UNIVERSITY OF EDUCATION, WINNEBA

SCRAP METAL ART: AN INSTRUMENT FOR PROMOTING ENVIRONMENTAL SANITATION

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DECLARATION

Student's Declaration

I, Evans Kwadwo Donkor declare that this thesis (with exception of quotations and references contained in published works which have all been identified and duly acknowledged), is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature …….. *Date* ……...……

Supervisors' Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis as laid down by the University of Education, Winneba.

Supervisor: Dr. Patrique deGraft-Yankson

Signature …….. *Date* ……...……

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DKE

DEDICATION

This work is dedicated to my wonderful family, Marian Ghapson, Willie Evans, Dorcas Wilson, Grace Aba Wilson and to my dearest Francisca Aba Prah.

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LIST OF ACRONYMS

ATSDR	(US) Agency for Toxic Substances and Disease Registry
DESSAP	District Environmental Sanitation Strategy and Action Plan
E.g.	Example
EPA	Environmental Protection Agency
EPAQS	Expect Panel on Air Quality Standards
ET AL	And Others
GMSSPMU	Ghana Mining Sector Support Programme Management Unit
IPCS	International Programme for Chemical Safety
IARC	International Agency for Research on Cancer
MIG	Metal Inert Gas welding
MMDA	Metropolitan, Municipal and District Assembly
NESSAP	National Environmental Sanitation Strategy and Action Plan
NBPS	New Bedford Public School
NIOSH	(US) National Institute for Occupational Health and Safety
OECD	Organisation for Economic Co-operation and Development
OSHA	(US) Occupational Safety and Health Administration
P. (PP)	Page(s)
SCOEL	Scientific Committee on Occupational Exposure Limits
STMA	Sekondi Takoradi Metropolitan Assembly
TIG	Tungsten Inert Gas welding
UNCED	United Nations Commission on Environment and Development

ABSTRACT

The focus of this studio-based study was to transform scrap metals into aesthetic masterpieces of art. It was premised on the assumption that the intuitive technique of working with scrap metal art provides the freedom and flexibility to exercise creative expressions on a three dimensional level of art. Moreover, our environment can be enhanced and saved from untidiness and destitution through different efforts, one of which the artist can contribute his/her quota creatively to transform the discards into a new forms of aesthetic values. Even though scrap metal art is widely known and practiced by a large number of artists around the world, in Ghana much has not been seen. The study commenced with the study and assessment of the scrap metal situation and possible environmental hazards or risks in the Sekondi/Takoradi metropolis. Structured questionnaires, interviews and observation were used to gather data using qualitative research approach. It employed descriptive methods of research data collection from artists, metalworkers/craftsmen, scrap metal collectors, scrap dealers, the Sekondi/Takoradi Metropolitan Assembly and Environmental Protection Agency for its execution and analysis of the results. The questionnaire sheets and interviews were carefully scored and transferred for analysis. The total number of sampled participants was 100. Questionnaires were administered on 65% of the respondents. The remaining Thirty-five were interviewed. The descriptive method was used to discuss the activities on scrap metals. To produce and document scrap metal art the researcher chose the studio-based research approach where aesthetico-action method was employed for techniques and procedures of executing scrap metal art. The outcome of the study on the nature of scrap metals in Sekondi/Takoradi indicated that its trade serves as livelihood opportunities for people with less educational background. The economic benefit from scrap metal trade was found to be satisfactory among its traders in its suburbs of Sekondi/Takoradi metropolis. Moreover, knowledge and education on health hazards and environmental pollution were found to be lacking in those engaged in the activity of scrap metal trade. Having identified the aesthetic qualities of scrap metals, therefore, a piece of sculpture was created with scrap metals as means of establishing the viability of the materials as potential material for creation of sculpture. This was also to demonstrate how scrap metal art could serve as a means of controlling the dangers posed by scrap metals in the environment. In other words, transforming dangers into beauty. Based on the outcome of the study, it was recommended that handling of scrap metal situation in the Sekondi/Takoradi metropolis should not be left solely in the hands of metal traders. With the ongoing diversification in aesthetic sensibilities and creativity, Ghanaian sculptors need to direct their attention to scrap metals as alternative materials for their work.

CHAPTER ONE

INTRODUCTION

Background to the Study

Metal in many years has been used in the development of productivity to provide both a quality of material and cost effective solution for civilization. It has been in the existence for ages and its philosophies, ideologies, techniques, methods of production have gone through stages. Scraps from metals consist of decomposable materials left over from product manufacturing and consumption, such as parts of vehicles, building materials and spare materials. Scrap metals create in both business and residential environments can have significant monetary value. This has brought a surge in scrap metals trade in every country among individuals and group associations. Artistically scrap metal art is the creative blend of found metal objects by means of joining, welding, riveting or gluing together to form a sculpture pieces. This practice or discipline has helped a special fascination for humanity.

Seabrook (2008) hints that scrap metal is as old as metal craft itself. Copper smelting is thought to have begun about seven thousand BC, in the Middle East. Taking elements from the earth and refining them into metals is so basic to civilization that we refer to eras in human history as the Bronze Age and the Iron Age. Through its highs and lows, civilization has always included a scrap trade, and unlike the arts and sciences, the scrap business has thrived in times of both darkness and enlightenment. Scrap metal art and its practice is founded on an inviolable truth

that almost all the metal that has ever existed in the world still exists, and always will exist.

Essentially, one significant factor that motivates scrap metal art in a society is its provision of environmental benefits in terms of reducing volumes of solid wastes and the consequence transformation of the aesthetics of the environment. Many sculptors like Alexander Calder, Alexander Rodchenko, Julio Gonzalez, Anthony Caro, Micajah Bienvenu, Lee Kelly, Rudy Kehkla, Sayaka Kajita Ganz, Mario Mallari Jr., Jeremy Mayer, Miran Elbakyan, Alex Kveton, Edouard Martinet, John Lopez, Wanssi Massimo, Abu-Bakarr Mansaray and others have used metals for numerous reasons. They include aesthetics and expressions of certain ideas and philosophies in their sculpture pieces.

In Ghana, scrap metal collectors, brokers, processors have exploited the commercial and practical values of the materials on an ongoing basis. Local level metal working companies like Tema Steel, Western Castings, Western Steel and Forgings have augmented scrap metals generally for engineering purposes. They use them for the manufacture of steel products such as cutting tools and cutlery, surgical instruments and engine blocks utilizing ferrous metals as their primary raw materials for the local market. This has ushered in various forms of trades in scrap metals especially in and around the areas where they abound. Both adults and children in order to collect and export these primary and secondary raw materials to other countries for their economic quest undertake the activity of scrap metals.

After many years of practice however, the scrap metal trade seems to lack the regulatory system that really benefits the nation in social, environmental and

economic context. Instead of benefitting the manufacturing community for instance, it has deprived them of the needed raw materials, and this compels large and small-scale metal fabrication companies to operate below capacity, due to the inadequate supply of the raw materials in the country. This situation is because of the uncontrolled export of large volumes of scrap metals out of the country spearheaded by scrap metal traders at various levels.

Again, people who engaged in scrap businesses have also contributed largely to the theft of telephone cable made of copper. This act is seriously affecting the operations of telecommunication companies in the country. The exportation of ferrous metals as such copper that was largely responsible for cable theft has resulted Government's wrath by banning scrap metals from travelling out of the country. This sends out obvious indications that the nation needs to seek more beneficial means of handling its scrap metal situation in ways that would not just rid the environment of scrap metals but serve the environmental aesthetically as well.

Various sculptors in Ghana such as Kwatei Nii Owoo of Touch of Bronze and others have practiced metal art but creatively in scrap metal art however, much has not been seen by way of using such compose pieces to promote environmental sanitation. It is however not too late for artists to intensify the production of scrap metal art as means of contributing their quota to the national efforts towards environmental sanitation and beautification.

Statement of the Problem

In Ghana scrap metals pose threat in many areas, especially the heavily populated and they carry risks of injuries and infectious disease, particularly to vulnerable groups such as the very young, the elderly and people who trade in them. Besides, scrap metals that have been dumped, such as car bodies and obsolete farm machinery can contain many toxic chemicals that can leach into the environment. Sharp jagged edges of rusting metal can injure farmers and wildlife while chemicals within car bodies can cause bush fires and destroy soil nutrient. These culminate into endangering and degradation of the environment.

Meanwhile, experience has amply taught us that, leaving the issues involved in the scrap metal situation entirely into the hands of local scrap metal traders has not been a good idea since it comes with all sorts of unwanted consequences including electrical and telephone cable thefts. In the midst of all these however, there seem to be very little attention on the aesthetic qualities of scrap metals, and their potential to serve as alternative raw materials for the artist. Being a non-traditional material in contemporary Ghanaian sculpture, there seems to be an oblivious and predominant less concern for the exploration of its aesthetics and its contribution to the quota of environmental sanitation in Ghana.

In Ghana, sculptors of the past and present often relied on traditional materials for production of works. This old practice tends to influence the progress, development and maturity in sculpture. Looking at metal especially its scrap fragments from artistic point of view, it possesses the potential of providing artists

with another dimension of material base even with the use of unwanted scraps left overs that seem less important to scrap dealers.

Objectives of the Study

1. To investigate the scrap metals situation in the Sekondi/Takoradi metropolis and assess the possible environmental risks associated with them.
2. To analyse scrap metals as materials for aesthetic and artistic expression.
3. To produce and document scrap metal art as means or promoting environment sanitation.

Research Questions

1. What is the general situation of the prevalence and handling of scrap metals in Sekondi/Takoradi metropolis?
2. To what extent can scrap metals serve as alternative materials for aesthetic and artistic expression?

Delimitation

For the purpose of this study, the research was focused on the assessment of scrap metals and its aesthetics as means of promoting environmental sanitation in Sekondi/Takoradi metropolis. It focused on specifically selected social and economic, environmental and aesthetic issues on scrap metals. The scrap metals factors that contribute to the environmental hazards and current condition when working with it and the extent to which scrap metal art can be aimed at promoting good environmental sanitation condition and adding value to it.

Limitation

It was challenging to obtain certain information which could enrich this research. Most interviewees especially scrap dealers in Kokompe were cold towards answering certain components of the questionnaires as they felt their job security was threatened. The researcher was threatened by many people with many others declining from allowing pictures to be taken on their activities and responding any questions even though it was explained to them as being for academic purposes only.

Definition of Terms

Aesthetic Concerning with beauty or the appreciation of beauty/relating to or denoting a literary and artistic movement in England during the 1880s, devoted to "art for art's sake and rejecting the notion that art should have a social or moral purpose.

Alloy A substance composed of two or more metals. Alloys, like pure metals, possess metallic lustre and conduct heat and electricity well, although not generally as well as do the pure metals from which they are formed.

Bronze Age Is a time period characterized by the use of bronze, proto-writing and other early features of urban civilization. It is also the second part of three-age system (Stone, Bronze and Iron Age) for classifying and studying prehistoric societies, particularly the ancient societies of the Mediterranean and Near East.

Catalyst	A substance that increases the rate of a chemical reaction without itself undergoes any permanent chemical change.
Conductivity	The degree to which a specified material conducts electricity or heat.
Copper	A red-brown metal, the chemical element of atomic number 29, which is a good conductor of electricity and heat and is used for electrical wiring and as a component of brass and bronze.
Ductility	Describes a metal or other materials that can be drawn out into a thin wire.
Ecosystem	A biological community of interacting organisms and their physical environment.
Environmental	The surroundings or conditions in which a person, animal or plant lives or operates.
Electrode	A conductor through which electricity enters or leaves something.
Ferrous	Are chiefly metals containing or consisting of iron.
Iron Age	Is the period generally occurring after the Bronze Age, marked by the prevalent use of iron or steel.
Metal	Is a solid material which is typically hard, shinny, malleable, fusible and ductile with good electrical and thermal conductivity, e.g. iron, copper and silver.
Non-ferrous	Are chiefly metals that do not contain or consist of iron.
Sanitation	Is a condition relating to public health.

Scrap	A small piece of material or amount of something especially metal that is left over after the greater part has been used.
Scrap metal art	Construction or fabrication of compose found metals shaped into art or sculpture piece.
Steel	A hard, strong grey or bluish-grey alloy of iron with carbon and usually other elements, used extensively as a structural and fabricating material.
Malleable	Describes a metal or other materials that can be hammered or pressed into shape without breaking or cracking.
Mechanical	Is a working parts of a machine or relating to machines or machinery.
Metallurgy	A branch of science concerned with the properties, production and purification of metals.
Metal-morphosis	Choosing Scrap metals for art work that depends solely on the theme.
Polystyrene	A synthetic resin which is a polymer of styrene.
Thermal	Relating to heat. In physics, relating to or denoting particles in thermodynamic equilibrium with their surroundings.
Welding	A process in which two or more pieces of metals are joined together by the application of heat, pressure, or a combination of both.

Importance of the Study

The importance of this study hinges on its ability to promote scrap metal art in Ghana and present it as an instrument for improving environmental sanitation. Some significant importance include educating the public on the relevance of scrap metal art and potential of managing the environment when it comes to sanitation. It will also offer artists the opportunity to explore into scrap metals thereby preserving the natural materials in the environment. Again it will serve as an academic reference material to students, lecturers and everybody in the visual art fraternity.

Organisation of the Study

The thesis report has been divided into six chapters. Chapter one has been already dealt with.

Chapter two of this thesis contains review of related literature. The review identifies related areas such as scrap metals, scrap metals and environmental sanitation, scrap metal art and artists. The review seeks to bring out the aesthetics benefits of scrap metal art in the context of promoting environmental sanitation.

Chapter three is made up of the methodology, which comprises the following: research design, population for the study, sampling, data collecting instruments, primary and secondary data, reliability and validity of data and information, data collecting procedures, analyses, interpretation of data, tools and materials**,** skills and procedures for the execution of work.

Chapter four comprises the data presentation, Analysis and discussion of findings obtained for interviews, observations and questionnaires. This chapter also accentuates the tools and materials used for the study.

Chapter five includes techniques and procedures used for the construction of scrap metal art.

Chapter six is made up of summary, conclusion and recommendations. References and appendices follow in sequence.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

This chapter examines literature concerning the area under study in order to establish the theoretical and empirical basis of the study. It expresses the fundamental theories with empirical evidence given by some authors which have bearing on the topic. As the topic is posed on scrap metals and environmental sanitation, the review of related literature is correlated to the topic and how approaches to the topic have changed over time to find out whether the study would give the scope, strengths and weaknesses and future direction of scrap metal art in Ghana. Among the topics and sub topics that have been reviewed in this study are:

- **Scrap metals**
  - Sources/location
  - Some common uses
  - Some known hazards
  - Some types/categories
  - Some finishes
  - Some melting points
  - Properties
- **Scrap metals and Environment sanitation**
- **Scrap metal art and Artists**

Scrap metals

Scrap metals are rusty pieces of nuts, bolts, iron, spark plug, nails, automobile and motorcycle parts. They are fragment, piece of discarded compact material (an element, compound or alloy) that have typically hard, opaque, and shiny features of good electrical and thermal conductivity.

Scrap metal has a history that has engaged numerous intellectual discourses over the years.

McNab (2008) indicates that metals have been used throughout recorded history for fine and decorative art. By the 1st century AD, the metals in prime use today; iron, copper, tin, lead, gold and silver had a long development that had begun some 10,000 BC earlier with the working of copper. The distinction between precious metals (gold, silver and since the 18th century – platinum) and base metals (iron, copper, tin and lead) dates from the ancient civilizations of the Middle East and prehistoric Europe.

Boyd (2011) in his technical speciality in metals is also of the view that humans have been using available metals since the dawn of time. Process metallurgy is one of the oldest applied sciences. Its history can be traced back to 6000 BC. Until the end of the 17th Century only twelve metals were known. Seven metals "Metals of Antiquity" which existed during that time were namely Gold, Copper, Silver, Lead, Tin, Iron, and Mercury.

Socorro Luanco (2014, p 2) brings the three distinct periods of metal ages to light that:

> In the metal ages there were three distinct periods, each of which is named for the materials that, because of their importance at these times, represented each period: The Copper Age (3000-5000 BC): owing to its low resistance, it was only used in decorative utensils. The Bronze Age (3000-5000 BC): a mix of copper and tin which had better properties than either of the two metals separately. The Iron Age (2000 BC): much more resistant than bronze. The Hittites were the first to master iron. The first metal object made by Humans was invented around 7000 BC. The first metal they used was copper. However, it was not very strong so they found out that when they added tin to the copper, the mixture was stronger and it was called bronze. Later, iron has been discovered and new objects become possible, such as weapons, the wheel or the plow. The wheel was very important in transport as it was used in carts pulled by bullocks. The plow allowed humans to work faster and in greater areas. Human beings realized that raw materials were very important for making new tools. The search for these new metals and raw materials was the beginning of trade.

The figure 2.1 shows first metal invented by humans around 7000 BC as described by Socorro Luanco.

Figure 2.1 *First metal invented by humans around 7000 BC for ploughing (Source: Socorro Luanco, 2014)*

Greer (2009) in her comparison between ancient metal casting and modern metal casting materials and processes, she wrote that ancient man began working with metal over 10,000 BC. The first metalworking was in the Mesopotamian area when man discovered native copper. Copper is soft enough to be fashioned into objects by hammering and shaping the material without heat. From this first discovery of copper, man progressed to the Chalcolithic period, where heat was used to aid in working the copper. When copper is cold worked, it becomes harder. Using heat to work the copper gave man more options for its usage. Using heat with copper soon led to alloying copper with other materials and the onset of the Bronze Age in Mesopotamia (See table 2.1).

Table 2.1: *An overview of the progression of metalworking through the first 9,000 BC*

Date	Development	Location
9000 B.C.	Earliest metal objects of wrought native copper	Near East
6500 B.C.	Earliest life-size statues, of plaster	Jordan
5000-3000 B.C.	Chalcolithic period: melting of copper; experimentation with smelting	Near East
3000-1500 B.C.	Bronze Age: arsenical copper and tin bronze alloys	Near East
3000-2500 B.C	Lost wax casting of small objects	Near East
2500 B.C.	Granulation of gold and silver and their alloys	Near East
2400-2200 B.C	Copper statue of Pharaoh Pepi I	Egypt
2000 B.C.	Bronze Age	Far East
1500 B.C.	Iron Age (wrought iron)	Near East
700-600 B.C.	Etruscan dust granulation	Italy
600 B.C.	Cast iron	China
224 B.C.	Colossus of Rhodes destroyed	Greece

(Source: Sarah Elizabeth Greer, 2009)

She further continued to say the Mesopotamians began working with metal in 9000 BC. Copper, gold, and silver were the first materials they noticed and worked. Their colour likely made them stand out from other stones. Additionally, when these metals are hit, they behave differently than a stone would. Stone is a brittle material, and when hit it tends to splinter and break. Gold and silver are malleable, and when hit both will conform to the new shape. Copper will become harder when hammered or hit, though it will not break. The use of these materials progressed into heating copper and learning how to melt it during the Chalcolithic period, from 5000-3000 BC. The Chalcolithic period led into the Bronze Age, which began in Mesopotamia about 3000 BC. In Mesopotamia and other areas in the Near

East, the Bronze Age lasted about 1500 BC. The Iron Age began in 1500 BC, but in this region iron was not cast for several thousand more years.

History of scrap metal in the making helps in the origin of metals used for our day to day activities. This creates an in depth knowledge for the artist to build more ideas on metals for the art fraternity.

Sources/Location

Lambert and Wilcox (1961) bring that scrap metals arise from two sources. Process scrap is produced in a number of manufacturing industries and consists of off-cuts, machinings, punchings, grindings and rejects from rod, wire, sheet, etc., used in the fabricating of metal articles. This material is usually clean and of consistent composition and thus is easily reused. Obsolescence scrap is a much more variable material and consists of metal objects that for one reason or another have reached the end of their useful life, either through wear, breakage or redundancy.

Ohimain (2013) deliberates in his research article that scrap ferrous metal are typically generated at household, auto-mechanic workshops and other commercial ventures. Scavengers i.e. waste pickers recover scrap iron from waste dumps and sell them to scrap dealers, who in turn supply the scrap to steel mills using 30 tonne truck.

OSHA (2008) confirms that ferrous scrap comes from sources such as mill scrap (from primary processing). Used construction beams, plates, pipes, tubes, wiring, and shot. Old automobiles and other automotive scraps. Boat scrap, railroad scrap, and railcar scrap. Miscellaneous scrap metal. Ferrous metals are magnetic and are often collected in scrap yards by a large electromagnet attached to a crane,

sweeping across piles of scrap to grab magnetic objects. Aluminium is the most widely-recycled nonferrous metal; the major sources of nonferrous scrap are industrial or new scrap, and obsolete scrap. Industrial or new scrap may include aluminium left over when can lids are punched out of sheets; brass from lock manufacturing; copper from tubing manufacturing. Obsolete scrap, the other major source, may include copper cables; copper household products; copper and zinc pipes and radiators; zinc from die-cast alloys in cars; aluminium from used beverage cans; aluminium from building siding; platinum from automobile catalytic converters; gold from electronic applications; silver from used photographic film; nickel from stainless steel and lead from battery plates. Nonferrous metals can also be recycled from captured particle emissions from metal primary or secondary production facilities. Other exotic and precious metals come from a variety of sources, such as gallium from gallium arsenide (GaAs) used in electronics; gold from precious metals manufacturing plants and from discarded electronics and jewellery; platinum-group metals from catalysts including catalytic converters, which automobile recyclers systematically collect; used catalysts from industrial processes mostly from the chemical and pharmaceutical industries; old electronics equipment; radioactive metal scrap may come from military applications such as depleted uranium; discarded medical equipment, building or storage material from nuclear power plants particularly nickel scrap or trace amounts found elsewhere such as Americium (Am-241) found in smoke detectors.

