Human Capital Obsolescence in the Building Construction Industry: Strategic Imperatives for Nigeria

A DISSERTATION

SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL OF

THE UNIVERSITY OF MINNESOTA

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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Advisor

July, 2015

Acknowledgements

I thank God for walking me through this path, and I am grateful to my wife for staying by my side during this uneasy journey. My sincere appreciation goes to my dissertation advisor, Dr. Rosemarie Park. Her supervision, encouragement, and patience made this work a reality. I cannot thank her enough.

I am very grateful to the members of my dissertation committee: Dr. Benjamin Ogwo who is also my mentor. He was available to me at all times that I needed him, even at odd times. He never held back, but gave all it took to make this work a better piece; Dr. Tom Sterltz, and Dr. James Brown, who were very patient and helped immensely in providing academic advice from the conception of the topic to the conclusion of the study. I am also grateful to Dr. Archivile who served in the committee briefly, but provided advice that sharpened the topic of the study.

My thanks go to Mr. Onaga Paul and Dr. Omeje Hyginus who devoted their time and resources to helping out with administration, collation, and coding of the questionnaire. I am also thanking Mr. Ezeagogwo Victor and Mr. Ogbu Damian for their supports with the administration of the questionnaire. Their supports with the administration of the questionnaire in Nigeria helped in making this study come true. I owe them a lot.

I acknowledge the support of Dr. Noro Andriamanalia. Her ceaseless supports throughout my entire program provided me with both financial and moral encouragement. She was akin to my securing University of Minnesota Diversity Teaching Fellowship and Community of Scholar's Travel Grant that helped me a lot during the program. I am also very thankful to Dr. Alicia Hofelich Mohr, who worked me through the analysis. She was very patient with me and provided me with unimaginable support. I am very grateful.

Finally, I am grateful to my family in Nigeria, who, despite the distance, continued showing concern about and support for my program. Their encouragements propelled me to the finishing line. I am very thankful to every one of them.

Dedication

To my wife, Agbo, Christiana Nneka, my mom, and members of Agbos' family for their unflinching supports. Finally, it is also dedicated to the building construction workers for their bravery.

Abstract

Businesses like the Building Construction Industry (BCI) depend to a large extent on the viability of the workforce. Consequently, businesses invest heavily on the development of their employees. Regardless of the level of pro-activeness in developing and updating of human capital, it is bound to deteriorate owing to inevitable changes in the individual and workplace technology. This deterioration is known as human capital or skills obsolescence. Human capital obsolescence could be classified into technical and economic obsolescence. Technical obsolescence originates from worker's wear (illness and injuries) or atrophy due to lack of use of skills and knowledge. The purpose of this study is to investigate the technical human obsolescence and the kind of retraining workers are engaging in to encounter skills obsolescence in the BCI in Nigeria. There are studies proffering solutions to human capital obsolescence, but there are hardly any targeting specific occupations like the BCI in developing countries like Nigeria. The available studies are not only limited to developed economies, but study clusters of occupations using variables such as wage scales that vary per occupation, and evaluate only general skills to the detriment specific to occupational skills. There is increasing evidence that BCI workers increasingly sustain injuries, sometimes fatal, at work. Also, there are contradictions in the literature on prevalence of skills obsolescence. Evidence exists that skills obsolescence leads to job loss, lack of job satisfaction, unemployment, poor productivity, and low craftsmanship. This descriptive survey was conducted in Southern Nigeria. The population consisted of 236,175 BCI workers in the regional headquarters (Enugu, Lagos, and River States). The 387 participants with a minimum of high school education were randomly selected for the study. Data was collected using researcher-made questionnaire. The data were analyzed using Pearson Correlation Coefficient, Kruskal-Wallis H test statistics and SPSS software. Among the findings are evidence of attrition of experience older workers; the most preferred professional training technique was Job Rotation; worker's age had no correlation with physical wear, but had negative correlation with skills atrophy; years of work experience had no relationship with skills obsolescence. Based on the findings, changes in institutional strategies for the improvement of skills and general working conditions in the industry are recommended. There should be accountability on the side of the employer for providing opportunity for skills improvement and better working conditions and opportunities for workers to improve their skills. Thus, it is also recommended that the industry intermittently conducts a skills obsolescence survey with the view of finding if and where obsolescence exists.

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Chapter One

INTRODUCTION

The economic development and competitiveness of many countries, to a large extent, depend on the viability of their workforce. This is also true of many businesses like the Building Construction Industry (BCI). As a result, many businesses invest heavily in the development of their employees, often referred to as human capital (knowledge and/or skills) development. In every economy, this investment in human capital development is evident in the development of two categories of workforce: the future workforce and the current workforce (Alders, 2005). Alders points out that whereas human capital of the young future workforce accumulates by receiving more education, the human capital of the current working generations accumulates through learning-by-doing, incentives that increase knowledge of existing technologies and the supply of current knowledge and skills. Nonetheless, he warns that at any moment in time, while the young can use all their accumulated human capital learned through the use of and interaction with recent technologies during their schooling, very few of the technologies learned by older workers are still in use because of changes and interactions with technology (2005).

As an individual begins to interact with his or her environment through planned and unplanned experiences, networks of relationships begin to form and accumulate into organized knowledge, skills, and abilities. The more an individual is exposed to new experiences, the more he or she accumulates human capital, and the more his or her competitiveness offers leverage in the labor market. The development of human capital through investment could be classified into two categories: formal and informal. Prominent among formal programs are education, schooling, and off-the-job or off-site learning such as seminars, workshops, and conferences (Ng & Feldman, 2010; Edin & Gustavsson, 2004). On the other hand, there are also informal programs, which involve on-the-job learning such as apprenticeship, mentorship, quality circles, job rotation, job shadowing, and tenure or experience (Sparks, Ingram, & Phillips, 2009; Hezlett & Gibson, 2007). In this study, human capital is be used interchangeably with knowledge and/or skills.

Regardless of the level of pro-activeness in developing and updating human capital, it is bound to deteriorate because of changes in individuals and technology. The deterioration of human capital is known as skills obsolescence, which is said to "occur when the person requirements of a job, which are demanded by its tasks, duties, and responsibilities become incongruent with the stock of knowledge, skills, and abilities currently possessed by the individual; given that the knowledge, skills, and abilities were previously congruent with job demands" (Fossoum, Arvey, Paradise, & Robbins, 1986, p. 364). Regrettably, knowledge and skills acquired by workers in the past are reduced to 'half-life' by the forces of both technological and individual developmental changes. Half-life of workers' human capital is the time after completion of training, and workers perform at half competency upon graduation in order to meet the demand of the profession owing to changes to developments (de Grip, 2006). Consequently, all the knowledge and skills acquired through preparatory programs cannot effectively be in use at all times throughout an individual's career. In other words, acquired skills may perfectly match today's skills requirements, but may become obsolete with the passage of time (Janβen & Backes-Gellner, 2009).

Human capital obsolescence may arise as a result of external and internal dynamism in individuals, enterprises, and/or organizations. To maintain competitiveness in the economic market, individuals or enterprises frequently yield to both internal and external processes for change. Scholars have come to a general consensus (e.g., Allen & de Grip, 2007; Alders, 2005; Strandbridge & Autrey, 2001; Fossum, et al, 1986) that change in an organization is, among other things, a consequence of technological development, competition, new style of relationship networking, and work organization and practices. Invariably, these changes are the primary cause of skills obsolescence. Technological changes cause skills obsolescence more than any other factor. Rapid and ever-increasing changes in technology have changed general skills required of the workforce globally. This has led to a continuous increase in the demand for a technology-enabled workforce (Strandbridge & Autrey, 2001). As new technology displaces old technology, skills associated with the old technology become no longer of value. Similarly, in addition to losing skills with the obsolescence of old technology, older workers retire earlier in the periods of higher technological change (de Grip, 2006; Alders, 2005). By contrast, older workers stay longer in an economy where the technological change is slow because their skills remain relevant, whereas in fast paced technological change, they are forced to either learn new skills or face skills obsolescence.

Technological development and its concomitant skills requirements lead to change in work organization that result in, to some degree, a change in the skills demanded by various occupations (de Grip & van Loo, 2002). One such organization is the BCI. Most organizations, particularly BCI, react to changes by redesigning their products, tasks, and employee responsibilities, thereby altering job requirements. To remain relevant and competitive, the BCI needs to diagnose the rapidly changing job tasks with the hope of identifying where obsolescence is most prevalent. As a result, some enterprises encourage individual and group learning in the workplace with the hope of moving towards high-performance work practices (Smith & Hayton, 1999).

Individual changes also lead to the depreciation of human capital. Naturally, as individuals grow older, their physical strength diminishes, resulting in an inability to perform some occupational tasks. The pending danger is skills obsolescence, especially among older workers in labor-intensive roles. Sickness and wear also lead to skills obsolescence, and sickness could be a result of ill health or job-related injury that prevents individuals from performing at maximum capacity. In the year 2004 and 2005, for instance, the incident rate of nonfatal occupational injury and illness in construction occupations in the United States was six out of 100 full-time workers (Bureau of Labor Statistics - BLS, 2006). These incidents may have led to a day or days absent from work and the subsequent non-performance of job-related tasks. Finally, skills can become obsolete due to no or insufficient use of the previously acquired skills and knowledge (van Loo, de Grip, & Steur, 2001). During initial preparatory training programs, individuals accumulate skills that eventually may not be put to use because of nonalignment of the skills with the needs of the job. In addition, this implies that knowledge and skills acquired through preparatory programs cannot effectively be in use throughout an individual's career.

Skills obsolescence can be classified into internal and external skills obsolescence, otherwise known as technical and economic skills obsolescence, respectively. Whereas the technical skills obsolescence originates from the changes in workers, the economic obsolescence originates from changes in the job or work environment (Janβen & Gellner, 2009; de Grip & van Loo, 2002). According to de Grip and van Loo (2002) the technical skills obsolescence includes wear – natural aging process, illness, injury, and atrophy – and lack of or insufficient use of skills. On the other hand, the economic obsolescence includes job-specific obsolescence (new skills requirements due to development in society), skills obsolescence by sectoral shifts (shrinking employment in an occupation or economic sector), and firm-specific skills obsolescence (external mobility). With recent high demands on high level skills and ever increasing changes in technology and organizational structure, some individuals may experience these skills obsolescence simultaneously.

Although some organizations provide retraining programs to cushion the effects of skills obsolescence, the rate of obsolescence should be of great concern to the BCI because of changing demands in the industry. In addition to ever-increasing new designs, job tasks, and responsibilities in the BCI, an overwhelming population of workers in the industry are field workers who undergo relative individual changes that characterize skills obsolescence. The natures of their job duties are predominantly arduous and active skills that demand the use of much health and vitality that may not be available to them as they grow older. For instance, in both developing and developed nations, the aging and eventual exit of the baby boomers from the workforce should be of great economic concern not only to the construction industry but also to other industries. Furthermore, recent emphasis on green jobs raises a red flag on impending skills obsolescence in the industry as the arrival of green jobs makes old skills obsolete. In the state of Michigan in the United States, for example, a study on green jobs shows that 49- 81 percent of employers, mostly in the construction industry, reported that new skills are required when working on green projects (BLS, 2009). Skills in the BCI vary in magnitude, by demand, and according to location. Consequently, there ought to be variations in type of deterioration, rates of deterioration of skills, and in measures for leveraging the consequences of obsolescence.

1.1. Theoretical Framework

Although literature (e.g. Allen & de Grip, 2007; Alders, 2004; Wolff, 2000) is replete with several theories or models on human capital associated with the concepts of human capital investment, returns, and obsolescence, evidence (e.g. van Loo, 2007) shows that these concepts, especially human capital obsolescence, could best be studied using human capital theory. As a result, this study will be adopting human capital theory as the theoretical framework and will be influenced by de Grip and van Loo's (2002) typology of skills obsolescence. Precisely, human capital deals with the individual's capability of producing goods and services (van Loo, 2007). "Early ability (whether acquired or innate); qualifications and acquired knowledge through formal education; and, skills, competencies, and expertise, acquired through training on the job" (Blundell, Dearden, Meghir, & Sianesi, 1999, p. 2) are the three main components of human capital, which separately or jointly constitute the sum total of human capital possessed by an individual. The major tenet of human capital theory is the study of investment and productivity (Gemeno, Folta, Cooper, & Woo, 1997).

Investment is associated with forgone alternatives or costs such as fees, earnings, reduced wages, training costs, and/or reduced productivity, which investors incurred with the hope of receiving maximized returns in the future. Thus, human capital theory views the above components of human capital as investments (Wolff, 2000) that should yield commensurate returns. In general, at the economic, organizational, and individual levels, the return of investments might result to favorable increase in Gross Development Product (GDP), productivity, an increase in wages, longer stay in employment, and job satisfaction. Improvement of individual skills is the fulcrum of human capital investment, so the failure of investments in making favorable returns may be attributed to several factors that include skills obsolescence.

Whereas an increase in skills through investment has a positive relationship with productivity (Wolff, 2000), deterioration or obsolescence of skills due to decay or decrease in value has a negative effect on wages and return on investment (Edin & Gustavsson, 2004). Due to obsolescence, higher investment is not always associated with higher returns. For example, Murillo (2011) indicates that workers who invested more in education by achieving higher educational attainment have greater obsolescence and invariably less commensurate returns on their investment, thereby making obsolescence an impediment to the expected returns on investments. It is worth noting that investment in human capital is gross investment in the development of skills and knowledge, and the net investment cannot be determined without accounting for human capital obsolescence over time (van Loo, 2007). Therefore, human capital obsolescence is apparently not tangential, but rather is the nucleus of human capital theory, hence the adoption of the theory for this study.

1.2. Statement of Problem

There are studies (e.g. Allen & de Grip, 2007; Janβen & Backes-Gellner, 2009; Murillo, 2010) proffering solutions to existing problems of human capital obsolescence, but there are hardly any that target specific occupations like the BCI. These studies are not only isolated to developed economies, studying clusters of occupations using “wage earning” equations that vary per occupation, but also evaluating only general skills to the detriment of in-depth specific occupational skills. The absence of skills obsolescence studies on specific occupational skills is not because it is not relevant, but likely because the authors of the existing studies may have little or no in-depth knowledge in specific occupations like the BCI as most of the studies are published in economics journals. This calls for actions on obsolescence studies from researchers with in-depth specific occupational knowledge. The construction industry, in general, through the creation of physical assets, counts toward a significant percentage of Gross Domestic Product (GDP) in both developed and developing countries (Winch, 2010; Debrah & Ofori, 2006). In

Nigeria, for instance, it accounts for about 70 percent of fixed capital formation and contributes 3 percent to the GDP (Adeyemi, Aina & Olaripe, 2006). In addition, records (e.g. Palmersheim, 2012; Fagbenle & Oluwunmi, 2010; Oloyede, Omoogun & Akinjare, 2010) show that construction workers in both developed and developing countries have either died or suffered injuries following the collapse of building structures. This has raised more concerns about the degree of technical obsolescence in the industry and has added to the urgent needs for the study of the industry, especially when, for example, the housing market is partly impeding economic recovery in the United States.

In another development, there are contradictions in the literature on vulnerability of skills obsolescence. While Allen and de Grip (2007) and others support that older workers are most vulnerable to skills obsolescence as training declines with age, Murillo (2011) suggests that workers with higher educational attainments are younger and suffer more obsolescence, probably, because of too much knowledge and too many skills they have acquired in the course of their education. While using training to measure the rate of obsolescence, Schulz and Roβnagel (2010) also point out that age has no negative effect on obsolescence. Schulz and Roβnagel, nonetheless, suggest that further investigation is necessary to clarify the contradictions. Therefore, this study, which targets specific occupational skills in BCI using the direct method approach by asking workers directly about their skills, will account for obsolescence that is not yet perceived by the workers themselves (van Loo et al, 2001) and will fill the gaps in the literature.

1.3. Purpose of the Study

This study will focus on identification of technical human capital obsolescence in the Carpentry & Joinery, Electrical, Masonry, and Plumbing (CEMP) trades within the Building Construction Industry in Nigeria. Specifically, the study will determine and/or identify:

(1) How often technical obsolescence occurs in the industry;

(2) Professional retraining practices that workers are adopting to alleviate the effects of obsolescence;

(3) Whether age has a positive or negative relationship with skills obsolescence;

(4) The effects of educational qualifications, trainings, and experiences on skills obsolescence; and

(5) The occupational trades in the industry that are more vulnerable to skills obsolescence.

1.4. Research Questions

The following main research questions will guide this study:

1. To what extent does physical wear (injuries and/or illnesses) cause skills obsolescence in the Building Construction Industry in Nigeria?
2. To what extent has obsolescence because of atrophy (lack of the use of skills) occurred in the Building Construction Industry in Nigeria?
3. What professional retraining practices are workers adopting to counter the effects of skills obsolescence in the Building Construction Industry?

4. What is the relationship between workers' participation in professional retraining programs and the degree of workers' skills obsolescence in the trades?
5. What kind of relationship (positive or negative) does worker age have with skills obsolescence?
6. Which occupational trades in the Building Construction Industry are more vulnerable to skills obsolescence?
7. What is the effect of years of work experience on skills obsolescence?
8. To what extent does skills obsolescence vary across educational qualification and/or training?
9. What is the nature of the distribution of obsolescence across different age categories?
10. How do workers in different years of work experience bracket experience obsolescence?

