as follows: environment-0.804, economic-0.859, social-0.807. With a p-value of <0.001, these results lead to the rejection of the null hypothesis (Ho), indicating a very high positive correlation between disposal as one of the reverse logistics practices and economic sustainability. Additionally, very high positive correlations were also observed in these three aspects, further highlighting the significant impact of disposal on sustainability across all three areas.

IV. CONCLUSIONS

The study reveals that the respondents from the Armor Division of the Philippine Army are predominantly middle-aged males (92.11%), with most aged 26-40 (69.08%). A majority are college graduates (56.58%), and service length is varied. The Armor Maintenance Battalion is the largest group (71.71%). The division places a strong emphasis on reverse logistics practices such as reuse, repair, remanufacturing, recycling, and disposal, prioritizing reuse to extend asset life. While repair and remanufacturing are seen as essential for cost reduction and resource conservation, practices like donation and recycling for financial gain receive less focus. The division is committed to sustainability, with efforts in environmental conservation, resource efficiency, and personnel welfare, though areas like waste reduction and recycling could be improved. Demographic factors like age and education do not significantly affect sustainability views, but gender and length of service influence perspectives on recycling, reuse, and disposal. Overall, reverse logistics practices are strongly linked to sustainability, supporting environmental stewardship, economic efficiency, and social responsibility, though there is room for growth in areas like recycling and personnel well-being.

V. RECOMMENDATIONS

Based on the findings, it is recommended that the Armor Division of the Philippine Army adopt a more structured policy to strengthen its reverse logistics and sustainability practices. The policy should enhance reuse, repair, remanufacturing, recycling, and disposal, with a focus on improving donation and redistribution of surplus equipment to educational or research institutions. This would help extend asset lifecycles and create external partnerships. Additionally, the policy should aim to improve financial recovery from recycling, particularly lowvalue materials, by targeting valuable materials from scrap and partnering with

recycling companies. To support preventive maintenance, the policy should include regular training on repair techniques and systematic upkeep, along with cost assessments for repairs. Furthermore, the policy should enhance remanufacturing processes, focusing on internal capacity and resource efficiency. Social sustainability should also be emphasized by ensuring fair treatment, safety, and equitable compensation for personnel alongside initiatives for improved working conditions. Finally, the policy should recognize demographic factors like gender and length of service by offering tailored training programs. Overall, a comprehensive policy addressing these areas will optimize operational efficiency and contribute to the Armor Division's long-term environmental, economic, and social sustainability goals.

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