Evaluating the views by various authors on sources/locations of scrap metals, the researcher postulates that scrap metals in Ghana around its regions especially

Sekondi/Takoradi, can be found throughout commercial, industrial, household and demolition companies as well as from junkyards, landfills, fitting shops and metalwork yards. They are often sold in small amount by scavengers and traders who deal in scraps. Unwanted metals like aluminium of beverage cans, pots and pans, brass faucets, fixtures, keys, copper communication wire, electrical wire, plumbing pipes, Stainless steel sinks, appliances, steel file cabinets, grills, lawn mowers and vehicles are some common household metals that serve as sources or location of scraps.

Looking at the sources of scrap metals in Ghana, it has been a trade among the people of Sekondi/Takoradi and other regions in social and economic context. It is no wonder that there had been a phenomenal increase in scrap business on our environment and these practices have contributed to some collapse of large and small-scale metal fabrication companies in the country due to individual preferences for cash income.

Some common uses

According to Makofsky (2014) many scrap metal sculptures are created to be useful objects. One can find scrap metal wall hangings, planters, garden art, mirrors, tables, desks, chairs and even sofas. Cabinets, shrines and niches are popular especially with hammered tin details. Other possibilities include coat racks, umbrella stands, candlesticks, picture frames and lamps with funky shades. Smaller items such as scrap metal vases, wine racks, CD holders, bookends and clocks are ideal gifts.

Dawes (2015) also explains that recycling scrap metal makes good economic and environmental sense. Scrap metal is one of those foundation materials that can be refashioned into many new uses. For industrial Uses, scrap iron and aluminium metals are being used extensively in the construction industry in projects such as roads and bridges. In the transportation industry, it can be used in the manufacture of automobiles, aircraft and other modes of transportation. Another more recent use is in detoxifying industrial wastewater. Scrap metals are also used widely in the production of containers, which are used extensively by many companies. Many appliances are also made out of scrap metal, especially aluminium. This use of scrap metals by so many industries has helped the environment by minimizing the need for mining natural resources that are becoming scarce. Scrap metal is also much cheaper to use in the manufacture of these items. For new and stronger metal products, scrap metals can be made into higher quality tools through a process using an electric arc furnace. Stainless steel can also be made in this way. Copper scrap is made into products using some of the same processes as steel, which also include blast and reverberator furnace processes. Aluminium scrap metal can also be melted at a much lower temperature than virgin aluminium, so the process consumes much less energy. This is generally true of all recycled metals, which not only saves on energy but Co2 emissions as well. This protects our environment, as well as providing an economic savings in the manufacturing process, which is then hopefully passed on to the consumer. For home furnishings, metal furniture is often made of recycled metals and can be beautiful and durable. Gliders, benches, tables and even lamps are just a few home furnishings that have been created from scrap metals. For artistic

uses, some people see a pile of scrap metals and envision a work of art. It has been used in beautiful sculptures by artists. Even people who are not professional artists have used their creativity to form works of beauty out of various recycled metals and are proud to display them on the walls of their homes. Decorative metalwork has a distinctive art style all its own.

For helping to preserve our environment, He further mentions the uses of scrap metal as it is important to note how much of a saving there is for the environment in the use of recycled steel, there is an 86% reduction in air pollution, reduction in water usage is 40%, and reduction in water pollution is 76%. Recycling scrap metal also reduces the size of our landfills.

Some known hazards

Scrap metals around the world, in Ghana especially Sekondi/Takoradi possess some hazardous substances which are contained from junkyards, and landfills such as lead wheel weights, chrome-plated engine parts, and silver electrodes. Some scrap metals are otherwise be non-hazardous such as processed vehicle hulks, drained and crushed used oil filters, and properly punctured aerosol containers, may be contaminated with residual amounts of hazardous substances.

OECD (1996), Nuclear Energy Agency report on recycling and reuse of scrap metals, states that there are potential health risks to workers and general public associated with both the recycle/reuse and the disposal/replacement alternatives for radioactive scrap metals management. These alternatives involve health risks from exposures to radiation and toxic elements as well as from industrial and transportation accidents. According to the Task Group assessment for both

alternatives the physical risks to workers from workplace accidents and to the public from transportation accidents are greater in magnitude than the risks from radioactive materials or chemicals. Table 2.2 shows the summary of health risks from radioactive scrap metals.

Table 2.2: *Summary of health risks from Radioactive Scrap metals*

Impact categories	Recycle/reuse	Dispose and replace
Radiological risk *	* 10^{-7} to 10^{-6} fatal cancer risk to metal workers and public; *10^{-2} to 10^{-1} population risk per year of practice	* Potential elevated cancer risk to miners
Non-radiological risks * Accidents (workplace)	*About 7 fatalities or serious injuries to workers	*About 14 fatalities or serious injuries to workers
*Accidents (transportation)	*10^{-2} fatality risk to workers and public	10^{-2} fatality risk to workers and public
*Chemical exposure from smelting **	*10^{-3} fatal cancer risk to worker; 10^{-4} to public	10^{-3} fatal cancer risk to workers; 10^{-4} to public
*Chemical exposure from coke production	* None	* 1 fatal cancer risk to workers; 10^{-2} to public

(Source: OECD, 1996)

Again the report continues to say that although the radiological health risks from either recycling or disposal and replacement area relatively low, this is not the case for non-radiological risks. Both alternatives involve substantial health risks from workplace and transportation accidents as well as from worker and public exposures to chemicals that are carcinogenic or toxic. Of these two types of risks, the accidental fatality and injury risks to the public and workers are higher and much more immediate. Health risks for individuals from chemical exposure and accidents are summarised in table 2.2. Many aspects of replacement processes are conducted within environments that are less stringently regulated than the environment in which recycle/reuse alternatives would operate. The highest human health risks are

those associated with accidents in the workplace. Replacement necessarily involves coal mining, ironing mining and coke production, occupations that have relatively high accident rates. In addition, the risk of a worker fatality associated with the replacement of 50, 000 tonne of radioactive scrap metals, is approximately 15 fatal or serious injuries to workers in steel mill and blast furnace operations compared to approximately eight for steel smelting and milling operations for recycling. Consequently, risks to workers from replacement/disposal alternatives exceed those for recycling alternatives.

Searl and Crawford (2012) on their review of health risk for workers in the waste and recycling industry scrap yards in both UK and US data indicate that scrap yard workers may have relatively high exposures to lead. The UK data suggests that blood lead levels in about 20% of workers under surveillance are sufficient to give rise to symptoms of weakness, irritability, asthenia, nausea, abdominal pain with constipation and anaemia. Long term exposure to lead at these levels is associated with kidney damage and proteinuria. About 30% of workers under surveillance have blood lead levels that reflect exposures that could damage peripheral nerve function and neurological function and an even greater proportion of workers are exposed to lead at levels that would damage an unborn child (if a woman was exposed). It is not known how many other scrap yard workers are similarly over-exposed to lead, but are not under medical surveillance. Inadvertent ingestion may make an important contribution to overall exposure levels and where there is settled dust in the workplace, poor washing facilities and poor personal hygiene practice, it is possible that exposures to ingested metals would exceed the inhalation intakes associated

with the workplace exposure limit, particularly in relation to lead. It seems plausible that over-exposure to other metals may also occur, but there are no data. Substances such as aluminium and copper are less toxic than lead such that a higher exposure could be tolerated whereas other toxic metals such as nickel and manganese are likely to be present in much lower quantities than lead in metallic waste. Co-exposure to other metals could increase the risks of kidney toxicity (e.g. nickel, mercury, and cadmium), neurobehavioural effects including impacts on mood and wellbeing (e.g. mercury, manganese), lung cancer (nickel) and adverse effects on an unborn child. The interactions between individual metals may be additive, less than additive or more than additive depending on the exact mechanism of toxicity.

A study of scrap metal workers undertaken by the New York State Department (2007) investigated worker exposure to lead at 101 metal recyclers throughout New York State. The companies were engaged in a variety of activities: torch cutting (59), shearing (48), stripping and cutting communication cables (28), melting metal (6) and dismantling batteries (5). Personal exposure concentrations for lead were measured for 6 torch cutters at 5 facilities cutting materials that included painted machine parts, unpainted highway guard rails, unpainted new plate steel, aluminium and copper. This report also shares some relevant information on health effects associated with different metals to which waste workers may be exposed. Table 2.3 shows metal and its effects when working with it.

Table 2.3: *Health effects associated with different metals*

Metal	Effects
Aluminium (Al)	Limited evidence from workplace studies of impaired cognitive function, motor dysfunction, peripheral neuropathy and other neurological symptoms, respiratory impairment and work-related asthma – not clear whether effects due to Al or co-exposure to other hazardous substances (IPCS, 1997).
Copper (Cu)	High levels of workplace exposure have been reported to cause metal fume fever. Respiratory symptoms have been reported in workers exposed to a number of metals including Cu. Workers exposed to concentrations that gave an estimated intake of 200 mg Cu/day developed signs of copper toxicity (e.g. elevated serum copper levels, enlarged liver). Cu may be associated with allergic dermatitis in a small proportion of individuals (IPCS, 1998).
Iron (Fe)	Fe oxide - Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis) Fe salts - irritation eyes, skin, mucous membrane; abdominal pain, diarrhoea, vomiting; possible liver damage (NIOSH Pocket guide to chemical hazards).
Lead (Pb)	The symptoms of lead poisoning include weakness, irritability, asthenia, nausea, abdominal pain with constipation and anaemia. Minor effects have been reported in adults at blood lead levels >20 ugdL-1 with more obvious symptoms at blood lead levels >40 ugdL-1. Lead is a neurotoxin and impacts on peripheral nerve function and neurological function have been found in adults at exposure levels well below those associated with overt toxicity (20 ug/dL). Long term low level exposure to lead is associated with kidney damage and proteinuria. Higher levels of exposure lead to severe kidney damage and potentially kidney failure. Lead is a confirmed animal carcinogen but there are insufficient data to demonstrate carcinogenicity in humans (IARC 2006; SCOEL, (2002; WHO, 2000).
Mercury (Hg)	Inhalation exposure of Hg vapour or exposure to inorganic Hg salts is associated with tremors, emotional instability, insomnia, memory loss, neuromuscular changes, headaches, polyneuropathy, and performance deficits in tests of cognitive and motor function. Some effects may be reversible on cessation of exposure. Neurotoxicity has been reported in workers exposure to elemental Hg at a concentration of 0.02 mgm-3. Inorganic Hg is also toxic to the kidneys. Proteinuria, a marker of impaired kidney function, has been observed in workers with urinary Hg levels consistent with exposure to concentrations of Hg in workplace air of about 0.02 mgm-3 (IPCS, 2003; SCOEL, 2007).
Nickel (Ni)	Ni is a respiratory carcinogen. Other effects reported in Ni-exposed workers include rhinitis, sinusitis, nasal septum perforation, lung fibrosis, allergic contact dermatitis. Ni and its soluble salts are potent skin sensitisers. In animal experiments, the concentration of soluble

	Ni salts associated with adverse respiratory effects is 0.06 mgm-3 although no adverse effects were observed following repeated exposure to 0.11 mgm-3 of an insoluble Ni salt (IPCS, 1991a; EPAQS, 2008).
Platinum (Pt)	Pt compounds are potent skin and respiratory sensitisers associated with contact dermatitis, rashes, sneezing, shortness of breath and severe asthma. Adverse effects have been reported at exposure levels <0.1 mgm-3 (IPCS, 1991b).
Silver (Ag)	Workplace exposure to silver and silver compounds is associated with agria - grey-blue discolouration of the eyes, skin, nails, mucous membranes and internal organs. Symptoms have been observed in workers exposed to Ag compounds concentrations of 0.005-0.38 mgm-3 although no effects were reported in workers reported to metallic Ag at concentrations of 0.003-0.54 mgm-3, higher levels of exposure may give rise to irritation and ulceration of the skin and gastrointestinal disturbance (SCOEL, 1993; NIOSH Pocket guide to chemical hazards).
Tin (Sn)	There is little information about the adverse effects of workplace exposure to Sn. Long term exposure to Sn(VI) oxide dust was reported to give rise to lung changes that were detectable in chest X-rays but were not associated with fibrosis or effects on respiratory health. There is limited evidence of adverse effects on the kidney. There have been rare cases of allergic contact dermatitis in humans exposed to Sn and a number of Sn (II) compounds have been identified as skin irritants. Studies in animals have shown that ingestion of Sn (II) compounds is associated with effects on body's handling of copper, iron and zinc that may adversely impact on health (IPCS, 2005; SCOEL, 2003).
Tungsten (W)	Irritation of eyes, skin, respiratory system; diffuse pulmonary fibrosis; loss of appetite, nausea, cough; blood changes Exposure to dusts containing W in the hard metals industry is associated with pulmonary fibrosis, memory and sensory deficits, and increased mortality due to lung cancer but these effects have been primary attributed to co-exposure to Co. There are limited animal data that suggest W may be a reproductive and developmental toxin (NIOSH Pocket guide to chemical hazards; ATSDR, 2005).

(Source: New York State Department, 2007)

Zuskin et al (2007) discuss that because metals are used as the basis for many art materials, artists working with diverse media are exposed to the toxic effects of various metals including lead, antimony, arsenic, uranium, chromium, cadmium, vanadium, and mercury. Metalworking may cause physical trauma and is

associated with numerous medical syndromes. For instance, scrap metal cutters may suffer from symptoms such as foul taste and dryness of the mouth, nausea, vomiting, fever, headache, cough, rhinitis, muscular aches, painful eyes, and skin burns. Lead is a component in ornamental glass and solders used for metal sculpture, jewellery and stained glass. Scrap metal cutting is hazardous and associated with significant lead exposure.

Illegal junkyards threatens communities, Toxic Action Center (2012) mentions that junkyards contain many hazardous materials including lead batteries, mercury from light switches, anti-freeze, Freon from cooling systems, Polychlorinated Biphenyls (PCBs), Chlorofluorocarbons (CFCs), asbestos found in the brake pads and lining of older cars, motor oil, and heavy other metals. These toxins pose real health risks. Mercury is linked to kidney disease, and lead from batteries may cause many health issues, including brain damage, problems with the blood and damage to the reproductive and nervous systems. Asbestos, and PCBs, are carcinogenic and oil-products have been linked to liver, kidney, and bone marrow diseases. Heavy metals and other contaminates may enter drinking water and pose a risk to human health for everyone living near a salvage yard. Anti-freeze is toxic to aquatic life. CFCs and Freon emitted from vehicles cause air pollution. If oil is spread on the ground, it may contaminate plants, animals, soil and groundwater.

In Ghana, handling, trading and recycling scrap metals pose danger. Looking at the article titled “Scrap dealers and health hazards: welcome to Korle Lagoon Ghana” published by Bannah and Abibat (2001) outlines that scrap metals pose dangerous health hazards to its environs. In their submissions, they bring out some

health issues concerning scrap metal activities with the people they encountered on field. This article outlines and brings to forth the possible related health hazards associated with scrap metal activities as:

> The sound of tools smashing and crushing metal is deafening. Dozens of young men, covered in dark grease and soot stains, sift through heaps of discarded appliances and pieces of rusted metal scavenging for anything valuable. An unpleasant smell rises from the nearby Korle Lagoon and we choke on thick clouds of smoke blanketing the area. This is the scrap yard at Old Fadama, Accra's largest slum community. The informal scrap metal business in Ghana is a relatively profitable venture for many young men from the northern part of the country and neighbouring countries residing in Old Fadama. However, the job comes with massive health risks. And since government authorities consider Old Fadama's residents illegal citizens of Ghana, they are not protected under national labour laws. The nature of scrap dealing is very demanding. Each day scrap dealers walk long distances under the scorching sun to and from shops, homes and landfill sites in search of discarded metal and used electrical gadgets like televisions, computers, microwaves and radios to sell to individuals and business owners. Groups of scruffy young men huddle around heaps of discarded gadgets, dismantling and extracting metallic components, iron, silver and copper by burning the pieces with fire

> and strips of worn-out car tires. They inhale dense black smoke without any safety gear, at great risk to their health. The toxic smoke is not only a dreadful threat to the men who are directly involved in this business, but also poses a serious danger to people within the immediate environment who have nothing to do with scrap business (p 17).

It further stated that the scrap dealers themselves do not seem to be aware of the health hazards they are exposed to in their business. "I'm not sick. I've done this for two years," says James, a scrap worker. Yusif Anda, a 40-year-old Burkinabe scrap dealer who has been involved in the trade for much longer, explains through a translator that although he is not visibly sick, he often coughs up black phlegm. Jake, an ex-farmer who has worked in the scrap business for two years, says his doctor advised him to quit his job because continuous exposure to naked flames and toxic fumes could result in fatal respiratory conditions. He says he knows the health risk is unquestionable. His income is hardly better than a tomato farmers' wage. All this work is done to benefit large industrial steel companies like Western Steel and Forging Limited in the harbour city of Tema in Accra. The companies buy the scrap metal for GH¢ 560.00 per tonne, or about $400 CAD. The income is distributed amongst the many men involved in the industry—a salary they wish would be higher considering the risk of their job. Many of the scrap workers we spoke to could not even identify the companies they sell to because they say their main concern is making money on which to subsist. They also hardly speak nor understand any widely accepted Ghanaian languages, which hinders their right to negotiate fair

incomes or protect their rights. They simply collect the scrap metal and collect their payment. Ghana's National Employment Policy states its main objectives are to "promote the goal of full employment in national economic and social policy, and to enable all men and women who are available and willing to work, to attain secured and sustainable livelihood through full productive and freely chosen employment and work" and to "Safeguard the basic rights and interests of workers." Therefore, it is hard to imagine why anyone would willingly engage in the risky industry of scrap dealing. But, since the government does not recognise Old Fadama's residents as legal Ghanaian citizens, they do not have access to job training or skill development programmes. So, they are compelled to take up the job. "We have families to take care of and remit our parents back in the villages, says James. "The government simply does not care about us, but we must survive."

In their article, it brought out scraps activities by scrap metal dealers and scavengers pose health hazards to their lives (see figure 2.2).

Figure 2.2: *Scrap dealers extract valuable metals like silver and copper from burnt electronics in Korle Lagoon, Ghana. (Source: Davis Ollennu, 2001)*

In Sekondi/Takoradi, scrap metals pose hazards in the handling and trading includes bits and pieces of metal parts that may be combined together with solder or bolts that either contain toxic heavy metal alloys such as cadmium, chrome, lead, or silver, or that are contaminated with toxic paint, solvents, or other hazardous waste. Scrap metals that are disallowed to be managed as hazardous include non-metallic or liquid forms, such as metal powder-impregnated rubber or residues from an industrial process, such as smelting. Scrap metals that are not primarily made of metal such as printed circuit boards are not considered hazardous scrap metal even if they contain small amounts of solid metal in or on them. Metallic wastes that contain or are contaminated with other hazardous wastes, such as unprocessed salvage vehicles or used oil filters, are not eligible for exemption until they have been processed. In extraction of valuable metals like copper and silver, the fumes of burnt electronics from plastic cause health hazards including lung cancer.

Some types/categories

Due to the scrap metal trade in Ghana, it has resulted in large quantities of metals being scattered throughout wide areas of its regions. Scrap metals in general around the world may have some types that makes it unique especially when working with them. This also attributes to scraps in Sekondi/Takoradi metropolis.

A study of scrap metal collection, Moyes and Vannachack (2005) cited that these remnants derive from the full range of metal military paraphernalia, from vehicles and oil drums through to bullet casings and large unexploded aircraft bombs. The bulk of the remaining metal is ferrous scrap, but there are also smaller

quantities of non-ferrous metal such as aluminium, tin and copper in the trading of scrap metals in the country.

Bridged Books Group (2012) is of the view that all metals may be classified as ferrous or nonferrous. A ferrous metal has iron as its main element. A metal is still considered ferrous even if it contains less than 50 percent iron, as long as it contains more iron than any other one metal. A metal is nonferrous if it contains less iron than any other metal.

OSHA (2008) again deliberates that scrap metals, in general, are divided into two basic categories: ferrous and nonferrous. Ferrous scrap is metal that contains iron. Iron and steel (which contains iron) can be processed and re-melted repeatedly to form new objects (ISRI NDb). Common nonferrous metals are copper, brass, aluminum, zinc, magnesium, tin, nickel, and lead. Nonferrous metals also include precious and exotic metals. Precious metals are metals with a high market value in any form, such as gold, silver, and platinum. Exotic metals contain rare elements such as cobalt, mercury, titanium, tungsten, arsenic, beryllium, bismuth, cerium, cadmium, niobium, indium, gallium, germanium, lithium, selenium, tantalum, tellurium, vanadium, and zirconium. Some types of metals are radioactive. These may be “naturally-occurring” or may be formed as by-products of nuclear reactions. Metals that have been exposed to radioactive sources may also become radioactive in settings such as medical environments, research laboratories, or nuclear power plants.

Papp (2001) affirms generally, scrap is categorized as new or old, where new indicates preconsumer sources and old suggests postconsumer sources. The many

stages of industrial processing that precede an end product are the sources of new scrap. For example, when metal is converted into shapes—plates, sheets, bars, rods, etc.; new scrap is generated in the form of cuttings, trimmings, and off specification materials. When these shapes are converted to parts, new scrap is generated in the form of turnings, stampings, cuttings, and off-specification materials. Similarly, when parts are assembled into products, new scrap is generated. Once a product completes its useful product life, it becomes old scrap. Used beverage cans and junked automobiles and appliances are examples of old consumer scrap; used jet engine blades and vanes, junked machinery and ships, and metal recovered from commercial buildings or industrial plants are examples of old industrial scrap. A wide variety of descriptive terms including home scrap, mill scrap, purchased scrap, prompt scrap, etc. have evolved to describe scrap generated by a wide variety of industry practices.