1.5. Significance of the Study

Generally, evidence has shown that skills obsolescence may lead to job loss, lack of job satisfaction, unemployment, poor productivity, poor craftsmanship, and/or poor general performance of the economy. Thus, this study helps in providing solutions to some of these problems at individual, firm, local, and national levels. Specifically, building construction workers in Nigeria benefit from this study. By identifying the areas of skills obsolescence and what individual workers are doing to avert the severe consequences, workers are more informed about their skills obsolescence. Thus, this study contributes to the knowledge in the industry because it will create more awareness of skills obsolescence in the industry; hence, encouraging workers to engage in specific retraining program or program to leverage the effect of the identified skills obsolescence and to learn from one another. By so doing, workers will be more capacitated in performing job tasks and invariably increasing their earnings, remaining employed, and increasing their level of job satisfaction. In Nigeria, for instance, Mbamali and Okotie (2012) identified diminished opportunities for the indigenous building construction professionals because of diffusion of local workforce by foreign professionals following globalization. Capacitating local practitioners increases their competitive opportunities in the labor market.

Construction enterprises will also benefit from this study. Identifying skills obsolescence will be part of a diagnostic process that will bring change towards the improvement of performance in the industry. The findings of the study will enable enterprises to provide specific and relative retraining programs for the most affected categories of workers. The intensity of the program or programs will be commensurate to the level of obsolescence of the involved group. This measure will, no doubt, increase the effectiveness and performance of the industry.

Upgrading of skills in the labor force has been a public policy issue for years (Eberts, 2008). Consequently, policy makers are often faced with the challenges of making decision on effective retraining programs for the labor force. This study will help policy makers in making such decisions. By identifying the rate of technical obsolescence (e.g. injuries), the policy makers will be more informed when designing a safety policy that will curb the rate of such obsolescence. For instance, if regular occurrence of injury is related to a specific skill area, working age group, or time of the day, intermittent mandatory safety training/retraining targeting the problem could be conducted. Furthermore, an intermittent general retraining policy that is contingent on the skills obsolescence rate could be put into place with help from the findings of this study.

Finally, this study offers a benefit to the economy of Nigeria. The construction industry contributes a significant portion of GDP of every nation. Therefore, improving the skills of the construction workers can result in an improvement in productivity of the BCI and subsequent improvement in the overall economy.

1.6. Delimitation of the Study

This study in no way attempts to determine all the skills obsolescence in the entire construction industries. It focuses on the skills necessary for constructing residential bungalows with emphasis on Carpentry/Joinery, Electrical, Masonry, and Plumbing (CEMP) skills within the Building Construction Industry. Furthermore, the study focuses on technical obsolescence as against economic obsolescence. Technical obsolescence, which includes wear, natural aging process, illness, injury, atrophy, and lack of or insufficient use of skills (de Grip & van Loo, 2002) originates from the relative changes in individual workers. Although natural aging processes can lead to injury while performing job activities, this study does not investigate the aging process because of the complexity, which may include a longitudinal study associated with evaluating aging process. Therefore, the study is based on the assumption that technical skills obsolescence occurs relatively in individuals irrespective of their location, culture, working environment, and/or their prior trainings and experiences.

1.7. Key Terms

Human Capital

Human capital consists of knowledge and skills individuals acquire through education and/or training and experience to enhance their productivity (Ng & Feldman, (2010). It is furthermore the knowledge, skills, and abilities which include the cognitive knowledge, psychomotor skills, and the capacity of performing a task residing in an individual (Arvey, Paradise, & Robbins, 1986). For the purpose of this study, human capital is defined as a totality of personal characteristics, which include natural or biological traits and the aggregate of learned knowledge, skills, and abilities in individuals that enables individuals to be productive members of an organization or a society.

Skills obsolescence

Skills obsolescence refers to the deterioration of skills. According to Kaufman (1974), it is the degree to which organizational professionals lack up-to-date knowledge or skills necessary to maintain effective performance in either their current or future roles" (p. 23). Sherer and Steger (1975) state that "a person is obsolescent to the degree that relative to other members of his profession, he is not familiar with, or is otherwise unfit to apply the knowledge, methods and techniques that generally are considered to be important by the members of his profession" (p. 265). Fossum, et al defines obsolescence thus: "Obsolescence occurs when the person requirements of a job which are demanded by the tasks, duties, and responsibilities become incongruent with the stock of knowledge, skills, and abilities currently possessed by the individual, given that the knowledge, skills, and abilities were previously congruent with job demands" (p. 364). However, in this study, skills obsolescence occurs when an individual who has been practicing in the BCI lacks the necessary cognitive knowledge, psychomotor skills, and physiological abilities to perform, at a given time, specific job tasks and demands of his profession.

Technical skills obsolescence

This is a depreciation of skills originating from individuals. It includes wear and atrophy. Whereas wear refers to natural ageing process, illness, or injury that result in depreciation of skills due to loss of physical and/or mental abilities, atrophy refers to the loss of skills due to lack of use of skills possessed by the individual (van Loo, de Grip, & de Steur, 2001; Murillo, 2011)

Economic Obsolescence

Economic obsolescence refers to the depreciation or loss of the market value of skills possessed by workers. The loss in value could be due to changes in technology and/or organization that leads to the development of new skills. For example, when new technology is developed, the old one and the skills associated with it become obsolete. It could also be due shrinking of employment in an occupation and/or external mobility that leads to workers' change of jobs because of the adverse economic situation in their industry (van Loo, de Grip, & de Steur, 2001; Arrazola, de Hevia, Risueño, & Sanz, 2005).

Direct Method of Measuring Obsolescence

The direct method of measuring skills obsolescence, which is the best method of measuring technical obsolescence, could either be an objective or a subjective method (de Grip, 2006). It is the objective method when workers are directly tested to determine whether the human capital they possess is deteriorating. On the other hand, the subjective method entails asking workers (and/or their employer) if their human capital is deteriorating.

Indirect Method of Measuring Obsolescence

The indirect method, which is the best method of measuring economic obsolescence, entails measuring productivity using workers' wages and measuring the probability of becoming unemployed or withdrawn from the labor market (de Grip, 2006).

1.8. Preparation and Qualification for the Study

As part of the requirement for the B. Sc. Degree, I conducted a thesis research for students' and teachers' perception of the study of Carpentry and Joinery in technical colleges at Enugu State, Nigeria. One purpose of the study was to identify the interests of students and teachers towards studying Carpentry and Joinery, their views about the methods of teaching the trade, and their opinion about the state and availability of instructional materials for teaching the course. I adopted a quantitative approach, and a research questionnaire was used for data collection. I administered and collected the questionnaire and analyzed the data using descriptive statistics. One of the findings of the study shows that high demand of the services of the trade in society influences the study of the trade in technical colleges. This study introduced me to the techniques of conducting quantitative research and created in me the desire to conduct similar research and learn more about educational research.

For my M. Ed. Thesis, I relied on previous knowledge and expanded my study in the same field, researching in-service training needs of building trade teachers in technical colleges. In this study, I did not only expand on areas of study to include Carpentry and Joinery, Brick/Block laying and Concreting, and Plumbing and Pipe Fitting, but also included more geographical areas of coverage. I used researcher-made instruments for the collection of data, and because of the larger geographical area of coverage, I recruited research assistants that helped in the dissemination and collection of the questionnaire. In this study, I hypothesized that there is no difference in the training needs of non-graduate degree trained teachers and graduate degree trained teachers on the need for teaching methodology and the use of instructional materials. After the analysis, using t-test statistics, the hypothesis was rejected at 0.05 level of significance. This study was, however, technically more in-depth and an extension of my previous study.

In addition, I have published two journal publications on (1) availabilities of facilities for the study of Carpentry/Joinery and (2) students' perception of the study of Carpentry/Joinery. I have also presented a conference paper in Canada in a comparative review of Vocational Education and Training in Nigeria and other developed economies. In preparation for this study, I have taken advanced level courses that are of significance to both quantitative and qualitative design and conduct of this study. They include Comparative System-and Quantitative Research in Work and Human Resource Education; Inferential Statistics and Regression Ethics and Responsible Research; Research Seminars; Research Design and Planning; and Interpretive Research. These courses have equipped me with the necessary skills needed for conducting this research.

Other experience and preparation include my prior involvement in building construction practices in Nigeria. I was a practitioner in the Building Construction Industry for more than a decade. This exposed me to day-to-day skills needed in navigating the industry. Furthermore, I also established a link with Anderies de Grip of Research Centre for Education and the Labour Market (ROA), Maastricht University, Netherlands, one of the world's leading scholars in skills obsolescence study. In fact, he validated the questionnaire for this study. Finally, I read and will continue to read the works of scholars and researchers that relate to this study. This helped me in gaining more insight on important, relevant issues. In this research, I built upon my previous researches and moved a step further and broader in the same field of study.

1.9. Summary

Every business, including the BCI, depends on their employees for economic competition. As a result, they invest heavily in the development of the human capital of their employees. However, the accumulated skills and knowledge, otherwise known as human capital, changes because of changes in individuals, technology, and organizations (Allen & de Grip, 2007; Alders, 2005; Strandbridge & Autrey, 2001; Fossum, et al, 1986). Consequently, human capital becomes obsolete with time. The obsolescence of human capital can be internal or external, also known as technical and economic obsolescence respectively (Janβen & Gellner, 2009; de Grip & van Loo, 2002). Whereas technical obsolescence is a consequence of wear (natural aging process, illness, or injury, and atrophy), economic obsolescence is because of changes in job-specifics, sectoral shifts, and firm-specifics (de Grip & van Loo, 2002). Although some businesses provide retraining programs to counter the effects of obsolescence, the nature of obsolescence should concern the BCI because of the job characteristics in the industry.

There is overwhelming evidence (e.g. Allen & de Grip, 2007; Alders, 2004; Wolff, 2000) that the concept of human capital obsolescence is better studied using the human capital theoretical framework. Hence, this study adopts human capital theoretical framework with an influence by de Grip (2002) of typology of skills obsolescence. There is, among other things, lack of study on skills obsolescence targeting occupational areas like BCI, and there is some variance in the literature on vulnerability of obsolescence among workers and occupational trades. This study is focused on addressing this gap.

Therefore, the purpose of this study includes identification of obsolescence in the industry and the retraining of professional practices workers engage in in order to counter the effects of obsolescence. Ten research questions guided the study. The findings of the study will benefit both the BCI and the practitioners in the industry. The next chapter examines literature related to the study.

Chapter Two

LITERATURE REVIEW

The purpose of this literature review is to understand human capital obsolescence with a focus on the Building Construction Industry. This chapter is organized into seven sections with the first section discussing, in brief, the general trends in human capital. The second section focuses on concepts of human capital, human capital development programs, and other variables that affect the acquisition and uses of human capital. The third section discusses obsolescence. It examines the meaning and existing definitions of obsolescence from the view of offering a suitable definition for the study of human capital obsolescence in the Building Construction Industry. It also discusses the types, causes, and methods of evaluating human capital obsolescence. In the fourth and fifth sections, current trends in the Building Construction Industry and trainings are discussed respectively. Finally, the sixth section examines related empirical studies, and seventh section draws conclusions.

2.1. General Trends in Human Capital

Human capital development and utilization are changing rapidly. The effects of the changes could be “double-edged,” leading to gain and/or loss of human capital. For instance, while some of the developed economies are outsourcing routine factory workers to contractors in developing countries because of cheaper labor cost (Aguirre & Reese, 2004), some developing nations are infusing more skill-intensive technology into their domestic workforce through direct foreign investment (Lee, 1996). As the physical capital crosses the border for the purposes of investments, so must human capital (Aguirre & Reese, 2004). In a developed economy like the United States, the outsourcing of production processes was outstanding in the last five years and has led to some lay-offs of workers, and to some extent, has led to the exit of high-tech skills. When a worker experiences a lay-off or any kind of job interruption, he or she will suffer technical skills obsolescence due to atrophy. An exit of high-tech skills creates skill shortages in that specific area. Conversely, a developing country that experiences an influx of high-skill/skill-intensive technology demand or sudden skill shift will suffer economic skills obsolescence. This applies both in developing and developed countries, especially in an occupation that is affected by frequent technological changes.

International competitions have revolutionized the construction industries (Snieska, Venclauskiene, Vasiliauskiene, & Gaidelys, 2011), especially in terms of practice. It is a common practice for a developing country and, to some extent, developed countries, to contract some of her developing construction projects to Multinational Construction Companies (MCC) through an open bidding system. These MCCs will, in turn, rely on local contractors and local workforce for the execution of their contracts. This process calls for optimal management and integration of both foreign and local human capital. In some instances where needed skills could not be sourced locally, it is sought and sourced from wherever they are available. Thus, Snesika, et al (2011) noted that in transition economy countries, otherwise known as developing economies, skilled and unskilled labor migration, to a large extent, determine housing price movement. In some developing countries, best talents are attracted overseas (a social program known as “brain drain”) because of the availability of jobs and better remunerations. Conversely, some skilled workers from developed economies work in developing economies, but are remunerated commensurably according to the worth of their labor in their home country.

Furthermore, high-tech information technology (e.g. Internet) has revolutionized how skills are taught and learned today. It has minimized, to the barest minimum, the effects of distance as an impediment to skills learning, and has also facilitated bringing individuals that are thousands of miles apart to a virtual classroom. Most of these technologies are readily available through information technology irrespective of geographical locations. Repairing a cracked ceiling, plastering a ceiling, building a brick wall, and sewer line installation are a few skills-learning activities that could be accessed from any part of the world via YouTube. By using this medium, individuals can learn and update their knowledge and skills, thereby avoiding the unnecessary consequences of skills obsolescence.

By and large, shifts in consumer demands, employment structures, and international business concerns are drivers of changes in industries and occupations (Syed, 2007), and, by extension, changes in human capital. Consequently, human capital concerns should be a discussion across all occupations. Thus, the discussions should not be isolated to developed or developing economies, some occupations, or be discussed in isolation. In other words, finding local and unilateral solutions to national problems relating to human capital could better be achieved through in-depth investigations of practitioners’ skills in a chosen occupation. This, hopefully, will avail to the practitioners the opportunities of learning from one another.

2.2. Human Capital as a Concept

This section discusses the meaning of human capital and how the concept is applied in recent literature. Also in the discussion are human capital development programs, which include education or schooling, training programs like off-the-job training and apprenticeship, and other variables such as experience that affect the quantity, quality, and use of human capital inherent in individuals.

What is human Capital?

Recently, the term human capital has been used synonymously with manpower and analogously to physical capital in the economic theory of factors of production. Applying economic logic, theory of human capital, as stated by Gemeno, Folta, Cooper, and Woo (1997), studies "individual decisions dealing with investments in productivity-enhancing skills and knowledge (schooling, training, firm-specific knowledge investment), career choices (decision to work, switching employment, labor mobility), and other work characteristics (wages, reservation wages, hours of work)" (p.754). Human capital, therefore, consists of knowledge and skills individuals acquire through education and/or training and experience to enhance their productivity (Ng & Feldman, (2010). Put differently, it is the knowledge, skills, and abilities residing in an individual (Arvey, Paradise, & Robbins, 1986), which include the cognitive knowledge, psychomotor skills, and the capacity of performing a task. Currently, human capital is used interchangeably with a skill which is a dynamic concept represented by an "intricate web of interconnected and interdependent variables such as industry – and occupation-specific issues and broader socioeconomic contexts" (Syed, 2007, p. 41). It includes basic skills (literacy and numeracy), generic skills (technical know-how, team-working, communication, problem solving, and planning), and organization-specific skills (how work is arranged and undertaken in specific organizational contexts) (Syed, 2007).

In a broader term, human capital should include all the natural endowments (biological traits - mental and physical) that characterize an individual and enable that individual to be able to behave in a certain way. For instance, the left and right brain hemisphere affect, to a large extent, the way individuals react to the environment. This in turn affects an individual's choice of profession and ability to excel. Similarly, a muscularly built individual is more likely to perform well in an occupation that demands heavy lifting (e.g. construction) than a thin and fragile individual. Furthermore, a very tall person stands the chances of outperforming a shorter counterpart in a basketball game. Inherited talents are also among the endowments individuals do not have control over and should count as part of human capital. There are also behaviors. Individual learn as they interact with the environment, and this includes culture. A person from a modern (verbal) culture is more likely to be a sales agent than a person from a traditional culture.

Based on the foregoing, human capital could be defined as a totality of personal characteristics which include natural or biological traits and the aggregate of learned knowledge, skills, and abilities in an individual that enable that individual to be a productive member of a society or organization. Worthy to note is that human capital embraces the whole spectrum of knowledge; more and valuable human capital increases vintage and competitive advantages. For the purposes of further discussion, "human capital" will be used interchangeably with "workers' knowledge and/or skills." Human capital could be acquired through education, formal or informal training, and experience; hence, investment in education and training are concomitant to an investment in human capital. And it could exist at the individual or organizational level.

2.3. Human Capital Development Programs

Economic stability and competitiveness in many individuals, to a large extent, depend on the viability of their human capital. By extension, economic development and competitiveness of many countries depend on the viability of their workforce. This is also true in many businesses. As a result, individuals and many businesses invest heavily in the development of self or their employees; this is often referred to as human capital development. In every economy, investment in human capital development is evident in the development of two categories of workforce: the future workforce and the current working generations. Alders (2005) points out that whereas human capital of the young future workforce accumulates by receiving more education, the human capital of the current working generations accumulates through learning-by-doing, incentives that increase knowledge of existing technologies and the supply of current knowledge and skills. Nonetheless, Alders warns that at any moment in time, while the young can use all their accumulated human capital learned through the use of recent technologies during their schooling, very few of the technologies learned by older workers are still in use because of constant changes in technology. This invariably causes the human capital of older workers to become obsolete very rapidly.

