Task and Need Analysis of Metal Work Casting in Katsina State of Nigeria

by

Darma Katsina Umaru

A Research Paper
Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree
in

Career and Technical Education

Approved: 2 Semester Credits

Dr. Howard Lee

The Graduate School

University of Wisconsin-Stout

July, 2009

The Graduate School
University of Wisconsin-Stout
Menomonie, WI

Author: **Umaru, Darma Katsina**

Title: ***Task and Need Analysis of Metal Work Casting in Katsina State of Nigeria***

Graduate Degree/ Major: MS Career and Technical Education

Research Adviser: **Lee, Howard, Ph.D.**

Month/Year: **July, 2009**

Number of Pages: **88**

Style Manual Used: **American Psychological Association, 5th edition**

ABSTRACT

The purpose of the study was to perform a task and needs analysis of metal casting occupations in Katsina State. The analysis does the following: identifies competencies required in the field, surveys the skilled manpower need of metal casting personnel, and identifies job opportunities that exist in the area of occupation in Katsina State.

The people in Katsina State need a standard for metal casting occupations, considering the industrial development taking place in the modern world of technology. In addition, a shortage of skilled manpower in metal casting has already proved a serious constraint to other development across the state and nation in general. The literature states that 7,510 of workers are needed and only 2,756 of workers are available (Bello, 2005).

The objectives for this study were:

1. Determine the future needs of metal casting jobs in Katsina State, Nigeria.
2. Identify program content in metal casting for the technical institutions, secondary technical colleges and other vocational schools in Katsina State,
3. Determine competencies required in metal casting work in Katsina State and Nigeria for the development of technology of industries, then use these competencies to develop the content of the curriculum.
4. Determine if there is a difference in metal casting manpower needs based on selected demographics.
5. Determine if there is a difference in metal casting tasks based on selected demographics.

A composite survey was developed from the current competency list of tasks, for the study, and the study clearly revealed vital criteria for the development of curriculum and hence course of study in metal casting in Katsina State Nigeria. These criteria will change the curriculum to meet the modern needs of metal casting workers and will better prepare students for employment in today's industry.

This study will allow Katsina State educational planners and policy-decision makers to recognize and adopt policies that will establish, develop, and implement educational programs for both the present and future needs of the society. The study will show the continual need for making curriculum changes in technological and vocational institutions.

The Graduate School

University of Wisconsin-Stout

Menomonie, WI

Acknowledgments

Thanks to Professor Dr. Howard D. Lee, my advisor and program director for M.S. and Ed.S. degrees in Career and Technical Education, for the generous way in which he placed himself at my disposal in various matters concerning my studies and stay in the United States. Acknowledgement also is due to Vicki Kuester, Dr. Abel Adekola and all the Library Learning Center staff A to Z for their guidance, help and assistance given to me du ring my studies.

I would also like to thank all my children and wife Samuhai, my friends, colleagues and all people of the community in Menomonie and the University of Wisconsin-Stout for their generosity.

Finally I wish to express my gratitude to my parents and my next immediate brother Abdulrasheed, again wife Samuhai, for their encouragement, inspiration, understanding and patience and will for my studies here in the United States of America. Thanks to all people.

TABLE OF CONTENTS

List of Tables

Chapter I: Introduction

Background Information

Nigeria, officially the Federal Republic of Nigeria, is a federal constitutional republic comprising of 36 states and one Federal Territory Abuja. The country is located in West Africa, and the name Nigeria is taken from the River Niger running through Nigeria (Fafunwa, 1994). Nigeria is the most popular country in Africa, the eighth most populous in the world, has a recorded population of over 150 million people (Bello, 2005). Of this population, 35 million are students (Giwa, 2007). The three dominant tribes are Yoruba in the southwest, Hausa in the north, and Ibo in the eastern region (Bello, 2005). Although people speak their native language, the official language in Nigeria is English (FGN, 1967). The country is rich in petroleum and many natural resources, such as iron ore, copper, coal, diamond, gold, and tin (NCER, 1999). Nigeria has many industries like, textiles, steel mining, steel rolling mills, foundry metal casting, fabrication metals, auto assembly and parts, local metal casting industry, metal recycle industry and many others (Edwin, 1999).

In Nigerian, the government controls all the three sectors of education namely Primary Education, Secondary Education and High Education. As of 2008 record, Nigeria has 43 Universities, 45 Polytechnics, 57 Advance Colleges of Education, 7,894 Secondary Schools. In addition there are many privates' schools approved by the Nigerian Government to operate in the country but under the control of the Government (Bello, 2005).

The Motto for Nigeria is Unity Faith and Progress (Press, 1985). In which Katsina State is one of the Unity States among the 36 states with the capital territory Abuja.

Katsina State is located in Northern Nigeria, with capital of Katsina City. Katsina state was formed in 1987 from the Kaduna State (KTSG, 1988). It has an area of 24,192 km square,

population of 15,653,376 peoples with Hausa as a native language, and English is the official language as approved by the Federal Republic of Nigeria (FRN, 1967). The Governor is Ibrahim Shehu Shema (PDP), heading the state government with 34 Local governments including Katsina local government area (KTSG, 1988). The Katsina State is among the developing States, with a good economy, sound good business sector, many industries, companies, vocational centers, schools and colleges, polytechnics and universities.

Katsina state has two universities, polytechnic, advance colleges of education, technical colleges and many secondary schools sited all over the state local governments area, in all the 34 local government areas in the state. The state polytechnic is Hasan Usman Katsina Polytechnic and is owned and financed by the state, but educational systems and curriculums are control by the federal government of the federation. The state government and Polytechnic Governing Councils can make adjustments on the curriculums of some certificate courses in the institutions to suite the industrial need and the needs of the state technological development.

Because of the rapid development in technology, much investment has been made in the industries of Katsina State. Many metal casting industries, both standard and local, were built during the creation of the state, thereby increasing the economy and progress of the State. These industries include Katsina Steel Rolling Company, Saulawa Metal Industry, Bilva Sanda Metal Casting, Funtua Metal Casting Industries, and many others in progress.

The increase of metal casting industries, and the concern of business men and government of the Katsina State, indicate there is a need for the update to the field of metal casting occupations in general. This will benefit the State and help with progress for industrial development (Adeyemi, 2000). At the same time considerations has to be given to the field of

metal casting occupation in general, so as to up lift the state image in technology and the progress, for the way forward in industrial development.

Because of the responses from business and industries in the state, rapid developments, technological changes, expansions of industries, and demands from the people, the curriculum of Metal Casting needs to be upgraded. Upgrading the curriculum will help to meet the employment challenges in the occupation of Metal Casting in the State. Hasan Usman Polytechnic is responsible for doing that, because 85% of the employees in the state graduate from there, and 15% go to other states in the federation (Bello.2005).

Hasan Usman Katsina Polytechnic offers many certificates, diplomas, national diplomas, high diplomas and training in many engineering fields for the benefit of the state and nation. Some of the courses offered at the Hasan Usman Katsina Polytechnic are laboratory technology, mathematics, computer, food science, hotel management, building technology, mechanical engineering and metal work technology. In addition to those courses, the Department of Technical Education College of Science and Technology offers the following National Certificate of Education (NCE) technical certificate courses; auto technology, building technology, electrical electronic technology, wood working technology and metal working technology.

The curriculum for the Metal Working technology department consists of the following; welding, forging, fabrication, machining, fitting, metal casting, and drafting. These programs focus on the field and careers of metal casting, a field in high demand due to the need of metal casting workers in Katsina State (Vein, 1995). Metal casting is the backbone of all the mechanical engineering courses, because all metals, such as iron ore, cannot to be used as found in the ground. The metals must be processed or refined by Metal Casting before being used.

Metal casting is a branch of mechanical engineering that deals with the melting of metals and pouring of the molten metal into molds from which castings are made (Thomas, 1965).

The importance of metal casting products in the society and in the world of today is indicated by how societies depend extensively upon metals and metals products. Many products would be nonexistent if it were not for metal casting, as metal cannot be obtained in a useable form from the earth. Practically all metal products start by first being cast in ingot (Daudal, 2002). For instance, metal ingot from which other areas of metal shaping starts must first be cast. Therefore, without the casting process of metal casting (foundry), there would be no metals, and if there were no metals, there would be virtually nothing.

Furthermore, the convenience enjoyed in modern homes depends largely on metal casting. Examples of this include grey-cast iron castings, which appear in the form of bath tubs, sinks, wash basins, furnaces and cooking utensils, and brass and bronze castings, which are found in the form of hardware, faucets, parts of washing machines and other household items (Emamodeeni, 2001). Mechanical equipment, aluminum and magnesium castings appear in the form of cooking utensils and parts for refrigerators, food mixers and vacuum cleaners (UNESCO, 1995). Edwin Doe, in his write-up on the values of foundry products to modern industry said, "Our modern land, sea and air transportation systems depend upon castings for their operation; that an average automobile has about 600 pounds or more of cast metal parts in its construction" (Edwin, 1999). In addition, modern civilization and lighting systems would be impossible without metal castings. These examples have clearly proven that metal casting engineering is a basic industry for the development of the modern world of technological advancement.

There is no doubt that modern civilization would not be as advanced as it is today if it were not for the metal casting and its products in the developing world of today. The metal casting industry is progressive and is always looking ahead. As it improves, so will civilization improve (Thomas, 1994). Industrial development has been frequently brought into special prominence in Katsina State government plan (KTSG, 1988). For example, the government frequently gives loans to small scale industries.

With the establishment of different iron and steel industries in the state and country, metal casting has helped to manifest this great aspiration of the government. Along with that, the concern of the state and its people for the establishment and greater attention for the vital basic industries in metal casting field Katsina State. These would draw to the maximum extent on the by-products and other raw materials available in the State and country for the manufacturing processes, and hence for a sound framework for further development in industrialization.

Education and training needs for such standards of industrial attainment become very apparent, considering the fact that shortage of skilled manpower has already proved a serious constraint to other development across the board (Bello, 2005).This study was designed and constructed to provide a task and need analysis survey to determine the competencies required in metalwork casting occupations following the job description. Skilled manpower is needed for metal casting personnel. Job opportunities exist in this area of study in Katsina State. In addition, it was hoped to reveal criteria for the development of curriculum, and hence course of study, in metal casting. This curriculum would be useful in technical and secondary technical colleges in Katsina State as well as other States of the Federal Republic of Nigeria..

Statement of the Problem

Changes in metal work casting field have naturally caused changes in curriculum and job entry level of training and skills. These affect the job opportunities and competency among the metal casting personnel in the Katsina State.

Purpose of the Study

The purpose of the study was to perform a task and needs analysis of metal casting occupations in Katsina State. The analysis does the following: identifies competencies required in the field, surveys the skilled manpower need of metal casting personnel, and identifies job opportunities that exist in the area of occupation in Katsina State.

The people in Katsina State need a standard for metal casting occupations, considering the industrial development taking place in the modern world of technology. In addition, a shortage of skilled manpower in metal casting has already proved a serious constraint to other development across the state and nation in general. The literature states that 7,510 of workers are needed and only 2,756 of workers are available (Bello, 2005).

Research Objectives

1. Determine a need analysis through a survey; this would be useful in determining level job competency entry into the area of metal casting.
2. Identify program content in metal casting for the technical institutions, secondary technical colleges and other vocational schools in Katsine State.
3. Determine competencies required in metal casting work in Katsina State and Nigeria for the development of technology of industries, then use these competencies to develop the content of the curriculum.

4. Determine skilled manpower need for the field of metal work foundry personnel in the State of Katsina and its environment.
5. Determine job opportunity that exists in the area of metal cast foundry in Katsina State and other parts of the country of Nigeria.

Importance of the Study

1. A critical study and analysis survey such as this should help to determine competencies required in foundry, skilled manpower need of foundry personnel, and job opportunities that exist in this area of occupation in Katsina State.
2. The study clearly revealed vital criteria for the development of curriculum and hence course of study in metal casting in Katsina State Nigeria. These criteria will change the curriculum to meet the modern needs of metal casting workers and will better prepare students for employment in today's industry.
3. This study will allow Katsina State educational planners and policy-decision makers to recognize and adopt policies that will establish, develop, and implement educational programs for both the present and future needs of the society. The study will show the continual need for making curriculum changes in technological and vocational institutions.