BBC (2014) on their design and technology page displays that metal is made from metal ores, which have to be mined and processed to transform them into usable materials. It is rare for metals to be used in pure form. Normally they are mixed with other metals to improve their properties: the mixture is called an alloy. Most metals are good conductors. There are two main types of metal alloys: ferrous and non-ferrous. Ferrous metals contain iron. Non-ferrous metals do not contain iron. Both types of metals can be recycled.

Based on the views shared, the researcher considers that scrap metals are divided into two groupings namely ferrous and nonferrous metal. Ferrous metals are those composed primarily of iron and iron alloys. Nonferrous metals are those

composed primarily of some element or elements other than iron. Nonferrous metals or alloys sometimes contain a small amount of iron as an alloying element.

Ferrous scrap metals

Bureau of International Recycling (2008) attests that ferrous metals are mainly composed of iron and have magnetic properties. Steel, an iron alloy containing carbon, is by far the most-recycled material in the world. Total steel production in 2008 reached 1.3 billion tonnes, of which over 500 million tonnes were made from scrap metal. The most commonly recycled items are scrap from industrial processes, end-of-life products such as containers, vehicles, appliances, industrial machinery and construction materials. The use of scrap metal has become an integral part of the modern steelmaking industry, improving the industry's economic viability and reducing environmental impact. Compared to ore extraction, the use of secondary ferrous metals significantly reduces CO2 emissions, energy and water consumption and air pollution. At the same time, the recycling of steel makes more efficient use of the earth's natural resources.

Castle Metals (2012) put in the simplest terms, ferrous metals are those which contain iron, whilst nonferrous metals do not have any iron content. There are, however, other differences between the two types of metal which have a strong bearing upon the tasks which they are usually called upon to perform.

They further outlines that ferrous metals and the kind of uses are usually:

Mild Steel – Carbon content of 0.1 to 0.3% and Iron content of 99.7 – 99.9%. Used for engineering purposes and in general, none specialised metal products. Carbon steel – Carbon content of 0.6 to

1.4% and Iron content of 98.6 to 99.4 %. Used to make cutting tools such as drill bits. Stainless Steel – Made up of Iron, nickel and chromium. Resists staining and corrosion and is therefore used for the likes of cutlery and surgical instrumentation. See our info graphic celebrating 100 years of stainless steel usage in buildings or the different types of stainless steel. Cast Iron – Carbon 2 – 6% and Iron at 94 to 98%. Very strong but brittle; used to manufacture items such as engine blocks and manhole covers. Wrought Iron – Composed of almost 100% iron. Used to make items such as ornamental gates and fencing (castlemetalseurope.com).

Bridged Books Group (2012) adapted from US Army's machining handbook utters that ferrous metals include cast iron, steel, and the various steel alloys, the only difference between iron and steel is the carbon content. Cast iron contains more than 2-percent carbon, while steel contains less than 2 percent. An alloy is a substance composed of two or more elements. Therefore, all steels are an alloy of iron and carbon, but the term "alloy steel" normally refers to a steel that also contains one or more other elements. For example, if the main alloying element is tungsten, the steel is a "tungsten steel" or "tungsten alloy." If there is no alloying material, it is a "carbon steel".

Engineering handbook (2006) describes that as the most abundant of all commercial metals, alloys of iron and steel continue to cover a broad range of structural applications. Iron ore is readily available, constituting about 5% of the earth's crust, and is easy to convert to a useful form. Iron is obtained by fusing the

ore to drive off oxygen, sulphur, and other impurities. The ore is melted in a furnace in direct contact with the fuel using limestone as a flux. The limestone combines with impurities and forms a slag, which is easily removed.

Nonferrous scrap metals

Bureau of International Recycling (2008) again the most commonly used non-ferrous metals are aluminium, copper, lead, zinc, nickel, titanium, cobalt, chromium and precious metals. Millions of tonnes of nonferrous scrap are recovered annually and used by smelters, refiners, ingot makers, foundries, and other manufacturers. Secondary materials are essential to the industry's survival because even new metals often require the combined use of recycled materials.

Scrap Recycling Industry (2006) informs that nonferrous scrap refers to scrap metal other than iron and steel, and includes aluminum, copper, lead, zinc, nickel, titanium, cobalt, chromium, and precious metals. Millions of tons of nonferrous scrap metals are recovered annually by scrap recyclers and consumed by secondary smelters, refiners, ingot makers, fabricators, foundries, and other industrial consumers in the U.S. and in more than 110 countries throughout the world. Nonferrous scrap is recovered from a wide range of obsolete consumer, commercial, and industrial sources—everything from soft-drink containers to automobile radiators to electronics and airplanes. The aluminum skeleton left after can lids are punched out of aluminum sheets, brass punchings from a screen manufacturer, copper scrap from manufacturing, and aluminum turnings generated in machine shops—all of these scrap materials are processed by the scrap recycling industry into specification grade commodities for manufacture into new products.

Bridged Books Group (2012) again shares that nonferrous metals include a great many metals that are used mainly for metal plating or as alloying elements, such as tin, zinc, silver, and gold. However, this chapter will focus only on the metals used in the manufacture of parts, such as aluminum, magnesium, titanium, nickel, copper, and tin alloys.

Castel Metals on nonferrous metals and their uses (2012) continues to share that:

> Aluminium – An alloy of aluminium, copper and manganese; very lightweight and easily worked. Used in aircraft manufacture, window frames and some kitchen ware. Copper – Copper is a natural occurring substance. The fact that it conducts heat and electricity means that it is used for wiring, tubing and pipe work. Brass – A combination of copper and zinc, usually in the proportions of 65% to 35% respectively. Is used for ornamental purposes and within electrical fittings. Silver – Mainly a natural substance, but mixing with copper creates sterling silver. Used for decorative impact in jewellery and ornaments, and also to solder different metals together. Lead – Lead is a naturally occurring substance. It is heavy and very soft and is often used in roofing, in batteries and to make pipes (castlemetalseurope.com).

Engineering handbook (2004) reiterates that nonferrous metals are metals that do not contain iron. There are two groups of metals; ferrous and non-ferrous. Ferrous metals contain iron, for example carbon steel, stainless steel (both alloys; mixtures of metals) and wrought iron. Non-ferrous metals don't contain iron, for example aluminium, brass, copper (which can be remembered as ABC) and titanium. One can also get nonferrous metals as alloys e.g., brass is an alloy of copper and zinc. Nonferrous metals are specified for structural applications requiring reduced weight, higher strength, nonmagnetic properties, higher melting points, or resistance to chemical and atmospheric corrosion. They are also specified for electrical and electronic applications.

All Metals & Forge Group (2013) explains that nonferrous metals are specified for structural applications requiring reduced weight, higher strength, nonmagnetic properties, higher melting points, or resistance to chemical and atmospheric corrosion. They are also specified for electrical and electronic applications. Material selection for a mechanical or structural application requires some important considerations, including how easily the material can be shaped into a finished part and how its properties can be either intentionally or inadvertently altered in the process. Depending on the end use, metals can be simply cast into the finished part, or cast into an intermediate form, such as an ingot, then worked, or wrought, by rolling, forging, extruding, or other deformation process. Although the same operations are used with ferrous as well as nonferrous metals and alloys, the reaction of nonferrous metals to these forming processes is often more severe.

Consequently, properties may differ considerably between the cast and wrought forms of the same metal or alloy.

Some finishes

Boardworks (2005) augment several surface finishing techniques can be used on metals. The most common ones are painting, lacquering, plastic coating and enamelling. In painting, surfaces must be smooth and de-greased as primer required. Hammerite is a good one-coat metal paint. Lacquering helps to prevent corrosion after polishing as a layer of cellulose or varnish is applied. This is often used on jewellery. Plastic coating is suitable for most metals. Object is heated and dipped in a tank of powder paint. Object is returned to oven to ensure a smooth, glossy finish. Enamelling is where powdered glass is melted onto the metal surface. This provides a hard (but brittle) finish with different colours and textures.

On metal plating, finishing and coating, Enterprise Ireland (2015) attests that metal finishing processes involve treatment of a metal work-piece in order to modify its surface properties, impart a particular attribute to the surface, or produce a decoration. Plating is a subset of such finishing operations that involves putting a coating of metal over a base metal substrate to give various desirable properties to the object. Metal coating is another subset of such finishing operations and involves the application of a paint or powder coating to a metal work-piece. Products from metal finishing operations can range from structural steel to jewellery. The reason(s) for carrying out metal finishing can include decoration, protection against corrosion, providing resistance to oxidation, high temperatures, or Ultra-Violent radiation, imparting mechanical properties, such as resistance to fatigue, improvement of

ductile strength, or longevity, resistance to the use of abrasives and imparting electrical & thermal properties such as semi-conduction, thermal resistance, fire resistance, etc.

These assertions justify that without metal finishing, products made from metals like scraps would last only a fraction of their present lifespan because of corrosion. Metal finishers use a variety of material and processes to clean, etch and plate metallic and non-metallic surfaces to create a work piece that has the desired surface characteristics.

Some melting points

Table 2.4: *Melting point of metal*

Elements	Symbol	Melting Point Celsius	Melting Point Fahrenheit
Aluminium	Al	659	1218
Brass (85 Cu 15 Zn)	Cu+Zn	900-940	1652-1724
Bronze (90 Cu 10 Sn)	Cu+Sn	850-1000	1562-832
Cast Iron	C+Si+Mn+Fe	1260	2300
Carbon	C	3600	6512
Chromium	Cr	1615	3034
Copper	Cu	1083	1981
Gold	Au	1063	1946
Hydrogen	H	-259	-434.2
Inconel	Ni+Cr+Fe	1393	2540
Iron	Fe	1530	2786
Lead	Pb	327	621
Magnesium	Mg	670	1240
Manganese	Mn	1260	2300
Nickel	Ni	1452	2646
Phosphorous	P	44	111
Silicon	Si	1420	2588
Silver	Ag	961	1762
Stainless Steel	Cr+Ni+Mn+C	1363	2550

Steel-High Carbon	Cr+Ni+Mn+C	1353	2500
Medium Carbon	Cr+Ni+Mn+C	1427	2600
Low Carbon	Cr+Ni+MnC	1464	2700
Tin	Sn	232	450
Titanium	Ti	1795	3263
Tungsten	W	3000	5432
Zinc	Zn	419	786

(Source: Garelick Steel, 1994)

All scrap metals are melted at different temperatures, and this chart shows some interesting comparisons, as well as relating the heated metal's colour to its temperature. The melting point of metals helped in working varied with the basic nature of the material (iron, steel, aluminium, magnesium) and the alloy of the metal. Figure 2.3 shows melting point of metal when welding by Haynes welding manual.

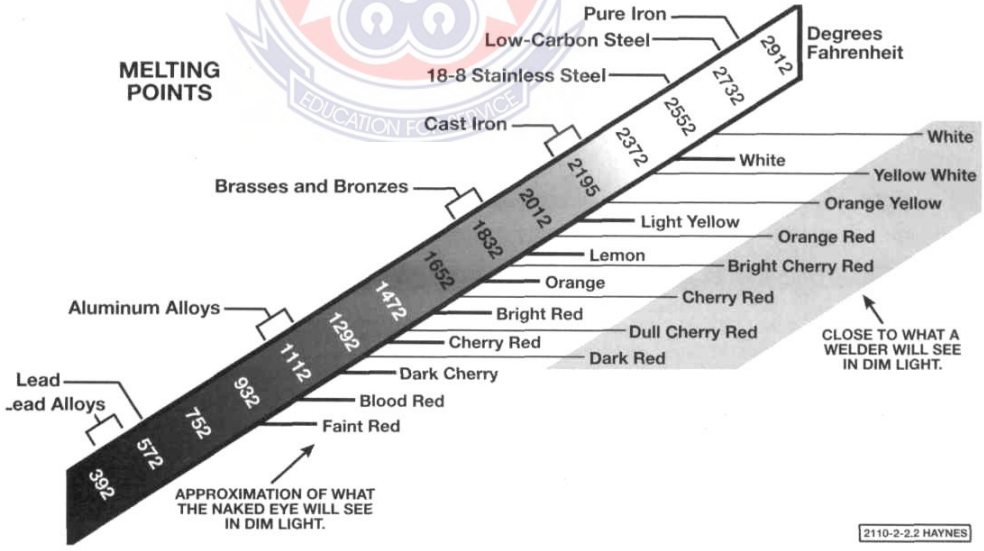

Figure 2.3 *Melting points of some metals (Source: John H. Haynes & Jay Storer, 1994)*

Properties

Scrap metals are generally malleable that can be hammered or pressed permanently out of shape without breaking or cracking.

Experts in chemistry, Goddard and Hutton (1961) are of the view that the importance of metals lies chiefly in their physical properties, especially their mechanical strength. Chemical reactivity is usually a nuisance in a metal when it is used as such, the rusting of iron being the most obvious example. The extent to which a metal is used depends on these factors and also on (a) its abundance in the earth's crust, and (b) the ease with which it can be extracted from its ores.

This assertion is mostly visible through the metal world, which reflects the attributes of working with metals. With scrap metal, it accumulates when steel is cut, drawn, extruded, or machined. The casting process also produces scrap as excess metal.

Wernick and Themelis (1998, p. 3) share that:

> Though the practice of recovering metals for their value dates back to ancient civilizations, today, the protection of Earth's resource endowments and ecosystems adds to the incentive for recovering metals after use. Industrial society values metals for their many useful properties. Their strength makes them the preferred material to provide structure, as girders for buildings, rails for trains, chassis for automobiles, and containers for liquids. Metals are also uniquely suited to conduct heat (heat exchangers) and electricity (wires), functions that are indispensable to industrial economies.

> Finally, metals and their compounds are used for their chemical properties as catalysts for chemical reactions, additives to glass, electrodes in batteries, and many other applications. The basic and unique properties of metals, including the ability to work them into complex shapes (ductility), this insures that long term demand for metals will certainly grow.

In their conclusion on scrap metals, they continue to say that scrap metals will remain an integral part of future industrial society due to their unique and valuable properties. Decades of increased productivity and more efficient technologies for metals production and use has diminished the share claimed by the primary and secondary metals industries in the US national economy. Nonetheless, metals appear in every rung in the ladder of value addition in the manufacturing base and are ubiquitous in the everyday activities and industrial backbone that supports modern economies. Because of the centrality of metals in industrial and consumer artefacts, improving resource efficiency and reducing losses in the metals sector cannot help but influence positive environmental change throughout the fabric of industrial society.

Socorro Luanco (2014) again explains that generally the pure metals are very difficult to obtain and also have not interesting mechanical properties. That is why, in most cases, are found with some impurities which give them more mechanical resistance.

He further illustrates some of the general properties of scrap metals:

Tenacity: The ability to support impacts without breaking. Metals are tenacious.

Ductility: The ability to form threads.

Malleability: The ability to form sheets.

Hardness: Scratch resistance. Metals are relatively hard materials.

Density: The quotient of the mass and volume of a form.

Electrical and thermal conductivity: Metals conduct heat and electricity well.

Metallic shine: Metals characteristically shine after being recently cut (before oxidation). Except mercury all metals are solid at room temperature.

Physical properties of Scrap metals

According to Army Institute for Professional Development (AIPD) (1985) these properties are related to the atomic structure and density of the material. They are coefficient of linear expansion. The coefficient of linear expansion is the increase in length of a body for a given rise in temperature. The increase is the changed length of a rod for each degree that the temperature is increased. Metal expands when heated and contracts when cooled. It increases not only in length, but also in breath and thickness. The increase in unit length when a solid is heated one degree is called the coefficient of linear expansion. They have heat and electrical conductivity. That is the ability of a material to conduct or transfer heat or electricity. Again, they possess magnetic susceptibility where the ability of a material to hold a magnetic field when it is magnetized. They are reflectivity. Reflectivity is the ability of a material to reflect light or heat. They also have

specific gravity as the ratio of weights between two objects of equal volume, one of which is water. Lastly their melting point is the temperature at which a substance passes from a solid state to a liquid state.

Helmenstine (2015) hints that metals are solid at room temperature (except mercury) which is the only liquid metal at room temperature. They have high melting and boiling points, good conductors of heat and electricity and are malleable, ductile, hard, and sonorous. Malleability is the ability of a metal to withstand hitting without shattering. This is why metals can be formed into various shapes and forms even when cold without breaking into lots of pieces. Ductility on the other hand is the ability of metal to be stretched very thinly without breaking hence the reason why they can be drawn out into wire. Metals are opaque and have high density thus sink when dropped into water.

Chemical properties of Scrap metals

According to Kreith and Goswani (2004) metals are usually inclined to form cat ions through electron loss, reacting with oxygen in the air to form oxides over changing time span; iron rusts over years whiles potassium burns in seconds. Metals have one to four valence electrons, have low ionization potential, readily lose electrons and are good reducing agents. He further stated that the transitional metals such as iron, copper, zinc and nickel take much longer to oxidize whiles gold, platinum and palladium do not react with the atmosphere at all. Some other metals such as Aluminium, some steels, and Titanium form a barrier of layer of oxide on their surfaces which cannot be penetrated by further oxygen molecules and thus retain their shiny appearance and good conductivity for a long time.

Mechanical properties of Scrap metals

AIPD (1985) again explains that the mechanical strength of a material is the property of resistance to external loads or stresses while not causing structural damage. Ultimate strength is the unit stress, measured in pounds per square inch, developed in the material by the maximum slowly applied load that the material can resist without rupturing in a tensile test. The strength of metals and alloys depends upon two factors: the strength of the crystals of which the metals are constructed, and the tenacity of adherence between these crystals. The strongest substance known is tungsten molybdenum; titanium and nickel follow in order of strength of commercially pure metals. Pure iron is much weaker, but, when alloyed with the chemical element known as “carbon" to make steel, it may then become stronger than any of the pure metals except tungsten.

It further discusses the strength and plasticity of metals as are considered the two most important properties that a metal can possess.

a) ***Tensile Strength*** – Tensile strength is the ability of a metal to resist being pulled apart by opposing forces acting in a straight line. It is expressed as the number of pounds of force required to pull apart a bar of material 1 inch wide and 1 inch thick. The tensile test is the one most often used to measure the strength of metals. Pure molybdenum has a high tensile strength and is very resistant to heat. It is used principally as an alloying agent in steel to increase strength, hardenability, and resistance to heat.

b) ***Shear Strength*** – Shear strength is the ability of a material to resist being fractured by opposing forces acting in a straight line but not in the same plane

c) ***Compressive Strength*** – Compressive strength is the ability of a material to withstand pressures acting on a given plane.

It continues to say that mechanical properties of metal have the following qualities:

Elasticity – Elasticity is the ability of material to return to its original size, shape, and dimensions after being deformed. Any material that is subjected to an external load is distorted or strained. Elastically stressed materials return to their original dimensions when the load is released, provided that the load is not too great. Distortion or deformation is in proportion to the amount of the load, up to a certain point. If the load is too great, the material is permanently deformed, and, when the load is further increased, the material will break. The property of regaining the original dimensions upon removal of the external load is known as elasticity.

a. The elastic limit is the point at which permanent deformation begins.

b. The yield point is the point at which a definite deformation occurs with little or no increase in load.

c. The yield strength is the number of pounds per square inch required to produce deformation to the yield point.

Modulus of Elasticity- The modulus of elasticity is the ratio of the internal stress to the strain produced. It expresses the stiffness of a material. For steel

and most metals, this is a constant property and is affected very little by heat treatment, hot or cold working, or the actual ultimate strength of the metal.

According to Hooke's Law: "The degree to which an elastic body bends or stretches out of shape is in direct proportion to the force (stress) acting upon it." But, this law only applies within a certain range. This goes to confirm (Fitzpatrick, 2006) assertion that the force *f* that the spring exerts on the mass is directly proportional to its extension, and always acts to reduce the extension.

Ductility-Ductility is the capacity of a material, such as copper, to be drawn or stretched under tension loading and permanently deformed without rupture or fracture. Specifically, the term denotes the capacity to be drawn from a larger to a smaller diameter of wire. This operation involves both elongation and reduction of area.

Malleability- Malleability is the property of a metal to be deformed or compressed permanently without rupture or fracture. Specifically, it means the capacity to be rolled or hammered into thin sheets. The property of malleability is similar to but not the same as that of ductility, and different metals do not possess the two properties in the same degree. Lead and tin are relatively high in order of malleability; however, they lack the necessary tensile strength to be drawn into fine wire. Most metals have increased malleability and ductility at higher temperatures. For example, iron and nickel are very malleable when heated bright red.

Plasticity- Plasticity is the ability of a metal, such as gold, silver, or lead, to be deformed extensively without rupture. This property, together with strength, is considered to be the two most important properties that a metal can possess.

Toughness- Toughness is a combination of high strength and medium ductility. Toughness is the ability of a material or metal to resist fracture, plus the ability to resist failure after the damage has begun. In short, a tough metal, such as a cold chisel, is one that can withstand considerable stress, slowly or suddenly applied, and that will deform before failure. Toughness has been defined by some metallurgists as having the property of absorbing considerable energy before fracture and, therefore, involves both ductility and strength. Toughness is a measure of the total energy absorbing capacity of the material, including the energy of both elastic and plastic deformation under a gradually applied load. Generally speaking, toughness applies to both strength and plasticity. Thus, a very easily deformed substance of low strength would not be considered tough, nor would a material of high strength, but with little plasticity, such as hardened tool steel. The true tough metal is one that will rapidly distribute within itself both the stress and resulting strain caused by a rapidly applied load.

Brittleness- The term "brittleness" implies sudden failure. It is the property of breaking without warning; that is, without visible permanent deformation. It is the reverse of toughness in the sense that a brittle piece of metal has little resistance to rupture after it reaches its elastic limit. Brittleness can also be

said to be the opposite of ductility, in the sense that it involves rupture with very little deformation. In many cases, hard metals are brittle; however, the terms should not be confused or used synonymously.

Corrosive Resistance- Corrosive resistance is the resistance to eating away or wearing by the atmosphere, moisture, or other agents, such as acid.

Abrasion Resistance- Abrasion resistance is the resistance to wearing by friction.