As one begins to interact with the environment through planned and unplanned experiences, networks of relationships begin to form and accumulate into organized knowledge, skills, and abilities. The more one is exposed to more experiences, the more one accumulates human capital, and the more is his or her vintage competitiveness in the labor market. The development of human capital through investment could be classified into two categories; (1) formal, and (2) informal. Prominent among the formal programs are education or schooling and off-the-job-learning such as seminars, workshops, and conferences. On the other hand, informal programs are training programs which involve on-the-job-learning such as apprenticeship, mentorship, quality circles, job rotation, and tenure or experience.

Formal Training Programs

A formal training program consists of planned and structured activities provided to learners in a formal setting with the intention of developing and/or improving learners' skills and abilities. Knowledge, skills, and values that constitute the totality of one's human capital are transmitted through these program activities. Some of the formal training programs include education or schooling and off-the-job-learning such as seminars, workshops, and conferences.

Education

Education is a formal mode of developing human capital. It involves planned and structured curricular programs delivered to learners as instructions through formal teaching/learning processes. It is the primary route to the development and accumulation of human capital. The knowledge and skills acquired through schooling are a formal accumulation of human capital that has some significance to workers' productivities. Through education or formal schooling, individuals acquire knowledge, skills, and abilities that can be relevant to and needed by many different jobs (Ng and Feldman, 2010; Edin and Gustavsson, 2004). The educational attainment (total number of years spent in school) and achievement are indirect measures of accumulated human capital. Human capital increases by receiving more education; therefore, the higher the educational attainment and achievement, the more the accumulation of human capital, and, invariably, the higher the rewards in the labor market.

Investment in education is an investment in human capital development. There is evidence (Blundell, Dearden, Meghir, & Sianes, 1999) that accumulating human capital through education is an investment with initial cost that individual hopes to recoup. The return to investment in education is reflected in workers' income, wages, or salaries and on workers productivities. A higher investment in education is concomitant to greater return rate in earnings and/or productivities. For instance, in some countries, one year of additional education produces a five to ten percent return rate; the return is even higher in primary education in developing countries (Blundell et al, 1999). Also, there is a relationship between education and the Gross Development Product (GDP); educated populations have higher GDP. Obviously, the educated workforce learns and adapts and has higher comparative advantages than less educated workers (Alders, 2005; Wolff, 2000). Education, nonetheless, does not provide in-depth frequent practical knowledge, but provides more in-depth analytical knowledge of the subject area.

In addition, few education programs provide specialized knowledge like one needed in the construction industry. Suffice it to say that some education programs are more important than others in developing human capital needs of the construction industry. In this respect, Vocational Education and Training (VET) is a more specific human capital development program that provides a combination of specific technical and generic skills needed for productive work in the economy (Wallenborn, 2010) and in the construction industry in particular. The above author contends that, in addition to VET being a mode of education, it is also a process of transmitting professional competences in a context of productivity, employability, and sustainable growth that promotes socioeconomic progress. As is evident in many countries (both developed and developing), the production of human capital for medium and small scale construction enterprises relies on VET programs as obtainable in technical colleges, and to a certain degree, in universities.

Off-the-Job Training

Another formal development program that leads to the development and growth of human capital is off-the-job-training, otherwise known as off-the-job-learning (Schultz and Roβnagel, 2010). This can be structured as formal workshops, conferences, and seminars. In some literature, these kinds of training programs are sometimes classified as non-certificated programs because they have no structured curriculum, and participants are not examined at the end of the program, hence the programs are not certificate-awarding. Although participants, at the end of the program, are awarded with a certificate of participation, this is only an indication that the bearer attended and participated in the program.

Workshop

Workshops provide practitioners in any occupation an opportunity to learn in a small group the newest developments in their trades or professions through an intense but brief course. In other words, it provides practitioners in an occupation the opportunity to acquire experiences in their trades or professions using the newest technology. According to Olaitan, Nwachukwu, Igbo, Onyemachi, and Ekong (199), the workshop involves the acquisition of work experience through interaction with a number of people who possess different experiences using different techniques. It involves institution or professional organizations systematically planning and organizing an “interaction” for the purpose of solving an occupational problem in a specific trade or profession.

In the above case, a number of interest groups, institutions, and individuals are invited to demonstrate their research findings or experiences concerning ways of finding solutions to the identified occupational problems. From the various demonstrations on the problem solving techniques in that occupation or profession, individual participants in the workshop gain knowledge and skills, which can later be transformed into work experience through practice (Olaitan et al, 1999). The workshop is characterized, among other things, by the pooling of information, the sharing of ideas and experiences, participants learning by doing, intensive study of practical phenomenon, practical sessions, and so on (Sowande, 2001).

Conference

Conferences, on the other hand, are the coming together of interest groups for discussion and exchange of views and ideas on a particular agreed topic(s). It is a continuing education program which provides the practitioner in an occupation or profession with the opportunity to improve his or her skills and knowledge with the latest developments and technologies in his or her occupational areas. It is usually organized by occupational profession in occupational areas with the view of providing technical information based on research findings on problem-solving approaches in that occupation or trade-related occupations.

The organizers of a conference usually invite individuals who are knowledgeable in that occupation to present papers consisting of in-depth technical information on ways of finding solutions to a given problem (Olaitan et al, 1999). The information presented can thereafter be transformed into an experience that can enhance occupational skills and knowledge performances and execution of a useful project or task in that occupation. A Conference is more or less a lecture-oriented approach to learning. Experts give lectures while participants take notes. Communiqué (official announcement) are usually issued at the end of a conference, and by the by, participants present feedback to the stakeholders about the conference.

Seminar

A seminar could be said to be a meeting for discussions and exchange of ideas. However, Procter (1995) in Sowande (2001) describes a seminar as an occasion when experts in a profession and a group of people meet to study and discuss topical issues relating to their occupation. This entails that the discussion is usually under the tutelage of an expert for the purpose of seeking for a solution to a problem. This approach to finding a solution to a problem is one of the continued educational training programs in many occupations and professions. A seminar is similar to a conference. Both are more responsive in nature than a workshop. Through seminars, serving occupational practitioners are exposed to modern and contemporary approaches, techniques, knowledge, and skills necessary to improving their competencies in their occupational trades or professions. In general, a seminar involves the lecture method, brainstorming, and discussions usually coordinated by the expert in an occupational area. It is less expensive to conduct and has quicker application values.

Informal Training Programs

Training is an outstanding program in the development of human capital. It could be seen as a program designed and provided in an informal setting to help workers develop skills and knowledge needed for a specific job. It is usually informal and different from education because, unlike education, it is often not structured and has no planned curriculum. This program is on-the-job-training or learning as workers engage in the skills of their trades while performing their normal job activities with tools and equipment used in the job and in real life situations. Different approaches could be used in providing training programs to prospective trainees; among them are apprenticeship, mentorship, job rotation or cross training, experience or tenure, and quality control. Some of these programs are briefly discussed below.

Apprenticeship Training Program

"Apprentice" is a word derived from the French word "apprende," which means "to learn" and could be defined as a learner who is learning a craft while serving the employer, and is entitled to learning instruction at a specific term (Sparks, Ingram, & Phillips, 2009). Apprenticeship has a long history. For instance, in 1561, Queen Elizabeth I instituted a statutory apprenticeship (Clarke and Winch, 2004), and in 1640, Thomas Millard produced an apprenticeship indenture document (Sparks, et al, 2009). Since inception of apprenticeship, several changes have occurred, but the characteristics remain the same. There are two models of apprenticeship: traditional and modern apprenticeship.

The traditional apprenticeship model is a practice-based mode of learning characterized by the craft hierarchy of master and journeyman/apprentice, with employer forcing on out-put in lieu of developing potentials and reliance on workshop with no formal technical instruction or assessment (Clarke & Winch, 2004). The model is, however, significant of demand and supply levels; on the demand, the apprentice wants a means of livelihood, and on the supply side, proprietor's accepting of apprentices enhances his or her business with minimal or no overhead cost (Sigh, 2000). Whereas the apprentice pays for apprenticeship training in many developing countries (Livingstone &

Kemigisha, 1995), in developed countries, the apprentice receives a stipend for training (Clarke & Winch, 2004; Lewis, 2007). Learning in a traditional apprenticeship is through imitation; the apprentice observes, copies, participates, and helps in carrying out job and related job activities (Singh, 2000). The duration of the apprenticeship varies with the individual's abilities and/or educational qualifications. Certainly, the contract specifies, among other things, the duration of the program. On expiration of the contract, the apprentice leaves without an assessment of his/her proficiency level in the practice of his or her trade. Rather, success in the business as a journeyman or as a sole proprietor of one's own business is used as a measure of proficiency at a later stage. However, it is not certain whether success in business is related to the number of years in apprenticeship.

In the modern apprenticeship model, apprentices contend their time with formal class instructions in a school setting and practice of the trade in a firm setting as the model includes formal theoretical instructions. The modern apprenticeship program functions in partnership with a vocational institution where occupational theories are taught by vocational teachers and industrial firms where practical skills of the occupation are taught by skilled trainers. This model bridges the gap between learning and the world of work as it is hoped that trainees will have a smoother transition to the work world after graduation.

Mentorship Program

The mentor is derived from Greek mythology, and originated from Homer's Odyssey. It was described as "Half-God, half-human, half-male, and half-female;

believed and unreachable; icon of wisdom; and the union of both goal and path" (Lindbo & Shultz, 1998; Bierema & Hill, 2005). When Odysseus was fighting the Trojan War, he entrusted his son, Telemachus, to his friend and advisor, Mentor. The Mentor, for a period of ten years, was trusted with the responsibilities of guiding, teaching, and nurturing Telemachus (Anderson & Shannon, 1983; Swamp, Leonard, Shields, & Abrams, 2001). Ever since, a mentor has always been considered one who has in-depth knowledge and expertise to teach and guide the young and inexperienced. Although, mentoring has been in existence for ages, it started appearing as an informal phenomenon in 1970s (Colley, 2002).

Consequently, for decades, mentorship has been associated with age and/or maturity and wisdom to guide mentees' academia, career, and/or personal development. Currently, mentors have been integrated as human capital development programs geared towards developing individual talents (Cummings & Worley, 2009). So many scholars (Lindbo & Shultz, 1998**;** Bierema & Hill, 2005; Hezlett & Gibson, 2007) have proffered varying definitions of mentoring. While some are interested in defining "mentor," others are focused on defining "mentoring." For example, Heclett and Gibson (2007) defines mentoring as "an intense, dyadic relationship in which a more senior, experienced person, called a mentor, provides support and assistance to a more junior, less experienced colleague, referred to as a protégé or mentee" (p. 385). Lindbo & Shultz (1998) defines and describes mentor as:

> "One who has knowledge and advanced or expert status; is attracted to, and nurtures, a person of talent and ability; and is willing to give away

> what he or she knows in a noncompetitive way. The most effective mentors want to share their knowledge, materials, skills, and experience, while offering support, challenge, patience, and enthusiasm" (p. 54).

Cummings and Worley (2009) states that mentoring is a direct, intentional transfer of specific knowledge from an experienced person (mentor) to the inexperienced person (mentee) for the purpose of the career development process. Most of the existing definitions in literature have overwhelming consensus on who a mentor and mentee are, but slightly differing views on an exhaustive list of roles and responsibilities of mentors. However, mentoring is generally agreed to be an intense one-on-one relationship.

All the foregoing notwithstanding, the primary purpose of mentoring as a human capital development program is for improvement of performance at the individual level (Cummings and Worley, 2009) and could be classified as informal or formal (Wright and Wright, 1987; Ragins and Cotton, 2000; Gibson, 2007). Informal mentoring develops unconsciously as people get to know each other. In this case, individuals choose their mentor or mentee as a result of compatibility in behavior and likeness. In contrary, formal mentoring is an organizational intervention and arrangement by which a mentor, the experienced employee, is assigned to a Mentee, the new and novice employee for career-related support and assistance (Gibson, 2007). In both cases, Gibson asserts that mentoring must be built out of mutual respect, trust, comfort, confidentiality, and commitment. According to Lindbo & Shultz (1998), Clutterbuck (2004), and other scholars, mentoring involves teaching, personal support, and skills/knowledge development. Several authors (Wright & Wright, 1987; Lindbo &

Shultz, 1998; Swamp et al, 2001) unanimously agreed that mentoring processes demand that mentors' responsibilities should include, among other things, the provision of technical information about how to perform job-specific tasks and acceptance and confirmation of a mentee's ability, thus increasing the mentee's self-confidence and competitive advantage.

The relationship inherent in the mentoring process is a dual interaction. In return for the services provided by a mentor, the mentee, according to Murray (2001) should possess, at least, the willingness to assume responsibility for his or her own growth and development; ability to perform in more than one skill area; and the ability to seek challenging assignments and new responsibilities. For any mentoring program to be effective, both mentor and mentee should be accountable to each other with respect to the above expectations.

Job Rotation

The development and emergence of job rotation was a result of the need to prevent or minimize work-related musculoskeletal disorders – WMSDs (Joegensen, Davis, Kotowski, Aedla, & Dunning, 2005). Thus, the objective of job rotation is to minimize the risk associated with biomechanical loading, which accumulates on a particular body part, and its effectiveness is dependent upon the balance of biomechanical stressors (Joegensen et al, 2005). In other words, job rotation targets the reduction of high forces on tissue- discs, ligaments, facet joints, and the muscles of the lower back, which present a high risk of injury (Frazer, Norman, Wells & Neumann, 2003). The underlying idea in job rotation is to increase production and profits by minimizing technical obsolescence associated with workers' wear.

Job rotation, otherwise known as cross training, and on-the-job training (Huang, 1999), is the process whereby workers rotate from one job that uses a particular set of muscles to another that uses a different set of muscles to alleviate the physical fatigues and stress for a particular set of muscles (Joegensen et al, 2005; Allwood & Lee, 2004; Frazer et al, 2003). According to Huang (1999), job rotation could be defined as "lateral transfer of employees among a number of different positions and tasks within jobs where each requires different skills and responsibilities" (p. 75). Other than focusing only on WMSDs, this definition considers learning new skills and development of responsibilities associated with job rotation. Thus, the author added:

> Individuals learn several different skills and perform each task for a specific time period. Rotating job tasks helps workers understand the different steps that go into creating a product and/or service delivery, how their own effort affects the quality and efficiency of production and customer service, and how each member of the team contributes to the process. Hence job rotation permits individuals to gain experience in various phases of the business and, thus, broaden their perspective (p. 75).

From the above perspective, job rotation is a skills improvement strategy. In agreement, Allwood and Lee (2003) opined that job rotation does not only allow operators to learn new tasks, but it also improves their problem solving skills by exposing them to problems in different job tasks in production processes.

Frazer et al (2003) also enumerated some benefits of job rotation that include "a cross-training, workforce, increase motivation/innovation, reduced boredom and monotony, reduced work stress, reduced absenteeism, lower turnover rates, increased ability to handle change, increased production, and reduced cumulative trauma disorder" (p. 905). All the benefits notwithstanding, Allwood and Lee (2004) warned that job rotation is costly and decreases workers' efficiency during the training time. Huang (1999) also warned that job rotation prevents job specialization; consequently, it prevents workers' attainment of optimal level of performance. Specialization, according to the author, is needed in some jobs where the cost in terms of training and supervision is prohibitive. Nonetheless, some organizations and individuals may opt for job rotation because the benefits outweigh the costs. For individuals, it could be more effective in managing wear and learning new skills.

Job Shadowing

Most often, job shadowing is associated with senior secondary or high school students' approach to acquiring working skills in real life situations and in their career choice. It is a work-based learning (Reese, 2005) or experiential learning (McCarthy & McCarthy, 2006) in which a student is paired with an experienced worker in a specific workplace and both spend workdays performing work activities inherent in the occupation. By so doing, students learn firsthand what it is like to be a worker in their chosen career (Lozada, 2001). Job shadowing is exploratory in nature and the students are not paid, but receive other rewards. According to Reese (2005), students receive other rewards that include “the chance to explore a career that is of interest to them, seeing the workplace environment first hand and witness the necessary skills on the job.” (p. 18). Further on the benefit of the program, the author states that Job Shadow Coalition describes it as “academically motivating activity designed to give kids an up-close look at the world of work and to answer the question, ‘Why do I have to learn that?’” (p. 19). Just as some other training programs, job shadowing has immense benefits.

Although the literature has mainly associated job shadowing with students, the program has been an application in training new employees or imparting new or updated skills in an organization. Thus, Reese (2005) advocated that job shadowing should not just be for students, but for teachers, as well. The author cited a situation in which teachers arrange with a business that gives them the opportunity of observing professionals using latest work techniques and technology in the workplace. In addition, job shadowing could also be used as a training program in many other situations. For example, it could be used as an orientation-training program for a new employee as well as a successive training program for an employee who is to succeed another employee in a given position. It could also be used for training employees in new or the updating of skills and job activities. In the context of this study, job shadowing could be used as a means of updating and learning new skills to alleviate the effect of obsolescence to the individual in particular and the organization in general.

2.4. Other Human Capital Variables

Despite education and training, there are other variables that affect the quantity and quality of human capital possessed by workers. They include: length of service or tenure, job certification, and age. These variables do not only affect the quality and quantity of an individual's human capital, but they also affect the return on human capital. These variables are briefly discussed below.