Limitations of the Study

1. The results of this study would directly apply to the educational and research institutions of learning, and industries in State of Katsina Nigeria. These results may not be applicable outside of the State of Katsina Nigeria.
2. The study results are limited to those establishments that are involved or associated with metal casting and its allied fields such as Metallurgical, Chemical

Engineering, Steel Rolling Mills, Local Industries, Mining and the other like. The study results cannot be applied to other occupations.

3. The study is limited to the development of Katsina State and its people. Results may not be applicable outside of Katsina State.

Definition of Terms

The following are definitions of terms used in the application and paper that may need more explanation for the reader.

Cast - To form metals by heating to melting temperature, by melting and pouring into a mold shape, and or sort kind (Thomas, 1994).

Foundry - An establishment for producing casting in molten metals of any kind, such industry manufactured component of machines (Thomas, 1994).

Ingot - A mass of metal cast in a form for shaping, remolding, refining or machining, it is in form of block substance and very heavy (Thomas, 1994).

Katsina SState - An old city in northern Nigeria, with 34 local Governments (county), now a state among the36 states in Nigeria West Africa (Giwa, 2000).

Mechanical Engineering - The discipline that involves the application and principles for analysis, design, manufacturing, maintenance and production of metals (Charles, 1984).

Metal - Any of a class of elementary substances as iron, gold, aluminum, copper, zinc, furious and nonferrous, that are typically characterized by opacity, ductility, conductivity, and luster (Thomas, 1994).

Molds - To shape, form and hollow a form for shaping something in molten or plastic state, especially during production in metal casing and plastic industries (Thomas, 1994).

Raw Materials - Not processed, from the finished or refined position, just materials at their crude state of being (Mashi, 1998).

Skills - The ability to do things well, expertness or dexterity in performance of craft, trade, or job, especially one requiring manual dexterity (Thomas, 1994).

Chapter II: Literature Review

Statement of the Problem

The purpose of the study was to perform a task and needs analysis of metal casting occupations in Katsina State. The analysis does the following: identifies competencies required in the field, surveys the skilled manpower need of metal casting personnel, and identifies job opportunities that exist in the area of occupation in Katsina State.

The people in Katsina State need a standard for metal casting occupations, considering the industrial development taking place in the modern world of technology. In addition, a shortage of skilled manpower in metal casting has already proved a serious constraint to other development across the state and nation in general. The literature states that 7,510 of workers are needed and only 2,756 of workers are available (Bello, 2005).

Introduction

This chapter will present the review of Metal Casting history and related literature as it reflects the effect of developmental changes in the field area. Concerns for the current labor force regarding up to date metal casting personnel competency, available of training and development in the future trend in the industrial market, and the modern time today. Considering the nature of the subject under study, a comprehensive review of literature is necessary, to be reviewed.

Sources for Literature Review

Metal Castings or Foundry, the products of metal foundry and industry, began approximately 6,000 years ago, in the Black Sea area (Simpson, 1976). Gold was the first metal found, but copper was the first metal cast. It was a harder metal and therefore better suited the need of people at that time. Due to the migratory manner of the early masses, the art of founding moved from place to place. Since time, there have been foundry men and molder that are still

using techniques whose rudiments were discovered more than 3,000 years before Christ (Simpson, 1976).

Man in those years had actually used metals for centuries for ornamental or utilitarian work. Specimens covering those periods are housed in museums throughout the world, and are preserved for historical purposes and records.

It was sometime between 3,500 B.C., the basic metallurgy of smelting and casting was discovered in the area of northeast Persia and beyond, and spread through the Middle East to Egypt (Childe, 1951). It was upon the foundation of this discovery that civilization was first built.

At first, copper daggers, swords and implements were cast in shallow open molds of stone or based clay (Hamilton, 1967). Hamilton stated that prior to 3,000 B.C., copper would blister in an enclosed mold, but it was discovered that by allowing copper with other metals, bronze could be made and that new metal was much easier to cast.

Metal bronze molders used tiny furnaces and their bellows were made of metal skin with a pipe through which to force the draught. Their ladles, forceps and tongs were the simplest tool, but they used all the basic techniques of their craft in making their work (Hamilton, 1967).

The discovery of iron and its melting was a tremendous step forward for mankind, for iron tools were cheap and more efficient than bronze. All kinds of new implements could be made during this time.

The forest could be cleared, land drained and cultivation improved (Coghland, 1970). The discovery of iron ore took place among the Chalybe's historical review. It took place among the Calybes of America, subjects of the Hittite empire, towards the first half of the second millennium B.C., and the knowledge of iron working in the whole of Europe and West Africa is

ultimately traced to this source (Coughland, 1970). How this discovery comes to be in this world where there had been some 2,000 years of experience of copper and bronze works is not definite. At the temperature required to melt copper, iron ore forms a spongy mass known as a "Bloom" in which iron, slag and cinders are mixed. But about 1400 B.C. the people of the American mountains discovered how to make this 'Bloom" into useful iron by heating, hammering and quenching in cold water over again. This first metallurgical process of carburizing is still used today (Simpson, 1976).

The new knowledge was carried through the Middle East of African countries by tribes, and uprooted by great upheavals between 1200 and 1000 B.C. and by 600 B.C. had spread into Africa and Central Europe (Forbes, 1976). Not until the late Middle Ages, when was it discovered that raising the heat of a furnace to the point iron would melt and pour, was there any cast iron (Forbes, 1976).

And in China, matters were very different. There, the iron ore had a high phosphorous content, and so a low fusion point. According to the literature, the Chinese used refractory clays for making crucibles. Their bellows were more developed and were drawn by water. For these and other reasons, Chinese metal worker discovered how to cast iron some 1,500 years before European fellows (Needham, 1984).

It is not known, however, whether this art of cast iron production was carried to Europe from China, or whether it was rediscovered in Europe, although either is possible (Needham, 1984).

On the other hand, Blast furnaces, which are still the main iron smelting medium, were gradually improved in Europe in the Middle Age and bellows were powered by water after about

1325 A.D., (Fell, 1968). Thus the temperatures needed for the smelting of iron in Europe may have been reached in ignorance of Chinese skill.

Whatever the truth, the first blast furnace was said to be built in the Liege and Rhine Land district around A.D. 1400 and began to cast. Also, according to Fell (1968), the first person to advertise skill in cast iron was Mencken Gast, of Frankfurt, Germany. Since that the time, an iron founder, one who pours iron, was and continues to be used for that work.

At about 50 years later, around 1450 A.D., the knowledge of iron metal casting had spread into other European countries. Italy, for example, has a story about Saint Antonius, the Bishop of Florence, who was called in to make a sign of the cross over a Blast furnace from which metal refused to flow because of blasphemies uttered by a foundry worker (Alexander, 1987). Fortunately, modern metal is less sensitive to bad language.

Early History of Metal Casting in Nigeria

The early history of metal casting in Nigeria, could be described as somehow an accidental discoveries, which brought to light by a great deal of ancient cultural heritage of the people of Nigeria. Literature review on the issue clearly showed that the artistic and scientific creativity of these cultures make the people of this subcontinent the proud owners of this historical discovery (Mannir, 1997).

Another history stated that, the famous Nok coupled with the societies of Igbo-Ukwu and Hausa, made the cultural discoveries and archaeological findings that clearly demonstrated the people of Nigeria are associated with the earliest iron smelting in Africa. Ife and Benin developed centralized institutions that supported the development of art, especially in terracotta, brass, bronze and iron castings.

The west of the Jos Plateau between the rivers, Niger and Benue, in the northern part of Nigeria, lays the Nok valley. The first discoveries of the Nok came accidentally during tin mining of this area according to Shaw, Thurston (1975). Open cast mining methods were employed to extract tin from gravels. During the course of these operations in the Nok valley before and during World War II, a number of recognizable archaeological objects had been turned out (Thurston, 1978). Some of these objects included the terra-cottas, the alluvial deposits, perforated quartz beads, tin beads, places of iron smelting furnaces, iron slag, clay draught pipes of furnaces, and quantities of foundry tools (Thurston, 1978).

It is well known from the literature, that the people south of the Sahara were the earliest iron smelters due to the pieces that were discovered. The various furnaces and iron slag, including the tuyeres, clay nozzle for bellows, clearly demonstrated that they were very advanced in this technology. A radiocarbon date of 500 B.C. is claimed for the Nok, and they may have started as early as 900 B.C. (Fagg, 1969).

The Igbo-Ukwu, is a town south of Onitsha in Anambara State of Nigeria. Like most major archaeological discoveries of Igbo-Ukwu, it was accidental (Charles, 1984). In 1938, a man named Isaiah Anozie was digging a pit to use for collecting rainwater at the back of his house. In so doing, he comes across a series of bronzes that were lying about two feet below the ground. Further excavation on the compound of Isaiah's brothers, Jonah and Richard Anozie, produced different and more sophisticated bronze works. All the objects recovered were intricately designed and made with a complete mastery of lost wax casting (Thurston, 1970).

The actual of where and how the Igbo-Ukwu bronzes and technique to make them entered this society could not be proved by the history, and is one of the enigmas of Nigeria art history. Bronze is an alloy of copper and contains a much smaller quantity of tin. Brass is an

alloy of copper and zinc. The Igbo-Ukwu castings are of bronze, with an admixture of lead, while the objects not cast by the lost wax process, but made by smelting and chasing are of almost pure copper (Thurston, 1978). This can only show that the ancient craftsmen of Igbo-Ukwu had significant knowledge of metallurgy to know that leaded bronze is more ductile than copper and is better for casting, while copper can be more easily hammered, twisted and engraved than bronze. The Igbo-Ukwu bronze castings have been dated to the ninth century A.D., but there is evidence which suggests that it might have been in the 15th century (Thurston, 1978).

In addition to these, the Ife discoveries, or more properly, Ile-Ife, have been important to city for the Yoruba's-Western part of Nigeria. The first attention to the cultures in this part of the country was in 1910 – 1911, when the German ethnographer, Leo Frobenius, discovered evidence of an ancient art tradition in terra-cotta and bronzes (Charles, 1984).

The early discoveries of these terra-cotta and bronze heads were of a remarkable naturalistic style showing a high standard of creativity of the people. Nearly 40 years after this discovery, Ife built a modern foundry, made by a sand mold technique and not lost wax as in the case of Igbo-Ukwu (Thurston, 1970). It is not known exactly when Ife art began to develop, but radiocarbon dates for the fully developed art range between the 11th and 15th centuries (Willett, 1970).

The Benin works of art now reside in a famous city in Bendel state of Nigeria. The Benin bronzes and brass are better known than those of either Ife or Igbo-Ukwu. Evidence of this is that an ancient Benin bronze cast mask was the symbol for the 1977 World Black Festival of the Art that took place in Nigeria in 1977. Their popularity is both because they are more numerous and

because they have been known to the world outside Nigeria for a longer time and can be seen in mediums both in Europe and America (Charles, 1984).

The people of Benin works of art and stylish castings, have been very remarkable and much has been written about them by Europeans who were intimately connected with the history of the ancient Benin City. Whether this founding art of Benin actually vanished from Ife to Benin is not yet known, but there is no significant bronze industry in Ife today. This is in contrast with the situation in Benin were craftsmen continue to produce bronze and brass sculpture for the tourist industry. However, excavations at Owo between Ife and Benin, have revealed the contemporaneous presence there of an art showing both the Ife and Benin style, in time range radiocarbon – dated to the 14-15th centuries (Willet, 1970). Thus it can be seen that there is an Ife-Benin connection in art and casting.

Also in the coast of the Niger River, west of the Benue Plateau, there exist some significant bronze discoveries. Certain iconology graphic motifs shared by the Benin and the Tada bronze may indicate influences exercised on the Benin bronze during the 16th century by some, as yet unidentified, northern industry (Thurston, 1978).