Fatigue- When metal is subject to frequent repetitions of a stress, it will ultimately rupture and fail, even though the stress may not be sufficient to produce permanent deformation if continuously applied for a relatively brief time. Such a repetition of stress may occur, for example, in the shank of a rock drill. Alternation of stress will produce failure more rapidly than repetition of stress. Alternations of stress mean the alternate tension and compression on any material. The definition of fatigue is the failure of metals and alloys that have been subjected to repeated or alternating stresses too small to produce a permanent deformation when applied statically.

Corrosion Fatigue- Failure by corrosion fatigue is a fatigue failure in which corrosion has lowered the endurance limit by the formation of pits which act as centres for the development of fatigue cracks. Moreover, when any protective film that has been placed on the metal is broken by fatigue stresses, corrosion spreads through the cracks in the film and produces pits which act as stress raisers. If a metal member exposed to fatigue is also exposed to corrosive agencies, such as a damp atmosphere or oil that has not

been freed from acid, the stress necessary to cause failure is lowered. It is interesting to note that the unit stress of an extremely strong heat treated alloy steel that is subjected to corrosion fatigue will be no greater than that of a relatively weak structural steel. The importance of protecting the surfaces of fatigue members against corrosion by galvanizing, plating, etc., is obvious.

Machinability- Machinability is the ease or difficulty with which a material lends itself to being machined.

Hardness-Hardness is the ability of a material to resist penetration and wear by another material. It takes a combination of hardness and toughness to withstand heavy pounding. The hardness of a metal is directly related to its machinability, since toughness decreases as hardness increases.

Scrap metals and Environment sanitation

The importance and practice of scrap metal activities on the environment to the development of the country cannot be overemphasized. Scrap metals pose two critical issues concerning the environment. One issue is that, it poses danger on the environment by contaminating water bodies and the atmosphere. Secondly, illegal scrap metal businesses have gained grounds and have also led to theft and shortage of raw materials for the local metal industries.

According to Clean up Australia limited of New South Wales (2009) scrap metal that has been dumped such as car bodies and obsolete farm machinery can contain many toxic chemicals that can leach into the environment. These include oil, petrol and diesel, battery acids, transmission and brake fluids plus radiator coolant.

Scrap metal can also create safety and fire hazards. Sharp jagged edges of rusting metal can injure bushwalkers and wildlife while chemicals within car bodies like petrol tanks can cause bush fires. This fact ascertained the first concern expressed by the researcher on scrap metal and its position on the environment.

Wernick and Themelis (1998) again elaborate introduction to recycling scrap metals for the environment that scrap metals play important part in modern societies and have historically been linked with industrial development and improved living standards. Society can draw on metal resources from Earth's crust as well as from metal discarded after use in the economy. Inefficient recovery of metals from the economy increases reliance on primary resources and can impact nature by increasing the dispersion of metals in ecosystems.

In Ghana, Sekondi/Takoradi basically, scrap metal trade has proven and continued to exist among individuals due to its monetary value through all these years. These raw materials do pose so much danger to the environment. There are scrap metal scavengers all over the place who hunt and sell scraps for money.

This practice has contributed largely to theft in metal cables and exportation of ferrous scrap metals. Addressing this issues Government has placed a ban on exportation of scraps. In 25 March 2013, Ghana joined nations in the sub-regions who banned exportation of ferrous scrap metals in order to feed their respective local steel industries.

Arguing the next issue, Iddrisu (2013) points to the fact that "Government has no intention of reviewing the ban on export of ferrous scrap, and will enforce the law religiously".

This brings to bare how serious the government has vowed to deal with miscreants of the law concerning scrap metals exportation. Looking artistically at scrap metals, it is the creative and innovative composition of found parts of metals into a work of art. This part reviews metals and its finishes, properties associated with the general concern of physical, chemical and mechanical properties of metals which basically supports scrap metal art as different found metals are put together to form an art piece. Scrap metal art, immensely, has been created towards aesthetic purposes but much has not been proven towards the promoting of environmental sanitation. With this view, artist can contribute their quota in promotion of sanitation as well as managing the environment by getting into scrap metals. Figure 2.4 shows scrap metals on the environment within Sekondi/Takoradi.

Figure 2.4 *Scrap metals in Sekondi/Takoradi (Source: Researcher, 2014)*

Looking at the scrap metals and environmental sanitation, environmental sanitation is every countries concern and pride. The efficiency of every country's development is steered on good conducive environmental planning and management.

The Ministry of Local Government and Rural Development (MLGRD) (1999) on Ghanaian national environmental sanitation policy says environmental sanitation is an essential factor contributing to the health, productivity and welfare of the people of Ghana. It is identified in Ghana's programme of economic and social development set out in "Vision 2020" as a key element underlying health and human development. The programme also identifies environmental protection and the improved management of human settlements as key factors in rural and urban development.

Ascertaining this fact, Earth Summit (1992) on UNCED shares that "As the global economy grows, developing countries all over the world are urbanizing at an alarming rate. Although urbanization is the driving force for modernization, economic growth and development, there is increasing concern about the effects of expanding cities, principally on human health, livelihoods and the environment".

In relations to environment, Barrow (1995) defines environment as "The sum total of conditions within which organisms live. It is the result of interaction between living (biotic) and nonliving (abiotic) parameters". Environment is the surroundings, which contains living and nonliving thing concerning its ecological factors.

Involving it to sanitation, Nyamwaya (1994) defines sanitation as the proper disposal of human waste. It includes keeping the human environment free of harmful substances that can cause diseases. Therefore, the pleasant physical environment in all human settlements, sanitation refers to the process of making or protecting health issues by maintenance of sanitary conditions. It also involves keeping the human environment free from disease causing trajectories through the proper disposal of domestic, street wastes and litter as well as wastewater.

Talking about environmental sanitation, solid and industrial wastes such as scrap metals both ferrous and nonferrous play part in environmental waste issues. The Ministry of Local Government and Rural Development (MLGRD) (2010) on national environmental sanitation strategy and action policy plan states that:

> For solid wastes, the 2000 Housing and Population Census reports that on the national level, 4.8% of households have their waste collected directly from their dwelling, 7.9% burn their household refuse, 57.6% use various household receptacles for storage and send it to designated public dumps including communal-container stations or sanitary sites. It is reported that 25.9% of households dump their refuse at unspecified locations including vacant lots, drains, embankment of water courses, rivers, lakes and wetlands. From data collected in 2008 by MMDAs for the preparation of DESSAPs more than 70% of residents resort to indiscriminate means of disposing of their refuse. Available data for Ghana's five largest cities show that collection and transport ratios (waste

> collected and transported to disposal/waste generated) for refuse is gradually improving over the last few years - Accra 70%, Kumasi 75%, Sekondi-Takoradi 60%, Tamale 55% and Tema 68%. 46. The poor disposal of refuse both in communities and its management at final disposal sites remain a bottle-neck faced by all MMDAs. Crude, open dumping is the practice in almost all communities. In the few cases where controlled-dumping is practiced, environmental impact whether immediate or long-term are ignored. Implementing improved site management procedures is therefore, often only in reaction to public outcry and threat of closure of operations by nearby communities (p 21).

The importance of proper environmental sanitation brings sound mind to every individuals who works towards national development. On essential benefits of environmental sanitation Njie (2013) brings to limelight that:

> The importance of sanitation cannot be over outlined, but it involves both household and environmental sanitations. Household sanitation also involves household food safety, and the maintenance of clean living conditions which do not promote the spread of disease. This includes general cleaning in our places where we keep food. Other areas of specialty can include environmental sanitation, which involves limiting environmental contributors to the spread of disease, commercial food safety in facilities like restaurants and farms, and hospital safety. This can

> also include isolating wells to prevent them from being contaminated, securing water supplies from outside the community, and developing a safe network of pipes to deliver water to residents. Sanitation departments must also concern themselves with garbage. Most urban areas have a garbage collection service, allowing citizens to set out their garbage on a specific day for teams of collectors who will gather it and deliver it to a processing facility (observer.gm).

Bentum (2013) as a sculptor and art philosopher says that as a meaningful contribution to the world of art, his carvings of tree trunks and branches address the issue of environmental cleaning in another dimension.

He therefore postulates that:

> Nature continually inspires artists to undertake environmental cleaning through careful selection of materials (tree trunks and branches) as raw materials for art production. Although these tree trunks and branches are scientifically taken care of by nature as a bio-degradable materials, their continuous stay on the street side and backyards is hazardous to humanity. They may also serve as abodes to reptiles and lunatics. They have gradually become a point of convergence for today's menace caused by plastic waste. Therefore their identification and collection as raw materials for art production may by itself serve as a mode of cleaning the

environment as well as preventing it from becoming the collection point for fly up and light weight non-degradable waste (p 1 & 2).

In relation to his view, where individual gathers their wastes also hoard. This is an increasing nuisance for heavily populated areas like scrap yards which carries risk of infectious disease, particularly to vulnerable groups such as the very young, the elderly and people practicing the trade. All these mean daily contact to an unpleasant environment. Solid or industrial wastes like metals can artistically be shaped into scrap metal art as in progress of environmental sanitation by improving health of its environs.

Scrap metal art /Artists

Scrap metal art is the creative composition of found metal objects into sculpture piece. Found metal objects are mostly seen in our environment such as junkyards. Artistically, scrap metal art is form by composition of found metals in the environment through methods and techniques like welding, riveting, gluing and tying. Many sculptors like John Lopez, Alexander Calder, Alexander Rodchenko, Julio Gonzalez, Anthony Caro, Micajah Bienvenu, Lee Kelly, Rudy Kehkla, Jeremy Mayer, Miran Elbakyan, Alex Kveton, Wanssi Massimo, Abu-Bakarr Mansaray and others have used metals for numerous reasons. They include aesthetics and expressions of certain ideas and philosophies in their sculpture pieces. Attraction of creating something of unique value from scrap metals is what has motivated many sculptors, metal artisans like welders to explore into new form of art called scrap metal art. Most of the great scrap metal artists are the ones who have been welders for a long time.

Scrap metal art is the activities that require a complete focus and vision. Artists create scrap metal art with a grand imagination. The raw material used in the making of those pieces of art is toted back to the home from the local yards. These rusted metals are sterilized and the old deposited on them is burnt off. Then these metals are manipulated into such beautiful Life Size Sculptures. Scrap metal art is gaining so much popularity in the world for the matter Africa. It is widely known and practiced by a large number of artists around the world. Rusted pieces of junk can be turned into amazing works of art. There are innumerable artists in Africa who work with recycled materials, metals, plastic, paper etc. among them some distinguished sculptors such as Romuald Hazoume of Benin, Bertiers of Kenya, Abu Bakarr Mansaray of Sierra Leone, Patrick Mulondo of Uganda, Wanssi Massimo of Ghana and Olu Amoda of Nigeria.

Talking about scrap metal artists in Ghana, Akwei (2015) espouses that the creative arts industry in Ghana receives the least of attention from policy makers and the public who have lost interest in the art hence killing the talents of many creative artists at the expense of the performing arts. In Accra, the only place that comes to mind when creative artworks are needed is the Art Centre of the Centre for National Culture, where there is a pool of creative artists who mostly display their works to foreign nationals from Europe and America. One creative artist who refuses to let the industry die out in its misery is sexagenarian scrap metal sculptor, Wanssi Massimo, who displays his sculptures in a pavement garden at Abelenkpe Junction, off the Olusegun Obasanjo Way in Accra.

Massimo, who hails from Nkonya in the Volta Region, believes art should be a consequential part of nature and his philosophy got him to secure the Garden Gallery which is under a tree with the greenery projecting the message his works convey. Born on October 22, 1954, Wanssi Massimo calls himself an 'Art Prophet' because according to him, everything he touched from infancy, turned into art. Massimo, who has lived in many African countries including Tanzania and Togo says his quest in life is to demystify art as many Africans still relate it to sorcery. Before opening up the Green Gallery in 2014, Massimo displayed his scrap metal sculptures in galleries across the country as well as exhibitions worldwide. He has participated in exhibitions in Togo, Nigeria, Benin and the United States of America where he believes the market is more in tune with the art than Ghana.

The 'Art Prophet' says Ghana has no art market, attributing the failure in that regard to the walls built around art works in the country which makes it difficult for people to see and express an interest. "People cannot even get close to beautiful artworks created from the environment which is locked up in galleries. As soon as they take a peep through the glass windows, they refrain from entering with the notion that it is expensive. Art is priceless," he said. Massimo explains that the only market in the country for creative artworks is for expatriates who know the worth of art but, unfortunately, buy in seasons. He believes the appreciation level is very low in Ghana. At his gallery, you will find beautiful fabrications made of scrap metal either shaped in human forms performing activities like drumming; or animal forms like the snake and giraffe.

The giraffe, for example, has its mid-section made up of a small gas cylinder and its head made of some bolts and nuts. Massimo chooses to leave the meanings of each sculpture to the eyes and mind of each observer to decipher according to their state of mind. The scrap metals, he said, are handpicked by himself at the Agbogbloshie and Gallaway markets in Accra where most of the scrap metals from the city are disposed of. He then takes them to his workshop cum residence at Alajo where it takes days or weeks to mould depending on the inspiration he has. He credits his wife of 33 years and four daughters for his inspiration as he always involves them in selection of what to be fixed where, with the aim of depicting natural situations that will create a story in the mind's eye. Wanssi Massimo started his display of sculptures at the pavement garden with one sculpture some two years ago. His motive was to observe the natural reaction of people who saw it; surprisingly, it was positive.

The responses got him to add other sculptures to the open-air gallery which led him to secure a license to legally occupy the pavement garden with his works. Aside beautifying the area, the gallery feeds himself and his family exclusively. As long as there are people like Wanssi Massimo, creative arts will live on. Figure 2.5 and 2.6 show some works of Wanssi Massimo.

Figure 2.5: *Massimo's work I*

Figure 2.6: *Massimo's work II (Source: Akwei, 2015)*

Looking at scrap metal artists beyond Ghana, Abu-Bakarr Mansaray born in 1970 Tongo, Sierra Leone, lives and works in Harlingen, Netherlands has made impact through his works of art.

Pigozzi (2008) documents story on Mansaray that Sierra Leone is one of the poorest countries in western Africa; in choosing a career as an artist Mansaray has laboured to stem the collapse of a nation drained by civil war. After leaving school in 1987, he settled in Freetown, where he became a voracious autodidact, studying all aspects of practical science and engineering. He revived a technique especially popular in central Africa of manufacturing decorative objects or toys out of wire and iron. But he applied an extreme form of this technique to build futuristic machines for extravagant purposes, creating contraptions that could produce fire, light, air, water, cold, motion, and sound. He is an artist making creations without limitation. He does drawings, paintings, sculptures . . . he also invent machines for my own use at home and sometimes for other people, he has proclaimed.

Mansaray's preparatory drawings also stand as independent artworks. These studies consist of detailed calculations, sketches, diagrams, and commentaries executed in pencil, ballpoint pen, and crayons. He likes doing strange, complicated drawings and designing intricate machines inspired by scientific ideas that are at times beyond the human imagination (for example, the machines he designed called Hell Extinguisher and Nuclear Telephone Discovered in Hell). . . . He wants people to feel the power of creation." No doubt the economic, political and social situation in Sierra Leone, a country where war has left behind nothing but ruins and charred bodies, has shaped Mansaray's imagination and the inspiration. In 1998 he managed

to escape his country under extremely difficult circumstances; however, his work continues to bear witness to the horrors of war.

Figure 2.7 shows Mansaray's work titled Sumanguru III.

Figure 2.7: *Sumanguru III (Source: Pigozzi, 2008)*

Patrick Mulondo also explores scrap metals for his sculpture works. Mulondo's sculptures explore the current trend of up-cycling, using metal scrap together with cast fibre glass to give old, found objects an entirely new and extraordinary life.

African Artbeat (2015) probes that Patrick Mulondo was born in 1989, the Ugandan artist graduated from Makerere University, where he majored in sculpture modelling and carving, and jewellery making. His sculptures explore the current trend of up-cycling, using metal scrap together with cast fibre glass to give old, found objects an entirely new and extraordinary life. His works are designed to be highly interactive and prompt viewers to question the reality of what they see.

Upon his artist's statement he shares that the challenge of creating an unequalled piece of art from flung metal parts, with the aim of recycling, is the task ahead in my career. He wants to give new life to the already-flung household and industrial scrap that he finds. His projects concern experimenting with scrap metal to solve the problem of its disposal yet communicating its beauty. He asked himself many questions: How far can sculptors contribute to recycling in society today? How can he, as a sculptor, develop sculptural concepts using scrap? What will the public response be towards this idea? Mulondo participated in making of The Journey Monument, an art piece commemorating Uganda's Golden Jubilee. His work, Sculptural body Adornment 2013, graces Makerere University. Mulondo has participated in an on-going group exhibition at Diani Beach Art Gallery, Kenya. He is currently developing concepts for the commemoration of the 20-year civil war in Northern Uganda, which ended in 2006. The Lord Resistance Army (LRA), a paramilitary group led by Joseph Kony, had committed atrocious crimes in the region. With sculptural means, Mulondo wants to explore the tragic effects of the war on the communities in the Gulu region, and show how they are rebuilding their lives. Mulondo has been part of group exhibitions at various galleries in Uganda in Kenya. In 2014 he had a successful solo exhibitions at the American Embassy in Kampala, Uganda, and in Diani Beach, Kenya. He is the only Ugandan artist chosen to be in the Kenya Artist Diary for 2015. Figure 2.8 shows one of his works titled Bevo, mixed recycled metals.

Figure 2.8: *Bevo, mixed recycled metals (African Artbeat, 2015)*

Joseph Bertiers Mbatia is both a brilliant painter and sculptor. He's also an authentic Kenyan with a kind heart and uproareous sense of humour.

Margaretta (2012) writes that ever since he won the first juried art competition jointly organised by the Alliance Francaise and the Goethe Institute in 2006, the jovial genius of the Kenyan sculptor-painter from Dagoretti, Joseph 'Bertiers' Mbatia has become a global celebrity. The juried prize was the first of many trips he's taken to Europe and beyond. That first one took him to Germany and France, visiting museums and art galleries in Berlin, Frankfurt and Paris. He even had a major exhibition of his art in Heidelberg. But even then, his preference was for Kenya and that kept him grounded and guileless. Since then, Mbatia went to Scandinavia several times as well as to the UK, US and West Africa. But he is definitely a 'homeyan' at heart, the kind of who admits he gets the most inspiration for his art from ordinary Kenyans living their everyday lives. It's a reality that one

can easily see in his exhibition of picturesque paintings and scrap metal sculptures currently at OneOff Gallery.

Mbatia has a gift for translating the energies, issues and absurdities of everyday Kenyan life into colourful and complex visual feasts that one can study for hours just to get all the jokes, juxtapositions and garrulous genius of Kenyans making do in their daily lives. For instance, a painting like 'Domestic Violence' graphically depicts the issue that's the current talk of town, that of women beating up their men. It's no laughing matter, but Mbatia's gift for making satire into a visual art allows his painting to convey the broader picture of the whole problem women have with the men of Kenya today. He does the same thing in his scrap metal sculptures. For instance, his 'Vision 2030" makes a powerful statement about how he doesn't see the vision materialising into anything new. His monumental metallic matatu looks no different from those on the roads today except for far the fact that it's more encumbered and crowded.

The artist admits he has a few paintings at OneOff which he has shown in earlier shows, such as 'Stupidity never goes out of style' which reveals the raucous style of humour that runs through most of Mbatia's art. The show seems slightly Spartan, which could be because Mbatia's work currently features in not one but three exhibitions: one in Nairobi, another in London and a third, in Denmark, where his art is part of a group exhibition entitled "Power and Light" which is travelling all around the country through July. He was also recently featured in another group show at the Michael Joseph Centre entitled 'Zebra in Red Heels'.

Another reason Mbatia does not have more artworks at OneOff is because he handed over a dozen art works to a British art dealer who successfully sold four of them to the renowned African art collector Jean Pigozzi. The other eight were exhibited in the Fred Mann Gallery in London. Mann sold four paintings during the big Art Basel showcase in Switzerland back in June 2011. Figure 2.9 shows Bertier's work titled the Country Bus.

***Figure 2.9**: Joseph Bertier Mbatia's Country Bus sculpture (Margaretta, 2012)*

In Egyptian Scrap metal art, Sultan (2012) brings to forth that it takes only a few old pieces of metal and welding tools and most importantly, talent and creativity to reshape things from a different and unusual perspective. Solid iron bars can turn into the limbs of a chimera. Rusted metal chips and pieces may become wings or structural elements in abstract forms. Heads of horses are "born" from the remaining parts of an old car or abandoned metal tools.

Everything depends on the ability of the artist to innovate, and come up with different visions for these pieces of metal. This idea formed the basis of Cairo's first

scrap-iron sculpture symposium, in which ten Egyptian artists participated, including Ahmed Abdul Fattah, Ahmed Moussa, Asaad Saeed Farhat, Tarek al-Kawmi, Taha Nasser, Abdo Ramzy, Ola Moussa, Kamal al-Feki, Hani al-Sayyed and Hisham Abdullah. Over the course of several months, the participants turned the garden of the Mukhtar Museum into an open workshop to make art out of scrap iron. Iron cans, rods and other metal remnants were the only tools in the artists' hands. The symposium is the first exhibition dedicated to this type of art in Egypt, even though iron sculpting has existed in the country since the 1920s. This art form has been practiced by many Egyptian artists, most notably Salah Abdel-Karim, who was honored during the event. Pictures of some of his works were printed on T-shirts worn by participants during the symposium.

Abdel-Karim is a prominent artistic figure in Egypt and the founder of this type of sculpting. He was born in 1925 and died in the mid-1980s, leaving behind a large body of work in the fields of sculpture and photography. Abdel-Karim began sculpting using scrap iron in the 1950s, after receiving an honorary prize at the Sao Paulo Art Biennial in 1959. Afterward, he received many other awards, both in Egypt and internationally, and with them, international recognition in this field.