Length of service, Tenure, or Experience

Length of service refers to "the amount of time worked with a company or governmental organization, regardless of changes in occupation" (Buckley, 1998. p. 29). This implies that an individual who has worked for a particular company or governmental organization such as, for instance, a carpenter and a bricklayer for five years respectively has a combine length of service of ten years. In a situation where the individual left and returned, the length of service combines the time before and after the absence. The meaning of tenure or experience may vary slightly, as it is mostly used to refer to the number of years a worker has spent in an occupation. Employers use this variable as a measure of human capital, especially during recruitment. It is assumed that an individual with high work experience in a job or related occupation will adapt more easily and be more productive in a job than a fresh individual without any work experience. However, tenure has its own shortcomings, too. It is augured that after a tenure of 13 years, workers may start losing their skills because their interest in retraining and the updating of knowledge declines; and after 19 years in the same position, they suffer from concentration of experience that may lead to loss of position in a labor market (de Grip, 2004). It is also argued by Allen and de Grip (2006) that concentration of experience in a particular job leads to frustration and stagnation.

Job Certification

Job certification is “any licensing or test completion requirement associated with an occupation that is administered outside the company and is a significant factor in the hiring, retention, or earnings for that occupation” (Buckley, 1998. P. 30). Because of the importance attached to licensing and the extra hard work needed for passing the test for subsequent certification, individuals with job certificates are considered to be more knowledgeable than their counterparts who are holders of college degrees. In some occupations, however, individuals are not allowed to practice their trades unless their appropriate professional boards license them. This notwithstanding, skills and knowledge demand of a subject area transcends the area of coverage for licensing. However, certification/licensing provides a view of the changing requirements of a profession (Edum-Fotwe and McCaffer (2000).

Age

Age is a very important factor when the employer is making any decision about productivity. It is highly related to the amount of human capital workers possess, and also to the behavior they exhibit towards their job activities. For instance, older workers are less likely to participate in retraining because they think they are too old to benefit from such programs; this view is also shared by their employers (Keely, 2007). Training intensity decreases with age (Syed, 2007) and older workers invest less time in accumulating human capital associated with recent technological knowledge (Janβen & Beckens-Gellner, 2009). As a result, older workers are more likely to suffer from negative effect of change in job content, thereby having less recent vintage of human capital (Allen & de Grip, 2007) and become subject to obsolescence (van Loo et al, 2001).

This "less advantageous" position is more prevalent on skill workers (Newman and Weiss, 1995), especially in the construction industry that is characterized by specialized skills and labor-intensive activities. In general, a high percentage of the working population is graying; the baby boomers are about to exit from the workforce. Every sector of the economy will probably experience a shortage of skilled labor following their exit; however, it is yet unknown whether this is also the same in the BCI in Nigeria. Nonetheless, many establishments are conscious of the challenges associated with age and are making some structural changes to extend the employability of older workers (e.g. Roth, 2010; Koc-Menard, 2009). This approach may not be plausible in an establishment like the construction industry with labor-intensive activities that require prolonged standing, stooping, lifting, climbing, and, above all, no permanent structure or site.

2.5. Obsolescence as a Concept

This section, first, discusses the concept of obsolescence, the origin and meaning of obsolescence. Secondly, it examines the existing definitions and proffers a definition of human capital obsolescence in the construction industry. Thirdly, it discusses types, causes, and measures of human capital obsolescence.

Meaning of Obsolescence

The word 'obsolescence' came into being in 1828, and is derived from the word 'obsolescent' which is a 1755 word formed from the Latin word 'obsolescentum or obsolesce' meaning 'fall into disuse' or to become obsolete. Obsolete, on the other hand is a related word that was formed in the 1750s from the Latin word 'obsoletus,' which means 'grown old or worn out.' Obsolescence is therefore the state, process, or condition of being or becoming obsolete (Dictionary.com Unabridged, n.d.). Since its origin, obsolescence has been used to describe the state of tools/equipment, and was later used to describe the state of human capital or knowledge and/or skills.

With respect to equipment, it becomes obsolescence when it becomes obsolete or falls into disuse. In a sense, equipment obsolescence occurs not only as a result of physical deterioration or wear, disrepair, or poor design, but also because of rapid technological development which forces machines out of use even though they are still productive (Whelan, 2002). Against this backdrop, Bhurisith and Touran (2002) define equipment obsolescence as the economic decline in equipment occurring over time due to technological advances (p 357). This definition only considered the economic life of machines and changes in technology as opposed to physical deteriorations. Shearer & Steger (1975) define machine obsolescence as a relational concept. According to the authors, "obsolescence of machines is determined in terms of its cost and the value of its output relative to other machines doing the similar work." (p. 126). More than fifty years ago, Brown (1957) noted the discrepancy that exists between the physical and economic life of machine tools. The physical life of a machine is more than twice its economic life. According to him, market and innovation are propellants of machine obsolescence. As a result, it can be a factor of fall or shift in demand (Brown, 1975; Shearer & Steger, 1975). When a demand becomes very low, manufacturers innovate and introduce new equipment that will be in high demand, thereby pushing the existing ones into obsolescence. Instead of deterioration being the motivating factor, technology innovation becomes the primary cause of obsolescence (Nair & Hopp, 1992). When this occurs, it is said to be planned obsolescence on the part of equipment makers. However, the arrival of new machines does not necessarily make the existing ones obsolete, especially if the cost of its procurement has not been recouped and it is still relatively cost-productive.

On the side of the machine end users, economic productivity is a reckoning force to obsolescence. When the cost of running a machine is higher than its productivity (Whelan, 2002), or when the new machines in the market cost less and perform an equivalent or greater volume of work most of the time (Bhurisith & Touran, 2002), obsolescence is evident and replacement of equipment is eminent.

Obsolescence/productivity and replacement estimates were well documented in detail in Nair and Hopp, (1992); Bhurisith and Touran, (2002); and Whelan, (2002). In an effort to monitor equipment/tool obsolescence, the United States military developed a part tracking tool called Tactrac from TacTech Inc of Yorba Linda, California that tracks all semiconductors worldwide and warns of their obsolescence (McHale, 2000). This device saved the U.S. Military billions of dollars, thereby paying off the cost associated with the equipment and saving a lot more money. In general, this is a justification for the study of obsolescence.

What is human capital obsolescence?

So many scholars have proffered varying definitions of human capital obsolescence. According to Kaufman (1974), a universally acceptable definition of obsolescence has eluded behavioral scientists including personnel and organizational researchers for many years. For instance, participants in the first Occupational Obsolescence Conference held in 1966 in the United States were unable to arrive at an acceptable clear-cut definition (Kaufman, 1974). In order to arrive at an acceptable definition, Kaufman considered three concepts that should make up a definition of obsolescence. These include a lack of knowledge and/or skills as a result of failure to keep up-to-date with knowledge and skills in a profession.

However, Kaufman questioned the consequences this has for an organization and its relationship to obsolescence. This results in ineffectiveness, which is the second concept. Kaufman is of the opinion that not every type of ineffectiveness is a result of obsolescence. A professional who is at abreast with the knowledge and skills of his profession but is unable or unwilling to use it is ineffective but not obsolescent. Suffice it to say that only the ineffectiveness resulting from lack of up-to-date knowledge and skills should be considered obsolescence. He opined that personal characteristics like ageing process, injury or illness, and none or insufficient use of knowledge and skills should not be attributed to obsolescence.

The above view is not incongruent with recent definitions and classifications of obsolescence (cf van Loo, de Grip, & Steur, 2001). The third and last concept in Kaufman's analysis is the job and professional roles. Professionals who cannot perform the roles ascribed to their position owing to not "keeping with the latest development in their disciplines" (p. 22) are considered to be professionally obsolescent. He likened professional obsolescence to versatility or potential obsolescence, which he described as limited capability of a person to take a different or greater responsibility. For example, laid-off professionals who are abreast with the knowledge and skills in their technical areas but could not be redeployed in another industry because of lack of professional versatility are obsolete. "Lack of" more correctly describes obsolescence than "loss of;" therefore, the loss of existing knowledge or individual characteristics (physical stamina, motivation, or ability to adapt to change) is not obsolescence, but deterioration. He concluded, and finally defines obsolescence as follows: "obsolescence is the degree to which organizational professionals lack up-to-date knowledge or skills necessary to maintain effective performance in either their current or future roles" (p. 23).

The above definition falls short of some concepts associated with obsolescence in recent literature. Obsolescence should be broader than how Kaufman defines it; it should not only include 'lack of' but also 'loss of' knowledge and/or skills. There is a general consensus that knowledge or skills that are not put into use are more or less “dead” as it will fade away from the individual’s repertoire with time. This is otherwise known as obsolescence due to atrophy or nonuse, a type of obsolescence classified by recent literature as a kind of technical obsolescence. A person in an interrupted work career will, in addition to lacking up-to-date knowledge and skills, lose his or her previously acquired knowledge. However, such a person, upon returning to work, will invest more on regaining the lost knowledge. Mincer and Ofek (1982) called this process “restoration or repair of previously eroded human capital” (p. 4). If the status quo of knowledge and skills is maintained at the time of exit and return, the returnee will obviously not be as effective in performance as the stayers or as at the time of his or her exit. Although, he or she may have accelerated recovery (Mincer & Ofek, 1982).

Furthermore, maintaining effective performance in the person’s current or future roles would not eliminate the possibility of becoming obsolescent in the practice of professional trades. The definition and assignment of roles are relative and could be organizational specific. Consequently, two persons could be equally effective in their assigned roles, but differ significantly in the quality and quantity of their output (Sherer & Steger, 1972). Therefore, a professional individual may be effective in performance of his or her assigned roles, but in a larger context, is obsolete. Put differently, an organization may be obsolete, and as a result, lacks the competitive advantage in production of goods and services, but individuals in that organization are very effective in performance of their assigned roles.

According to Nelson (u.d.), the above definition only considered the distance between the skills possessed by professional individuals and the ideal skill set necessary to complete job tasks. On the contrary, Sherer & Steger (1972) define obsolescence as a relational concept (Nelson, u.d.) as could be seen thus: “A person is obsolescent to the degree that relative to other members of his profession, he is not familiar with, or is otherwise unfit to apply the knowledge, methods and techniques that generally are considered to be important by the members of his profession” (Sherer & Steger, 1975, p. 265). Explaining the definition, the authors likened man power or human capital obsolescence to machine obsolescence, which is “determined in terms of lost value of its output relative to other machines doing similar work” (p. 265). Similarly, an individual is obsolescent when there is a negative return on his net benefit to his organization. They considered two implications in their definition; (1) in the absence of job changes or performance deterioration, the individual may still become obsolescent when his counterparts engage in developing training and he fails to, or when there are low paid entrants in his job, (2) in relation to other people in the field, two individuals, one out-of-date and the other incompetent, are considered to be equally obsolescent. In fact, relating individual obsolescence to others could not be better explained than above. What Sherer & Steger’s definition implies is that so long as a person is at par in performance with members of his or her profession in an organization, such individual will never be obsolescent. But what happens when an organization in its entirety is obsolescent?

Nelson (u.d.), after considering varying definitions, defines skills obsolescence as “the deficiency of skills necessary to fulfill the tasks associated with one’s employment position or comparable employment position" (pp. 3-4). This is a broader definition that expanded Kaufman's (1974) definition. Kaufman describes "deficiency" as lack of up-to-date knowledge and skills, and "comparable position" in his analogy is versatility obsolescence. A generic economic definition of skills obsolescence was put forward by van Loo, de Grip, & Steur, (2001). They simply define skills obsolescence as "when skills become less valuable in the production process of a firm" (p. 1). As could be seen from the literature (de Grip & van Loo, 2002; de Grip, 2006; Nelson, u.d.), the above definition fails to consider 'technical' skills obsolescence, which is the obsolescence that originates from the workers. The definition is, however, restricted to 'economic' skills obsolescence, which is the obsolescence that affects the value of workers' skills.

Fossum, et al, (1986) discusses both psychological and economic definitions of personal input and job requirement prior to their concluding on the definition of obsolescence. They first try to establish a relationship between personal input and job requirements. According to them, understanding person's knowledge, skills, and abilities (KSAs) necessary for effective performance of job tasks and duties is akin to defining obsolescence. Thus, while knowledge is the content or technical informational needed for adequate performance in a job, skills are the psychomotor processes required for the performance of job tasks. Abilities, on the other hand, are the capabilities or achievement levels represented cognitively.

Job requirements, according to Fossum, et al are not only described by the tasks and behaviors for accomplishing them, but are also characterized by the KSA's relevant for accomplishing the tasks. From economic demand and supply perspective, job requirements are affected by change and demands of skills resulting from changes in an organization's products. As a result, the authors state, "job requirements are a function of both the cost of KASs and other factors in the market and the demand for goods and service these KSAs will produce" (p. 364). Based on the above relationship and the prior discussions, Fossum, et al define obsolescence thus: "Obsolescence occurs when the person requirements of a job which are demanded by the tasks, duties, and responsibilities become incongruent with the stock of knowledge, skills, and abilities currently possessed by the individual, given that the knowledge, skills, and abilities were previously congruent with job demands" (p. 364). This definition is broader and has the advantage of the possibility of assessing an individual's obsolescence independent of making reference to the performances of his professional colleagues. In addition, the "ability" attribute of the definition takes care of some obsolescence that can originate from individual's physical attributes, which has been neglected or excluded from other definitions.

With regard to the above considerations, obsolescence could be simply defined as the inability of one to perform at full competency or standard as an individual and/or a member of an organization or profession.

What is Human Capital Obsolescence in the Building Construction Industry (BCI)?

Based on the foregoing, a suitable definition of human capital obsolescence in construction industries will be one not restricted to only economic depreciation of individuals' human capitals or to the performance of others in the profession. The ideal definition will consider the need for old skills necessary for the maintenance of products of construction industries as the products outlast the life of a person and sometimes the life of construction industries. Consequently, the learning and maintaining of old skills needed for these tasks is necessary. Most importantly, the ideal definition should be open to environmental development changes, changes in demand, and mental and physiological changes in individuals practicing the profession.

Therefore, for the purpose of this study, obsolescence in the construction industries is defined as follows: "Obsolescence in the construction industries occurs when an individual who has been practicing in the industry lacks the necessary cognitive knowledge, psychomotor skills, and physiological abilities to perform, at a given time, specific job task demands of his profession." This definition allows for considerations of changes in specific skill needs as a result of changes in technology and demands and changes originating from individuals. What needs to be pointed out is that certain skills may be outdated, but it is still needed for the purpose of maintaining structures built with such skills. For instance, skills inherent in handmade architectural designs will be needed for maintaining such existing architectural artifacts. By and large, according to Janβen and Backes-Gellner, (2009) new skills do not always completely replace older skills, but can also be complementary to older skills.

Types of Human Capital Obsolescence

Human capital obsolescence can be classified into internal and external skills obsolescence. This is otherwise known as technical and economic skills obsolescence

(Alders, 2004; Aubert, Caroli, & Roger, 2005; van Loo, de Grip, & de Steur, 2001). Detail classification of obsolescence is shown in Table 2.1.

Technical Obsolescence

Technical skills obsolescence originates from changes in workers. In other words, it is a depreciation of skills and knowledge, which originates from individuals (van Loo, et al, 2001). The technical obsolescence could be wear or atrophy. Whereas wear refers to the depreciation of skills due to the natural aging process, injury, or illness, atrophy refers to the depreciation of skills and knowledge due to no or insufficient use of skills and knowledge (Janβen & Gellner, 2009; de Grip & van Loo, 2002; van Loo, et al, 2001).

Economic Obsolescence

The economic obsolescence originates from changes in job or work environment (Janβen & Gellner, 2009; de Grip & van Loo, 2002), which may be a result of changes in technology and/or economic values. The economic obsolescence includes job-specific obsolescence (new skill requirements due to development in society), skills obsolescence by sectoral shifts (shrinking employment in an occupation or economic sector), and firm-specific skills obsolescence (external mobility) (van Loo, et al, 2001). With recent high demands on high level skills and ever-increasing changes in technology and organizational structure, some individuals may experience these skills obsolescence simultaneously.

Table 2.1
Types of Skills Obsolescence

Types of Skills Obsolescence	**Depreciation of Human Capital by:**
Technical Skills Obsolescence Wear	
	Natural aging process, illness, or injury
Atrophy	No or insufficient use
Economic Skills Obsolescence Job-specific skills obsolescence	New skill requirements for the job due to developments in society.
Skills obsolescence by market development	Shrinking employment in an occupation or economic sector
Company-specific skills obsolescence	External Mobility

Van Loo, de Grip, & de Steur (2001, p. 3)

Causes of Human Capital Obsolescence

Obsolescence could be attributed to so many changing factors resulting from economic production processes, organization restructuring processes, and the changes happening on the individual as an agent of production. Thus, obsolescence occurs as a result of (1) technological changes, (2) changes in the organization, and (3) changes originating in individuals.

Technological Changes

Human capital obsolescence may arise as a result of external and internal dynamism in individuals, enterprises, and/or organizations. To maintain competitiveness in the economic market, individuals or enterprises frequently yield to both internal and external processes for change. There is a consensus among scholars (e.g., Fossum, et al, 1986; Strandbridge & Autrey, 2001; Alders, 2005; Allen & de Grip, 2007) that change in an organization is, among other things, a consequence of technological development, competition, new style of relationship, and work organization/practices. Invariably, these change catalysts are the primary cause of skills obsolescence. Technological changes cause skills obsolescence more than any other factor. Rapid and ever-increasing changes in technology have changed the concepts of skills required of the workforce on a global scale. This has led to a continuous increase in the demand for technology-enabled workforce (Strandbridge & Autrey, 2001). As new technology displaces old technology, skills associated with the old technology become obsolete. Similarly, in addition to losing skills with the exit of old technology, older workers retire in the earlier periods of higher technological change (Alders, 2005; de Grip (2006). In contrast, older workers stay longer in an economy where the technological change is slow because their skills still remain relevant, whereas in fast-paced technological change, they are forced to learn new skills or face skills obsolescence.