Similarities in the technique employed between Ife bronze and Tada bronze, such as the unification of the core and mold to achieve stability during casting, would seem to indicate a connection (Willet, 1970).

Concerning this historical background review of the ancient foundry men in Katsina state Nigeria, may have to believe that with the significant iron smelting of Nok culture, and the highly creative brass, bronze castings of Igbo, Ife and Benin, etc., the Katsina State Nigerian ancient craftsmen had developed sophisticated articles obtained by the people of this sub-continent.

Metal Casting Industries

Metal Casting work or foundry, is basically the easiest way to shape metal with practically no limitations, simply melting it in a furnace and pouring the liquid metal into prepared molds where it solidifies into the cast shape required (Samin, 2005). Metal casting education in Katsina state Nigeria is on the threshold of industrialization and is one of the main concerns of the government (Abrahim, 2007). Metal casting is needed for vital basic industries which would utilize the available raw materials and by-products in the country for the manufacturing processes, and hence form the basis for further industrial development.

A survey literature of the Economic Conditions in Nigeria's Minerals production has revealed that the country is endowed with vast mineral resources that could form a solid framework for gigantic metal industries that are needed in the country (Abrahim, 2007).

Among the mineral potentials mentioned are bauxite, diamond, and iron ore, all of which are deposited at Kebbi with an estimated reserve of two billion metric tons. Other, smaller deposits of these minerals are found between Enugu and Nsukka. In addition, lead and zinc are found in the Abakalike area, and about five to eight billion metric tons of limestone is located in Kankara Katsina State (Ziya, 2008).

Other equally important minerals for the metal industry that are available include kaolinite with an estimated reserve of 250 million cubic meters , fire clays with an estimated 800 million cubic meters, and natural gas oil reserve with approximately two billion tons. These deposits and figures are based on the 1987-1991 survey of economic condition in Nigeria (FMMP, 1991).

A United Nation's special study publication on iron and steel demand in Nigeria revealed that, as a result of the rapid increase in reinforced concrete used in building construction, growth

of steel imports for building rose from 13,000 tons in 1987 to about 60,000 tons in 1997. Galvanized steel sheets of iron and steel, used to make household utensils and metal furniture and fixtures, are imported in very large quantities (UNIDO, 1999). This UNIDO publication concluded that the increasing volumes of imported iron and steel components and materials raised the possibility of a national iron and steel project to produce some of these items.

The different iron and steel complexes in Ajakuta and Wari, and the steel rolling mills of Katsina and Jos, are remarkable worthwhile industrial programs (FMMP, 1981). Also, it has been shown that the main burden of industrial development in Nigeria remains with the private sector, which has not had the financial resources in the past years. According to a publication by Davis on Nigeria's option for long-term development, it is very important that the local manufacturers are industrialized (Davis, 1990).

Vocational and Technical Education in Katsina Nigeria

The section of this literature review is concerned with the traditional vocational education, or what is now called career and technical education. The specific foundry education and training in the country is covered. It is necessary to review the history of vocational and technical education in Nigeria in all, because history ought to exert a powerful influence on the country's education and training, particularly in the field of metal casting, foundry, art work, commerce, technology, and science in nature (Charles, 1984).

Katsina State Nigeria's general educational aim has always been characterized in craft training and job-orientation (Bello. 1997). In the past, training in the areas of craft and trade, such as smelting, sculpturing, iron-brass and bronze castings, and carvings, etc., were largely run by an apprenticeship system. Usually the children were not trained for trades by their parents, but by relatives, master craftsmen or friends, in the particular field or trade. Parents had some

psychological reasons for sending their children to be trained by other hand s rather than undertake the education of their children themselves. One of the reasons was that the children might be very slack, and might not take the job learning seriously, if apprenticed to their parents. In other words, parent's moves were to ensure discipline and concentration in training process (Bello, 1997).

The apprentices aged between nine and 25 years old usually were required to perform services other than the trades they came to learn. The duration of training varied considerably among trades and masters, but incorporated in the training programs were some other activities that would prepare the apprentices for the future, such as moral and agricultural training (Charles, 1984).

For most of the skilled trades, families and/or tribal groups constantly reserve and pursue the skill. These skills were highly valued and in some cases, zealously guarded. Evidence of these sort of restrictions in passing skills on to others of different groups can be seen in the over centralized skills of blacksmithing in Awka in the East, Jos in the North and Hadan in the Western part of the country. Also, evidence these restrictions is seen in the famous Benin centered brass and bronze carvers and in the Bendel area.

The traditional system of education and training, although undergone without elaborate equipment or complicated teaching methods, clearly began as a wider education process in which the indigenous societies of the country passed, as their cultural heritage, from one generation to the next.

Metal Casting Personnel Needs

Needs assessment and analysis, deals with the need for a training/education program. What is the gap between the knowledge and skills required to perform a job and what is known

by the worker? If there is, how was it determined? If there is not a need for a training/ education program, then what is the problem? What went into deciding on the technique selected to gather the data, and are data sources appropriate for the decisions that need to be made? Needs assessment and analysis will answer these questions (Lee & Nelson, 2006).

The section on technical education in the National Policy on Education (1997) has clearly stressed the great need for trained skilled manpower, as well as basic scientific knowledge. There are also provisions in the national plan that specified the need for the industries to provide technical training outside their own programs. A more direct aspect of the policy is the section regarding the insufficient attention given to the effort of skill development in certain basic fields, like food technology, clothing manufacturing, service mechanics, metal casting, etc. (Yahaya, 1997). These skills are needed for the economy.

Both the present and the future needs of the country must be considered in making curriculum changes in technical education. In addition, government will intensify efforts to introduce more technical courses into secondary school curriculum. The curriculum in the technical schools will need to be broadened to meet the present and future needs. Courses in such fields as food processing and preservation, clothing manufacture, technology of service mechanics, metal castings, electric and electronic etc, will be considered. With more Polytechnics and Colleges of technology being established, a wide range of these courses will be provided to meet national needs (NPE, 2000).

It becomes clear that the Government of Nigeria is fully aware of the need to train these much needed skilled manpower, particularly in the areas of service mechanics, spare parts manufacture or foundry, computer, mineral resources, civil, architecture, quantity survey and agricultural engineering (Yahaya, 1997) . New iron and steel industries developed in the country

have resulted in much demand for more trained and skilled personnel. Effort has been made in this direction, as indicated in the Nigerian Economic Review (1999) which reported that construction of the metallurgical training complexes at Alaja and Onitsha was completed. This training complex will provide training facilities for workers in the iron and steel industries located at Ajakuta, Alaja, Jos, Katsina and Calaba (NER, 1999).

In addition, discussions have started with the United Industrial Organization (UNIDO) in order to secure their assistance in the establishment of a metallurgical research and test center in Nigeria. Based on the demand for iron and steel workers, the need and demands for metal casting personnel will be considerable in Nigeria in the next years ahead (UNIDO, 2008). On the other hand, occupational training oriented towards job market needs has to be developed in the country.

It is with this need in mind, that the application of task analysis technique is being utilized to formulate the course contents and competencies required, for such training programs in the field and occupation of metal casting.

Task Analysis

In the book, Instructional Analysis and Course Development, (Lee, and Nelson, 2006) described task analysis, as a process of identifying appropriate content. Many techniques can be employed to determine content to cover in the training or education setting. The result of content identification is listing of appropriate duties and task. A task analysis, therefore, has the objectives of identifying the tasks involved in the system being studied, and of identifying the training needs of the situation. Task analysis is creating an inventory of tasks.

The key to developing effective training courses and curricula is valid content. Needs assessment provides the rationale for the course, and task analysis identifies specific content to

be covered in the training or classroom setting. Content is what is taken to the next course and what is applied on the job. Needs assessment and task analysis determine content, and evaluation revises it (Lee & Nelson, 2006).

A list is made of all the tasks, and this list is used to develop the curriculum of the occupation in question. A task analysis is needed to determine the knowledge and skill content of each task.

Technique of the Analysis

In most cases the main goal of career and technical education is to prepare people for eventual employment in industries. In order to ensure successful employment, programs have to be designed to provide instructions leading to occupational competency as required by the industry.

It has been suggested by Fryklund 1970, that one of the ways to ensure relevance between program of instruction and occupational competency is through the use of the occupational analysis technique. That is a technique by which the essential elements of an occupation, or any part of occupational activities, are identified and listed for instructional purposes (Fryklund 1970). Fryklund also mentioned that in order to teach an occupation, a subject, or an activity, there first must be an inventory of the elements to be taught. Through this procedure the essentials of elements of an occupation are discovered.

In another publication, the job task and the required performance levels were validated by incumbent workers to develop valid performance-based curriculum materials for selected occupational programs (Alabama, 1976). Such research based material, no doubt, should provide a core for developing job relevant occupational curricula.

Survey Procedures

After the task inventory has been completed, and the required job related tasks have been identified, the analysis questionnaire can be compiled. The questionnaire is then used to determine background information about the respondent and their attitudes towards the relevancy of each task (Halfin, 1983).

The questionnaire constructed is said to include such criteria as:

1. How often the task is performed.
2. The relative time spent on the performing task.
3. The importance of the task as related to completing the job.
4. The ability to perform the task.

In conclusion, Halfin stated that after the questionnaires are retuned and checked for completeness, responses are tabulated and then a summary of statistics can be derived. The results obtained from the analysis of task data can then be used to guide the development or revision of curriculum for an educational or training program.

Man Power Needs

Needs assessment is a process consisting of a set of activities and procedures that identifies the merit or worth of a training or education programs. Often called front-end analysis, need assessment seeks answers to questions concerning the potential need within the work place or community for a training or education program or course (Lee & Nelson, 2006).

The needs for change in an organization or educational set up, is very important as things and technology changes with time every day. And for any community or organization to developed and be effective, it should have to be organized with good set up procedures in their programs of instructions and relevant materials for schools and training purposes.

As stated, for the meaning of organization in a book, Instructional Analysis and Course Development by Lee and Nelson (2006), an organization refers to a broad area, such as a town, city, or region, where an institution such as a technical college is concerned with determining the need for programs.

Katsina state of Nigeria, as a community with some technical colleges and vocational schools, those that deals with the technical programs of studies and training of man power development, then, for the development and advancement as well as the progress of the state and its industries have to consider the future needs of their peoples. Actually needs to have up to date programs of studies those that meets the challenges of the modern technological development is important. Even though Katsina State is a developing type of community in these nature, but not withstanding efforts must be made, so as to be able to be one of the developed state in the nation.

The needs for well trained technicians in all fields, was stated in an article, *Man Power Needs in the Work Force* (2007, July 23, 2008). Workshop held at science and Technical Board Katsina. Industries and ministries of work and housing, now lack trained technicians in almost all the fields in engineering technology (Bello, 2006).

Curriculum Development in Vocational and Technical Education

In order to clarify this definition of curriculum it is important to examine how it may be distinguished from the concept of instruction. Whereas curriculum constitutes a broad range of student experiences in the school setting, instruction focuses on the delivery of those experiences. More specifically, instruction may be perceived as the planed interaction between teachers and students that (hopefully) results in desirable learning (Finch & Crunkilton, 1989).

Taken into account are the instructions stated to aid learning in a chronological order, so as learning will take place. Instructional development, on the other hand, consists of planning

done in direct support of student learning and conditions under which it occurs (Kindred et al., 1976). Naturally, when curriculum development is taken into consideration, then there should be a higher level of generalization of activities attached. As such metal casting curriculum for technical schools and vocational colleges has to be revised from time to time, for the up grading of the courses and industrial changes or development as relates.

Conclusion

The pattern of industries concerned regarding the growing need for metal casting personnel is evident in the literature of the last 10-15 years. Beside of the changing new technology and other updates, same changing in demographics is found to be a matter of concern in the literature of this modern time of today. The changing of technology which make almost all operations or work possible to be automated and computerized in the industries, un like in those years or passed time, were by all the operations and or activities in the industries are done manually. Same, most of the equipments, tools, and some gadgets used in the olden days are now replaced with the modern ones, in which they are easier to operate, quicker in performing operations, and mass productions of the products to be produced. All these are possible, in that, because of the technological development of the computer age of the current time now.