His works are exhibited at the Egyptian Museum of Modern Art and other places affiliated with the Egyptian Ministry of Culture. Egyptian art critic Sobhi al-Sharoni told Al-Monitor of Abdel-Karim's works, "Abdel-Karim took the art of scrap iron sculpting to an entirely different and unprecedented level among contemporary and old artists. He opened up new avenues for liberation and renewal.

His sculptures abided by the laws of aesthetic balance and harmony between blocks and blanks. They are mostly diagnostic works." Sharoni added, "His style was characterized by a deep understanding of the raw material and achievements made in the world of art. They expressed the inclination toward manufacturing in Egypt after the July 23 revolution, as iron was a stark symbol of it. His statues of superstitious animals mainly expressed the estrangement felt by modern men and their horror of weapons of mass destruction".

Figure 2.10 shows AbdoRamzy is an Egyptian artist known for his metal sculptures.

Figure 2.10: *Abdo Ramzy's Scrap Metal work (Source: artistabdoramzy.com, 2012)*

Again looking at scrap metals beyond Africa, Will Wagenaar, John Lopez and others are have created sculptures of differents sizes and forms with scrap metals.

InspirationGrid (2014) reviews that the Florida-based artist Will Wagnaar creates curious robot machines out of recycled materials. He constantly searches scrap yards and markets for discarded objects that he transforms into playful work of art. Wagnaar's robot sculptures, all recycled and bottled together, seem at once antique and futuristic. The figure 2.11 shows work of Will Wagenaar.

Figure 2.11: *Robot by Will Wagenaar (Source: Inspirationgrid, 2014)*

John Lopez has been another promising scrap metal artist who welds giant's outsized beasts including a triceratops being ridden by a cowboy from scrap he salvaged from abandoned farm machinery.

Julija (2014) expresses that the South Dakotan sculptor John Lopez creates life-sized scrap metal sculptures with a uniquely Western American twist. In his hands, old discarded farm equipment is recycled into sculptures of iconic creatures from the American West like a bison, a horse ploughing a field or a Texas Longhorn. Lopez already had a career as a bronze sculptor, but after creating a

family grave for his deceased aunt using scrap metal, he began creating recycled metal sculptures out of found or donated pieces of metal as well. Figure 2.12, 2.13, 2.14 and 2.15 show some works of John Lopez.

***Figure 2.12**: Bison by John Lopez (Source: Julija, 2014)*

***Figure 2.13**: Texas Longhorn by John Lopez (Source: Julija, 2014)*

Figure 2.14: *Horse by John Lopez (Source: Julija, 2014)*

Figure 2.15: *Iron Star (Horse) by John Lopez (Source: Julija, 2014)*

CHAPTER THREE

METHODOLOGY

Overview

This chapter focuses on Research Design, Population for the Study, Sample/Sampling Technique, Method of Data Collection, Data Collection Instruments, Data Analysis Plan, Tools and Materials, Skills and Procedures for the Execution of Work.

Research Design

Being a studio-based research, the descriptive and aesthetico-action research designs were adopted for this study. These research designs were focused on individual experiences as well as human interaction that allowed the researcher to investigate the scrap metal situation within Sekondi/Takoradi metropolis and assess the possible environmental risks associated with them. These research designs were chosen to analyse scrap metals as material for aesthetic and artistic expression and to produce and document scrap metal art as means of promoting environmental sanitation. These were chosen because they provided a systematic way of looking at events, collecting data, analysing information and documenting results. They were used to narrow down a very broad field of research into one easily researchable topic.

The adoption of qualitative research approaches was to situate this study around those that do not quantify their results through statistical summary or analysis. It studies typically involve interviews and observations without formal measurement (Marczyk et al, 2005).

In studio-based research, aesthetico-action research is a cyclic, open-ended, active process that involves observing, reflecting, planning, acting, observing and reflecting. When creating art, one explores possibilities in sketchbooks, on storyboards, on the computer screens, or in our mind about what one is going to do. The process is reflexive and includes cycles of creating—observing—reflecting—creating that occur simultaneously (Marshall, 2010).

The combination of qualitative and studio-based research approaches was therefore used to gather information for data analysis and again documenting the techniques and procedures for executing scrap metal art. The research approaches employed various methods, strategies, techniques and procedures to obtain relevant information to provide answers to questions posed and assisted in drawing suitable conclusions after the data had been analysed.

This is in conformity with the aim of this research, which is to explain some kind of causation factors of scrap metals and helps to improve our everyday lives when working with them. This method was chosen to produce scrap metal art with the view to manage environmental sanitation.

Population for the Study

The study focused on Metal artists/craftsmen, scrap metal dealers/scavengers, Environmental Agencies, Art lecturers and students at the Sekondi/Takoradi metropolis. Population for the study was the total collection of elements about which the researcher made some inferences. The study located scrap metals dealers/collectors/scavengers at Assakae scrap metals near Obiri Junction, West Tanokrom scrap metal yard and Kokompe scrap metal and fitting yard within

Sekondi/Takoradi metropolis. Metal artists/craftsmen both lecturers, students and artisans formed part of the population.

Sample/Sampling Technique

Sampling is the process of selecting units (people, organization) from a population of interest so that by studying the sample the researcher may fairly generalizes the results back to the population from which it was chosen. In administering the questionnaire, purposive sampling technique was employed. Based on the researcher's knowledge and understanding, purposive sampling procedures enabled the researcher in handpicking individuals or groups who were of relevance to the subject under study. This method of data collection was appropriate because there were a predefined groups or specific groups in mind. The right individuals whom the researcher considered to have the facts and other resources useful to the research being conducted were contacted and this served as the sample size. The various groups of people interviewed, scrap metal yards and fitting shops visited were all selected from Sekondi/Takoradi metropolis. Among the places resorted for interviews were Assakae scrap metal yard, West Tanokrom scrap metal yard, Kokompe Scrap Metal yard/fitting shops, Sekondi Takoradi Metropolitan Assembly (STMA), Environmental Protection Agencies and Metal artists both art lecturers, students and artisans.

In view of this, 100 individuals were identified, 65 of whom questionnaires were administered. Twenty (20) individuals from the Assakae scrap metals, five (5) individuals from West Tanokrom scrap metal yard, five (5) individuals from Kokompe Scrap Metal yard/fitting shops, three (3) individuals from the STMA,

Environmental Protection Agencies, two (2) Metal scavengers from Sekondi, fifteen (15) Metal Artisans/craftsmen and twenty (20) Art lecturers and students from Takoradi Polytechnic. Thirty five (35) out of the 100 individuals identified were interviewed.

Method of Data Collection

Primary Data Collection

Primary data was collected through interviews and observations. These are data observed or collected directly from first-hand experience. The data collection methods employed for the research include observation, questionnaire and interview. The data collected were assembled, described, analysed, combined, interpreted, and evaluated; conclusions were drawn and recommendations were made. Photographs were taken to support claims and concepts were explained.

Secondary Data Collection

Secondary data was obtained from journals, books, articles, newsletters, magazines, the internet and published and unpublished materials. The researcher also obtained data from existing documents of related institutions and departments, some national and international records and experiences on scrap metals and environmental sanitation management to ensure that the research outcomes and experiences are logically explained. Information was gathered from the records of the Planning Office of the Sekondi/Takoradi Metropolitan Assembly, The Metropolitan Health Department, The Waste Management Department, The Regional Health Directorate, Effia-Nkwanta Hospital and Environmental Sanitation

Policy document from the Ministry of Local Government Rural Development (MLGRD).

Data Collection Instruments

The researcher employed observation, questionnaire and interview as research tools to collect data. The researcher employed participant observation through which interactions with experts pertaining to scrap metals and environmental sanitation was made. The respondents' concepts and attitudes towards scrap metals and environmental sanitation were recorded through the face-to-face oral interviews. In employing these approaches, people's opinions on scrap metal art and its future were noted. Apart from the interview, the researcher also used questionnaire research tools to collect data.

Observation

The study used observation that involved the systematic viewing of people's actions and the recording, analysis and interpretation of their behaviour towards scrap metals in Sekondi/Takoradi Metropolis. It was also a complex combination of sensation (sight, sound, touch, smell and even taste) and perception. This provided an opportunity to get beyond people's opinions and self-interpretations of their attitudes and behaviour towards an evaluation of their actions in practice of scrap metals.

According to Kothari (2004) observation implies the collection of information by way of investigator's own observation, without interviewing the respondents. The information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of

respondents. Observation is all about the researcher´s direct own observation without the involvement of respondents. There are two types of observation methods depending up on the observers sharing or not sharing in to the activities or the lives of the group under observation. These are the participant and non-participant observation. If the researcher takes part in to the activities of the groups that h/she observes, it is called participant observation. However, if the researcher chooses not to take part in to the group under observation, it is called non-participant observation.

Observation is used in qualitative research, it usually consists of detailed notation of behaviours, events, and the contexts surrounding the events and behaviours (Best, 2002).

The participant observation was adopted where the researcher observed and visited scrap metal dealers/scavengers who solely trade and sell them for livelihood at the selected areas in order to give consequential clarification to the problem pertaining to the study.

Questionnaire

Questionnaire is set of questions for obtaining information and given to people to gain statistical information. Usually questionnaires are set based on research questions set aside by the researcher. Such questionnaire was given to prospective respondents to fill (Singh, 2006).

Questionnaire was prepared and distributed for the purpose of securing responses. Generally these questions were factual and designed for securing information about certain conditions or practices of which recipient is presumed to

have knowledge. Interviews were conducted in the case where respondent could not read and write. In such cases, questions were called out sequentially to the respondents and the responds to the questions noted exactly as they communicated. The respondents were given the opportunity to freely respond to the questions asked. Explanations were given to respondents on items that were not clear or easy to understand. The essence of the questionnaire was to gather information from the targeted people already specified. This was prepared for target groups engaged in the formal and informal scrap metals collection or activities. This was found to be important in order to get qualitative data. The questions were mainly designed to collect the attribute data that is required to study the characteristics of scrap metals and its environmental attribution to sanitation in aesthetic dimension. In addition, some of the questions were designed to give information about the individual perceptions regarding the social, aesthetic, and environmental ties they have within their respective trade.

Interview

Interview chosen was verbal interaction conducted in which the interviewee gave the needed information vocally in the presence of the interviewer concerning the study.

According to Kothari (2004) investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews.

This method of collecting data was usually carried out in a structured way where output depends upon the ability of the interviewer to large extent. In the purpose of an evaluation, this method involved the interviewer and the interviewee.

In a direct verbal interaction, the interviewer asked the interviewee certain questions for response. The responses of the interviewees were noted and used later on. The interviewees in a point were given the opportunity of freedom to respond to the questions asked him or her.

The researcher used the interview method to collect information from the selected metal artists/craftsmen, scrap metal dealers/scavengers, environmental agencies, Art lecturers and students at the Sekondi/Takoradi metropolis. Interviews conducted were both done in English language and the local dialect (i.e. Twi). The local dialect made it easy for understanding and provided the correct responses since most of them neither understood nor could speak the English language. On the average, 30 minutes was spent on each respondent.

Data Analysis Plan

After accumulating information on scrap metal in relation to environmental sanitation in Sekondi/Takoradi metropolis, data collected from the questionnaire and personal interviews were analysed and interpreted using descriptive research design. The benefits of using descriptive research design were that, it allowed the researcher to describe and use words and photographs to represent all the individual scores in the sample. The questionnaire sheets and interviews were carefully scored and transferred for analysis. The total number of targeted groups was 100 but questionnaire were administered to a total of sixty-five (65%) respondents and thirty-five (35%) interview conducted in Sekondi/Takoradi metropolis. Regarding the qualitative data, an interpretive approach was used in which responses from respondents were unbiased to the questions as basis for researcher's description. For

the reliability and relevance of the output, the patterns and themes of the responses were seen as an important aspect. The descriptive research design was used to elaborate the activities on scrap metals. It helped the researcher to bring out how art can be used as a means of promoting environmental sanitation. It was also used to break up the whole information gathered into parts for easy interpretation and understanding of using words rather than numbers. This method was used in grouping the information gathered into categories for the purpose of discussions. The research method was also very useful in the study.

Also being a studio-based, aesthetico-action research procedures were followed to produce scrap metal art where methods, techniques and procedures were carried out by creative, cognitive, praxis and reflexive manner to substantiate the results of data gathered from the field into work of art.

Tools and Materials

Tools for this study comprised of hand implement or equipment. They were used in easy production and performance of task. Materials on the other hand, were physical substance of worldly nature of which the artefacts were composed or made. Materials come in two forms where one is organic and the other is inorganic. Organic materials are materials that can decompose and are naturally made. Example is wood. Inorganic materials are chemical or artificial substance containing less or no carbon substances. Example is metal. Purposely for the study inorganic materials were employed for the execution of work. The study made use of tools and materials which consisted of welding machine, car rims, metal square/round pipes, bolts and nuts, nails, spoon handles, spring fenders, copper wire, iron rods, anti-rust paint, electrodes, protective gloves, goggle and tools and equipment such as bolt

cutter, cold chisel and sledge hammer in the processes of fabricating the scrap metals.

Welding Machine

In executing the scrap metal art, welding machine was the device used which provided an electric current to perform welding. It required a low and high current which ranged between 80 amperes to 12,000 amperes in spot welding.

Welding two razor blades together at 5 amps with gas tungsten arc welding is a good example. Welding machines are usually classified as constant current (CC) or constant voltage (CV); a constant current machine varies its output voltage to maintain a steady current while a constant voltage machine will fluctuate its output current to maintain a set voltage.

The CC welding machine was used to join together metal parts by heating the surfaces to the point of melting and pressing or hammering them together. This process was much fortified and quite easier for metal parts to forge. Welding scrap metals together, the CC machine in which metal parts were heated and fused together at the melting point of the prescribed type of metal welded (Reference to melting point of scrap metals at Chapter Two).

Bolt Cutter

Bolt cutter tool was used in cutting metal rods, springs, bolts and other scrap metals for the construction of work. This bolt cutter, sometimes called bolt cropper, can be used for cutting chains, padlocks, bolts and wire mesh. This was used for working on big metals and it typically had long handle and small blade, with compound hinges to maximize leverage and cutting force. The bolt cutter yielded 20

kilo newtons (4,500 Ibf) of cutting force for a 250 newtons (56 Ibf) force on the handles.

Cold Chisel

Cold chisel made of tempered steel was used for cutting cold metals, meaning that they were not used in conjunction with heating torches and forges. It was used to remove waste metal when a very smooth finish was not required. It comes in variety of sizes, from fine engraving tools that are tapped with very light hammers, to massive tools that are driven with sledgehammers. There are four common types of cold chisel namely flat chisel, cross cut chisel, round nose chisel and diamond point chisel. The flat chisel was used in cutting metal plates and any others scrap metals to the exact shapes for construction of the work.

Sledge hammer

Sledge hammer tool was used to shape strong metals to the desire form as in appropriate and any given time when needed. It was used to apply more force when cutting the scrap metals for construction of the work due to its large size. Along with the mallet, it shares the ability to distribute force over a wide area. It had large, flat head attached to a lever (or handle). The head was typically made of metal as its specification suited the work.

Automobile engine parts

Car shocks or spindles, ball joints, sump pan, rotor (disk brakes), exhaust manifold, cam shaft, cam sprocket, ball joints, tire rims and parts of car engine made of different sizes were used as parts of features for the bull in the construction. This composition gave the work an outer edge of a wheel, holding the tire. It made the

composition up the rotors (disk brakes) made up of outer circular object or design of the wheel on which the inside edge of the legs on an axle, mounted below the ground such as automobiles. For example, on a bicycle wheel the rim is a large hoop attached to the outer ends of the spokes of the wheel that holds the tire and tube. Spindles or shocks were used with iron rod for enforcement of the work. It is a spiral shaped metal that serves as a protective device or guard over the wheel of an automobile. This made such effect on the thighs of the work. The cam shaft of automobile engine was used for the legs of the bull giving it a proper grounding to stand on. The sump pan for the head and the exhaust manifold for the tail.

Bolts and Nuts

Bolts are fasteners often used to make a bolted joint. This was used as a combination of the nut applying an axial clamping force and also the shank of the bolt acting as a dowel, pinning the joint against sideways shear forces for construction of the scrap metal art. For this reason, many bolts had a plain unthreaded shank as this makes for a better dowel. Bolts has a wide variety of head designs. These were designed to engage with the tool used to tighten them. Some bolt heads instead lock the bolt in place, so that it does not move and a tool is only needed for the nut end. Head designs that overlap both are the Allen and Torx heads; hexagonal or splined sockets. These modern designs span a large range of sizes and can carry a considerable torque. A nut is a type of fastener with a threaded hole. The two partners are kept together by a combination of their threads' friction, a slight stretch of the bolt, and compression of the parts. In applications where vibration or rotation may work a nut loose, various locking mechanisms may be employed: Adhesives, safety pins or lock wire, nylon inserts, or slightly oval-shaped threads.

The common shape was hexagonal, for similar reasons as the bolt head - 6 sides were used to give a good granularity of angles. Combination of these bolts and nuts were used artistically by considering its designs and its effects it had.

Iron Rod

Iron rod also refers as wrought iron, a non-ornamental iron used in building and heavy construction. Wrought iron that had an iron alloy with a very low carbon (0.04 to 0.08%) content in contrast to cast iron (2.1% to 4%), and had fibrous inclusions 2% by weight was used for the constructing framework or armature. This material was used as reinforcement for the construction of the scrap metal work and has a semi-fused mass of iron with slag inclusions which gives it a "grain" resembling wood that was visible when it was etched or bent to the point of failure. It was tough, malleable, ductile and easily welded.

Anticorrosive Paint

Anticorrosive paint was a substance used to spread over the surfaces which left a thin decorative or protective coating on the scrap metals. Anticorrosive is a kind of thin adherent coating use for the treatment of metals against corrosion. This substance was used together with air compressor for spraying and treating scrap metal art surfaces leaving the form a rusty nature of metal finish.

Electrodes

The consumable electrodes were essential in the electric arc priming and are used as addition material as well. The electrode is formed by a metal rod known as the core covered by a flux coating of mineral or organic materials. In electric welding, a conductive element that makes the final connection with the work to

create an arc of electrical energy. In arc-welding, it is the rod or stick. In MIG it is the welding wire, and in TIG it is a tungsten rod. The metal stick or rod was used together with the welding machine for joining and constructing the work.

Protective Gloves

This was used as a covering for the hand having separate parts for each finger and thumb wear for protection. Leather gloves have been worn by people for thousands of years. The unique properties of leather allow for both a comfortable fit and useful grip for the wearer. The grain and pores present on the leather gave the gloves the unique ability to assist the researcher gaining gripped on hot object while welding, grinding and cutting of the scrap metals. As soft as a leather glove may be, its pores and grain provide a level of friction when "gripped" against an item or surface. Again, this was worn to ensure protection against electric shocks of direct accidents caused by the shock itself can be anything from minor burns to heart failure and protection against burns caused by hot work pieces, sparks, molten metal, red-hot electrodes etc.

Protective Goggle/Welding Face shield

A close-fitting protective glasses was worn with side shields for protection of the eyes against injury. Proper safety precautions are required to avoid accidents related to the gas and power supplies, to the sparks, heat, fumes, and visible and invisible rays from the heat source. This was worn to ensure protection against ultraviolet and infrared light as many welders have experienced the discomfort of arc-eye or sunburnt skin on unprotected parts of the body, usually due to insufficient or incorrect protective equipment and protection against flying chips when using a

chipping hammer to remove slag from the weld, there is always a risk of flying chips which are a potential danger. The chips are sharp and can cause serious damage to the eyes.

Protective Clothing

Protective cloth was worn and provided protection for the researcher during welding, especially when the researcher had to work close to the work piece and where movement was restricted. It is very important that the welding jacket is worn when welding overhead, to protect the body and arms against falling sparks and slag. In addition it was worn for protection against sparks, molten metal and electrical shock. The researcher wore dry protective clothing during arc welding. This was to ensure safety against body burns when welding.

Measuring Tape

It was a measuring instrument consisting of a narrow strip of rubber marked in inches and centimetres used for measuring dimensions of scrap metals and its sizes, width, breadth and length which was preferred for the construction work.

Skills and Procedures for the Execution of Work

The significance of skills and procedures as intermingled in the execution of scrap metal art illustrated how two technicalities and disciplines can actually work together in producing a profoundly harmonic effect. Consequently, successful recruiting of these elements necessitate a high degree of artful humanity. In studio-based research, these artistic approaches from aesthetico-action method allowed the researcher for subjective interpretation of these two approaches in executing the work. The concept involved these two approaches and practices deepened the

knowledge of the researcher whereby procedural knowledge of the work where focused. Skills and procedures were the fundamental ability, expertise or dexterity used in the execution of scrap metal art done in certain order and manner. The actual amount of good art that a professional produces is quite small next to the sheer bulk of bad stuff they have to go through in the procedures to achieve positive results. The researcher employed elements and principles of art, conceptualisation of direct observation, research style and subject, scientific and structural approach that accounted for the skills and procedures for the execution of the scrap metal art. These skills and procedures are accentuated in the Chapter five for the construction of the scrap metal art.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

Overview

This chapter outlines the findings and discussion of results of field data obtained from the interviews, questionnaires and observation conducted in Sekondi/Takoradi on scrap metals prior to its aesthetics and environmental sanitation in a different dimension. The field data was intended to ascertain the knowledge, factors and environmental hazards associated with scrap metal situation in the oil city of Sekondi/Takoradi. The data established were generated from interviews, questionnaires and observation.