Changes in Organization

Changes in organizational structures also increase the obsolescence of human capital. As development in organizational structures is constantly changing, organizations intermittently embark on planned change – change planned by the members of an organization and directed towards increasing the organization's effectiveness (Cummings & Worley, 2009) to leverage the effects of change. The need for change arises when the organization's status quo becomes unsustainable and requires some levels of organization development intervention. According to Cummings and Worley, organization development intervention is sequentially planned activities, events, and actions directed towards increasing the organization's effectiveness.

Technological development and its concomitant skill requirements lead to change in work organization that result, in some degree, variations in the skills demanded by various occupations (de Grip & van Loo, 2002). Most organizations react to changes by redesigning their products, tasks, and employee responsibilities, thereby altering job requirements. To remain relevant and competitive, construction industries need to diagnose the rapidly changing job and tasks with the hope of identifying where obsolescence is most prevalent. As a result, enterprises encourage individual and group learning in the workplace with the hope of moving towards high-performance work practices (Smith & Hayton, 1999).

Changes in Individual

Individual changes also lead to the depreciation of human capital. Naturally, as individuals grow older, their physical strength diminishes, resulting in an inability to perform some occupational tasks. The pending danger is skills obsolescence, especially among older workers, in certain roles. Furthermore, individual change due to sickness and wear also lead to skills obsolescence. Sickness could be a result of ill health or job-related injury that prevents individuals from performing at maximum capacity. In the year 2004 and 2005 in the United States, for instance, the incident rate of nonfatal occupational injury and illness in construction industries was six out of 100 full-time workers (BLS, 2006).

Finally, skills can become obsolete due to no or insufficient use (van Loo, de Grip, & Steur, 2001). During initial preparatory training programs, individuals accumulate some skills which eventually may not be put to use because of non-alignment of the skills with the skill needs of the job. For example, on the course of education and/or training for a career, the individual acquires all kinds of knowledge and skills. However, some of those knowledge and skills may not be evoked frequently from the individual's repertoire in the course of performing job responsibilities. As a result, those knowledge and skills tend to deteriorate. This implies that knowledge and skills acquired through preparatory programs cannot effectively be in use throughout an individual's job career.

Evaluation of Human Capital Obsolescence.

Many scholars have conducted studies designed to measure skills obsolescence. The measure of human capital obsolescence could be classified into two methods – direct and indirect methods. De Grip (2006) identified two direct and indirect methods respectively. The direct methods are;

1. Objective methods: testing the deterioration of human capital that workers possess and
2. Subjective methods: asking workers (and/or their employers) if they face obsolescence of their human capital (p. 5).

The indirect methods include:

1. Measuring of productivity: wages; and

2. Measurement of the probability to become unemployed or withdraw from the labor market (p. 5).

According to the author, each method – direct and indirect methods, has its relative merits and demerits. While the direct method is best used in measuring technical obsolescence, it could not be used in measuring economic obsolescence. On the other hand, the indirect methods can be used in measuring both technical and economic obsolescence. However, van Loo, et al (2001) warn against using this method in measuring technical obsolescence because of its failure to account for obsolescence that is not yet perceived by workers themselves. The method is best in measuring the labor market effect (de Grip, 2006).

The direct methods of measuring human capital often involve the use of questionnaire in collection of data. The questionnaire is administered directly to workers asking them specific questions about their skills. Blechinger and Pfeiffer (2000) and van Loo (2001) are some examples of studies that applied this approach in measuring obsolescence in German Apprenticeship Training program and in Netherland Labor Workers respectively. In both cases the authors obtained their data from secondary sources.

The indirect method is the most widely used method in measuring human capital and its obsolescence. Mincer and Ofek (1982); de Grip (2008); Edin and Gustavson (2008); Allen and de Grip (2007); and Gorlich and de Grip (2009) are a few examples of studies that used the indirect methods approach in measuring one form of human capital or another. Wage increase or decrease is predominantly used in these studies and are only obtained through secondary sources of data.

2.6. General Trends in the Building Construction Industry

Society generates value through the creation of physical assets like factories for manufacturing goods, offices and shops for delivering services, hospitals for health care, and residential structures for human habitations. All these count for a significant percentage of GDP in both developed and developing countries (Debra & Ofori, 2006; Winch, 2010). These physical assets, most of the time, originate as abstract ideas and are transformed into realities by construction industries (Winch, 2010). The construction industry is unique, and everything about it is changing constantly. Designs, materials, and workforce as well as competition and risk allocations are changing (Edum-Fortwe & McCaffer, 2000). In addition, changes in material and labor cost make construction activity time sensitive.

Experts in the field have argued on the uniqueness of the construction industry. On the basis of it being a final product, and on its immobility and high varieties, Gonzalez-Diaz, Arrunada, and Ferrandez (2000) argue that the construction industry (1) has a unique product that is adapted to particular buyers, location, and uses that discourages the use of project-specialized assets, (2) builds immobile structures resulting in transformation taking place on the site with each project demanding a new working center, and (3) includes the use of products from fragmented small and large plants with varying heterogeneous activities. In other words, construction does not only include integration of different resources, but also integration of varying degrees of subspecialized skills that are necessary in completing a project. Glover, Long, Haas, and Alemany (1999) also assert that the industry is uniquely labor-intensive and relies on fragmented specialized skills with mixed firms and employees that often change from the beginning to the end of a project. They added that construction workers are more attached to their craft than to individual employers. Working condition or environment also makes the industry unique. Construction activities are carried out under exposed weather or partially enclosed structures and demand physical stamina for lifting, prolonged standing, bending, stooping, (BLS, 2011) and other challenging postures. In corroboration to the working condition in the construction industry, de Grip (2006) laments that workers in the industry face the highest risk of wear due to physically heavy working conditions that characterize their job activities.

In general, the construction industry is divided into (1) building construction contractors (general contractors) – residential, industrial, commercial, and other buildings; (2) heavy and civil engineering contractors – sewers, roads, highways, bridges, tunnels, and so on; and specialty contractors – carpentry, painting, plumbing, block/brick laying, and electrical works (BLS, 2011). Since construction involves the coordination of fragmented trades, it requires a general contractor who specializes in residential or commercial building to be responsible for the completion of the building project. Perhaps immobility and other specific characteristics make subcontracting quasi per none in the construction industry. The general contractor, on securing a contract for a project, contracts some segments of the project to specialized trades. The contracting specialties execute their contracts with their specific firm or trade employees. In as much as subcontracting encourages the use of highly specialized skills and reduces monitoring cost, Gonzalez-Diaz et al (2000) asserts that it is the responsibility of the general contractor to monitor the quality, standard, and completion of the project.

Perhaps, because of a great deal of reliance on subcontractors and short duration of projects, the construction industry hardly engages much in providing training to employees (Debrah & Ofori, 2006). Most workers in the industry practice skills of their trade using only their initial training they obtain in vocational schools or through apprentice programs. Their only source of acquiring further learning is on-the-job experience. Because of the fluidity of their workers, the industry lacks the incentive to invest in training (Glover, et al, 1999). The consequence of lack of further training or upgrading of knowledge in the industry is negative performances, particularly in the area of cost, quality, and productivity (Debrah & Ofori, 2006). In addition, skills obsolescence is another adverse effect resulting from lack of training and intermittent break from job, especially between a project's completion and the time of securing another contract.

Finally, BLS (2011) reports that many of the occupations in the industry have a substantial percentage of self-employed workers, and over 68 percent of establishments employ fewer than five workers. This and other aforementioned characteristics make the industry to be overly unique.

2.7. Characteristics of the Building Construction Industry in Nigeria

Generally, the Building Construction Industry in both developed and developing countries has similar characteristics. The final products of the industry are as immobile as they are uniquely adapted to a particular buyer, location, and use (Gonzales-Diaz, 2000). Furthermore, the process of production in the industry is generally arduous. The industry does not only signal the direction of development of a nation, but it is also the fulcrum where physical infrastructures that are sine-qua-non to national developments are tied (Dada, 2012). Holding these general trends constant, there are some other trends that are very particular to a country either because of the culture or value orientation of the country. Nigeria is such country that, in addition to the common trends in BCI, has some characteristics that are very peculiar.

First, the climate, geography, and the topography of Nigeria are very favorable for the construction of residential bungalows with minimal risks and non-sophisticated skills. For instance, there is hardly any need for specialized substructure construction like timbering to trenches that requires specialized skills. In addition, there is hardly any occurrence of natural disaster that demands fortification of building structures, which demands specialized skills that take a longer period of time to learn and maintain. In any nation, the standard of building structures and minimum skill standard of practitioners are defined in regulatory construction laws. In Nigeria, there are three regulatory Acts: the Public Health Act, The Town and Country Planning Acts, and the Building Regulation Acts (Fagbenle & Oluwunmi, 2010). Although these three Acts guide the construction industries in Nigeria, it is the Building Regulation Acts that specifically regulate the construction of residential bungalows in the country.

Although Nigerian Building Regulation Acts might have established minimum standards for building construction in the country, the effectiveness of any law is dependent on adherence to its established standards. The Nigerian construction industry is vulnerable to unethical practices due to corruption in the country. Thus, meaningful construction developments in the country have been deterred by corruption (Oyewobi, Oganiyu, Ola-Awo, & Shitu, 2011). Corruption in the industry undermines the quality of the product of the industry and its production processes, thereby encouraging the use of substandard materials and unqualified skilled personnel. Corrupt practices have adverse effects in the construction of residential buildings. For instance, it increases the construction cost that has eliminated the construction of middle and low-income houses (Oyewobi, et al, 2011). It has also led to the collapse of building structures at various stages in Nigeria because of the use of substandard building materials and labor (Fagbenle & Adedamola, 2010; Oloyede, Omoogun, & Akinjare, 2010).

Thus, Oloyede, et al (2010) attributed the use of unqualified and inexperienced building contractors and unskilled workers as one of the causes of frequent building collapses in Nigeria. In their study, “Tackling Causes of Frequent Building Collapse in Nigeria”, the use of incompetent building craftsmen was ranked second by both estate professionals and the public after non-enforcement of the existing laws that was ranked first by the academia group. These findings, in one way or another, could have a relationship with how practitioners are trained and retrained. In a setting where standards and laws are regarded highly and executed in later, practitioners will be compelled to not only have adequate pre-trainings, but also retraining programs for updating skills and knowledge in the industry. If it is otherwise, the outcome will be the production of ill-equipped practitioners that are not proficient in their skill areas and do not take seriously the importance of updating skills and knowledge. Consequently, there will be a high rate of obsolescence among such a class of craftsmen.

The elimination of the construction of middle and low-income housings and the collapse of the building structures are associated with possible layoffs of workers, unemployment, bodily injuries, and/or possible loss of life. Fagbenle and Oluwunmi (2010) documented in detail the lives lost as a result of building collapses in Nigeria from 1974 – 2010. The skills in the construction industry suffer under any of the above circumstances. When a worker is injured or laid off, he or she loses his or her skills as a result of wear or atrophy, which is characterized as technical obsolescence.

In another development, the BCI vested that the construction of residential bungalows is mostly made up of the informal sector. Uwakwe (2000) in Fagbenle and Oluwunmi (2010, 269) describes as “that segment of firms or individuals that engage in construction or other activities without obtaining the necessary designs, planning, and construction documents”. This perfectly describes the characteristics of small-size building construction firms, which in Nigeria are classified into category ‘A,’ whose contract sum is not more than two million Naira (Fagbenle & Oluwunmi, 2010). These are made up of fragmented and compartmentalized firms mostly with 1-10 employees on permanent employment. Workers are employed on a day-to-day basis. Thus, in Fangbele and Oluwunmi (2010) study of the influence of the informal sector of building collapse in Nigeria, these categories of firms constituted 80 percent of the firms studied. This situation is perfect for breeding obsolescence because the practitioners pay little attention to the acquisition and improvement of standard skills.

Though there is currently no documentation on the age of building construction workers in Nigeria, the general trend in both developed and developing countries is that the workforce is aging. This lack of documentation about the age of the Nigerian workforce in general supports the need for this study. One of the objectives included identifying the age characteristics of the building construction segment of the workforce.

2.8. Building Knowledge and Skills Training Programs in Nigeria

In Nigeria knowledge and skills in the BCI could be acquired through formal institutional training and/or through apprentice training programs. The formal training programs are available at post primary and tertiary levels of education programs. At the post primary level, the program is available in technical and vocational schools. On the other hand, building trade programs are taught at tertiary level in Universities, Polytechnics, and Colleges of Education (Technical).

Vocational Education and Training (VET) in Post Primary Institutions

The building knowledge and training programs are offered at the post primary level and for three years duration (Osuala, 1995). Presently, the programs offered at the post primary education level are taught in technical colleges at craft and advanced craft level in various trades (FRN, 1998). The craft level lasts for three years while the advanced level lasts for one year after successful completion of craft level. Entrants into the program are candidates who have successfully completed junior secondary school and wish to pursue their career in VET programs. At this level, trades are more compartmentalized; thus Brick/Block Laying and Concreting, Carpentry and Joinery, Electrical Installation, and Plumbing and Pipe Fittings are studied as discrete programs under the umbrella of building construction.

Vocational Education and Training (VET) in Post-Secondary Institutions

Students who successfully completed their post primary vocational schools and wish to further their education in their chosen vocation or related vocation in tertiary institutions have options in the career and type of institutions. Vocational education is offered in Nigeria Universities, Polytechnics, and Colleges of Education (Technical). The duration of study varies per type of degree or certificate.

VET Program at University

In addition to science and technology studies, some universities offer vocational and technical teacher education programs. The duration of the programs depends on entry qualification that the candidates possess. For holders of ordinary level certificates, National

Diplomas (OND/HND) or other advanced certificates, and National Certificate in Education, it is four, three, and two years respectively for degree programs and more for post-graduate degrees. The vocational and technical teacher education programs lead to the production of vocational and technical education teachers in varying vocations and capacities.

VET Program in Polytechnics

Polytechnics, on the other hand, are structured towards the production of middle and high level skill technicians. The polytechnic programs are structured in two phases of two consecutive years. The first two years lead to the awarding of the Ordinary National Diploma (OND) certificate after completion of a compulsory one-year supervised industrial work experience. The OND program could be a terminal or preparatory program for further study. Upon completion of the OND program, an individual is equipped with middle level skills that will enable him or her to compete for jobs or go back to school for further study. The second phase of two-year study in polytechnics leads to the award of the Higher National Diploma Certificate (HND). Usually, the entrants into this program are holders of OND, and the program is designed to equip students with high level technical skills

VET Program in Technical Colleges of Education

The building trade training programs are available in the technical colleges of education; the building trades programs available in this type of institution include Masonry, Woodwork, and Electrical Installations. The technical college of education program prepares vocational education teachers who will, after successful graduation, teach vocational subjects in junior secondary schools. It is a three-year program that leads to the National Certificate of Education (Technical). Students in this program contend their time with learning vocational knowledge/skills and teaching pedagogy. These result in limited practical experience; hence, the Federal Government of Nigeria introduced in 1973 Students' Industrial Work Experience Scheme (SIWES) to bridge the gap between theory and practice in institutions' curricula (Ogwo, 2000). The scheme is under the auspices of the Industrial Training Fund (ITF) – national training authority financed by the training tax (Middleton, Ziderman, & Adams, 1993). Graduates who acquire enough practical skills through this program are also employed in the BCI where they engage in construction activities other than teaching

2.9. Training as an Intervention on Obsolescence

Although initial training provides trainees with the necessary skills needed to enter into the work world, it cannot sustain an individual throughout the duration of his or her career. This brings training to bear. Training, according to Smith and Hayton (1999), is a human resource flow management strategy and a means of enhancing employee performance. Specifically, at the organizational level, it is a program designed to increase productivity and maintain the competitive advantage of the organization. Although training could be organizational oriented, the primary indicator resides in individuals that constitute the organization. As a consequence, Smith and Hayton (1999) state that "improvement of employee performance" and "improvement of the adaptability and flexibility of the workforce" (p. 254) are but a few factors that motivate enterprises to train employees. No provision or participation in training invariably increases the chances of becoming obsolescent. On the other hand, every training activity should in one form or another reduce human capital obsolescence.

Consequently, de Grip (2006) developed a typology of training activities (as shown in the *Table 2.2* below) that targets the reduction of a particular kind of skills obsolescence. Because of the intensity of physically heavy activities in some occupations, he recommends that workers facing obsolescence due to physical and mental wear should seek retraining in another occupation with less demanding working condition. This is particularly true of workers in the construction industry. The author further added that atrophy could be remedied with refresher courses, but with retraining if the skill gap is too large.

By and large, there has been a general consensus (Smith & Hayton; 1999; Pischle, 2001; Lee & Hsin, 2004; de Grip, 2006) that training has both quantitative and qualitative effects on human capital, which is specifically evident in an increase in wages, employability, productivity, performance, and competitiveness of both individual workers and their organizations.