Chapter III: Methodology

Introduction

Katsina state's education curriculum, is Nigeria's education curriculum, particularly those regarding technical-vocational education, has been patterned significantly by the colonial legacy. But with the present quest and aspiration of the state's and nation towards industrialization and hence the changing role of technology in its system, teachers of technology and program planners would find it very useful to revise or develop their programs to suit the needs of this changing economy.

Purpose of the Study

The purpose of the study was to perform a task and needs analysis of metal casting occupations in Katsina State. The analysis does the following: identifies competencies required in the field, surveys the skilled manpower need of metal casting personnel, and identifies job opportunities that exist in the area of occupation in Katsina State.

The people in Katsina State need a standard for metal casting occupations, considering the industrial development taking place in the modern world of technology. In addition, a shortage of skilled manpower in metal casting has already proved a serious constraint to other development across the state and nation in general. The literature states that 7,510 of workers are needed and only 2,756 of workers are available (Bello, 2005).

Back ground of the Survey Instrument

Lee and Nelson (2006) in describing the importance of appropriate data analysis techniques states:

> Data analysis procedures need to match the types of data gathered and the data collection technique used. For example, focus groups are effective in generating comprehensive

lists of problems, needs, and suggestions. If the list is going to be used to develop a survey questionnaire, duplicate statements are removed and every statement placed in the same format.

Considering an analysis and survey such as this would be available for the in determining competencies expected for job entry into area of metal casting industry and also to develop program content in metal casting for the technical institutions in Katsina state.

The background information herein would provide methods and procedures which clarify the limits and appropriateness of this study to specific applications. The information was presented in a format that is accurate and descriptive of the competencies required for job entry into the metal casting industry; survey of the skilled manpower need and job opportunities that exists in this area of occupation in Katsina state.

The chapter three of this study was developed, therefore, to give the reader a general over view and an understanding of the procedures and methodology followed in collecting and analyzing the data for the research.

The methodology procedures are described under the following headings:

1. Description and selection of the population surveyed,
2. Development of survey instruments.
3. The survey instrument (questionnaires).
4. Pilot testing of instruments.
5. Data collection and recording.
6. Data processing and analysis strategies (statistical analysis).
7. About the unknowns.
8. Limitations of the study as it relates to the research in question.

9. Data decision rule followed.

Description and Selection of the Population Surveyed

As stated in the statement of the problem, the entire study was conducted among different categories of personnel in the major and minor iron and steel complexes, namely, Katsina steel rolling mills, Saulawa metal work, Bilya Sanda Metal work, the premier technical colleges at Mashi, and Funtua, the Hasan Usman Katsina polytechnics, college of advance studies and technical education Dutsinma, as well as five state local education authorities and Industry.

A randomly selected sample of 100 personnel and registered members of the Metal Casting Association of Katsina State as per the lists of the members, out of the estimated 145, made up the population for the research. The total estimate of personnel in these establishments were as follows: about 20 cast metal steel staff each at the Steel rolling mills and Saulawa metal work complexes, 10 research engineers/administrators at the Hasan Usman polytechnic, 15 instructors/administrators of department/principles in each of the three technical colleges that are familiar with metal casting, seven instructors/technicians, lecturers each from the two colleges of technology that are associated with materials and processes, six faculty members each of the two higher institutions surveyed, that are concerned with metallurgy or materials and processes; and three administrators/industrialists each from the five state's local government authorities of education and industry that are particularly more associated with metal casting or metal working fabrication in the state.

A breakdown of the categories or personnel surveyed areas prescribed consist of: Eighteen given to Katsina steel rolling mills and 13 to Saulawa metal fabrication work, 14 to Bilya Sanda Metal Work Katsina, 13 to Funtua Metal Casting Funtua, 14 to Ubale Metal Foundry, 16 to Zubairu Metals Batsari, and 12 to Iron Works Faskari. And the remaining

questionnaires were also distributed as follows: Hasan Usman katsina Polytechnic was given eleven, Technical College Funtua was given ten, and Government technical Mashi was given the remaining fourteen, which make the total questionnaires 100.

Development of the Population Surveyed

A survey instrument in the form of a questionnaire was used for this research. And the development of the instrument was based on the task inventory approach for the task analysis aspect of the research. For this type of survey it is necessary to construct a task inventory, so as to indentify and compile a list of duty competency and task statements for the training need. A comprehensive list of duties competency lists and training need for metal casting men or personnel's, as well as the current number and future personnel need have been identified in the questionnaire.

From the books, Instructional Analysis and Course Development, page 140-146, on determine rating scale, and develop instructions, for importance and training need guides. A survey of instruments used in similar studies, and other instructional materials was reviewed. Were by a total of five duty statements and 50 test statements have been identified from the syllabus of metal work casting in Katsina State, and these task statements complied and grouped under each of the duty statements were set on the questionnaire.

In the preparation of the study and task statements, several factors and general guidelines were taken into consideration, particularly those recommended by Malching (Lee & Nelson, 2006).

Previous study in similar type of surveys have indicated that Likert format instruments are the most effective systems of collecting information of this nature of study.

The Survey Instruments

In this survey instrument identified, each of the task statements has two to five point Likert type rating scales. One scale is used for ranking its level of importance and the other the frequency of performance.

The scale used is shown below:

Level of Importance

1 = Not Important

2 = Moderately Important

3 = Important

4 = Very Important

5 = Essential

Frequency of Performance for the training need

1 = None/No Need

2 = Slight Need

3 = Moderate Need

4 = High Need

5 = Very High Need

All together, with the task inventory, a section used for collecting demographic information about the respondents was added. It asked for information on the location of his work, experience, sources of training and other job related information, apart from the specific duties and tasks performed, Care was taken to ensure that only the bare necessary relevant information was asked in this section.

To maintain anonymity, respondents were not required to include their names. However, respondents who desired a feedback on the finding of the survey were requested to include their names and address.

On the other section of the survey, that concerns survey of the skilled manpower need of metal casting personnel, and job opportunities that exist in this field of occupation in Katsina state Nigeria, a different procedure were utilized or used in the survey instrument.

Responses regarding skilled manpower need range from Yes or No, and are requested to state the number of employed currently in the services, and as well as future need of the personnel number within five to10 years.

1. Yes _____
2. No _____
3. Number of employed currently _____
4. Future personnel # within 5 – 10 years _____
5. If any other (Specify) _____

Whereas those regarding job opportunities that exist were based on yes or no responses, and were restricted to those personnel in the making decision about employments.

Pilot Testing

Perhaps the most difficult aspect of this survey was the development of a valid and reliable data collection instrument. In an effort to improve these qualities, an exercise to pilot test the draft instrument was carried out. The main purpose of this exercise was to determine the communicability and to improve the validity and reliability of the instrument set to be used, before it was formulized into the actual questionnaire.

Suggestion and recommendation for the study, as well as getting the authority from the company, was done by Dr. Welty. Whereby, the subjects for the exercise were selected from the Badger Iron Works, Inc. Menomonie, Wisconsin, United States of America. They were workers from the five different sections of the company, two managers and three international graduate students who were identified to participate. During the study great care was taken, so as to ensure that, these participants have the appropriate knowledge and understanding of metal casting, and or are of the background knowledge, information and experience.

In addition, care was taken to ensure that the three graduates identified and or selected are from the developing countries like Nigeria, in which their countries are facing similar industrialization problems as Katsina state Nigeria.

Participants were requested to carefully review and comment on the following aspects of the instrument:

1. Inclusion and exclusion of duty and task statements
2. Arrangements and well set up as well as comprehension
3. Organized and formatted format of the questionnaire
4. Good layout and general Impression of all the questions
5. Any other comment for improvement, and suggestions if any.

After all the above noted, and based on the feedback generated by the pilot testing, observations, corrections, and computerizations, the instrument was revised accordingly, finalized, and brought out into the form of a questionnaire to be used for the study.

Instrumentation

The procedure adopted to acquire the desired information for this survey was somewhat very usual and in order. Although the study paper was to be at University of Wisconsin-Stout, the actual process of administering the survey instruments was carried out in Katsina Nigeria which is quite a distance away. Few problems were encountered in the process of arrangement, these are;

From the human subject approval, one of the IRB evaluator was not satisfied on how the subjects of the study are known or identified from the survey as stated. These were answered for, as there is a list of the registered members for Metal Casting Katsina State chapter, these list will be used to select the subjects of the study.

Another problem in countered, were how to send the questionnaire to Nigeria, and be collected in good time. These were also over come, as a tentative arrangement was developed with colleagues appointed as coordinators from Katsina State and be executed successfully and in good time.

Communication was expected to be one of the major problems, but careful planning was utilized to overcome these problems.

The survey was carried out during the summer 2009. Letters were sent to the various establishments, where the questionnaires were to be directed through each group's administrative heads. These introductory letters were meant merely to inform those concerned of the intention to send survey questionnaires for research purposes. Around the same time, three former colleagues in Katsina State, Nigeria were reminded about their roll part in the whole exercise. They were to act as local coordinators to reduce expenses and to overcome the communication problems. Because of the geography of the state in the country distances between the total areas

to be surveyed, the researcher was constrained to choose three local coordinators representing the three main regions or parts in the areas, namely; Eastern, western, and northern parts of the state. These three local coordinators hold the titles of, senior lecturer, engineer and technician. Towards the later end of the same week, the following were sent to the said coordinators in bulk, by email, copied and attached, for them to print and distribute to the subjects. The following steps were undertaken to ensure consistency:

1. Detailed instructions regarding the administration of the questionnaires.
2. List of the subjects complete with names, positions and addresses as copied from the register of the association.
3. Questioners.
4. Human subject certificate and approval to conduct the survey
5. Instructions for returning questionnaire to the local coordinators in each area or zone.

Care was taken to ensure that copies of the questionnaires, introductory letters and envelopes were sufficient for use in the survey including those needed during the follow-up stages as required.

A colleague there in Nigeria, who frequents and knowledgeable in research, was responsible for bringing back the completed questionnaires by email, and he also coordinated everything.

Funds were provided for the purchase of local postage stamps, telephone charges and other miscellaneous expenses. Close contact was maintained with my colleague and coordinators at every stage of the survey. Every effort was made to monitor the survey through these two groups from here.

As was envisioned the whole survey exercise was completed by the early time, middle July 2009. Upon completion, the coordinators back to the United State of America to the colleague who sent them in bulk as instructed or email to the researcher directly for quick action. The completed questionnaires were then given, processed and analyzed accordingly.

Data Processing and Analysis Strategies (Statistical Analysis)

All relevant and useful information from the returned questionnaires were extracted and entered into the computer, from the tinplate, and be analyzed;

In line with the goals and objectives of the study, information gathered was to be analyzed based on the following guide lines;

1. Demographic information was analyzed as subgroup and total group.
2. Responses to each task statement were to be analyzed as a total group to determine the mean and standard deviation for the level of importance.
3. Responses to each task statement were to be analyzed as a total group to determine the mean and standard deviation for the frequency of performance.
4. Data for task statement under each duty statement were to be analyzed as a total group to determine the rank order of the duty statements for both the level of importance and the frequency of performance.
5. Item statements on the need survey were to be analyzed on the basis and standard deviation, frequency counts and percentages on all questions. The response data were to be organized into tables for clarity and analyzed accordingly.

On the unknown that might be thought, in which would directly affect the result of this study, was the rate of response to the mailed questionnaires. A response rate of less than 50 would have affected the generalization of the result.

However, a precautionary measure was taken; the three coordinators were told that if the overall response were less than 60%, the problem of generalization of the result would arise, particularly in construction of the size and geography of the area. Fortunately it is hoped that a response rate of 79% to 95% would be achieved.