Geographical and Background Study of Sekondi/Takoradi Metropolis

The Sekondi/Takoradi Metropolis is one of seventeen districts in the Western Region with a land area of about 49.78 km^2. It forms part of twenty two metropolitan, municipalities and districts in the Western Region of Ghana. Sekondi is the administrative capital of the metropolitan and makes it the third largest in the whole of Ghana. It is bordered to the East by the Shama District, to the North by the Mpohor Wassa East District, to the West by the Ahanta West District and to the South by the Gulf of Guinea. The Sekondi/Takoradi Metropolis is characterized by shale and sandstone resting on a hard basement of granite, gneiss and schist. The faulting system has marked influence on the land form especially along the coastline which clearly follows the main fault direction of North East. The surface of the metropolis is fairly watered, with the drainage pattern being largely trellis in nature with minor dendrite forms. The two main rivers flowing through the metropolis are

the Whin and Kansawora rivers, while the lagoons are the Essei and the Butre. Generally, the Metropolis does not experience severe weather conditions. The climate of the metropolis is equatorial, with an average annual temperature of about 22^{0C}. Rainfall is bimodal with the major season occurring between March and July and the minor season occurring between August and November. The mean annual rainfall is about 1,380 mm, covering an average of 122 rainy days. The natural vegetation has largely been degraded due to slash and burn farming practices and other human activities. The existing vegetation in the north and central portions of the Metropolis is mainly woodland. However, along the coastal areas there are thickets interspersed with tall grass species. The Metropolis is of varied landscape; the coast line has capes and bays, which have been largely eroded. The central portion of the metropolis is low lying with an altitude of about 6 metres below sea level. Otherwise, the area is undulating with ridges and hills (STMA, 2011).

Sekondi/Takoradi is often referred to as Ghana's twin city because it was formed by two cities, Sekondi (locally called Sekunde) and Takoradi. The area was first inhabited by Fanti fishermen from the Central region who settled at present day Amanful, the area around Ayire estuary and the present Takoradi Harbour area. This perhaps explains why Fanti is the common local language spoken in the area even though the region has a large number of other ethnic groups predominantly the Ahantas. Historically, Sekondi was a major fishing and trading town with its shopping centre at European Town (the commercial and city centre of Sekondi). It flourished in the 1900s after the construction of the western railway (minerals). It

subsequently became a town council in 1903 under the Town Council Ordinance 26 (Danquah and Abakah, 2001).

The relocation of the Ghana Railway headquarters, the establishment of the Takoradi Port in the late 1920s coupled with a booming trade and commerce in Takoradi made it a large business and trading centre with a diversified local economy. It attracted many immigrants from within and outside the municipality and grew in size, robbing Sekondi of its importance hitherto. By this time, Takoradi was not recognized as a major city. It was a town in the Sekondi Municipality. In 1946, the Council added Takoradi to the Sekondi Town Council and by 1963 Sekondi and Takoradi were recognized as one and as a city, Sekondi-Takoradi. Sekondi having lost its economic significance to Takoradi became a fishing, dormitory and administrative town, having over 90% of the government and administrative offices including Western Regional office and the Sekondi Takoradi Metropolitan Assembly (STMA) office; whereas Takoradi became the commercial and service centre having the city's largest market (Market Circle) as well as many banks, industries, hotels and offices. In 1994, the name of the Assembly was changed to Shama Ahanta East Metropolitan Assembly (SAEMA) by legislative Instrument 1316. It included the Shama, Sekondi, Takoradi and Ahanta local areas. However, in 2008 the Ghanaian government in its bid to enhance the nation's decentralization process created more districts and separated Shama and Ahanta from SAEMA. Shama became an official district, Shama District Assembly (SDA) whereas Sekondi-Takoradi resumed its initial metropolitan status as STMA. STMA is bordered to the west by Ahanta West District, to the east by SDA, to the north by

Mpohor Wassa East District and to the south by the Sea. Presently, there are three sub metros within STMA namely Sekondi /Takoradi, Essikado-Ketan and Effia-Kwesimintsim (Ghana Mining Sector Support Programme Management Unit (GMSSPMU, 2005).

Figure 4.1 below illustrates the study area of Sekondi/Takoradi metropolis.

Figure 4.1: *Study Area of Sekondi/Takoradi Metropolis (Source: Google Map)*

Demographics of Participants

Ages of Respondents from the data gathered showed that 35% of the respondents were below the age of 20 which was the highest percentage of Age distribution. The second highest percentage of respondents (30%) was within age group of 46-55 years. Fifteen respondents were between the ages of 21-35 years, and 10% respectively were within the age group of 36-45 and above 55 years. Thus, the average age of participants was about 20 years with the youngest being 15 years and the oldest 55 years. The analysis according to age indicated that most of the respondents fall within the energetic working class due to the work nature.

Distribution of Respondents by Sex also presented 65 respondents, 90% were males and 10% were females. This indicated that greater numbers of respondents were males. The reason for the male dominance was due to the labour intensive nature of scrap metal collection.

At the educational levels, 70% of respondents had no formal education whilst 30% have had some form of education to university level. Out of those with formal education, they could read and write. Respondents with no or little formal education could neither read nor write. Although some have had some form of education, they had little knowledge of scrap metals.

Discussion and Analysis of Findings

Discussion and analysis of the findings of this study has been presented under two broad themes. This enabled the researcher answer the two main research questions that informed the conduct of this project.

The General situation of Prevalence and Handling of Scrap metals in Sekondi/Takoradi.

Based on the research questionnaires and interviews, respondents expressed their views on general situation of the prevalence and handling of scrap metals from different angles. They confirmed that scraps are wasted irons, waste metals that are disposed and lying in the open. They are discarded metals such as car parts, iron rods and others. They are heavy and durable metals that have been rejected or unwanted.

All these views merit the description of scrap metals as redundant materials especially metals discarded for reprocessing. They are also identified to be an

amount of metals that are left over after the greater part has been used. Scrap metals once collected from residents and other sources in locations like Kokompe, Assakae-obiri junction, West Tanokrom and the rest, are most commonly hauled directly to a local scrap yards. Scrap yards in Sekondi/Takoradi were typically junk yards where junk cars and other machinery parts had been crashed or milled then sold for recycling purpose. Analyzing the findings of prevalence and handling of scrap metal, these factors were considered.

Availability

Scrap metals cover anything made of metal. The most common form of scrap metal is appliances and other household items, but also include car parts, machinery, building materials and others. The availability of scrap metals in Sekondi/Takoradi was a collection methods and processes that came in different form based on data collection instruments. Scrap metals was collected minimally (30%) from different activities like domestic homes, junk factory, industrial areas, Aluminium workshops and landfills but maximally (70%) from mechanical/Fitting shops, metal workshops/welding shops and scrap metal scavenging.

Mechanical/fitting, metal workshop and scrap metal scavenging contributed largely to the collection of scraps in the Sekondi/Takoradi metropolis. Looking at scrap metal scavenging it was the act where people who scavenge around searching and collecting for discarded waste like metal scraps from metal working shops, fitting shops and landfill sites. Scrap metal scavengers or collectors in the Sekondi/Takoradi metropolis looked unkempt, in tattered clothes, carrying sacks containing their daily routine picks of metal junks.

From Kokompe no.1 and 2, West Tanokrom, Assakae Obiri junction to other places, scrap metal scavengers regularly moved from streets to streets looking through discarded items in the hope of finding something useful. In their quest they moved from one street end to the other with intended pace. Their eyes, through years of consistent practice, sift through refuse bins. With their hands, they picked through debris, finding useful items from discarded objects. Mostly in their picks were scrap items ranging from iron to aluminium. While many had found the sight of these scavengers as entirely dirty, due to the urge of getting a means of livelihood, this financial situation has driven them into such practice. They pick up scrap items of relative use and sell them to interested buyers who are largely involved with recycling activities.

An interview with Abubakar Sadick, a scrap dealer at the Assakae Obiri junction said that he buys and receives scraps from all these sources especially fitters and companies who have rejected their metal parts mostly irons. He continued to say that after gathering them to a maximum he transports and sells them to Tema for Steels companies for recycling them into metal sheet plates, iron rods, steel pipes and other requisite metal value for humanity use or purpose (See figure 4.2 and 4.3 Photographs by researcher).

***Figure 4.2**: Heap scraps packed up at West Tanokrom scrap metal yard*

***Figure 4.3:** Transportation of hauled scrap metals for recycling*

Upon this data, redundant farm machineries, dumped air conditions, vehicles parts, aluminium cans, metal buckets and industrial equipment are biggest scrap metal objects collected from scrap metal scavenging, mechanical/fitting, metal workshops and landfill sites within the Sekondi/Takoradi metropolis. These scrap metal objects as environmental filth are typical paradigm of insanitation leading to environmental threats. Artists especially sculptors can take these objects and construct them into shapes which serve in making art from scraps.

It was also observed that the process of recycling metals or shaped into art usually creates much or less pollutants and greenhouse gases than extracting that metal from its ore. In recycling, aluminium only uses about 5% of the large amount of energy required to extract it from its ore. It is good for the earth and fetches money for the individuals. On the other hand, the collection and sorting of domestic materials to be recycled or shaped into art can be expensive, time consuming and require energy.

Industrial areas, junk factories, domestic homes and landfills contributed minimally to the collections of scraps in the Sekondi/Takoradi metropolis. Below is an example of landfill site where disposal of waste material serve as a method of filling in and reclaiming excavated pits (See figure 4.4).

***Figure 4.4**: Scavenger searching landfill for scraps*

Trade and Industry

The industrial trading of scrap metals in Sekondi/Takoradi seems to be on higher side where scrap metal dealers, collectors retrieved them from all sources and sell them as their livelihood. The people who mostly trade in them were Muslims both from Ghana and other West African citizens. The scrap metals trade in Sekondi/Takoradi metropolis is of great social and economic importance. In many situations, it serves as source of livelihood and income generation for those operating it. It was obvious therefore that scrap metals trade is not only about scavenging and metal theft as was the general perception of many people. Though, the activities of these traders are not clean and beautiful as any office work, It has its own dignity. But like any human activity however, it also has advantages and disadvantages.

Based on the data accumulated from respondents' views on the advantages on scrap metals, the following deductions were made:

1. It brings income to the indigenes of Sekondi/Takoradi.

2. It serves as a material for the scrap artist and small scale metal fabricators.

On the downside of scrap metal activities, it was collectively shared that:

1. It is costly when purchased for art considering other materials for art.
2. It promotes metal theft.
3. It contributes to pollution and hazard when left bare on the environment.

Comparing materials like fibre glass, wood, cement, jewellery, stone and paper to scrap metal, people preferred to trade in scraps more than any other business. The result indicated that scrap metals constituted 74% among the kinds of materials mentioned. For this, many reasons were attributable to this including the fact that scrap metal products were considered to possess durability, dynamism, heaviness and value for money. Fibre glass, cement and jewellery constituted 26%. Stone, wood and paper respectively recorded no percentage.

According to respondents (those who were interviewed and those who answered questionnaires), greater number of respondents thought that working with scrap metals require more time, labour and money. Scrap metals were considered to be expensive, time consuming and physical related based on the data gathered. It was deduced however that trading of scrap metals in Sekondi/Takoradi was not meant for any aesthetics consideration. It mainly involved buying and selling of scraps in large quantities to minor and major industrial recycling companies in Tema and its environs.

Environmental sanitation and Hazards

The unkempt environment and hazards are potential dangers of scrap metals, including workers getting caught in, struck by, or crushed by the equipment used to move the scraps; amputation from that same equipment; and respiratory illnesses from chemicals or dust on the scrap. Unfortunately, people who engage in this business often do not consider safety when handling scrap metal because it occurs after the forming job is done. However, safe work practices are just as essential when performing this task as when stamping and forming the product itself.

The implications of scrap metals to environmental sanitation according to data gathered indicated that scrap metal yards and its surroundings are unkempt and unfriendly for human habitation. Its reflection on the environment is one of a pollutions, noise and eyesore. Taking the views of respondents, approximately 90% considered scrap metals as untidy due to its unkempt nature on the environment, 10% considered it as a vehicle that promotes environmental sanitation because people gather them in a particular place and trade them for recycling. Approximately 100% of the sample considered scraps metals as objects that pose danger to the environment.

On the awareness of environmental hazards associated with scrap metals was, 80% of the respondents ticked “Yes” meaning that they were aware of the environmental hazards scrap metals pose. Twenty (20%) of the remaining respondents ticked “No” indicating their ignorance on the health hazards in scrap metal activities. It was believed therefore that junkyards could be a source of

pollution and endanger the health of nearby communities if they are not properly maintained and regulated.

Based on the views of respondents, approximately 90% identified what they considered to be part of the hazards associated with scrap metals. According to them scrap metals can contribute to hazards like:

1. Damage to the eyes and lungs when burnt.
2. Increase in scrap metal theft.
3. Poor sanitation.
4. Injuries to the body.

The remaining 10% were of the view that scrap metals do not pose any hazards when handling them properly like wearing safety gear like boots, nose respirators and gloves. This goes on to confirm Bannah and Abibat's (2001) assertion that scrap metals pose dangerous health hazards to its environs.

Putting measures across on management of health hazards of scrap metals, it was totally shared that scraps must always be recycled or shaped into art, appropriate disposal into junkyard, wearing safety gadgets when handling it.

Based on environmental sanitation and hazards, scrap metals in Sekondi/Takoradi can provide significant support that would benefit humanity and the environment but when it is not handled properly can pose environment hazards like injuries to the body, metal theft and others.

Metal theft was a problem that grew because of the expensive nature of metals that resulted in lead metal being taken from churches' roofs, bronze statues being stolen and vital cables made with copper as it goes to confirm the expression

made by Abubakar Sadick (Scrap dealer) who had always refused to buy goods believed to be stolen. Some of the suitable places for collecting scraps materials are dumping points and junkyards. But it is always very wise to be aware of the hazards involved that can take one by surprise. At such point, like metal waste dumping, one can easily get injured by cuts when not in safety gears. So many bunches of illegal immigrants and people who come looking for scrap metals to sell it over to the market in the same form can be a real danger. The consequences of the activities of these individuals who mostly hide behind the scrap metal trade have serious implications on the society and the national economy as a whole. On countless occasions, their activities resulted in power outages and telephone network malfunctions in the metropolis.

CHAPTER FIVE

TECHNIQUES AND PROCEDURES USED FOR THE CONSTRUCTION OF SCRAP METAL ART

Overview

This chapter describes the techniques and sequential procedures used in constructing scrap metal art. It also brings to forth the experimentation of scrap metal and environmental sanitation in different dimension of art through the used aesthetic-action method. The researcher employed the assemblage and construction method with arc welding metal technique in finishing. The techniques and procedures followed in executing the scrap metal art were acquisition of scrap metals, conceptual development of sketches, assembling and constructing of scrap metals into desire shapes and arc welding technique for composing items together.

Techniques

Techniques were the manner in which technical details or basic physical movements and procedures were used to accomplish the construction of the scrap metal art.

Civardi (2007, p. 5) says that “For someone to be able to acquire or learn a technique of something, the person must go through experimentation, practice and constant application”.

The researcher utterly agreed on the author’s submission that for espouse of techniques one needed to follow procedures, experimentation, practice and constant application. Uniquely and distinctively one needed to adopt technique for recognition.

There are several techniques of joining metal parts together. These several techniques are mechanical interlocking, mechanical connection (screws, nuts, bolts, rivets), gluing or chemical bonding, welding methods (friction and diffusion), brazing procedures, soldering processes. Joining metals into scrap metal art were most often done by welding, soldering and brazing techniques.

Arc welding technique was chosen for the study because construction of scrap metal art requires the most energy, because it had to reach melting point of metal by heating. Melting the metal connecting parts led to their fusion and forming of joints. Because of this, the arc welding technique was suitable for joining metal parts with different melting points together. The advantage of this technique is that joint made by welding is very firm and easy to operate.

Comparing this technique to the others, Craftsmanspace (2014) shares that brazing requires less energy than welding, but more than soldering technique. With brazing technique the metal parts is heated above 450°C. Brazing technique is suitable for joining the thin parts, or for joining dissimilar metals. The joint made by brazing is very firm. Soldering technique used the lowest amount of energy, because the parts were heated below 450°C. Soldering technique is suitable for joining the thin parts or for joining dissimilar metals. The joint made with soldering and brazing are not firm enough for load-bearing constructions.

Before choosing this technique, analysis of what kind of scrap metals for assemblage and constructing was needed. The form to create as well as its dimensions would determine the type and thickness of material, and that would determine by which technique adopted. In Arc welding technique, there were

different types of welding techniques which comprised Oxy-acetylene gas welding, Arc welding, Mig welding, Tig welding, Duty-cycles welding and Plasma arc welding.

The study employed arc welding technique for the construction of scrap metal art. The study of the Arc welding used an electrical welding process in which a consumable, flux coated electrode rod made an arc with the work. Also called stick welding. Arc welding deposited a coating of slag over the seam, which must be chipped off after it cooled. As one of the oldest forms of welding, arc welding technique offered versatility, strength and the ability to handle big projects and thick materials in constructing the work.

Principle of Manual Metal Arc Welding (MMAW) commonly called "stick electrode" welding is, as for all arc welding processes, based on the electric circuit. The electric arc formed between electrode and work piece has two objectives, to melt the edges of the joint forming a melt pool on the work piece, and to melt the tip of the coated electrode (Wilhelmsen, 2005).

Electric arc welding had been around for almost 100 years, and the fact that it is still around today illustrates its continued usefulness. The official acronym for arc welding is SMAW, which stands for Shielded Metal Arc Welding. The basic components of the setup include the machine (the power source), a ground lead you clamp to the work anywhere except where the weld is to be made, an electrode lead which runs from the machine to an electrode holder, which is a handle with a clamp that holds consumable electrodes. The electrodes are metal rods covered with a coating. In use, the welder strikes an arc against the parent metal with the electrode,

which completes the circuit between the two leads and causes a bright light and concentrated heat (Haynes and Storer, 1994).

Based on the views shared by these authors, arc welding had the preferred characteristics to the other welding techniques. This technique is used for both interior and outdoors works. It joins or repair very thick materials. With these views the study employed the arc welding technique for the construction of scrap metal art.

Procedures

Procedures are application of specific order that must be carried out to achieve a desire results. The fundamental aim of the research study involved around scrap metal art and how contemporary Ghanaian artists could do away with traditional materials and explore into unconventional materials like scrap metals by contributing their quota to environmental sanitation in different dimension. In the past, Ghanaian artists basically relied on traditional materials for production but in this technological era materials keep changing. The researcher chose scrap metal as an art and instrument for promoting environmental sanitation. Choosing this concept, central idea with logical step by step with fixed sequential approach were formed and demonstrated for the execution of scrap metal art. This used creative imagination and skills in producing aesthetically pleasing objects, environments, and experience. In constructing the scrap metal art procedures were followed to achieve the work done. The study employed six procedures in executing the scrap metal art by acquiring scrap metals, developing conceptual sketches, preparing surface of scrap metals, composing them, cutting and forming processes using arc welding technique and finishing the scrap metals.

Procedure 1: Acquisition of Scrap metals

Acquiring scrap metals for the execution of work came in many forms, sizes and shapes which had unique characteristics that made it suitable for the desired work. As mentioned earlier in chapter three on tools and materials for construction and fabrication of work, the researcher chose and bought scrap metals that suited the theme of the work titled "Struggle for Perfection".

Acquiring the materials for the construct of work scrap metals were bought from scraps dealers and some were also collected from colleagues whose car parts were not in use. This helped in choosing scrap materials like car sumps, rotor (disk brakes), shocks/spindles, cam sprocket, wheel rims, exhaust manifold, spring fenders, iron rods, bolts and nuts, iron rods for the desired work. Locations such as Assakae scrap metals, West Tanokrom, Kokompe no.1 and no.2, and other metal works were much exploited for the study. The figures 5.1A/B/C, 5.2A/B, 5.3A/B and 5.4 show the various scrap metals acquisition from the mentioned locations within the Sekondi/Takoradi metropolis (photographs by researcher).

Figure 5.1A: *Location No.1 — Assakae Scrap Metal Yard*

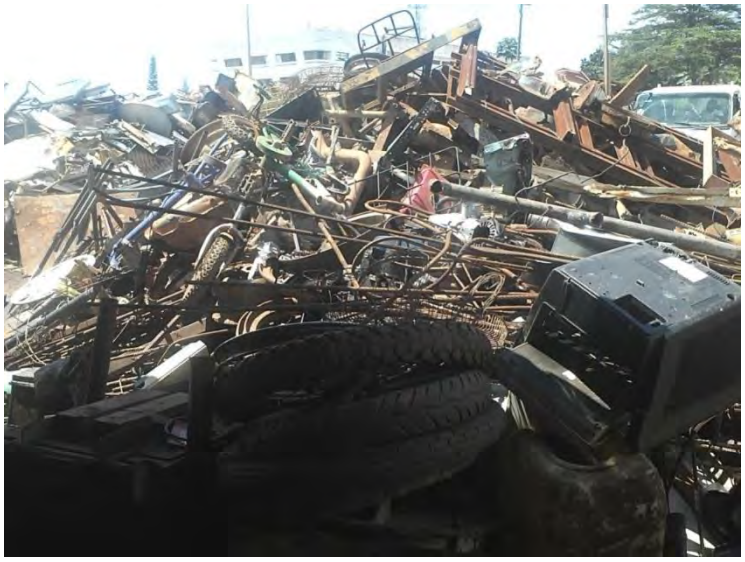

Figure 5.1B: *Location No.1 — Assakae Scrap Metal Yard*

Figure 5.1C: *Location No.1 — Assakae Scrap Metal Yard*

Figure 5.2A: *Location No.2— West Tanokrom Scrap Metal Yard*

Figure 5.2B: *Location No.2— West Tanokrom Scrap Metal Yard*

Figure 5.3A: *Location No.3— Kokompe No.1 & 2 Scrap Metal Yard*

Figure 5.3B: *Location No.3— Kokompe No.1 & 2 Scrap Metal Yard*

Figure 5.4: *Selected **s**crap metals from various locations for construction of work piece*

Procedure 2: Conceptual development of Scrap metals into sketches

In view of the core concept and research study, series of sketches were drawn to fit the theme called "Struggle for Perfection" for the work. This process brought out the critical and analytical forms of two dimensional sketches into three dimensional form. Modelling of forms were done with free hand and later scanned and enhanced it with computer.