Table 2.2
Possible learning remedies for the various types of human capital obsolescence

Types of skills obsolescence	Possible training/learning remedy
Technical human capital obsolescence	
- Wear	Training to cope with demanding working conditions or retraining for another job
- *Atrophy*	Refresher course or retraining
Economic human capital obsolescence	
- Job-specific human capital obsolescence	Learning on-the-job or (substantial further training)
- Skills obsolescence by sectoral employment shifts	Retraining
- Firm specific obsolescence	Learning on-the-job in another firm or retraining

Source: de Grip, (2006, p. 19)

2.10. Review of Related Empirical Studies

So many scholars have devoted a good deal of time studying human capital. The earlier studies were confronted with the problems of measuring human capital. Most of the studies used secondary longitudinal data in estimating human capital obsolescence.

Murillo (2011) studied human capital obsolescence among salaried workers in Spain. The author noted that changing trends in technology, especially in developed countries, cause workers' knowledge to depreciate; as a result, workers need to continually update their skills through training. In addition, workers need greater educational requirements to perform an equally or less difficult task than before. Consequently, they invest in education for higher wages as well as for upgrades in knowledge and skills. With this in mind, the study was designed to analyze the link between human capital depreciation and the educational level of Spanish salaried workers.

The study adopted the Raymond and Roig (2004) model which is rooted in the Neuman and Weiss (1995) model of estimating human capital. Thus the model allowed for the estimate of depreciation rate of human capital with respect to occupation and educational level of workers as well as technical and organizational changes related to workers' jobs.

Wage equations were estimated by sector and occupation. The Spanish Wage Structure Survey of 1995 and 2002 was the data used for the analyses. Each survey contains 107,874 and 106,206 observations respectively. The findings of the study indicate that the depreciation rate of human capital varies across educational levels being greater at the upper level of educational attainment. Specifically, there was schooling depreciation of 0.39 percent between 1996 and 2002, and experience depreciation of 2.03 percent between 1995 and 2002. Equally, return to schooling and experience decreased by 0.48 percent and 0.21 percent respectively. In addition, the findings also indicated greatest depreciation of experience on those working in high technology sectors. These results are in agreement with the findings of similar studies (e.g. Neuman and Weiss, 1995; van Loo, 2007). With particular reference to the findings on high depreciation of human capital among highly educated workers, the author concluded that promoting education and ongoing training should be encouraged for workers.

Van Loo, (2007) conducted a similar study titled “The speed of obsolescence: Evidence from the Dutch public sector”. The framework for the study was based on human capital theory. The authors defined human capital as the capacity of an individual to produce goods and services, and noted that investment in human capital is a representation of stock of investment that can be used in a workplace. The purpose of the study was to estimate the speed of obsolescence and the contributing factors. Thus, questions that guided the study were: how fast do skills and knowledge depreciate; what is the relationship between age and agenda; and is educational attainment, occupation, and sector of employment related to the speed of skills obsolescence? The authors adopted quantitative research approach using the self-assessment instrument. The respondents, Dutch public sector employees, assessed their acquired skills and knowledge during education and on-the-job that are currently useful, as well as their length of active career. The respondents were stratified by age and by 12 subsectors in the Dutch public domain and Web-link to the questionnaire items containing items on labor condition, job satisfaction, HRD policies, and skills and knowledge needed to perform effectively was sent to 5,000 participants of which 2,533, constituting 51 percent responded. This data was combined with other survey data on pension entitlement, wage, age, gender, length of service, and sector of employment. Percentages and Analysis of Variance (ANOVA) were used in the analysis.

The major findings of the study indicated that Dutch public employees lose an average of 2.6 percent of their skills and knowledge yearly. With statistically significant difference ($F= 39.2$, $p=0.00$), the study reported a lower rate (2.3%) of skills obsolescence among men than females (3.2%). This could be the result of frequent family-related career interruptions that are prevalent among females, the authors noted. Similarly, with a statistically significant difference ($F=180.0$, $p=0.00$), younger workers under the age of 30 lose 8 percent yearly average of their skills and knowledge as opposed to 1 percent that exist among workers that are 56 years and older. This finding raises doubt on the relevancy of skills and knowledge learned during education to job skill requirement. However, according to the authors, this could as well be the result of frequent change of jobs among younger workers. Some other significant findings include a simultaneous higher rate of obsolescence with higher educational attainment and a higher rate of obsolescence of occupation susceptible to technological and organizational changes and innovations. This is incongruent with several studies (e.g. van Loo, de Grip & Steur, 2001; de Grip & van Loo, 2002; Murillo, 2011) that have identified changes in technology as one of the major causes of obsolescence.

The authors, however, did not indicate how errors could arise from the use of two separate surveys designed for different purposes and administered to different categories of workers at different times, and how it was controlled. In addition, the design of the study only permitted for the measure of general skills and not specific skills that characterize the 12 subsectors studied; however, the authors acknowledged the inability of the study to account for some possible variations in depreciation rates of different skills bearing in mind that some skills will not depreciate while others will increase. Furthermore, considering the variables of the study, more results could have been generated by treating variables in a stepwise through regression analysis. Nonetheless, the study revealed some interesting findings, especially with regard to young and old workers.

A study by Shankar (2005) examines investment in human capital through the provision of incentives for firm-specific and general training as a measure of mitigating skills obsolescence. The study notes two types of human capital investment – skill specialized (vertical up Skilling) and skill diversified (horizontal scrolling) investment. Whereas the first type of investment enhances productivity and specialization in primary skills, the latter promotes acquisition of new skills. After data analysis, the result indicates that when skills obsolescence is looming, there is a high probability of horizontal movement rather than up Skilling along the promotion ladder within projects. At the risk of high obsolescence, workers specializing in one skill profit less (because their skills cannot be used in a variety of occupations/projects) than workers in diversified skills. This is more apparent in technology-intensive occupation as ever-changing technology leads to skills obsolescence. Therefore, incentive for human capital investment is dictated by the level of technological involvement of an organization. Organization with a low level of technological intensity is more likely to invest more on specific skill developments that encourage workers to grow up the work ladder. On the other hand, intensive technology organizations, obviously, will invest more on training workers to be able to perform a series of parallel skills in the organization. Thus the author recommends adoption of more skill diversification and less skill specialization in technology-intensive firms.

Janβen and Backes-Gellner (2009) conducted a study that argues for the existence and recognition of knowledge-based tasks and experience-based tasks. They define knowledge-based tasks as ‘tasks depending strongly on the general stock of technological knowledge available to society’ and experience-based tasks as ‘tasks demanding personal characteristics that can be improved by gaining more and more experience’ (p. 84). They further argue that human capital of workers performing knowledge-based tasks suffers from obsolescence while the human capital of workers performing experience-based tasks does not. Thus, the purpose of their study was to find out whether human capital depreciates differently for workers engaging in knowledge-based and experience-based tasks over a period of time.

The findings show, among other things, that in the distribution of tasks across unskilled, blue collar, white collar, low education, medium education, and male workers perform more knowledge-based tasks than experience-based tasks. On the other hand, civil servant, highly educated, and female workers perform more experience-based tasks. This finding on highly educated workers is in contrast with the general assumption that educated individuals accumulate more technological knowledge resulting from their schooling; however, since changes in technology bring commensurate depreciation of skills (Alders, 2005), this group of workers suffer more obsolescence.

Schulz and Roβnagel (2010) investigate workplace informal learning, exploring age differences in learning competence. The results of the study show, among other things, that readiness to learn and investing in learning efforts are important aspects of learning competencies. However, one of the most interesting findings of the study is that age has no effect on success in informal learning. In addition, the results indicate that there are no differences, $F(2, 467) = 8.86$, $p>0.42$, in participating in training as a function of age. This finding is contrary to all the negativities in literature (van Loo, de Grip, & De Steur, 2001; Alders, 2005; Allen & de Grip, 2007; Syed, 2007; Janβen & Backes-Gellner, 2009) indicating that participation in training declines with age and that cognitive function also declines with age. The author, however, recommended further investigation.

In another technology-related study, Oladapo, (2006) examines the current state of information and communication technology (ICT) in professional practice in the Nigerian construction industry using surveys. Professional practitioners, architects, engineers, and surveyors in Southwestern Nigeria made up the population of the study. The findings indicate that the practitioners are currently using ICT for drawing, designing, and for the preparation of bills of quantities, but still indulge in the traditional way of managing data and documentation. Sixty percent of the respondents reported being connected to the internet and using it for sending and receiving e-mails. About 80 percent reported being optimistic for the future of ICT in the construction industry in Nigeria. This implies that in addition to other technologies associated with the practice of the trade, the practitioners are keeping abreast with the ICT as it concerns the industry; however, this goes with its positive concomitant effect on skills obsolescence. This study signifies that the construction industry in developing countries is bracing technology, as well.

2.11. *Summary of the Literature Review*

Most of the studies reviewed above and several others drew a sample population from a cluster of occupations (administration, agriculture, manufacturing, construction, mining, business services, communication, transportation, et cetera), thereby marring an in-depth study of obsolescence. For example, the Janβen and Backes-Geller (2009) population sample was drawn from 83 job categories, many unrelated. It is only basic and general common skills that could be studied using such composition of the population sample. In addition, composition, skills demand, and job characteristics differ significantly according to occupations. For example, generalizing the rate of skills obsolescence of an office clerk and a carpenter using data collected with common instruments could be misinformed. So there is a need to have a study that targets specific occupation as recommended by Janβen and Backes-Gellner (2009).

In addition to studying clustered occupations, wage-earnings equation was a predominant approach adopted by many scholars in estimating human capital depreciation. This approach is not the best, as earnings vary per occupation. Thus, for more than a decade, Neuman and Weiss (1995) have argued that there are differentials in wages with experience which manifests differently in different occupations; consequently, it is improper in experience-wage study to draw a population sample from a cluster of occupations without controlling for the vintage effects. Again, in some cases, the data used in some studies were collected indirectly (secondary data) several years ago, several years apart, and from different respondents. Such data cannot be a true representative of the actual situation in specific occupations then and now. Designing a human capital obsolescence study that focuses on specific occupational skills is imperative. Using a direct method approach – asking workers directly about their skills, is the best approach for the study as it accounts for obsolescence that is not yet perceived by the workers themselves (Van Loo et al, 2001). The wag- earnings mostly used in the literature are best for measuring the labor market effect (de Grip, 2006). Based on the foregoing, there is, among other things, the need to assess obsolescence using direct measure bearing in mind the recommendations of some scholars for further study to clarify conflicting issues in their findings.

Chapter Three

METHODOLOGY

This section deals with the procedures, which were used in carrying out the study. These include the design, area/delimitation, population, instrumentation, validation of instrument, method of data collection, and data analysis. They are presented below.

3.1. Design of the Study

This study is a quantitative descriptive study focused on the Building Construction Industry in Nigeria. It was conducted using the survey research design for identifying the skills obsolescence in the BCI. The appropriateness of this method is based on the fact that survey research is a descriptive study, which tends to identify present conditions and points to present needs (Osuala, 2001). This study is survey research because it involves the identification of skills obsolescence and the choice of retraining the services that workers in the BCI use in order to ameliorate the effects of skills obsolescence. The essence of using this approach is to cover a variety of skill areas inherent in the industry.

3.2. Area of the Study

The area of this study was Nigeria, however the study was further delineated to Southern Nigeria. The subjects of the study were selected from the three regional states' headquarters – Enugu State in Southeast, Lagos State in Southwest, and Rivers State in South Nigeria that make up Southern Nigeria. Furthermore, the area is restricted to the metro areas of the regional headquarters – Enugu, Lagos, and Port Harcourt. These states and the selected metro cities share common characteristics in terms of culture, weather, building structures, and building practices/codes.

3.3. Population of the Study

The population of the study was comprised of workers in the BCI in the metro cities of the regional headquarters in Southern Nigeria that specialize in the construction of residential bungalow buildings with a particular focus on Carpentry/Joinery, Electrical, Masonry, and Plumbing trade sectors. However, based on the statistics published by the Nigerian National Bureau of Statistics (NNBS, 2010), the household distribution of employed persons by economic sector and state shows a population of workers employed in all the construction sector as 40,394 for Enugu, 128,723 for Lagos, and 67,058 for River State, giving a total of 236,175. There was no documentation on the BCI workers in the metro cities of the regional headquarters. Hence, the overall population of the construction workers in the regional headquarters of Southern Nigeria was used as the population of the study.

3.4. Sampling Technique and Size

The random sampling technique was used for the selection of participants for the study. The participants were randomly selected with the help of three research assistants who are practicing building construction professionals and very knowledgeable in the industry. These assistants helped in identifying active professionals who attended at least secondary education and are literate enough to complete the questionnaire. Availability and accessibility during the time of the study informed the selection of the participants. Using a sample size calculator with a large population of 20,000, the confidence level of 95 percent, confidence interval or margin of error of plus/minus 5 (Creative Research Survey, 2013) a sample size of 387 participants was identified. Consequently, a total of 387 questionnaires were distributed, among which 278, representing 71.83 percent, were successfully completed and returned. This rate of response exceeded response norm expected for survey in construction industry in general (Edum-Fotwe & McCaffer, 2000) and the BCI in particular.

3.5. Instrumentation and Procedures for the Collection of Data

A structured questionnaire was used for the collection of data. It was titled "Human Capital Obsolescence in the Building Construction Industry (HCOBCI) Questionnaire" and was divided into two major sections (*Appendix C*). Section A was the respondents' personal data with respect to sex, educational qualification/training, number of years of work experience, age, and area of specialization.

The first part of Section B was made of six response items for wear (personal injury or sickness). These items focused on injuries that affected the job performance of workers. It ranged from an injury that had no effect on job performance to those that led to absence from work for three weeks or more. The second part was made up 59 items on skills inherent in the Building Construction Industry. These items were generated from the Technical College Curriculum on the Building Drawing and Introduction to Building

Construction (National Business and Technical Examination Board - NABTEB, 1995) (*Appendix A*). This curriculum deals with basic skills needed for the construction of a residential bungalow. Finally, the third part consisted of six professional retraining programs workers that can engage in to ameliorate the effects of their skills obsolescence. The items were designed to provide answers to the research questions.

A five-point Likert scale was used to determine the frequency of personal injury or illness and training programs using response options of Very Much Often, Much Often, Often, Rarely, and Never, while Very Little, Little, Quite Some, Fairly Much, Very Much, and Not Applicable (NA) options were used as responses to the question "How much of the knowledge and skills you acquired during schooling and/or apprentice can you still apply on your current job?" (Blechinger & Pfeiffer, 2000).

The questionnaire was distributed to the respondents in a hard copy. The choice for the distribution of the questionnaire in a hard copy was relative to what is prevalent in the country because access to a computer and the internet is very limited. It took respondents an average of three weeks to complete and return the questionnaire. The respondents were not in any way rushed in completing and returning the questionnaire.

3.6. Validity and Reliability of the Instrument

Consequence to the instrument being a researcher-made instrument, it was validated by experts. Specifically, one expert in the study of skills obsolescence, one in the BCI, and one in research methodology was used for face validation of the instruments. The experts, at face value, judged the instrument on whether it contained appropriate items and questions that measured what was to be studied. The questionnaire was modified based on their inputs.

The reliability test of the instrument was analyzed using Cronbach Alpha Coefficient (α). Personal data were excluded from the reliability test, and the remaining three sections of the instrument were tested separately and collectively. The result shows that wear, atrophy, and in-service training program has 0.77, 0.97, and 0.73 alpha coefficient respectively. The reliability of these items put together was also tested and 0.96 alpha coefficient reported. All the reliability test results passed Cronbach Alpha Coefficient reliability threshold of which researchers agreed to be between 0.7 and 1.

3.7. Data Analysis

The analysis of the data is based on the information collected from the questionnaire. Section A of the questionnaire was analyzed using frequency count and percentage to determine participants' response to those items. Section B of the questionnaire was analyzed using mean, standard, Pearson Correlation Coefficient (r) and Kruskal-Wallis H Test statistic at the 0.05 level of significance. The "Not Applicable" item response category in the knowledge and skills of Section B of the questionnaire was excluded from the analysis as it indicated that the respondents never obtained education or training in that field.

To make a decision on the items on the issues related to the degree of obsolescence and extent of wear and atrophy, the real limits of numbers as shown in *Table 3.1a* and *3.1b* below were used to interpret the mean response to each item. To determine the extent of personal wear, the mean and standard deviation of the response on each item were computed. As indicated in Table 3.1a, the corresponding mean value with the degree or extent of personal wear in the industry indicates the level of obsolescence attributed to wear. The higher the mean, the higher the evidence of wear, and thus the presence of obsolescence. Hence, providing answers to *Research Question 1.*

The degree or extent of atrophy, on the other hand, is interpreted using *Table 3.1b*. The mean and the standard deviation of responses to the items were calculated and used in determining the degree or the extent of atrophy in the industry. Since the lack of use of knowledge and skills results to obsolescence, less frequency of use of the knowledge and skills causes higher degree or extent of the obsolescence. In other words, the little uses of the skills results to a higher degree of the atrophy. Therefore, the corresponding mean value with the degree or extent of the atrophy as shown in Table 1b indicates the level of the obsolescence as a result of atrophy, thereby providing answers to *Research Question 2*. However, to determine the professional retraining practices workers are adopting to ameliorate the effect of the obsolescence, as indicated in *Research Question 3*, the mean response to the items in this category was ranked. The professional retraining practice with the highest mean indicates the most favored practice of choice, while the one with the smallest mean is the least favored choice. To provide answers to Research Question 5, Spearman Correlation Coefficient was used to analyze the age and obsolescence relationship.