This bias was thought to be capable of affecting their response to the statements on the survey and in turn affect the result of this study. Surprisingly, the respondents from these groups were unanimous with those of the metal workers in most of their opinion and hence responses.

Data Decision Rules

The main objective of this study was to validate competencies for the purpose or establishing entry level and hence curriculum content materials for the metal castings occupation. With this in mind, it was necessary to determine which of the task statements listed in the task inventory constitute valid competencies.

To do this, each task statement had to be examined and decisions made to either retain or reject it based on the analyzed data:

1. Decisions based on the metal casting group data.
2. Means and standard deviations for both the level of importance and the frequency were examined.

Table 1

Data Decision Rule

Level of Importance	
Mean Value	Decision
3.00 – 5.00	Retain
2.00 – 2.99	Refer
4.00 – 1.99	Reject

As outlined in Table 1, each task categorized into one of the three categories: Retain, refer or reject. This was based on the mean value for the level of Importance.

Task that will fall into 'retain' or' reject' category by this process were to be automatically retained or rejected without further reference.

Table 2

Data Decision Rule

Level of Importance		
Standard Deviation	Mean	Standard Deviation
1.00 or less	3.00 – 5.00	1.00 or less

However, any task which will fall into the 'refer' category was to be referred to the three other criteria as shown in Table 2.

Any referred task which satisfied all the three criteria was to be retained. But failure to satisfy any one of the three criteria, the task in question would be rejected.

Based on the above rules, task were consider necessary as entry level skills for the metal casting occupation and would be selected and compiled.

Chapter IV: Data Analysis and Interpretation

Statement of the Problem

The purpose of this study is to perform a task and needs analysis of metal casting occupations in Katsina State. The analysis does the following; identifies competencies required in the field, survey the skilled manpower need of metal casting personnel, and identifies job opportunities that exist in the area of occupation in Katsina State.

This study explored the following objectives:

1. Determine the future needs of metal casting jobs in Katsina State, Nigeria.
2. Identify program content in metal casting for the technical institutions, secondary technical colleges and other vocational schools in Katsina State,
3. Determine competencies required in metal casting work in Katsina State and Nigeria for the development of technology of industries, and then use these competencies to develop the content of the curriculum.
4. Determine if there is a difference in metal casting manpower needs based on selected demographics.

Introduction

This chapter provides an analysis of data gathered by the survey instrument. But as at the first stage, pilot study was introduced.

Interpretation and Finding of Data

The relevant information generated was put into the computer, and resulting data was analyzed based on the guidelines and decision rules established in Chapter 4.

Data for the survey of metal casting competencies, required in the field of metal casting curriculum for the program in colleges of Katsina State, as per the curriculum content being

used. Items analysis of the response to the questionnaire was conducted for all the item statements. Data for the needs, job opportunities survey of the metal casting personnel that exist in the area of occupation in Katsina State were analyzed based on percentages of yes or no responses, and mean number of workers employed, number of establishment that responded, standard deviation of response, number and percentage of positive response to likely future personnel need within 5-10 years in the occupation area listed.

Data Rate of Response

From the 100 questionnaires sent out, 85 were returned. Number of questionnaires distributed to each establishments and or industries, the number returned and percentage of returns were analyzed based on the total response. Table 3 indicated the above information. Where is the information I added here? I gave you a draft of this. Find it add it to here.

Table 3

Survey Distribution and Percentage of Returns by Groups

Participants	# Sent	# Return	% Returned
Katsina Steel Rolling Mills Katsina	13	13	15.3
Bilva Sanda Metal Work	10	8	9.4
Iron Work Faskari	10	10	11.8
Funtua Metal Casting	10	7	8.2
Hasan Usman Katsina Polytech	10	10	11.8
Ubale Metal Foundry Daura	10	9	10.6
G. Tech Mashi	10	7	8.2
Govt. Tech Funtua	10	9	10.6
Saulawa Metal Fabrication WTC R/D	10	8	9.4
Zubairu Metals Batsari	6	6	7.1
Total	100	85	100

Characteristics of Demographics Sample

From the demographics section, five different items were asked, where the respondents are to indicate their response by placing X or check mark in the appropriate box provided, that which describes their own experience in metal work casting field. Table 4, bellow as seen, were set up to present the number of respondents and percent of the response in various positions on the job work or position of the respondents.

Demographics Data Analysis

The analysis for the five demographic items are shown in Tables 4 to 8.

Table 4

Present Job

No.	Present Job	# Responses	% Responses
A	Metal casting worker	57	67.1
B	Instructor of Mechanical Engineering program	10	11.1
C	Officer in state local education ministry	4	4.8
D	Principal of the school/college	4	4.8
E	Manager/supervisor in metal casting industry	10	11.8
	Total	85	100

First a look at the demographic data on Table 4, which is for the present job or position of the respondents in their establishments. Data showed that many of the respondents are from the metal work casting process, the questionnaire was sent to metal casting association of Katsina State. The association members are industrial workers, very few of them come from institutions, ministries and other establishments, in which all the members have knowledge, experience and or back ground in metal casting.

Table 5 below are for the type of establishment the respondents are working or employed currently.

Table 5

Establishments of the Employee

No.	Kind of Establishment Employed	# Responses	% Responses
A	Factory/Industry	62	76.5
B	College/Institution	8	9.4
C	Polytechnic/University	2	2.4
D	Trade Center/no formal training	3	3.5
E	Other (specify). On job training	10	11.8
	Total	85	100

Table 5 is for the establishments, industries, schools, ministries of education, boards of education and local industries, those that are dealing with metal casting in the State. Higher number of the respondents from the data, also indicate are from the industrial sectors, this is because in Katsina State there are many metal casting industries those that manufactured agricultural tools and equipments. Only a few came from Polytechnic University and Trade Center.

Table 6 ask about where the respondents received their training. Was it from formal training, school, and or trained locally.

Table 6

Training or Experience

No.	Training or Experience	# Responses	% Responses
A	Technical college/vocational school	28	32.9
B	Apprenticeship/local training	15	17.6
C	Polytechnic/university	23	27.1
D	Trade center/formal training	12	14.1
E	Other (specify). Local training	14	18.8
	Total	85	100

For the training and or experience of the respondents, as in Table 6, most of the respondents are graduates from technical colleges and vocational schools, which indicate that industries do employed workers with basic knowledge and skills in metal casting field. As such these showed an indication of the need for more middle level manpower technicians, then the laborers with no educational background in the field of metal casting.

For Table 7, the respondents were asked to state the particular area in metal casting, that he or she have better knowledge and or associated with.

Table 7

Area of Associated or Knowledgeable

No.	Area Associated	# Responses	% Responses
A	Core making	21	24.7
B	Molding production	17	20.0
C	Pattern construction	15	17.6
D	Furnaces	18	21.1
E	Finishing/fettling	14	16.5
	Total	85	100

A look at Table 7 showed that an even distribution of the respondents' number, this is because all the five items are important and very necessary in the production of metal casting process. Without any one of them, metal casting manufacture would not be possible for the products to be produced in any metal casting industry, since they inter relate one another in process

The last table for the demographics is found inTable 8, which asked respondents the years of service in the metal casting field on the job or position.

Table 8

Years at the Present Job

No.	Number of Years on the Job	# Responses	% Responses
A	One month – one year	2	2.4
B	Two – three years	11	12.9
C	Four – six years	19	22.4
D	Seven – ten years	25	29.4
E	Other (specify). Over 11 years/above	28	32.9
	Total	85	100

Table 8, is concerned about the years of experience of the respondent of the questionnaire. Virtually, it showed that the majority of the respondents spent much more time in the professions, with at least 11 years and above. For that, then there is a need for training and retraining of the workers, as well as the need for the current basic knowledge of new technology of computerized tools, equipments, gadgets and automated machineries now available in modern industries. In as much as these automated machines and equipments are used, so as to aid the industrial production capabilities and to have more rapid development and advancement, the worker or employee must have educational training which will update their knowledge in general.

Data analysis procedures need to match the types of data gathered and the data collection technique used. For example, focus groups are effective in generating comprehensive lists of problems, needs, and suggestions (Lee & Nelson, 2006).

Survey respondents are rated each competency according to the scale and procedure. The mean score and standard deviation of each competency was calculated and used to decide its desirability accordingly.

Table 9

Pattern Making and Construction

Task	Frequency		Importance		Rating	Decision
	Mean	S.D.	Mean	S.D		
Construction of right materials	4.72	0.51	4.92	0.39	High	Retain
Working drawing interpretation	4.89	0.41	4.93	0.34	High	Retain
Determine pattern allowance	4.38	0.58	4.68	0.55	High	Retain
Selection and cutting of stock	4.43	0.57	6.46	0.57	High	Retain
Selection of reference or data on lines	4.52	0.59	4.48	0.56	High	Retain
Shaping of stock to dimension	4.60	0.58	4.67	0.67	High	Retain
Gluing and clamping of stock	4.36	0.62	4.28	0.78	High	Retain
Allowances of contractions, tapes and fillets	4.77	0.48	4.83	0.61	High	Retain
Surfaces smoothing	4.55	0.54	4.62	0.44	High	Retain
Fixing of wrapping and lifting of plates	4.30	0.62	4.27	0.76	High	Retain

The table for pattern making and construction, as shown with 10 tasks listed. Accordance with data decision rules, all the 10 tasks were retained and therefore are considered as necessary

entry level competency for metal casting program and occupations. There are two ways to look at the result, respondents considered the importance of pattern making, because there can be no molding process to act as the receptacle for the liquid metal and without the pattern to form such mold. Two it indicated that respondents were quite unanimous in opinion with the level of importance as well as frequency performance of the 10 tasks listed. It also clearly shows by the value of the high mean and low standard deviation indicating high agreement.

There were also10 tasks listed under sand preparation and in accordance with the data decision rules, all the tasks were rated to be retained and were, therefore, considered of necessary entry level competency required for metal casting program. Unanimously, respondents considered all the ten tasks as generally important, and frequently performed. The average mean and standard deviation in their group, all indicated that the respondents were unanimous in their opinion.

Table 10

Sand Preparation

Sand Preparation	Frequency Mean	S.D.	Importance Mean	S.D	Rating	Decision
Table 11, 10 tasks were listed under the core making competency. The data clearly showed that t						
Sand classification and selection	4.44	0.61	4.62	0.63	High	Retain
Sand preparation and mixing	4.92	0.31	4.87	0.45	High	Retain
Tempering sand (mixing H2O2)	4.87	0.44	4.88	0.55	High	Retain
Sand testing	4.00	0.66	4.66	0.84	High	Retain
Sand distribution to molding station	4.30	0.59	4.60	0.63	High	Retain
Facing of sand	4.44	0.63	4.52	0.54	High	Retain
Running of sand against the pattern	4.48	0.58	4.40	0.41	High	Retain
Provision of runner and feeding system	4.56	0.65	4.81	0.49	High	Retain
Withdrawal of pattern and others	4.49	0.67	4.77	0.59	High	Retain
Brushing and final cleaning	4.87	0.59	4.83	0.65	High	Retain

As shown the respondents considered all task listed as important and frequently performed as was indicated in the mean and standard deviation reading obtained. In addition, all the 10 tasks were retained and are considered necessary entry level competencies in metal casting.

Table 11

Core Making

Task	Frequency Mean	Frequency S.D.	Importance Mean	Importance S.D	Rating	Decision
Core sand classification	4.61	0.48	4.75	0.47	High	Retain
Core sand preparation using required additives	4.18	0.59	4.71	0.62	High	Retain
Composition testing	4.53	0.54	4.45	0.55	High	Retain
Distribution of sand mixer to the stations	4.54	0.58	4.55	0.59	High	Retain
Core construction using core boxes	4.78	0.43	4.58	0.52	High	Retain
Use of core reinforcement	4.59	0.53	4.71	0.47	High	Retain
Use of core carriers and handles	4.82	0.62	4.83	0.48	High	Retain
Core dressing	4.80	0.51	4.81	0.43	High	Retain
Core baking	4.82	0.45	4.73	0.49	High	Retain
Assembling of baked cores	4.81	0.43	4.81	0.43	High	Retain

Table 12 shows the 10 tasks listed under melting and furnace operation. In accordance with the data decision rule, all the 10 tasks were retained and therefore considered very important entry level competencies for metal casting. This has actually indicated by the fact that, all the tasks in the group were rated high and are to be retained, as a result of their importance in the program of metal casting. In addition to that, the frequency of performance and level of importance respectively, are clearly reflected a high consensus by the respondents opinion and agreement on their rating of the tasks.