Conceptual sketches

The conceptual sketches developed for the study took its source of inspiration from Rodeo. The tradition of Rodeo is an exhibition or contest in which cowboys show their skills at riding broncos, roping calves. The Philosophy of Rodeo as originated in the 19th century from Spain brings fun to its observers. This sport abounds in so many forms which has contributed to humanity but has not been utilized in artistic contexts especially in Ghanaian Contemporary art. This sport has been a great guidance on the form of sculpture created for the construction of scrap metal art. After judiciously studying the various poses of the action bull from different angles, a particular one was picked for the study and suitable sketches were made considering its philosophical connotation on academics**.** The illustrated figures show sketches of bull in different poses for the study.

Figure 5.5: *Conceptual bull (Source: drawing-pencil-sketches.com, 2014)*

Figure 5.6: *Sketch one*

Figure 5.7: *Sketch two*

Figure 5.8: *Sketch three*

Figure 5.9: *Sketch four (Final)*

Procedure 3: Surface preparation of Scrap metals

Surface preparation of scrap metals especially scraps with oil or grease on the surface were removed using a cleaner or rug. This was based on the experienced that grease or oil scrap metals turned to catch fire while welding. Where possible, the affected parts were rubbed with cloth. All loose rust and surface coatings were removed to ensure proper welding fortification of scrap metals.

The surfaces of scrap metals acquired were also roughened preferably with abrasive. Alternatively a die grinder or angle grinder was used. When grinding the researcher made sure the surface was roughened, not polished. Grinding the surface was cross scored to improve adhesion when welding. All these treatment of surface preparation of scrap metals were done to ensure proper welding of the constructed and assembled work. The figure 5.10 shows how the scrap metals surfaces were prepared to receive a good welding.

***Figure 5.10**: Preparing surfaces of scrap metals*

Procedure 4: Construction and Assemblage of Scrap metals into art

Art can be in any form. But no matter which form, it must be expressive and close to nature and creation. It is this stage and time that the researcher brought out the creative skills or potentialities to the maximum. The fascination of making one thing stunning out of a discarded one attracts several people to the craft of scrap metal art. Scrap metal art "The Action Bull" composed of car shocks, tire rims, bolts and nuts, spring fenders, tin cans, steel wire, and automobile engines components were just some of the inventive potentialities.

Constructing and assembling found metal objects was made by joining preformed pieces of scrap metals by arc welding. It differs radically in principle from carved and modelled sculpture, but of which are fabricated out of a homogeneous mass of material. Constructed and assembled scrap metals was made out of such basic preformed components as metal tubes, iron rods, plates, car engines parts, tire rims, bolts and nuts. These were cut to various sizes and shaped before they were assembled or used as they were. Assembling and constructing was usually reserved for constructed scrap metals that incorporates any of a vast array of ready-made or found objects, such as car parts like rims, spring fenders etc., old farm machineries, random bits of hardware and bits of discarded appliances.

Numerous techniques had been employed for joining these components, most of them derived from crafts other than traditional sculptural ones; for example, metal welding and brazing, wood joinery, bolting, screwing, riveting, nailing, and bonding with new powerful adhesives but which the study employed the metal arc welding technique. The level of ways in creating these impression on artistic ground

just needed uniqueness and imagination with blend of scrap metals and a couple of techniques for manipulating them into art works. In this step of art nothing was wasted. It was easy to accumulate a lot of raw materials for the project.

An armature of framework was created with iron rod to hold the pieces in place. Measurement was taken for the size of the action bull. Pieces of the measured iron rods and scrap metals were arranged and composed in other to achieve the final result. The Figures show how scrap metal art was constructed.

Figure 5.11(A)*: Selected metal base*

Figure 5.11(B): *Measuring of iron rods*

Figure 5.11(C): *Cutting of iron rods*

***Figure 5.11(D)**: Bending of iron rod*

***Figure 5.11(E)**: Testing of bent iron rod on work base*

Figure 5.11(F) *Curling and perforating of metal base for iron rod*

Figure 5.11(G): *Tacking and welding of iron rod*

***Figure 5.11(H)**: Constructed armature for the work*

***Figure 5.11(I)** Attaching scrap metals onto the armature*

Procedure 5: Arc welding, cutting and forming processes of Scrap metal art

The philosophy of arc welding, cutting and forming processes of scrap metal art prepared the researcher's skill and productive workforce by promoting creativity, respect for diversity and formation of a strong work ethic. The construction of scrap metal art were done by arc welding and some fabrication techniques. Arc welding metal technique was the process utilised for the concentrated heat of an electric arc to join metal by fusion of the parent metal and the addition of metal to joint usually provided by a consumable electrode. Arc welding was the main focus technique for the constructing of scrap metal art. The formed and machined parts of the scrap metals were assembled and tack welded into place then rechecked for accuracy. Special precaution was taken to prevent warping of the welded pieces due to heat. Heat was selectively applied to the scrap metals in a slow, linear sweep. The scrap metals had a net contraction, upon cooling, in the direction of the sweep. This highly skilled processes removed significant warping using this technique. Forming the scrap metals was the process of materials deformation. The scrap metals pieces was formed by applying force to it. The force was great enough to change the shape of some objects from its initial shape.

This process of forming was controlled with the use of tools such as pinches and dies. Metal cutting and forming processes used for the construction of scrap metal art were the building of metal structures by cutting, bending, curling, perforating and assembling processes.

Cutting: The cutting process was done by shearing, sawing and chiselling scrap metals with manual variants into specific shapes and sizes for the purpose of the study.

Bending: This was done by hammering some parts of scrap metals to fit the desire shape for the work. Iron rods were bent to form the framework or armature of the exact work.

Curling: This method or process was applied to some parts of scrap metal forming of the constructed work. It added a hollow, circular roll to the edge of the metal sheet. The process used the hand type of metal curl to curl the need portions of the work than the machine metal curl as fabricated to achieve the curl.

Perforating: This was a cutting process that punched multiple small holes close together in flat scrap metal pieces. This was done using electrode and arc welding process on lighter scrap metals to bring a wide variety of surface texture to the composition.

Assembling: Scrap metal art were done by assembling and joining processes where the pieces of metals were joined using arc welding technique. These objects were put together, heated and melted together, causing the joined parts to function as one. This stage consisted making three dimensional artistic compositions by putting together the found scrap metal objects.

Balancing the work on the pedestal base:

The freedom of movement in a work when balancing is felt intuitively rather than when having followed strict rules, but having a basic knowledge of some guidelines is always useful when making composition of such nature. Scrap metals are heavy and durable when working with it. Looking at the constructed work, scrap metals of weighty was asymmetrically balanced and arranged on the standing legs of the bull as a commonly technique used for optimizing input, output, reducing latency and ensuring fault-tolerant alignments. The scrap metals used were varied in weight that ranges from car wheel rims, exhausted pipe, bolts and nuts. The upper part of the bull seems heavier that lower part where it seems to raise its back legs. This is how the visually-heavier look of the work balances the heavy objects in terms of weight on the upper part from the pedestal base to its back.

In achieving the balance, heavy metals weighing 300 kilograms were used to form the neck, head, standing legs all constituting the upper part of bull where less than 300 kilograms of scrap metals were used to form the back of the bull by maintaining the weight of gravity on the pedestal base. In Physics, the Newton's law of gravity relating to masses and separation of particles were applied. Making one side heavier particularly on the ground as the force attracts the body of the bull towards the centre of the ground. The weight of metal pedestal base weighing 350 kilos also formed part of the balancing where it seems heavier than the arranged scrap metals.

Choosing the scrap:

The "metal-morphosis" as the researcher termed it as choosing of scrap metals for art work depends solely on the theme. The components of scrap metals are intentionally left in the shape and state in which they were found which gives these sculptures a unique character. The unique character and appearance of scrap metals are also valued for its versatility because it often gives additional function both practical and aesthetic values. The study chose disk brakes of different shapes and sizes mostly round but invariably, as it was the integral part of the constructed work. Considerations for the choice of scrap metals for the work was done to compliment or contrast in terms of style, texture and forming the exact shape of the theme selected. The scrap metals selected were sumps, rotor (disk brakes), cam sprocket, shocks/spindles, lower control arms, camshaft and exhaust manifold. Looking at formation of a car, transformation of oil starts by collecting any often undesirable liquids and keeps it in the sump pan. Then it ends at the exhaust manifold by bringing fumes out of the car. With this concept, sump pan is the starting part of the car and ends at its tail end of the exhaust manifold or pipe. Based on this concept, the researcher creatively used sumps for the bull's head and used the exhaust manifold for the tail (See Figure 5.12(A), 5.12(B) and 5.12(C)).

Figure 5.12(A): *Arc welding processes of scrap metals into composition.*

Figure 5.12(B)*: Arc welding processes of scrap metals into composition*

***Figure 5.12(C)**: Arc welding processes of scrap metals into composition*

Procedure 6 — Finishing of Scrap metal art

The effects of light on every individual sight and the type of finishing prone to climatic condition are all considerable factors when finishing a work of art. In this study, scrap metals played important role of the research study where metal finishing processes involved treatment of scrap metals work pieces in order to modify its surface properties, impart a particular attribute to the surface, or produce a decoration due to its rusty nature of metals. Plating, painting or coating formed components of such finishing operations that involved putting a coating of anti-rust paint over a base scrap metals substrate to give various desirable properties to the object by leaving it natural rust finish. The reasons for carrying out this metal finishing were that the anti-rust paint checked decoration of metal surfaces, protection against corrosion from rain and sunshine, provision of resistance to oxidation and high temperatures, or Ultra-violet radiation. It was also intended to check impartation of mechanical properties, such as resistance to fatigue, improvement of ductile strength, or longevity, resistance to the use of abrasives, and impartation of electrical or thermal properties such as semi-conduction, thermal resistance, fire resistance (See figure 5.13, 5.14, 5.15, 5.16 and 5.17).