Furthermore, research questions 8, 9, and 10 were analyzed using nonparametric test – Kruskal-Wallis H test statistic at $p>0.05$ level of significance. The application of this statistic is based on the results of the test for the normality of assumption of the population sample, which the results indicate deviation from normality of assumption. Both graphic methods (histograms, boxplots, Q-Q-plots), numeric methods (skewness and kurtosis indices), and formal normality tests (Razali & Wah, 2011) were used in making judgment on whether the sample population was normally distributed or not. For interpretation, the histogram, box-plots, and Q-Q-plots were physically examined; skewness between – 0.5 and + 0.5 and kurtosis of 3 were considered for normal distribution (Bulmer, 1979; Balanda and MacGillivray, 1988); and Shapiro-Wilk normality test was considered at $p > 0.05$ level of significant.

However, to achieve this objective, some data were aggregated creating new variables Thus, in the analyses, the responses on items relating to skills obsolescence and that relating professional retraining activities were averaged. Then, computation was performed to find respondents' educational qualification/training, participation in retraining programs, and work experience affect their skills obsolescence. SPSS software was used in final computations.

Table 3.1a

Relating of Response Categories on Extent of Personal Wear (Injuries/Illness) to the Real Limit of Numbers

S/N	Response Categories	Numeric Value	Real Limit (Mean Value)	Degree or the Extent of Wear
1	Very Much Often	5	4.50-5.00	Very Much
2	Much Often	4	3.50-4.49	Much
3	Often	3	2.50-3.49	Little
4	Rarely	2	1.50-2.49	Very Little
5	Never	1	0.50-1.49	Minimal

Table 3.1b

Relating of Response Categories on Extent of Atrophy to the Real Limit of Numbers

S/N	Response Categories	Numeric Value	Real Limit (Mean Value)	Degree or the Extent of Atrophy
1	Very Little	5	4.50-5.00	Very Much
2	Little	4	3.50-4.49	Much
3	Quite Some	3	2.50-3.49	Little
4	Fairly Much	2	1.50-2.49	Very Little
5	Very Much	1	0.50-1.49	Minimal

3.8. *Protection of Human Subjects - IRB*

In as much as there was a minimal participation risk in this study, participation was absolutely voluntary. Although the bio data like age, sex, experience, educational qualification, and training were collected, there was no identifier in the questionnaire linking the participants to any response, questionnaire, or data collected. This notwithstanding, the approval of IRB prior to the administration of the questionnaire was sought. Thus, the IRB approved (*Appendix* D) the study with the following reference number: 1310E44904.

Chapter Four

PRESENTATION OF DATA AND RESULTS

This study examined the technical – wear (injuries and illnesses) and atrophy (no use), constituting human capital obsolescence in the Carpentry/Joinery, Electrical, Masonry, and Plumbing (CEMP) trades within the Building Construction Industry in Nigeria. The study specifically examined how often obsolescence occurs in the industry, professional retraining practices the practitioners adopt to alleviate the effect of obsolescence, the relation age has with obsolescence, the effect of educational qualification/training on obsolescence, and experience on obsolescence, and the occupational areas of the Building Construction Industry that are more vulnerable to skills obsolescence. Consequently, ten research questions were formulated to guide the study.

They are:

1 To what extent does physical wear (injuries and/or illnesses) cause skills obsolescence in the Building Construction Industry in Nigeria?

2 To what extent has obsolescence because of atrophy (lack of the use of skills) occurred in the Building Construction Industry in Nigeria?

3 What professional retraining practices are workers adopting to encounter the effects of skills obsolescence in the Building Construction Industry?

4 What is the relationship between workers' participation in professional retraining programs and the degree of skills obsolescence of the individuals in the trades?

5 What kind of relationship (positive or negative) has workers' age with skills obsolescence?

6 Which occupational trades in the Building Construction Industry are more vulnerable to skills obsolescence?

7 What is the effect of years of work experience on skills obsolescence?

8 To what extent does skills obsolescence vary across educational qualification and/or training?

9 What is the nature of the distribution of obsolescence across different age categories?

10 How do workers in different years of work experience brackets experience obsolescence?

Thus, in this chapter, the data for the study are analyzed and the results presented based on the research questions that guided the study.

First, the demographic characteristics of the respondents are presented. Secondly, the results of the quantitative analysis are presented. In this section, each of the research questions was analyzed with the statistical tools best suited for finding answers to the questions as indicated in chapter three. Data, table(s), and answers are presented after each research question.

4.1. Demographics of the Respondents

Personal data of the respondents provided demographic information as shown in *Table 4.1*. Information about respondents' sex, age, educational qualification and/or training, years of work experience, and occupational area was collected. Of the population (N = 278) of the study, 89.21 percent (N = 248) were male, while 10.79

percent (N= 30) were female. The age of the respondents was categorized into subgroups of group 18-25, 26-35, 36-45, 46-55, and 56 and above. *Table 4.1* shows 18-25 (15.2%; n = 53); 26-35 (36.1%; n = 100); 36-45 (31.8%; n = 88); 46-55 (14.1%; n = 39) and 56 and above (2.9%; n = 8) of the respondents identified with each age group.

The respondents also indicated their highest education/training qualification either Apprenticeship Training Program, Vocational/Technical School, Technical College/Polytechnic, University (Bachelor's Degree), or University (Graduate Study). As shown in *Table 4.1*, Apprenticeship Training Program (19.2% (53)), Vocational/Technical School (17.4%; (48)), Technical College/Polytechnic (33.7% (93)), University -Bachelor's Degree (25.7% (71)) and University - Graduate Study (4.0%; n = 11) are the distribution of the respondents' according qualifications. On the other hand, in the years of work experience 0-5 subgroup constituted 15.2 percent (52), 6-10 23.9 percent (66) , 11-15 33.7 percent (93), 16-29 16.3 percent (45), and 21 and above 10.9 percent (30) of the population. In the occupational area of the participants, carpentry/joinery constituted 19.5 percent (54), masonry 45.1 percent (125), plumbing 18.8 percent (52), and electrical 16.6 percent (46) of the population of the study.

Table 4.1
Summary of Respondents' Demographic Characteristics

	N	%
Sex		
Male	248	89.21
Female	30	10.79
Total	278	100
Age		
18-25	42	15.16
26-35	100	36.10
36-45	88	31.77
46-55	39	14.08
56+	88	2.89
Total	277	100
Highest Education/Training		
Apprenticeship Training	53	19.20
Voc. /Technical School	48	17.39
Tech. Col. /Polytechnic	93	33.70
University (B. Sc.)	71	25.72
University (Grad. Study)	11	3.99
Total	276	100
Years of Work Experience		
0-5	42	15.22
6-10	66	23.91
11-15	93	33.70
16-20	45	16.30
21+	30	10.87
Total	276	100
Occupational Area		
Carpentry	54	19.49
Electrical	46	16.61
Masonry	125	45.13
Plumbing	52	17.77
Total (N)	278	100

Note: Sex and Occupational Areas have no missing item while Age, Highest Education/Training, and Years of Work Experience are missing 1 (0.4%), 2 (0.7%), and 2 (0.7%) respectively.

4.2. Research Question 1

To what extent does physical wear (injuries and/or illnesses) cause skills obsolescence in the Building Construction Industry in Nigeria?

To provide answers to the above question, an item-by-item analysis was conducted and the data are presented in *Table 4.2* below. The respondents responded to the first part of Section B of the questionnaire. Six items relate to the question of how often the respondents have been involved in the job related injury/illness for the past one year. The items are to be rated with five-point Likert scale consisting of 5-Very Much Often, 4-Much Often, 3-Often, 2-Rarely, and 1-Never. The evident and degree of wear (illness and injury) is indicated by the mean response in each item. The level of the mean value is concomitant to the degree of existence of obsolescence due to wear. The descriptive statistic of the responses to the items are shown in tables 4 and 5 below.

Table 4.2
Mean and Standard Deviation of the Respondents' Responses on the Extent of Personal Wear in the Building Construction Industry

Items	$\bar{X}$	SD	Rate
Occurred, but no effect on job performance	1.88	.83	VL
Placement on lighter job responsibility	2.23	1.36	VL
Absent from work for 1-3 days	2.30	1.27	VL
Absent from work for 4- 6 days	1.95	1.07	VL
Absent from work for 1-2 weeks	1.64	.82	VL
Absent from work for 3 weeks and above	1.47	.82	M

Note: *The degree of obsolescence: Very Much (VM) 4.50-5.00; Much (M) 3.50-4.49; Little (L) 2.50-3.49; Very Little (VL) 1.50-2.49; Minimal (M) 0.50-1.49. Total # of Respondents (N) = 278.*

Table 4.3

Frequency and Percentage of Respondents' Response on the Physical Wear Items by Response Categories

Items	N F (%)	R F (%)	O F (%)	M F (%)	V F (%)
Occurred, but no effect on job performance	98(35.3)	102(36.7)	54(19.4)	5(1.8)	1(0.4)
Placement on lighter job responsibility	118(42.4)	65(23.4)	25(9.0)	43(15.5)	23(8.3)
Absent from work for 1-3 days	113(40.6)	35(12.6)	73(26.3)	42(15.1)	13(4.7)
Absent from work for 4- 6 days	129(46.4)	54(19.4)	75(27.1)	7(2.5)	9(3.2)
Absent from work for 1-2 weeks	154(55.4)	74(26.6)	43(15.5)	4(1.4)	1(0.4)
Absent from work for 3 weeks and above	187(67.3)	56(20.1)	21(7.6)	6(2.2)	3(1.1)

*Note: N (Never), R (Rarely), O (Often), M (Much Often), V (Very Often), and F (%) (Frequency/Percentage). Total # of Respondents (**N**) = 278*

The data presented in *Table 4.2* above shows that the respondents indicated very little degree of evidence of obsolescence due to wear in four items and no obsolescence in one item, thereby providing answers to the research question "To what extent does physical wear (injuries and/or illnesses) cause skills obsolescence in the Building Construction Industry in Nigeria?" The mean values of the four items with little degree of obsolescence are within the 1.50 – 2.49 mean limits using the real limit of numbers as shown in *Table 3.1a.* On the other hand, the one item with the mean value with a minimal degree of obsolescence is within the 0.5 – 1.45 mean limit.

Although four of the items indicated very little rate of obsolescence, the incident that caused absent from work for 1 – 3 days has the highest rate of occurrence (M = 2.30; SD = 1.27), followed by an incident that caused placement on lighter job responsibility (M = 2.3; SD = 1.36). Incident that caused absence from work for three weeks and above occurs the least (M = 1.47; SD = .82). However, further analysis using frequency and percentage was conducted to x-ray the details of the respondents' response on each item on the response categories. The details of the response are shown in *Table 4.3.*

4.3. Research Question 2

To what extent has obsolescence because of atrophy (lack of the use of skills) occurred in the Building Construction Industry in Nigeria?

Data in answering this question are provided in the part of Section B of the questionnaire that consisted of 59 items that relate to how much of the knowledge and skills respondents acquired during schooling and/or training they can still apply on their current job. These items are to rate with 5-point Likert scale consisting of 5-Very Little, 4-Little, 3-Quite Some, 2-Fairly Much, 1-Very Much, and 0-Not Applicable, which was a response option for skills the respondents did not acquire during schooling and/or training. This opting was excluded from the analysis. These items relate to obsolescence due to atrophy – no use of skills. The data in *Table 4.4* below are data on an item-by-item analysis of the respondents' response to these. The degree or rate of atrophy is determined by the level of the mean score of each item. A high mean value represents a high degree or rate of obsolescence. Similarly, a low mean value represents a little degree or rate of obsolescence.

Table 4.4
Mean and Standard Deviation of the Respondents' Responses on the Extent of Skills Atrophy in the Building Construction Industry

Items	$\bar{X}$	S.D	Rate
Standard Practices			
Graphic symbols, lettering, and their applications	3.49	1.58	L
Title block – essential information, layout and dimensioning methods.	2.27	1.38	VL
Scale and range of scales for site plans, floor plans, elevation and component details.	2.28	1.42	VL
Drafting Materials and Equipment			
Uses of drawing pens, lettering templates, draughting machines, etc.	2.27	1.58	VL
Plan printing machinery and devices	2.30	1.46	VL
Use of Computer Assisted Design (CAD)	2.43	1.73	VL
Basic Principles of Design			
Form, function, beauty, etc. of building plan.	2.29	1.64	VL
Basic parts (bedroom, kitchen, bath/toilet etc.) and functions of modern residential bungalow.	2.17	1.42	VL
Installation standard of water and sanitary services	2.23	1.55	VL
Site characteristics and characteristics of floor plan – e.g. adequate and properly located openings	2.64	1.54	L
Factors (site regulations, materials, labor, etc.) influencing design of residential building	2.40	1.36	VL
Preliminary Sketch Design			
Preliminary sketch designing of modern bungalow in a surveyor's plot plan justifying space arrangements	2.58	1.51	L
Site, floor, foundation and roof plan and elevations of 3-bedroom bungalow.	2.33	1.42	VL
Detail drawings of component parts, e.g. floor sections, door sections, roof sections, etc.	2.39	1.38	VL
Determination and drawing of details of essential sections – hood railing, plumbing, septic tank/soak-away etc.	2.36	1.47	VL
Reproduction of Drawing			
Production of drawings through tracing and printing.	2.65	1.58	L
Working and Site Safety			
Causes and prevention of hazards in workshop and construction sites	2.42	1.53	VL
Health and safety in construction industry	2.53	1.49	L

Items	$\overline{X}$	**S.D**	**Rate**
Hand Tools			
Identification, uses and maintenance of hand tools in building trades	2.19	1.51	VL
Basic Processes in Carpentry and Joinery			
Characteristics and uses of timber	2.36	1.64	VL
Different stages of timber processes, e.g. conversion, seasoning, preservation, manufactured board, etc.	2.36	1.67	VL
Site Preparation			
Site preparation procedures, e.g. tools, equipment and materials used in site clearing, leveling techniques, site and soil investigation, hoarding/hutments, etc.	2.53	1.57	L
Principles and methods of setting out building.	2.50	1.53	L
Foundation			
Functions and different types of foundations.	2.40	1.57	VL
Equipment and methods used in concrete mixing.	2.44	1.58	VL
Temporary Structures			
Temporary support to trenches – timbering	2.51	1.56	L
Scaffolding, and other temporary supports			
Dismantling of temporary structures (e.g. Scaffolding, hoarding and formwork)	2.41	1.54	VL
Demolition of unwanted structures	2.45	1.56	VL
Floors			
Functions of various types of floor and preparation of solid and suspended floors.	2.64	1.53	L
Characteristics and construction of hardwood floor	2.67	1.56	L
Floor finishes and laying, treatment and preservation of floors.	2.73	1.54	L
Walls			
Types of wall, functions and walling materials.	2.56	1.51	L
Methods of constructing walls	2.37	1.44	VL
Techniques in reinforcement of structures	2.37	1.49	VL
Rendering	2.56	1.54	L
Siding	2.53	1.59	L
Painting and general finishing	2.69	1.59	L
Concrete, mortar mixing and Damp Proof Course (DPC).	2.69	1.59	L
Fixing Openings			
Identification of timber and other materials suitable for doors and window construction	2.50	1.52	L
Types/functions/construction of doors and door frames	2.60	1.44	L

Items	$\overline{X}$	**S.D**	**Rate**
Types/functions/construction of windows and window frames	2.56	1.48	L
Sketch illustration of methods of fixing doors/frames and windows/frames.	2.49	1.44	VL
Uses of various types of door and window ironmongery	2.57	1.50	L
Needs and provision of weathering structures at openings	2.61	1.58	L
Roof			
Identification of types and parts of roofs, roof terminologies and functional requirements of roof	2.61	1.48	L
Materials, maximum allowable span, construction, and factors affecting choice of roof structures	2.49	1.53	VL
Stairs			
Sketch illustration of various types of stair and their basic principles of design and construction	2.61	1.54	L
Finishes			
Types of wall, ceiling and joinery finishes, and their applications	2.49	1.51	L
Services			
Sketch illustration of constructional details of drainage system and installation of sanitary wares	2.67	1.51	L
Different methods of supply and installation system of electricity in dwellings	2.40	1.49	VL
Identification of various electrical fixtures, their principles and uses	2.53	1.62	L
Production and interpretation of electrical plans	2.48	1.67	VL
Preparation of detail plan of electrical services	2.40	1.5 9	VL
Management Skills			
Concepts, principles and methods of preparing schedules	2.27	1.53	VL
Specification and location of material components or activity	2.37	1.50	VL
Project estimating and tendering	2.55	1.57	L
Project supervision – at all stages of construction	2.61	1.62	L
Progress evaluation	2.49	1.48	VL
N		278	

Note: *The degree of obsolescence: Very Much (VM) 4.50-5.00; Much (M) 3.50-4.49; Little (L) 2.50-3.49; Very Little (VL) 1.50 - 2.49; M (M) 0.50-1.49; N (Total # of Respondents)*

From *Table 4.4* above, thirty items have mean ranging from 2.50 - 3.49 and twenty-nine items with the mean ranging from 1.50 – 2.49 indicating that the respondents have “little” and “Very Little” degrees of obsolescence in thirty and twenty-nine items respectively. However, some specific skill areas recorded more obsolescence than others did. Specifically, skills and knowledge in standard practice indicated 66.67 percent of “Very Little” and 33.33 percent obsolescence respectively, while drafting materials and equipment, reproduction of drawing, hand tools, basic processes in Carpentry and Joinery, site preparation, foundation, temporary structures, scaffolding and other temporary supports, floors, stairs, and finishes all indicated 100 percent evidence of “Very Little” or “Little” obsolescence on skills and knowledge relating each area respectively. Though, most of these areas have each one to three items measuring the skills obsolescence.