Table 12

Melting and Pouring

Task	Frequency Mean	Frequency S.D.	Importance Mean	Importance S.D	Rating	Decision
Selections of melting unit	4.38	0.55	4.72	0.61	High	Retain
Fuel and flux organization	4.67	0.61	4.69	0.44	High	Retain
Scrap analysis and selection	4.44	0.57	4.58	0.56	High	Retain
Furnace lining	4.81	0.43	4.71	0.43	High	Retain
Furnace operations	4.72	0.59	4.37	0.61	High	Retain
Analysis of melting metals	4.51	0.49	4.17	0.48	High	Retain
Melting metal tapping and pouring out	4.35	0.60	4.52	0.67	High	Retain
Ladle handling and utilization	4.74	0.45	4.44	0.58	High	Retain
Observing safety precautions	4.73	0.57	4.78	0.45	High	Retain
Processing of molten metal into molds	4.56	0.61	4.71	0.62	High	Retain

As on Table 13, 10 task statements were listed under fettling and inspection. Respondents general consensus considered all the ten tasks stated important. With an average means of 4.45 was shown for frequency of performance, and 4.60 for the level of importance. While the average standard deviation of 0.35 for the frequency of performance and level of importance respectively were obtained under this duty statement. Which clearly indicated the unanimous opinion among the respondents. In accordance with the data decision rules, all the 10 tasks were retained, therefore, are considered as necessary entry level competencies required for metal casting.

Table 13

Finishing or Fettling and Inspection

Task	Frequency Mean	Frequency S.D.	Importance Mean	Importance S.D	Rating	Decision
Molding knock-out operation	4.62	0.47	4.81	0.57	High	Retain
Fettling or removal of runners/risers	4.18	0.58	4.43	0.54	High	Retain
Blasting and tumbling operations	4.53	0.56	4.76	0.60	High	Retain
Mold dressing, washing/weighing	4.54	0.51	4.65	0.53	High	Retain
Grinding of sharp edges	4.78	0.43	4.71	0.51	High	Retain
Polishing and cleaning	4.68	0.55	4.82	0.43	High	Retain
Inspection of the product	4.79	0.51	4.81	0.48	High	Retain
Final check of all sizes	4.86	0.50	4.70	0.44	High	Retain
Quality control checking	4.85	0.42	4.66	0.47	High	Retain
Packaging in of the products	4.78	0.43	4.76	0.42	High	Retain

Table 14 shows the order rank of the sample and grand means of the five stated duty statements for both performance, frequency, and level of importance of each statement of the five. These duty statements were all ranked in accordance to the grand means of each. The grand means for each statement was determined by the averaging the means for all the tasks in the duty statement. Ranking of the five duty statements was necessary in order to convey all to the curriculum developer for a course on programs of study in this occupation, as priorities and for considerations based on level of importance, frequency and performance.

Table 14

Duty Statements of the Grand Means for the Tasks

Duty Statement	Frequency Rank	Frequency Main	Importance Rank	Importance Main
Pattern making & construction	2	4.67	2	4.78
Sand preparation	4	4.55	4	4.63
Core making	5	4.47	5	4.57
Melting and pouring	1	4.73	1	4.84
Finishing or fettling and inspection	3	4.59	3	4.71

Data on Currently Employed and future Personnel Need within 5-10 Years

As indicated from the Table 15 bellow, all the respondents were unanimous in the need for future personnel, that they are in need of more personnel within 5-10 years. Because of the development that is taking place in Katsina State. Actually the industries has to be more technologically oriented then the olden time, since many of the equipments and machineries are computer controlled in this time of technological advancement. Secondly, on the other side on the job opportunity that exists in metal casting area, data analysis indicated that number of establishments that responded, indicated numbers personnel need to be employed in each of the duty areas of the program. Therefore, the respondents fore see the new development that is taking place in the world of computer technology, and the new dimension of the industrial equipments, tools and machineries now in use for the set up of modern metal casting industries in developed nations.

Table 15

Data on Currently Employed and Future Personnel Need Within 5-10 Years

Programs	# of Respondent from Establishment	Mean # Employed	S.D.	Future Personnel Need Within 5-10 Years	
				No.	Percent
Mold construction/core making	4	2.76	1.72	23	29.20
Pattern making/construction	9	1.44	0.74	23	29.12
Furnace operation/control	10	2.60	1.96	23	29.11
Finishing/fettling	5	2.40	1.68	23	29.11
Quality control/inspection	4	2.76	1.72	23	29.11
Other programs	4	2.50	1.73	22	27.86

Table 16

Manpower Needs and Job Opportunities

Question	Yes/No	Number	Percentage
Would your establishment have a formal training program for your metal casting or foundry workers?	Yes	29	97
	No	3	3
	Total	32	100%
Would training programs in metal casting occupation conducted in another institution be helpful in your establishment?	Yes	27	84
	No	5	16
	Total	32	100%
Would your establishment be interested in employing part-time students of training as part of training?	Yes	26	81
	No	6	19
	Total	32	100%
Would your establishment be interested in employing graduates of such training programs on a full-time basis?	Yes	25	78
	No	7	22
	Total	32	100%
Would your establishment need graduate with computer background knowledge in machines operations?	Yes	31	98.9
	No	1	1.1
	Total	32	100%

Table 16, Manpower Need and Job Opportunities shows the responses to the five questions by those in charge of employment. The first asked about formal training programs and 29 out of 32 indicated a positive need for training. When asked if the training would need to be conducted in their own establishment, 25 out of 32 indicated yes. The third question asked about the need of part-time workers training needs and 26 out of 32 indicate this would be welcome. The fourth question asked about employing graduates of metal casting program and 25 out of 32 indicated yes. The last question asked about the need for graduates with back ground knowledge in machine operations and 98% expressed need for those graduates.

Table 17

Present Job by Pattern Making and Construction Tasks

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.851	0.742	3.648	0.675
Instructor of ME Program	3.432	0.621	3.542	0.834
Officers in Local Ed M.	3.643	0.681	3.445	0.811
Principle of Education	3.554	0.813	3.321	0.525
Manager/Supervisor	3.728	1.221	3.481	0.654

Table 18

Present Job by Sand Preparation Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.875	0.832	2.812	0.642
Instructor of ME Program	3.533	0.691	3.111	0.532
Officers in Local Ed M.	3.581	0.781	2.991	0.532
Principle of Education	3.451	0.811	3.452	0.456
Manager/Supervisor	3.381	0.645	3.121	0.611

Table 19

Present Job by Coil Making Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.451	0.741	3.551	0.543
Instructor of ME Program	3.612	0.622	3.132	0.434
Officers in Local Ed M.	2.891	0.765	2.719	0.678
Principle of Education	3.562	0.571	3.671	0.712
Manager/Supervisor	3.664	0.674	3.433	0.776

Table 20

Present Job by Melting and Pouring Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.841	0.561	3.812	0.612
Instructor of ME Program	3.445	0.498	3.467	0.767
Officers in Local Ed M.	2.753	0.645	3.742	0.581
Principle of Education	3.451	0.761	3.665	0.832
Manager/Supervisor	3.616	0.546	3.465	0.745

Table 21

Present Job by Finishing and Inspection Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.752	0.768	3.525	0.641
Instructor of ME Program	3.821	0.657	3.632	0.732
Officers in Local Ed M.	3.523	0.721	3.532	0.811
Principle of Education	3.625	0.592	3.811	0.834
Manager/Supervisor	3.755	0.834	3.781	0.689

The efficiency to mean that things are being done right, Tables 1-5 for the tasks on the five main program contents are most valuable in analyzing the efficiency of metal castings program. An analysis of the mean and standard deviation of the tasks in all the five tasks reveals a high degree of agreement among the respondents that the program is being good and well in the field.

The following observations are offered from the analysis and rating of those tasks. First, all areas show a rating of satisfactory or plus, that is the total mean scores are all over 3.500. Second, the employed response on these tasks, on the present job by pattern making, sand preparation, core making, melting and pouring as well as the finishing and inspection tasks, show there is no significant difference between as per the t-test conducted, that this is certainly good news considering the subject of the study being accepted by all the five sets of different personnel in Katsina state.

Table 22

Work Experience by Pattern and Construction Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.853	0.784	3.765	0.741
Instructor of ME Program	3.453	0.922	3.438	0.801
Officers in Local Ed M.	3.781	0.824	3.121	0.998
Principle of Education	3.780	0.657	3.670	0.875
Manager/Supervisor	3.821	0.767	3.882	0.756

Table 23

Work Experience/Training by Sand Preparation Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.653	0.638	3.453	0.756
Instructor of ME Program	3.883	0.687	3.781	0.456
Officers in Local Ed M.	3.834	0.784	3.614	0.583
Principle of Education	3.687	0.696	3.733	0.681
Manager/Supervisor	3.734	0.589	3.589	0.473

Table 24

Work Experience/Training by Core Making Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.753	0.756	3.767	0.674
Instructor of ME Program	3.875	0.811	3.754	0.834
Officers in Local Ed M.	3.786	0.652	3.645	0.718
Principle of Education	2.875	0.745	3.878	0.682
Manager/Supervisor	3.694	0.775	3.525	0.515

Table 25

Work Experience/Training by Melting and Pouring Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.451	0.654	3.438	0.757
Instructor of ME Program	3.319	0.873	3.389	0.923
Officers in Local Ed M.	3.438	0.767	3.911	0.845
Principle of Education	2.678	0.578	3.414	0.734
Manager/Supervisor	3.923	0.774	3.513	0.617

Table 26

Work Experience/Training by Finishing or Fettling and Inspection Task

Present Job	Frequency		Importance	
	Grand Mean	SD	Grand Mean	SD
Metal Casting Worker	3.765	0.798	3.522	0.575
Instructor of ME Program	3.819	0.546	3.853	0.621
Officers in Local Ed M.	3.678	0.689	3.924	0.857
Principle of Education	2.961	0.852	3.632	0.734
Manager/Supervisor	3.453	0.616	3.745	0.815

On the above five tasks on present job of the present work experience and/or training as per the five tasks, pattern making, sand preparation, core making, melting and pouring and finishing and inspections, an analysis of the mean and standard deviations of the five tasks above shows a high degree of agreement among the respondents. As such all the tasks when compared with work experience of the respondents there is no significant difference between based on metal casting as by the t-test conducted on the five tasks and the work experience and/or training of the respondent.

Chapter V: Summary, Conclusions and Recommendations

Summary of the Study

The objectives of metal casting program is to provide the graduates, the opportunity to enter the industry with knowledge and competency to succeed. Graduates should also have field-related skills, general education course work which provides students with oral and written communication skills, critical thinking skills, and computer literacy skills in the field of metal work casting occupation.

In a developing state and or country like Katsina State of Nigeria, a survey of this nature, actually was relatively rare. The educational curriculum, particularly those regarding technical and vocational education has been patterned significantly by the colonial legacy; as such any review and update of them will help develop the country's industrial development in general.

There have been, for instance, consistent demands in government educational policies for both the present and future needs of the country to be considered in making curriculum changes in technical vocational education. In addition, the curriculum content to the technical institution should be broadened to embrace certain basic fields which are relevant to the country's present and future needs, such as the computer technology.

If, for instance, expansion of primary and secondary education in the country is to proceed with the respect to considerations other than trained specific skills requirement, then important courses such as metal casting and in fact some other vital specialized programs must be related to some measure of anticipated need for the technological development in Katsina State of Nigeria.