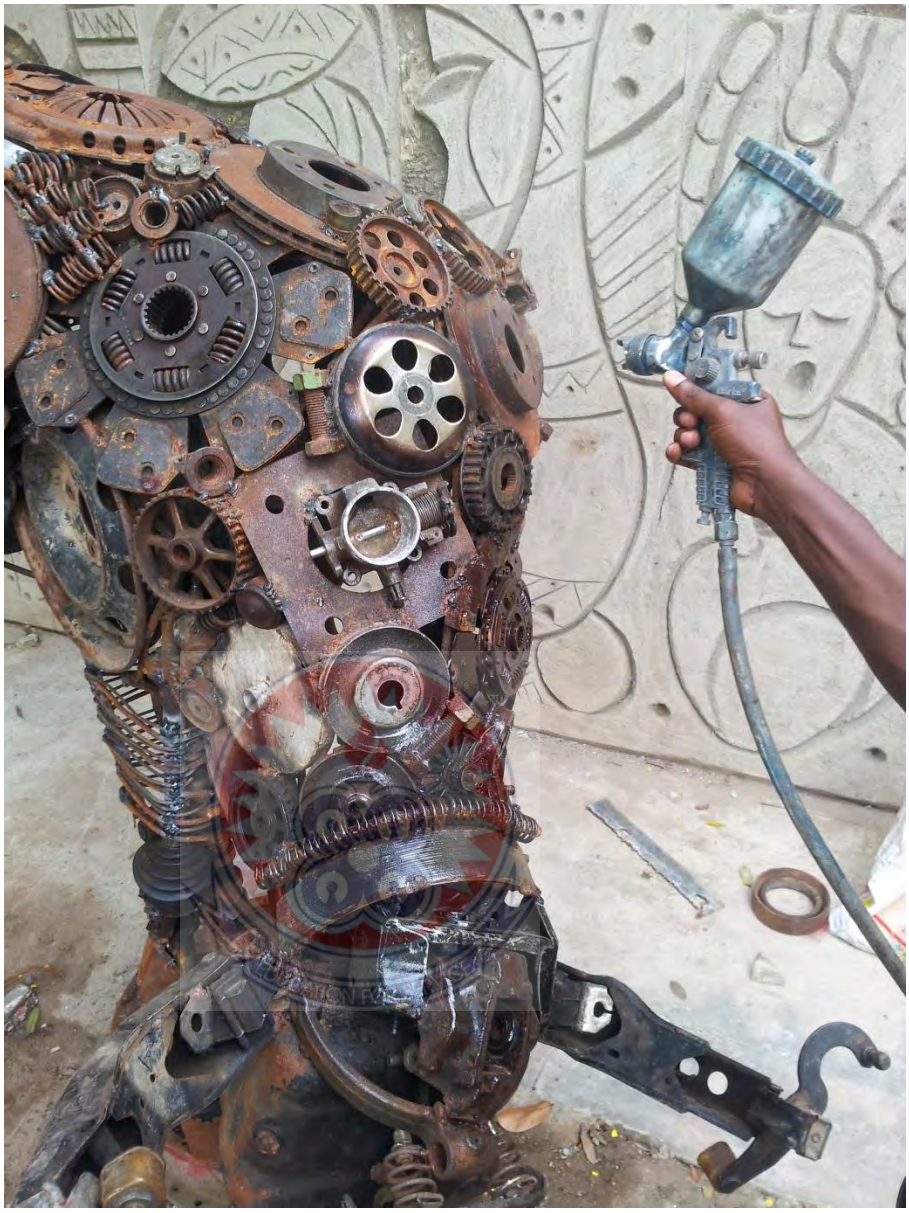

***Figure 5.13**: Spraying of Anticorrosive paint as finishing agent*

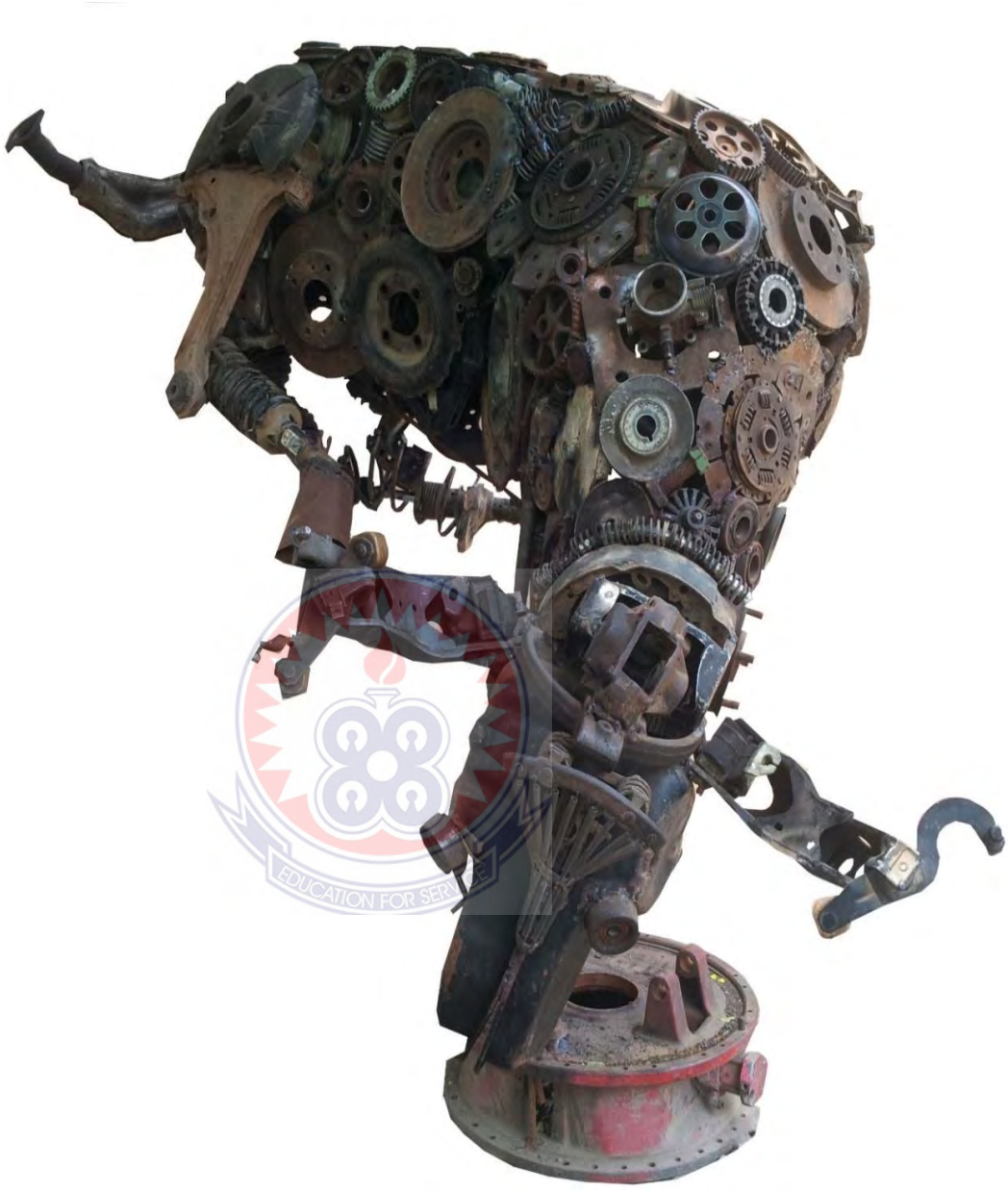

***Figure 5.14**: Finished work from three quarter view*

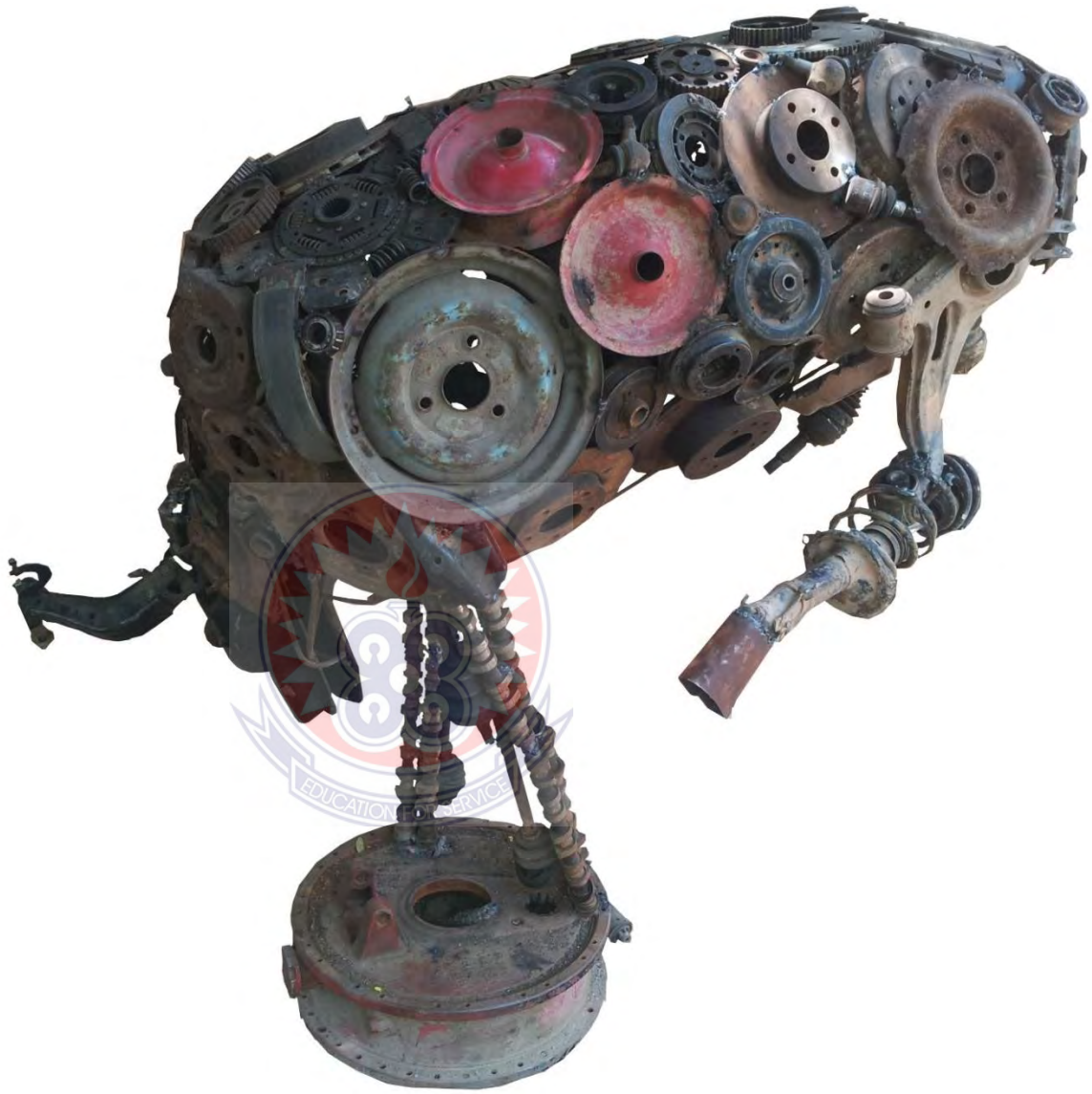

***Figure 5.15**: Finished work from side view*

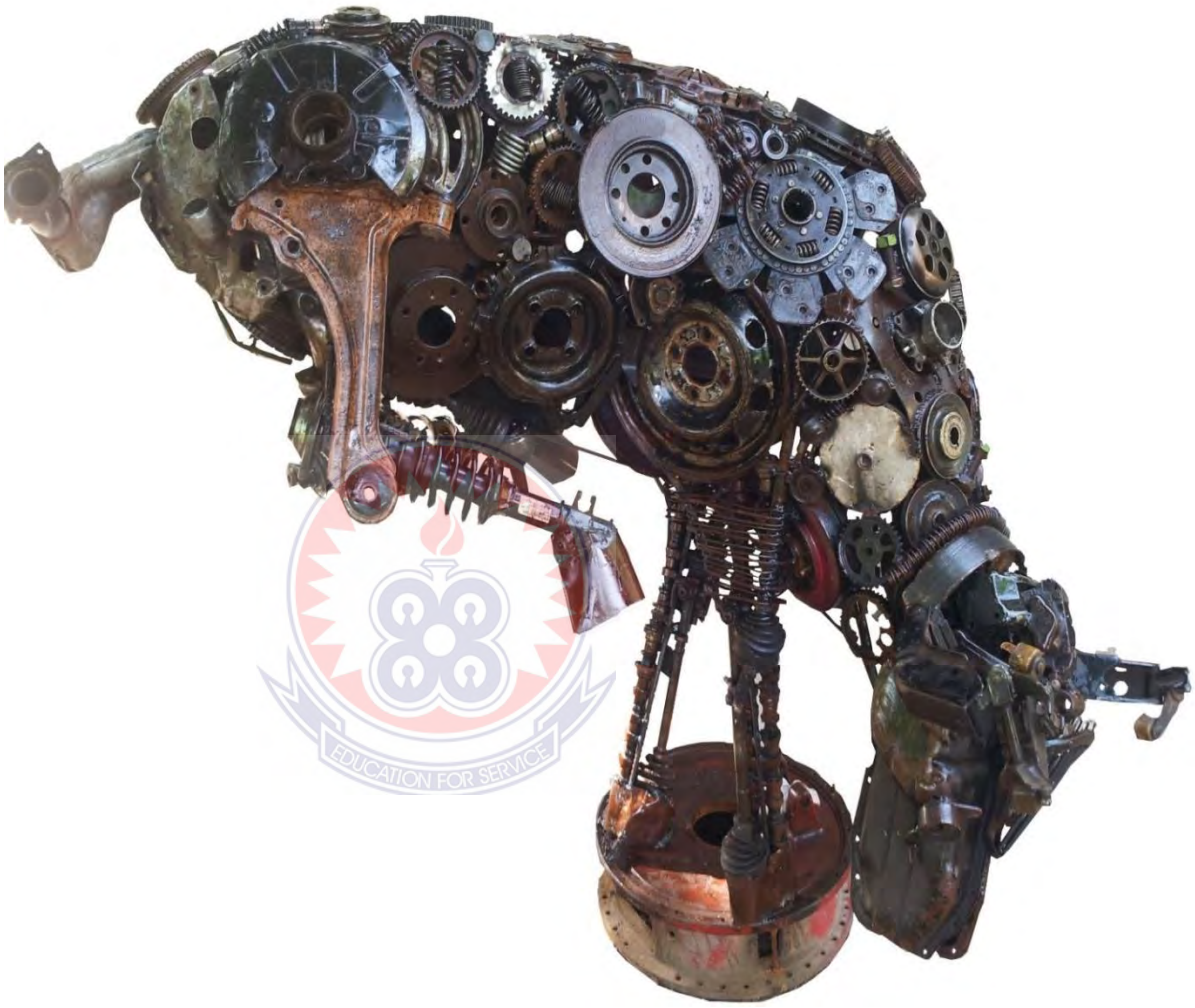

Figure 5.16: *Finished work from frontal view*

Plate 5.17: *Finished work from top view*

Aesthetic Appreciation of Scrap metal Art work

Title

The ensuing aesthetic manifestation from the assembled scrap metals was entitled **Struggle for Perfection**. This was inspired by the steady growth of the University of Education, Winneba (UEW) from its inception as a university college and its persistent struggle to achieve perfection and excellence through hard work.

Artistry and style of aesthetics in the work advocates importance and strength of tertiary education in Ghana. This was inspired by Immanuel Kant's interpretation of aesthetics which seems to create a connection between beauty and institutions of learning. Kant perceives aesthetics as a field giving priority to form over function (cited in Bruyn, 2014). Beauty, he said, was independent of any particular figure with which it was attached. A horse might be beautiful apart from whether it raced well. He asserted that knowledge is not something that is created merely by outside institutions but also by our natural constitution. The seat of judgment now moved from medieval reasoning toward the idea that human intuition could be a source of knowing. And aesthetics began to develop as a university discipline.

Philosophy

The philosophy which sets this scrap metal art apart is the brilliant formal clarity of the constructed sculpture and its extraordinary elegance of articulation. Its degree of virtuosity is the uniqueness that brings all parts of found metal objects together using the arc welding technique. The scrap metals are welded together. This gives the work a form of an extra level of visual richness. The beauty of this scrap metal art is how the found metals parts have been welded together into an

aesthetically pleasant —car parts like rims, ball joints, metal shocks, spring fenders etc., old farm machineries, random bits of hardware and bits of discarded appliances. Every discarded scrap metal was important to the artist and it was up to him/her to bring it to life. Reshaping and attaching the various components, giving old discarded metal objects a new purpose as well as a bit of soul was therefore the researcher's philosophical expediency, fitting the entire concept into what he described as "metal-morphosis". This expediency was shown by working with scrap metals that demonstrates the potential of scrap metal as a medium for sculpture using arc welding technique in promoting environmental sanitation as an artist's contribution to national development.

Description

This scrap metal art piece is an action bull composed of different discarded metals parts ranging from sump pan, camshaft, cam sprocket, lower control arms, rotors (disk brakes), exhaust manifold, spindles/shocks, car rims, ball joints, iron rods, bits of bolt and nuts twisted, turned, crumped, flattened and arc welded into a monumental piece as erected on a solid metal pedestal. It is a full-sized in-the-round sculpture piece poised of three dimensionality which measures 87 x 85 x 20 inches. It has two hind legs raised up while the other two stoutly stands the ground like splendour attest to the centurion struggling in the coliseum. Synergistic expression of the work piece shows how heavy and compact the scrap metal piece demonstrates. The delight and exquisite beauty of scrap metals from different forms, sizes, features joined together gives the work unified interplay of geometric shapes in rhythmic manner. Displaying the intriguing projections at both ends of the scrap

metal pieces give the work an irregular alignment whilst the undulating circular curves of metals arranged by twist and turn of the piece, give it a relaxed rhythmic feel. Various volumes of scraps stacked and staggered together create outdoor entertaining tucked among the aesthetics of the environment.

The action bull, has a block-like head with a curved jaw as its gazes at the ground. The display of mastery with the use of different scrap metals coupled with shapes of curvilinear and rectilinear objects in the work allows the inimitable feminine and masculine feeling in the entire piece as the institution is embodied with all the genders. It has two red wheel rims signifying the blood that the founding members of the University toil in struggling to put up this noble institution. The work piece has a serious, determined and a straightforward character portraying students of the institution who have tuned their minds and performances towards academic excellence and knowledge. In the apotheosis of this piece accentuates a dialogue between the observer in the feeling of readiness, strength, determination, rage and struggle for Academic success. The piece of composition illustrates rational properties such as symmetry, order and proportion as seen through the accuracy and meticulous rendition of features of the animal.

The action bull echoes through the unique qualities of scrap metal objects used and the impressive arrangement of different and assorted scrap metals created by the reflection of variety whilst the expressive display of the metal joints in the overall composition defines its abstract nature. The juxtaposition and play of positive and negative elements gives the weighty and substantial pieces an undeniable sense of lightness. The positive and negative spaces, the shadows, the

texture, the line, the moving symphony of rusty nature of finishes, aim at the end result of a richly satisfying aesthetic sculptural experience.

Interpretation

The action bull interprets struggle for perfection where humanity may be regarded as a process of successive achievements, and every movement in this process is a step taken towards the actualisation of the ideal which beckons one to itself. All beings, and human endeavours are comprehended by actions. These actions strive for higher human and spiritual achievements. In the struggle to achieve higher feats, one realises pleasure. It is well said that man never is; he is always to be. Men do not entirely live in the present. There is an element of the future in whatever is done, and men never confine themselves to the present merely. This means to say that people identify themselves though in a covert manner, with ideals to be achieved in the future, which are hoped to bring larger fulfilment. In the action bull, the flat circle base made of solid metal portrays the support of University of Education Winneba in Ghana that seeks to offer well-rounded knowledge and skills to both able and less deprived people who seek to develop the mind and hand towards national development while struggling for perfection. The solid metal base also gives the work a firm support that ensures stability. This portrays the institution's affirmative support to its students while pursuing and struggling for perfection to higher heights in Academics.

Retrospectively, the bull also symbolises UEW's struggle to attain perfection through rigorous situations since it started as a University College in 1992 by government ordinance and placed in a special relationship with the University of

Cape Coast. As part of the efforts to create a stimulating intellectual environment, the university was established as part of the tertiary education component of the Education Reform Programme which was launched by the Government of Ghana in 1987. The institution has now become autonomous and has been, by struggle attained excellence through thick and thin. The university's motto, which is Education for service is the bedrock of every country's development, and this institution keep struggling to live up to expectation. In the field of teacher education, UEW is ranked very high in the sub region as it continues to offer students with teaching and learning skills to excel in higher heights. All these endowments of the institution are depicted in the strength and variations in the metals with which the bull was constructed. The real nature of a Bull possesses a wild fighting or struggling spirit and this animal always seeks to attain satisfaction and perfection no matter what come forth and that is how the University of Education has grown to become.

Scrap metals as alternative materials for Sculpture

The Aesthetic and artistic expression of scrap metals as alternative materials for sculpture can never be overlooked as an artists. Turning scrap metals into a unique art is allure of creating something of exceptional value from scraps. Most of the great scrap metal art produced had welding techniques making them last for a long time. This area is a tool for the creative minds. What gives a fascinating quality to the work is the junk parts of cars and trucks being used in such uniformity. The raw materials use in the making of scrap metal art is carried back home from the local junk yards. In making these art forms, rusted metals are sterilized and then

these metals are manipulated where some parts of the metals are burnt off to give a clinical finish into such beautiful life size sculptures. Creating or producing all these fascinating forms have its own challenges to the artist which mainly has to do with health hazard and expensive nature of scrap metals.

The nature of scrap metals in Sekondi/Takoradi metropolis tends to be traded and transported for recycling in the industrial steel companies in Tema, Ghana. It has not been used in the practice of art. All respondents interviewed both in the scrap metal trade and outside said this practises is due to the financial benefits associated with the trade.

Observing the level of scrap metals as material for sculpture production in Sekondi/Takoradi, it was observed that scrap metals are mostly used for recycling purposes. Participants attributed to exportation of scraps which had been banned from travelling outside the country but traded within local vicinity for recycling them into domestic products like iron rods, metal pipes etc.

Data showed that 85% of the respondents were very mindful of scrap metals being recycled for industrial purposes and 15% reacted to the creation of art from scrap metals. This cumulatively gave a total responses where scrap metal situation in Sekondi/Takoradi were practiced in two ways or options. First option was recycling scrap metals into newer shapes useful with other equipment whiles the second option was using scrap metals for art.

Conclusion

Respondents were consensus on the notion that aesthetics of scrap metal art can provide significant support for environmental beautification and protection.

Environmental ethics would benefit from taking environmental aesthetics like shaping scrap metals into art more seriously. Endorsing scrap metal art will result in embracing the collective scrap bag of our culture and applauds the universal desire to create something beautiful from the leftover materials, the discards and throwaways of a material culture. Experts agreed that aesthetics of scrap metal art on the environment, inspired by scraps, leftovers and throwaways, will highlight the creative redemption of materials into powerful works of art and beauty. It was a general opinion that in current environmental awareness and consciousness of sanitation in Sekondi/Takoradi, scrap metal art will provide the creative possibilities for reusing, reworking and giving redundant materials new life.

Scrap metal art is an interesting area in art and continuing legacy in the field of sculpture. Its practice must be encouraged in the oil city of Sekondi/Takoradi metropolis not only for aesthetic purposes but the promoting of environmental sanitation as well. The outcome of the study, therefore gave credence to the assumption that scrap metals can be alternative materials for sculpture.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This chapter discusses the summary, conclusions and recommendations drawn from the findings.

Summary

Scrap metals as components of metal objects such as car bodies, obsolete farm machineries and other metal objects found in our environment pose nuisance in many areas especially the heavily populated. They carry risks and health hazards particularly to vulnerable groups such as very young, the elderly and people who trade in them. Scrap metals of sharp jagged edges can injure farmers and wildlife while chemicals within car bodies can cause bush fires and destroy soil nutrient. These culminate into endangering and degradation of the environment. Meanwhile, experience has amply taught us that, leaving the issues involved in the scrap metal situation entirely into the hands of local scrap metal traders has not been a good idea since it comes with all sorts of unwanted consequences including electrical and telephone cable theft.

Unfortunately, the aesthetic qualities of scrap metals, and their potential to serve as alternative raw materials for the artist has never been fully realised in Ghana. Being a non-traditional material in contemporary Ghanaian sculpture, there seems to be an oblivious and predominant less concern for the exploration of its aesthetic qualities and its contribution to the quota of environmental sanitation in Ghana.

The studio-based study therefore sought to investigate the scrap metal situation in the Sekondi/Takoradi metropolis and assess the possible environmental risks associated with them. It also analysed scrap metals as materials for aesthetic and artistic expression. In order to justify these factors, scrap metals work was constructed or produced and documented into a sculptural form to corroborate its claim towards environmental sanitation within the Sekondi/Takoradi metropolis.

Preceding investigations involved issues on review of related literature that discussed various issues about metals, scrap metals as well as environmental related activities as documented in the literature. Comprehensive studies were also made on history and sources of scrap metals and environmental sanitation.

Qualitative research approach using descriptive design and studio-based research design using aesthetico-action method were employed for the study. These research designs were focused on individual experiences as well as human interaction that allowed the researcher to investigate the scrap metal situation within Sekondi/Takoradi metropolis and assess the possible environmental risks associated with them. These research designs were chosen to analyse scrap metals as material for aesthetic and artistic expression and to produce and document scrap metal art as means of promoting environmental sanitation.

Various places, groups and individuals were targeted for the study. The study was delimited to Assakae scrap metal yard, West Tanokrom scrap metal yard, Kokompe Scrap Metal yard/fitting shops, Sekondi Takoradi Metropolitan Assembly (STMA), Environmental Protection Agencies and Metal artists/craftsmen both art lecturers, students and artisans.

Findings on the data generated from interviews, questionnaires and observation were discussed and analysed. 100 individuals were purposively sampled, sixty-five (65%) of whom answered questionnaires with thirty-five (35%) interviewees. The researcher took part in scrap metal trade in order to acquire in-depth knowledge on scrap metals and its activities in the Sekondi/Takoradi metropolis. The study provided comprehensive discussions on the findings observed during the experimentation and the data collection processes as data gathered were assembled, analysed and interpreted using words. Techniques and procedures based on the aesthetico-action research were used to construct scrap metal art as the study adopted assemblage and construction method using arc welding technique. Tools and materials for the study comprised of hand implement or equipment for welding related projects.

Conclusions

There have been enough evidence from the study to conclude that the Sekondi/Takoradi metropolis is saddled with the responsibility of ridding the environment of many environmentally threaten situations one of which is its scrap metal situation. With continuous growth of this metropolis as a results of the oil find in that area, these situations promise to sour higher and in greater magnitudes. It is therefore, plausible to conclude from the study that leaving the scrap metal situation in the metropolis solely into the hands of scrap metal dealers cannot be a good idea.

There was also enough evidence from the study to conclude that scrap metals pose a lot of dangers to the people who live close to scrap metal deposits, most of which are not known to both the inhabitant and the people who deal in them. This is

besides the nuisance and environmental degradation associated with unattended scrap metal deposits and junkyards.

It can also be inferred from the outcome of the study that sculptors in the metropolis continue to operate within their comfort zone with little or no effort towards exploring new materials especially scrap metals. The success in the creation of "Struggle for Perfection" can therefore be seen as a springboard for considering scrap metals as alternative materials for sculpture that has environmental sanitation in perspective.

Main findings of the study established the heavy presence of scrap metals in the Sekondi/Takoradi metropolis. The study also brought to light the health hazards and environmental threat that scrap metals pose to the metropolis. It was also established through the investigations that issues concerning scrap metals have been left solely into the hands of scrap metal dealers who have more interest in money making than solving environmental issues. The fact that sculptors in the metro have remained comfortable in the use of traditional materials was also confirmed, implying a little consideration (if any) to the use of scrap metals.

The creation of a sculpture piece titled "Struggle for Perfection" in scrap metals therefore gave credence to the assertion that scrap metal art cannot only rid the environment of the threat situation of scrap metals but be an important source of materials for an exploration into other interesting components of sculpture making. "Struggle for perfection" right from its conceptual stages to final execution has indeed sent out a strong message in support of the need for artists to give scrap metal art a much greater thought. The piece has not just provided aesthetic enjoyment to

the numerous observers who troupe by each passing day, but been a marvel to many people (both artists and laymen) who least imagined that something so admirable could emerge from scrap metals. Indications to its acceptability in the environment has been overwhelming, with passersby unanimously assenting to its aesthetics potentialities. This by all implications marks the success of this study.

Recommendations

Based on the foregoing discussion the following recommendations are made for the development of scrap metal situation in the Sekondi/Takoradi metropolis; as well as the consideration of scrap metals from aesthetics perspectives.

The handling of scrap metal situation in the Sekondi/Takoradi should not be left solely in the hands of metal traders. The Government has to licence scrap metal dealers and enforce trade policies and strategies for proper and healthy handling of scraps to curb unwanted consequences including electric and telephone cable theft. Health institutions should also provide health data on scrap metals for practicing artists, craftsmen or dealers in supporting hygiene education activities and contributing to regulation and standard-setting for environmental sanitation services and health hazards associated with toxic scrap metals.

There should also be measures to ensure that scrap metal dealers make environmental sanitation a priority besides profit making by contributing immensely towards the development of environmental sanitation policy of Ghana and uplifting its strategy and action plan in high esteem.

With the ongoing diversification in aesthetics and creativity, Ghanaian sculptors need to direct their attention to scrap metals as alternative materials for

their work. They should make it collective responsibilities with Sekondi/Takoradi EPA and other responsible entities in Ghana to help enforce the environmental sanitation policy of the country to promote sanitation in various communities.

Sculptors should not see scrap metals as garbage or junk but as an opportunity. Investment should be made into scrap metals as materials for Sculpture. This will provide sculptors with different approaches, techniques and procedures as they explore the aesthetics and artistic qualities of a different medium that abound in interesting techniques and procedures.

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APPENDIX

UNIVERSITY OF EDUCATION, WINNEBA

SCHOOL OF CREATIVE ARTS

Questionnaire for Sculptors (Artists), Metalwork Artisans, Scrap Dealers (Collectors/Scavengers) and Environmental Protection Agency

SCRAP METAL ART: AN INSTRUMENT FOR PROMOTING ENVIRONMENTAL SANITATION

Dear Respondent,

This questionnaire is a data collection tool in support of the above research aimed at assessing scrap metal in different dimension concerning art and environmental sanitation. Please you are kindly requested to provide answers to the questions listed below. Please be assured that the information is purely for Academic purpose and all information given shall be treated confidential.

SECTION A

Background of Respondent

Please Tick where it demands and provide answers where appropriate.

1. Age?

   Below 20 yrs ☐ 21-35 yrs ☐ 36-45 yrs ☐ 46-55 yrs ☐ above 55 yrs ☐

2. Sex of respondent? Male ☐ Female ☐
3. Occupation……
4. Educational level

   None ☐ Primary level ☐ Secondary level ☐ Any other…….....

SECTION B

(A) General situation in the prevalence and handling of scrap metals in Sekondi/Takoradi

Please Tick where it demands and provide answers where appropriate.

5. What kind of material will you consider working with?

   Stone ☐ Wood ☐ Clay ☐ Paper ☐ Scrap metals ☐ Any other……..

6. What do you consider as Scrap metal?

……
……
…….

7. What are the scrap metal collection methods and processes in the Sekondi/Takoradi?

   a. From junks factory ☐
   b. from vintage farm machineries, motor vehicles ,found objects car fitting shops ☐
   c. from domestic home ☐
   d. from industrial area ☐
   e. from streets ☐
   f. from busies, landfills ☐
   g. Any other …….

8. Does working in scrap metal require more time, labour and money?

   YES☐ NO☐

9. What do you think is the most significant advantage and disadvantage with scrap metals?

……
……
……

10. What do you consider as environmental sanitation?

……
……
……

11. Do you consider scrap metals as untidy in our communities in relations to the environment?

YES☐ NO☐

12. Does scrap metal pose dangerous threat to the environment when considering sanitation?

YES☐ NO☐

13. Are you aware of the environmental hazards associated with scrap metals?

YES☐ NO☐

14. Do you consider the provided situations are hazards associated with scrap metals?

a. causing damage to the eyes and lungs ☐
b. explosion due to excessive heat or physical damage ☐
c. handling sharp or pointed pieces of scrap metal poses cut ☐
d. Increased in scrap metal theft ☐
e. poor sanitation ☐
f. Any Other…….

15. What measures are in place to minimize/manage these hazards?

……
……
……....

(B) Scrap metals as alternative materials for Sculpture

Please Tick where it demands and provide answers where appropriate.

16. To what level can scrap metal art used as means or promoting environmental sanitation?

    a. For recycling ☐

    b. For exportation ☐

    c. Any Other……..

17. Is there a difference between scrap metal art and metal art? YES☐ NO☐

18. What is the nature of scrap metal in Sekondi/Takoradi metropolis?

    a. Practiced as an art ☐

    b. Not practiced as an art ☐

    c. Trade as scraps ☐

    d. Any Other…….

19. What are the challenges in production of scrap metal art?

    a. Material inefficiency ☐

    b. Expensive in nature ☐

    c. Time consuming ☐

    d. Hard to produce or fabricate ☐

    e. Any Other……