This study, identified the root based foundation, and analysis of the metal casting competencies The age-old metal crafts in Katsina, Nigeria amply demonstrate the foundry skills

of the people in this State of Nigeria. However, apart from this heritage (Literature review – Historical Background), there has been an overwhelming demand from the country/society, the government, private, and public, research and development institutions and educational sectors of Katsina state, for the establishment of metal casting industries and training programs.

A total of 50 tasks were identified and listed under five main duties or areas of metal casting, and in the task inventory. All tasks were remained and were therefore considered by the respondents as necessary job competencies for the metal casting occupation in the country.

On account of being judged to be both important and frequently performed, these tasks should hope to be incorporated in the curriculum at Katsina state institutions, as required competencies.

Generally, the respondents have rated the tasks on both criteria of judgments higher than that normally expected. This tendency could be attributed to their zealousness to the questions and in having such tasks incorporated in the cast metal training programs. In addition, all of the tasks are very important to the program of studies in metal casting field.

Tasks analysis survey has been identified as a rational, objective and efficient method of gathering occupational data and it's instrumental to modern curriculum design and development, in educational settings.

Conclusions

The following are the conclusions from the study and will be organized by research objective as follows.

Research Objective #1. Determine the future needs of metal casting jobs in Katsina State, Nigeria. The study investigates the future needs of metal casting, on the table 15 the data stated the need for future personnel by even stated the numbers and the percentage were calculated,

these shown that, there are need for more educated workers in the field as per the technological development. And for more employment in the industries, these will actually develop the occupation of metal casting greatly in the area.

Research Objective #2. Identify program content in metal casting for the technical institutions, secondary technical colleges and vocational schools in Katsina State. From the study, five curriculum contents were identified and investigated, which all of them received attention from the survey respondents, equally it shown that the program content ought to be up graded to meet the current trend of modern technology. They are pattern making and construction, sand preparation, core making, melting and pouring, and finishing or fettling and inspection. The mentioned programs identified, with the suggested ones mentioned in the recommendations and with the addition of computer literacy, computer added design, and computer added manufacture, actually the metal casting program will be one of the most needed and up graded program in Katsina State technical institutions, and vocational schools.

Research Objective #3. Determine competencies required in metal casting work in Katsina State and Nigeria for the development of technology of industries, and then use these competencies to develop the content of curriculum.

Data analysis did indicate that, all the five competencies analyzed really are needed, because the respondents of the survey instruments agreed unanimously with all the five competencies as in tables of competencies with high ratings, and are all to be retained. Also it was even found that, new competencies were needed to be added to the excising, especially the knowledge of the computer competencies, in the program of study in metal casting. In addition to that, this will help the curriculum developers in re arranging, identifying, updating, and

developing competencies required in metal casting field, which will aid to the development of technology of the industrial sector of Katsina State.

Research Objective #4. Determine if there is a difference in metal casting manpower needs based on selected demographics. The demographics study identified that, there is a needs for more trained and more educated personnel, so as needed to fill many places in the industries. Because all the industries answered yes, with 98%, therefore, they need for more workers or personnel's in future, within or from 5-10 years. Refer to Table 16 for manpower needs and job opportunities.

Research Objective #5. Determine if there is a difference in metal casting tasks based on selected demographics. From the tables of demographics data 4, to 8, in which the data indicated clearly, by the percentages of the respondent response, actually there is a great difference. Because, all the means and standard deviation are of above average, for the tasks stated on the survey instruments.

Recommendations

The recommendations of the research:

Recommendations based on this study, will be based in two parts. The first will deal with the research study itself or what could have done differently, and the second part with the recommendations as a result of the study.

Recommendations of the Research

1. The study was developed in Menomonie, Wisconsin and distance to Nigeria presented a logistic challenge. It would have been better to be in Nigeria to develop and gather and analysis of data for the study.

2. Instrument development was done with limited research. To ensure full validity and reliability of the survey instrument, it might have been better to conduct a focus group of metal casting workers in Nigeria, rather than in Menomonie, Wisconsin.
3. New and emerging tasks may not have included in the survey instrument. There are many new things being introduced in the metal casting field and the survey instrument may have only limited new and emerging tasks. More research should have done in the general metal casting field like Japan, United States and Germany that are using new technology.

Recommendations as a Result of the Study

1. An added study of this nature should have to be done in future, so as to identify more finding and data for the education and industrial development in the field of metal casting program.
2. The data collected for job entry level skills manpower for the metals casting occupation personals in Katsina, Nigeria. Should be used to develop relevant curriculum for training and education purpose, advice will be given to the curriculum committee about the finding of the research.
3. Tasks identified by this survey should be considered as the required competencies for training in metal casting in the country of Katsina State. As these will help develop good, update, and current development in the industries and institutions. However, further work is necessary in using these competencies as a basis for developing specific objectives suitable for instructional purposes.

4. Rank orders of duty statements could be used as a guide to curriculum developers and programs designers for the order of priorities in duty areas, area of emphasis for content material treatment, and time allocation for content materials.
5. Further investigations or studies are needed to confirm the advisability of using both educations, job incumbents for the survey of this nature in future study.
6. Computer literacy skills, computer aided manufacturing, and computer aided designs should be added to the metal casting curriculum, since most of the tools, equipments, and machineries in modern industries are computerized.
7. Despite the Government big investment and policies on technical education in the country, the authority concerned for the implementation of Government proposals, policy, and decision making e.g., the National Board for Technical Education and the Industrial Training Fund could not be both very reluctant in carrying out these policies.

References

Abraham, D. K. (2007). Technical and vocational curriculum and implimentation. *Arts and culture forum*, 14-15.

Adeyemi, T. K. (2000). Equality of access and catchment area factor - In university of technology In nigeria. In T. K. Adeyemi. Lagos, Nigeria: Ada Printing Press.

Ahonen, L. (2004), *Fake book of the nations* . New York: Huffman.

Alabama. (1976). *Human resource development in the eye of the researchers.* University printing organization.

Alexander, M. K. (1987). *Task analysis and curriculum programs.* Ibadan Nigeria: Pengum Publishers Ibadan.

Bello, G. (2005). Perspective of qualty education in Nigeria. *B.A.T.C. Zaria*. Zaria Kaduna State: A. D. Tukur Tukur, p. 5-6.

Callaway, A. (1964). Indigenous education in Nigeria and apprentice ship system. *Journal of African Studies*, 4-10.

Center, R. (1999). The emergence of new technological development in northern Nigeria. *History and Culture*, 17-19.

Charles O. (1984). *Metal cast for Nigeria.* Thesis for graduate studies in Vocational and Technical Adult Education.

Childe, D. B. (1951). *Fundmental basic principles of metal casting design.* Massachusetts USA: Avanture Works Press.

Coghland, L. M. (1970). *Notes on pre history in the age of iron ore.* London Geat Britain: Oxford Publishers.

Colt, G. B. (1977). *Curriculume development and analysis.* Germany: Western Germany Company.

Daudal. (2002). *Basic concepts of the human development.* System printers of South African Unity Publication.

Davis, M. (1990). *Economic report on Nigeria's option for long term development.* Onicha, Nigeria: West African Publishers.

Edwin, D. (1999). *Values of foundry products for modern indusries in the state and local government.* Kaduna State: Nigerian Society Of Engineers.

Edwine, H. D. (2001). *Value of foundry.* AA Press.

Emamodeeni. (2001). History of West African national development planning procedures public printing press.

Fafunwa, B. A. (1994). *History of education in Nigeria.* Ibadan Nigeria: I.l Printers.

Fagg, L. K. (1969). *Pre history culture for Nok and Ife people.* Ibadan Nigeria: Ollende Publication Company.

Fell, K. D. (1968). (1984). *Eaely iron industries and steel production with new furnaces.* Zaria Kaduna State Nigeria: Sulhu Badan.

Finch C. F., & Crunkilton J. R. (1989). *Curriculum development in vocational technical education.* Ellyn and Bacon, Inc.

FMMP, F. (1991). Survey of economic condition in Nigeria's minerals. F*ederal Minstry of Mines and Power*, 23-26.

Forbes, K. M. (1988). *Understanding and using statistics basic concepts.* Published simultaneously in Canada.

FGN. FRN. (1967). Federal republic of Nigeria government of the Federation National Publication of the Government.

Folly, N. M. (1964). *Development of vocational and technical education.* Ibadan City Nigeria: Benly Printing Press I,

Giwa,A.K. (2006). Current educational curriculum, Dan Zaki Publications

Giwa, A. K. (2007). Perspective of quaties in Nigerian technical education. *Bagauda seminer* (pp. 4, 6). Kano State Nigeria 2007. Dan Zaki Publishers.

Giwa, A. K. (200). *Procedures for construction and using task inventories for vocational and technical education major.* Dan Zaki Publishers

Halfin, H. (1983). *Research and analysis for industrial finding.* Publication of British Broadcasting Agency Press.

Hamilton, T. M. (1967). *History of the Nigerian railway foundry workshops.* Enugu Nigeria: Personal Community Press LTD.

Kindred, E.M. (1976). *The development of educational strategies in developing countries.* Publishing Company Inc.

KTSG. (1988). *The Katsina State government of the federal republic of Nigeria.* Government Press Publication.

Lee, H. D., & Nelson O. W. (2006) *Instructional analysis and course development.* America Technical Publishers.

Mannir, S. N. (1997). *Instructional system for technology in Nigeria.* Zaria, Kaduna, Nigeria: Deowwon Printers.

Mashi, A. R. (1998). Reforms and innovations technical and vocational education. *Science And Technical* (pp. 4, 6-7). Katsina Nigeria: Kofar Kaura Katsina.

Needham, C. O. (1984). *Science and civilization in developing countries.* London: Comb B. U. Publication London England.

NER. (1999). Nigerian economical regional agency. Regional research agency development of West African Countries.

Npe, G. (2000). Extract on vocational and technical education. *Government Printing Press Conference* (pp. 14-16). Kaduna Nigeria: Government printing press.

NCER. (1999). Nigerian national commission of education referenced. Government publications of the year.

Power, F. M. (1967). *Survey of economic condition in Nigerians minerals.* Lagos Nigeria: Government Printing Press.

Press, G. (1985). *Third national development plan.* Lagos Nigeria: Government Press.

Publishers, D. (1985). *Dictionary of occupationl titles.* London UK: G. Allen Ltd.

Samin, L. M. (2005). Process and technique for vocational curriculum in Katsina state Nigeria. *Technical and Science Education*, 16-18.

Simpson, D. M. (1976). *Guide for task analysis and curriculum content for engineering.* London: Center Finders Press.

Smith & Mass, M. (1965). *Production and materials concepts in metal casting industries.* London: John Wiely & Sons.

State, K. (1987, July). Science and technical Retrieved june Friday, 2009, from http://www.ngex.com/Nigeria/state/katsina

Thomas, G. (1994). *Metal work technology.* Jos: J.N Kees.

Thurston, S. H. (1978). Nigeria's archaological and early history in the nation technological development. *Teaccher Journal of Art and Science*, 21-22.

UNESCO. (1995). Methodology of education planning for teachers of technology. *Polytechnic Maiduguri* (pp. 21,24). Maiduguri Nigeria: G & B Publishers.

UNIDO, U. N. (2008). Special study into iron and steel development in Nigeria. *Unied Nation Industrial Development*, 23-25.

Vein, F. (1995). Occupational analysis and process in developing countries. *Journal of Occupation*, 3-5.

Willet, H. K. (1970). Survey of recent results in radio carbon chronology of West Africa. *West African Way Forward to Development* (pp. 23-25). Niamy Republic of Niger: West Africa com.

Yahaya, U. D. (1997). Indigenous education among the state's indigines of Katsina state . *Nigerian Apprentice Publication*, 31-33.

Ziya'ulhak, D. U. (2008, 02 12). Nigeria today and tomorrow as technology change. *Commerce and Indutries*, 11-12.

Appendix A

Cover Letter

Cover Letter for Metal Casting Survey

Katsina Umaru Darma

University of Wisconsin Stout

105 220 10th AV E McCalmont Hall

Menomonie 54751 Wisconsin

July 10, 2009

Name _____

Title _____

Address _____

Metal Casting Questionnaire

Occupational Analysis and Survey

Dear Sir:

I am a native of Katsina State, completing a Master of Science degree in career and technical education at the University of Wisconsin Stout, Menomonie, Wisconsin, W .I. U.S.A. I am conducting a task and need survey of the metal casting occupation to determine: competencies required in the field, manpower need of metal casting personnel, and job opportunities that exist in Katsina State of Nigeria.

The result of the study hopingly will be utilized for the development of curricula and hence courses of study in technical institutions, secondary colleges, and vocational schools, for the development of business and industries in Katsina State.

Sir you are important for this study and the success is dependent upon your cooperation. Please complete the enclosed questionnaire and return to my assigned local coordinator in your area, who will be coming to collect the questionnaire to return to me.

Thank you for your assistance.

Sincerely

Katsina Umaru Darma

Appendix B

Survey Questionnaire

QUESTIONNAIRE

TASK AND NEED SURVEY OF METAL CASTING IN KATSINA STATE OF NIGERIA

SECTION I DEMOGRAPHICS

Instructions:

Indicate your response by placing an X or check mark in the appropriate box, that describes your own experience, etc.

Example:

The Metal Casting area that I am mostly concerned with is:

a. Iron casting foundry ..... ☐
b. Aluminum alloy foundry ..... ☐
c. Local aluminum foundry ..... ☐
d. Gold, copper foundry ..... ☐
e. Steel foundry or industry..... ☐

Then, please complete each item of the questionnaire following the directions and example above.

!. What is your present job or position?

a. Metal casting worker ..... ☐
b. Instructor of mechanical engineering program ..... ☐
c. Officer in State local education ministry ..... ☐
d. Principal of the school/college ..... ☐
e. Manger/Supervisor in metal cast Industry..... ☐

2. In what kind of establishment are you working or employed?

a. Factory/Industry ..... ☐
b. College/Institution ..... ☐
c. Ministry/Education ..... ☐
d. School board/research institution ..... ☐
e. Other (specify) ..... ☐

3. From where did you obtain your experience or training in Metal casting and or metallurgy field?

a. Technical college/vocational school ..... ☐
b. Apprenticeship/local training ..... ☐
c. Polytechnic/University ..... ☐
d. Trade center/No formal training ..... ☐
e. Other (specify) ..... ☐

4. What is the area that you are particularly more associated with or have better knowledge of?

a. Core making. . . . . ☐
b. Molding production . . . . . ☐
c. Pattern construction . . . . . ☐
d. Furnaces. . . . . ☐
e. Finishing/Fettling . . . . . ☐

5. For how long have you been in your present job or position?

a. One month – One year. . . . . ☐
b. Two – Three years . . . . . ☐
c. Four – Six years . . . . . ☐
d. Seven – Ten years . . . . . ☐
e. Other (specify) . . . . . ☐

Section II Metal Casting Competency

Listed on the following pages are Competencies Required in Metal Casting Program. Please indicate the rate of performance of each competency at the end of the appropriate section, in the space provided at the end of each section to add to competencies. Use the following ratings:

COMPETENCY RATING SCALE

A. Level of Importance	B. Training Need
1 = NI = Unimportant	1 = N = None/No Need
2 = MI = Moderately Important	2 = S = Slight Need
3 = I = Important	3 = M = Moderate Need
4 = VI = Very Important	4 = H = High Need
5 = E = Essential	5 = VH = Very High Need

The flowing task relate to the Pattern Making and Construction. Please go ahead and rate the level of importance and frequency of performance as it relates to your job or work.

Pattern Making & Construction Competency	A. Importance NI MI I VI E 1 2 3 4 5	B. Training Need N S M H VH 1 2 3 4 5
1. Selection of right materials	1 2 3 4 5	1 2 3 4 5
2. Working drawing interpretation	1 2 3 4 5	1 2 3 4 5
3. Determine pattern allowance	1 2 3 4 5	1 2 3 4 5

Pattern Making & Construction Competency	A. Importance U MI I VI EI 1 2 3 4 5	B. Training Need N S M H VH 1 2 3 4 5
4. Selection and cutting of stock	1 2 3 4 5	1 2 3 4 5
5. Selection of reference or datum lines	1 2 3 4 5	1 2 3 4 5
6. Shaping of stock to dimensions	1 2 3 4 5	1 2 3 4 5
7. Gluing and clamping of stock	1 2 3 4 5	1 2 3 4 5
8. Allowances of contractions, taper and fillets	1 2 3 4 5	1 2 3 4 5
9. Surfaces smoothening	1 2 3 4 5	1 2 3 4 5
10. Fixing of rapping and lifting of plates.	1 2 3 4 5	1 2 3 4 5
Sand Preparation Competency		
1. Sand classification and selection	1 2 3 4 5	1 2 3 4 5
2. Sand preparation and mixing	1 2 3 4 5	1 2 3 4 5
3. Tempering sand (mixing H2 O2)	1 2 3 4 5	1 2 3 4 5
4. Sand testing	1 2 3 4 5	1 2 3 4 5
5. Sand distribution to molding station	1 2 3 4 5	1 2 3 4 5
6. Facing of sand	1 2 3 4 5	1 2 3 4 5
7. Riming of sand against the pattern	1 2 3 4 5	1 2 3 4 5
8. Provision of runner and feeding system.	1 2 3 4 5	1 2 3 4 5
9. Withdrawal of pattern and others	1 2 3 4 5	1 2 3 4 5
10. Brushing and final cleaning	1 2 3 4 5	1 2 3 4 5
Core Making Competency		
1. Core sand classification.	1 2 3 4 5	1 2 3 4 5
2. Core sand preparation using required additives.	1 2 3 4 5	1 2 3 4 5
3. Composition testing	1 2 3 4 5	1 2 3 4 5
4. Distribution of sand mixes to the stations	1 2 3 4 5	1 2 3 4 5
5. Core construction using core boxes	1 2 3 4 5	1 2 3 4 5

Core Making Competency	A. Importance U MI I VI EI 1 2 3 4 5	B. Training Need N S O F A 1 2 3 4 5
6. Use of care reinforcements	1 2 3 4 5	1 2 3 4 5
7. Use of core carriers and handles	1 2 3 4 5	1 2 3 4 5
8. Core dressing	1 2 3 4 5	1 2 3 4 5
9. Core baking	1 2 3 4 5	1 2 3 4 5
10. Assembling of baked cores	1 2 3 4 5	1 2 3 4 5
Melting and Pouring Competency		
1. Selections of melting unite	1 2 3 4 5	1 2 3 4 5
2. Fuel and flux organization	1 2 3 4 5	1 2 3 4 5
3. Scrap analysis and selection	1 2 3 4 5	1 2 3 4 5
4. Furnace lining	1 2 3 4 5	1 2 3 4 5
5. Furnace operations	1 2 3 4 5	1 2 3 4 5
6. Analysis of melting metals	1 2 3 4 5	1 2 3 4 5
7. Molten metal tapping and pouring out	1 2 3 4 5	1 2 3 4 5
8. Ladle handling and utilization	1 2 3 4 5	1 2 3 4 5
9. Observing safety precautions	1 2 3 4 5	1 2 3 4 5
10. Pouring of molten metal into molds	1 2 3 4 5	1 2 3 4 5
Finishing or Fettling and Inspection Competency		
1. Molding knock-out operation	1 2 3 4 5	1 2 3 4 5
2. Fettling or of removal of runners/risers	1 2 3 4 5	1 2 3 4 5
3. Blasting and tumbling operations	1 2 3 4 5	1 2 3 4 5
4. Mold dressing, washing/weighing	1 2 3 4 5	1 2 3 4 5
5. Grinding of sharp edges	1 2 3 4 5	1 2 3 4 5
6. Polishing and cleaning	1 2 3 4 5	1 2 3 4 5
7. Inspection of the product	1 2 3 4 5	1 2 3 4 5

Finishing or Fettling and Inspection Competency	A. Importance U MI I VI EI 1 2 3 4 5	B. Training Need N S O F A 1 2 3 4 5
8. Final check of all sizes	1 2 3 4 5	1 2 3 4 5
9. Quality control checking	1 2 3 4 5	1 2 3 4 5
10. Packaging in of the products	1 2 3 4 5	1 2 3 4 5

Section III Industries

This section relates to the manpower needs, job opportunities survey of the metal casting personnel that exist in the area of occupation in Katsina State of Nigeria. For each area of metal casting occupation outlined below, indicate the number of people you now employ and whether there are needs for more employment in the future. Mark letter X on Yes or No responses.

Please complete the final section

1. Would your establishment have a formal training program for your metal casting or foundry worker?

   Yes _____ No _____

2. Would training Program in metal casting occupation conducted in another institution be helpful in your establishment?

   Yes _____ No _____

3. Does your establishment be interested in employing part time students of training as part of training process?

   Yes _____ No _____

4. Does your establishment be interested in employing graduates of such training program on a full time basis?

   Yes _____ No _____

5. Would your establishment need graduate with computer back ground knowledge in machines operations?

   Yes _____ No _____

Programs	Number of currently employed	Future personnel need # within 5 – 10 years
6. Mold construction/Core making	_____	Yes _ No _ # _____
7. Pattern making/Construction	_____	Yes _ No _ # _____
8. Furnace operation/control	_____	Yes _ No _ # _____
9. Finishing/fettling	_____	Yes _ No _ #_____
10. Quality control/Inspections	_____	Yes _ No _ # _____
If any other (Specify)	_____	Yes _ No _ # _____

Please thank you very much for your kind cooperation.

Appendix C

IRB Permission & Certificate

UW-Stout Human Subjects Training Certification

By completing the information below, I certify that I have completed UW-Stout's computer-based training on human subjects protection and that I know and understand the information provided in this training.

First Name: Katsina Umaru

Last Name: Darma

Stout ID: 0122437
Use the middle 7 digits. 00 **0055555** - 0

E-mail Address: darmak@uwstout.edu *example@uwstout.edu*

Phone Number: 715 232 2260

Status: ○ Faculty ○ Academic Staff ○ Classified Staff ○ Undergraduate ◉ Graduate Student

College or Unit: College of Education, Health and Human Sciences

Department: Graduate School

Please use the box below to comment on this or any other compliance training you would like to receive.
(Please limit your comment to 255 characters or less.)

Submit Form Reset Form

Appendix D

Approval From UW-Stout

Consent to Participate In UW-Stout Approved Research

Title: *Task and need survey of Metal casting work in Katsina State of Nigeria*

Investigator:
Katsina Umaru Darma
University of Wisconsin Stout
105 220 10th E McCalmont Hall
Menomonie WI 54751 U.S.A.
715 232 2260

Research Sponsor:
Self

Advisor: Dr Howard Lee

Description:
The research is to identify program content, determine competencies and future need of metal casting occupation in Katsina State, for the development of curriculum in the field, so as to upgrade the standard. For the development of business and industries

Risks and Benefits:
This will help to develop and upgrade the metal casting industries in Katsina state, for the new modern and up to date graduates with computer back ground on the tools and machinery now being use in our modern industries. In addition these will boost job opportunities for the people and rapid development of the nation.

Special Populations:
Questionnaires, 40 – 50 will be send to Managers and worker in metal casting industries Katsina State of Nigeria

Time Commitment and Payment:
The Questionnaire will take 7 – 10 minutes to answer, because no any comment is needed.

Confidentiality:
Your name will not be included on any documents. We do not believe that you can be identified from any of this information. This informed consent will not be kept with any of the other documents completed with this project

Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. Should you choose to participate and later wish to withdraw from the study, you may discontinue your participation at this time without incurring adverse consequences.

IRB Approval:
This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

Investigator: Katsina Umaru Darma
Phone; 715 232 2260
Email; darmak@uwstout.edu

Advisor:
Dr Howard Lee

IRB Administrator
Sue Foxwell, Director, Research Services
152 Vocational Rehabilitation Bldg.
UW-Stout
Menomonie, WI 54751