Similarly, on the knowledge and skills relating to the basic principles of design and preliminary design the respondents indicated having 75 percent of “Very Little” and 25 percent of “Little” obsolescence on the items, respectively, while respondents indicated having 50 percent each with “Very Little” and “Little” obsolescence on items relating to working and site safety and roof, respectively. Finally, the respondents reported 71.43 percent of “little” and 28.57 percent of “Very Little” on the items relating walls, 83.33 percent “Little” and 16.67 percent “Very Little” obsolescence on the knowledge and skills relating to fixing openings, and 60 percent “Very Little” and 40 percent “Little” obsolescence on the knowledge and skills relating to services and management skills, respectively.

4.4. Research Question 3

What professional retraining practices are workers adopting to encounter the effects of skills obsolescence in the Building Construction Industry?

To provide answers to this question, mean and standard deviation of the respondents' response to the six items of the questionnaire relating to the professional in-service or retraining practices was calculated and ranked from the highest to the lowest order as shown in Table 4.5. While the in-service or retraining program with the highest mean is ranked the first choice, the one with the lowest mean is ranked the least choice of preferred retraining program workers often adopt to ameliorate the effects of the skills obsolescence. Therefore, the preferred professional in-service training of workers in order of preference is Job Rotation (M = 3.20; SD = 1.12), Independent study (M = 3.13; SD = 1.01), Workshop/Seminar (M = 2.95: SD = 1.30), Mentoring (M = 2.86; SD = 1.01), Job Shadowing (M = 2.79; SD = 0.96), and Professional Conference (M = 2.77; SD = 1.08).

Table 4.5

Ranking of the Respondents' Choice of Professional In-service or Retraining Programs

Retraining Program	**Mean**	**Std. Deviation**	**Rank**
Job Rotation	3.20	1.12	1
Independent Study	3.13	1.01	2
Workshop/Seminar	2.95	1.30	3
Mentoring	2.86	1.01	4
Job Shadowing	2.79	.96	5
Professional Conference	2.77	1.08	6

Total (N) = 278

4.5. Research Question 4

What is the relationship between participants' participation in professional retraining programs and the degree of skills obsolescence of the individuals in the trades?

To find the relationship between participants' participation in professional retraining practices, the Pearson Correlation statistic was computed at $p > 0.01$ using respondents' response to the professional retraining items and obsolescence (wear and atrophy) items. While the professional retraining practices were made up of six items, the wear and atrophy have six and 59 items respectively. Thus, participants' participation in retraining was computed against wear – illness and/or injury, and atrophy. The result, as shown in *Table 4.6* below shows that there is a significant correlation between participation in training and wear (sig (2-tail) *p-value* = 0.000) with a positive Pearson's *r* value of 0.389. Since Pearson's r is not close to 1, the relationship could be said to be weak. The existence of a positive relationship between the two variables means that changes in training variable correlates with changes in wear variable. That is, as the practitioners increase their participation in (re)training, their chances of wear also increase.

On the other hand, the results on the atrophy shows that there is no statistical correlation (sig (2-tail) *p-value =0*.852) between participation in (re)training and skills atrophy with a negative (-0.011) Pearson's r value. Since the Pearson's r value is very close to zero, participation in professional retraining programs, therefore, has no relationship with knowledge and skills atrophy.

Table 4.6
Pearson Correlation Showing the Participation in Training and Skilsl Obsolescence

		Training	Wear	Atrophy
Training	Pearson Correlation	1	.389*	-.011
	Sig. (2-tailed)		.000	.852
	N	278	276	278
Wear	Pearson Correlation	.389*	1	.014
	Sig. (2-tailed)	.000		.813
	N	276	276	276
Atrophy	Pearson Correlation	-.011	.014	1
	Sig. (2-tailed)	.852	.813	
	N	278	276	278

*Significant at p > 0.01 (2-tailed).

4.6. Research Question 5

What kind of relationship (positive or negative) has age with skills obsolescence?

To determine whether age has a positive or negative correlation with skills obsolescence in the Building Construction Industry, the respondents responded to obsolescence items – dependent variable, and to the age item – an independent variable, which has response categories of 18-25, 26-35, 36-45, 46-55, and 56 and above. The data was analyzed at p>0.05 level of significance using Pearson Correlation statistic. As shown in *Table 4.7* below, the result shows that practitioners' age has a weak correlation with wear (sig (2-tail) *p-value* = 0.390; Pearson's r = 0.052), but not significant at p > 0.05. Hence the changes in practitioners' age are not related to the changes in their wear.

However, the results of the test on the atrophy show that practitioners' age has a negative correlation with skills atrophy (sig (2-tail) *p-value* = 0.024; Pearson's *r* = -0.135).

This means that as a practitioner's age increases, his/her skills obsolescence decreases. Although the correlation is weak because the Pearson's *r* value is closer to zero.

Table 4.7
Pearson Correlation Showing Age and Skills Obsolescence

		Age	Wear	Atrophy
Age	Pearson Correlation	1	.052	-.135*
	Sig. (2-tailed)		.390	.024
	N	277	275	277
Wear	Pearson Correlation	.052	1	.014
	Sig. (2-tailed)	.390		.813
	N	275	276	276
Atrophy	Pearson Correlation	-.135*	.014	1
	Sig. (2-tailed)	.024	.813	
	N	277	276	278

** Significant at p >0.05 (2-tailed).*

4.7. Research Question 6

Which occupational trades in the Building Construction Industry are more vulnerable to skills obsolescence?

To provide answers to the above question, the mean and the standard deviation of the participants' response to the obsolescence items, wear and atrophy were analyzed against each occupational area. As shown in Table 4.8, the results show that skills obsolescence because of wear – illness and injury, have the highest rate in Carpentry/Joinery (M = 2.32; SD = 0.99), while electrical has the second highest rate of wear (M = 1.9; SD = 0.79). Masonry (M = 1.89; SD = 0.87) and Plumbing (M = 1.62; SD = 0.73) are in the third and fourth position respectively. Therefore, the occupational area that is more vulnerable to skills obsolescence due to wear – illness and/or injury, in sequential order is Carpentry/Joinery, Electrical, Masonry, and Plumbing.

On the other hand, the results on the skills obsolesce due to atrophy, the Plumbing has the highest rate of atrophy (M = 3.25; SD = 1.03), while Electrical has the second highest rate of atrophy (M = 2.57; SD = 0.76). Carpentry (M = 2.30; SD = 0.82) and Masonry (M = 2.4; SD = 0.82) are in the third and fourth position respectively. Therefore, in a sequential order, Plumbing, Electrical, Carpentry, and Masonry are more vulnerable.

Table 4.8
Mean and Standard Deviation of the Occupational Areas' Vulnerability to Skills Obsolescence

	Occupational Area	**Mean**	**Std.**
	Carpentry	2.32	.99
Wear	Electrical	1.90	.79
	Masonry	1.89	.87
	Plumbing	1.62	.73
	Plumbing	3.25	1.03
Atrophy	Electrical	2.57	.76
	Carpentry	2.30	.82
	Masonry	2.24	.82

Total (N) = 278

4.8. Research Question 7

What is the effect of years of work experience on skills obsolescence?

The years of work experience, the independent variable with response categories 0-5; 6-10; 11-15; 16-20; and 21 and above, and the obsolescence items, dependent variable, were analyzed for providing answers to the above question. To find the correlation between years of working experience and skills obsolescence, variables the Pearson Correlation coefficient was performed at p > 0.01 level of significance. The results, as shown in *Table 4.9* below, indicate that there is a very weak relationship between years of work experience and wear (sig (2-tail) *p-value* = 0.977; Pearson's *r* value= 0.002) because of the Pearson's r value, which is close to zero. Hence, the changes in the years of work experience do not correlate with the changes in wear. The significance test indicates that there is no significant relationship as the sig (2-tail) *p-value* = 0.977 is greater than 0.01

Similarly, the result also indicates that years of work experience has a very weak correlation with atrophy (sig (2-tail) *p-value* = 0.851; Pearson's *r* = 0.011) because the Pearson's r value is close to zero. The significance test indicates that there is no significant relationship because the sig (2-tail) *p-value* = 0.851 is greater than 0.01. Therefore, the changes in the years of work experience do not correlate with the changes in atrophy. In other words, skills and knowledge obsolescence of workers are not in any way a function of their years of work experience.

Table 4.9
Pearson Correlation Showing the Years of Work Experience and Skills Obsolescence

		Year of Work Experience	Wear	Atrophy
Years of Work Experience	Pearson Correlation	1	.002	.011
	Sig. (2-tailed)		.977	.851
	N	276	274	276
Wear	Pearson Correlation	.002	1 276	.014
	Sig. (2-tailed)	.977		.813
	N	274		276
Atrophy	Pearson Correlation	.011	.014	1
	Sig. (2-tailed)	.851	.813	
	N	276	276	278

Correlation significant at p > 0.01 (2-tailed).

4.9. Research Question 8

To what extent does skills obsolescence vary across educational qualification and/or training?

The analysis of Highest Education and/or Training item, which is made up category options of Apprenticeship Training Program, Vocational/Technical School, Technical College/Polytechnic, University (Bachelor's Degree), and University (Graduate Study) in the Section A – bio data of the questionnaire and 57 obsolescence items in Section B of the questionnaire provided answers to this question. However, prior to the analysis, test of normality was performed. A result of a Shapiro-Wilk's test (p> .05), skewness and kurtosis as shown in *Tables 4.10 and 4.11*, and a visual examination of the histograms, Q-Q plots, and box plots indicate a deviation from normality on distribution of respondents' highest education and/or training programs. In other words, there was a violation of normality for both obsolescence due to wear and atrophy.

Table 4.10
Shapiro-Wilk's Test of Normality of Assumption on Distribution of Respondents in Educational and/or Training Qualification and Skills Obsolescence

Obsolescence	Highest Edu/Training	Shapiro-Wilk		
		Statistic	df	Sig.
Atrophy	Apprenticeship Training Program	.969	53	.191
	Vocational/Technical School	.950	48	.041
	Technical College/Polytechnic	.948	93	.001
	University (Bachelor's Degree)	.882	69	.000
	University (Graduate Study)	.874	11	.086
Wear/Tear	Apprenticeship Training Program	.867	53	.000
	Vocational/Technical School	.765	48	.000
	Technical College/Polytechnic	.903	93	.000
	University (Bachelor's Degree)	.853	69	.000
	University (Graduate Study)	.783	11	.006

Significant at p>0.05

Table 4.11
Skewness and Kurtosis of Normality of Assumption Test on Distribution of Respondents in Educational and/or Training Qualification and Skills Obsolescence

Highest Edu. and/or Training Qualification		Wear		Atrophy	
		Stat	**SD**	**Stat**	**SD**
Apprenticeship Program	Skewness	0.720	0.327	0.318	0.327
	Kurtosis	0.802	0.644	0.154	0.644
Vocational/Technical School	Skewness	1.099	0.343	0.455	0.343
	Kurtosis	-0.209	0.674	-0.365	0.674
Technical College/Polytechnic	Skewness	0.588	0.250	0.192	0.250
	Kurtosis	0.769	0.495	0.912	0.495
University – Bachelor's Degree	Skewness	0.349	0.289	0.432	0.289
	Kurtosis	-1.318	0.570	-1.307	0.570
University – Graduate Study	Skewness	-0.103	0.661	-0.087	0.661
	Kurtosis	-2.247	1.279	-1.318	1.279

Normality of Assumption value: Skewness = between -0.5 and + 0.5; Kurtosis = 3 (Balanda and MacGillivray, 1988; Blumer, 1978).

Therefore, for a sample of a population that, "do not meet the assumptions …. (i.e., i) errors are normally distributed, ii) equal variances among the groups, and, iii) uncorrelated errors) and subsequent post-hoc tests, the Kruskal-Wallis test (kruskal.test) can be employed" (Pohlert, 2014, p. 1). Kruskal-Wallis H test, otherwise, known as H test, is a non-parametric test and one-way analysis-of-variance by rank that does not require complicated statistical assumption (Pohlert, 2014; Chan & Walmsley, 1997). The H test "makes only very general assumptions related to the distribution's source" (Chan & Walmsley, 1997, p. 1757). It is suitable for analyzing a study that has one independent variable with three or more levels; hence, the use of the H test for variation of obsolescence across the educational qualifications or levels. In this study, educational qualification and/or training is an independent variable with five levels.

After the analysis at p> 0.05 level of significance, the Kruskal-Wallis H test (*Table 4.11*) shows that there is no statistically significant difference, $\chi^2(4) = 8.749$, $p = 0.066$, with a mean rank response of 140.20 for Apprenticeship Training Program; 107.47 for Vocational/Technical School; 145.14 for Technical College/Polytechnic; 143.85 for University (Bachelor's Degree); and 151.14 for University - Graduate Study in the response of the respondents in the various education and/or training groups on items relating to the obsolescence due to wear. This shows that the distribution of obsolescence due to wear is the same across the various education and/or training groups. On the contrary, the results also showed that there was a statistically significant difference in the response of the respondents in the various education and/or training groups on items relating to the obsolescence due to atrophy χ^2 (4) = 15.941, p = 0.003, with a mean rank response of 131.41 for Apprenticeship Training Program; 104.98 for Vocational/Technical School; 151.59 for Technical College/Polytechnic; 141.44 for University (Bachelor's Degree); and 189.32 for University (Graduate Study) as shown in *Table 4.12*.

Following the evidence of statistically significant difference in the atrophy variable, a follow-up test, pairwise a comparison as shown in *Table 4.13***,** was conducted to evaluate pairwise differences among the different education and/ training groups. The result indicates no significant difference between BCI trade workers who graduated from Vocational/Technical School and those that graduated from Technical College/Polytechnic (p = 0.010). There is also no significant difference between practitioners who graduated from Vocational/Technical School and those that graduated from University - Graduate Study, ($p = 0.016$). Finally, there was no significant ($p > 0.05$) difference between other pairs of condition.

Table 4.12
Kruskal-Wallis Mean Rank of Highest Education/Training, Wear and Atrophy Variables

	Highest Edu. and/or Training	N	Mean Rank
Wear	Apprenticeship Training Program	53	140.20
	Vocational/Technical School	48	107.47
	Technical College/Polytechnic	93	145.14
	University (Bachelor's Degree)	69	143.85
	University (Graduate Study)	11	151.14
	Total	274	
Atrophy	Apprenticeship Training Program	53	131.41
	Vocational/Technical School	48	104.98
	Technical College/Polytechnic	93	151.59
	University (Bachelor's Degree)	71	141.44
	University (Graduate Study)	11	189.32
	Total	276	

Table 4.13
Kruskal-Wallis Pairwise Comparisons of Highest Education/Training and Atrophy Variables

Sample 1-Sample 2	Test Statistic	Std Error	Std. Test Statistic	Sig.	Adj. Sig
Vocational/Technical Scho ol- Apprenticeship Training Program	20.426	15.903	1.662	.097	.966
Vocational/Technical School-University (Bachelor's Degree)	-36.464	14.914	-2.445	.014	.145
Vocational/Technical School-Technical College/Polytechnic	-46.607	14.184	-3.286	.001	.010*
Vocational/Technical School-University (Graduate Study)	-84.339	26.680	-3.161	.002	.016*
Apprenticeship Training Program-University (Bachelor's Degree)	-10.038	14.489	-693	.488	1.000
Apprenticeship Training Program-Technical College/Polytechnic	-20.180	13.737	-.1.469	.142	1.000
Apprenticeship Training Program-University (Graduate Study)	-57.913	26.445	-2.190	.029	.285
University (Bachelor's Degree) -Technical College/Polytechnic	10.142	12.579	.806	.420	1.000
University (Bachelor's Degree) -University (Graduate Study)	-47.875	25.862	-1.851	.064	.641
Technical College/Polytechnic-University (Graduate Study)	-37.732	25.448	-1.483	.138	1.000

**Significant at* $p>0.05$

4.10. Research Question 9

What is the nature of the distribution of obsolescence across different age categories?

The independent variable, age, with the response categories, 18-25, 26-35, 36-45, 46-55, and 56 and above, and the dependent variables, obsolescence was analyzed to provide answers to the question. The test for assumption of normality was performed. A result of a Shapiro-Wilk's test (p> .05), skewness and kurtosis as shown in *Tables 4.14* and *4.15,* and a visual examination of the histograms, Q-Q plots, and box plots indicate that the respondents were not normally distributed among the age groups. As shown in the *Tables,* the distribution respondents in the age groups in both wear and atrophy variables indicate some violations of normality of assumption.

Table 4.14

Shapiro-Wilk's Test of Normality of Assumption on Distribution of Respondents in Age Groups and Skills Obsolescence

Obsolescence	Age	Shapiro-Wilk		
		Statistic	df	Sig.
Atrophy	18-25	.931	42	.014
	26-35	.916	100	.000
	36-45	.932	86	.000
	46-55	.946	39	.062
	56-Above	.789	8	.022
Wear/Tear	18-25	.913	42	.004
	26-35	.794	100	.000
	36-45	.865	86	.000
	46-55	.949	39	.077
	56-Above	.861	8	.123

Significant at p>0.05

Table 4.15
Skewness and Kurtosis of Normality of Assumption Test on Distribution of Respondents in Age Groups and Skills Obsolescence,

Age		Wear		Atrophy	
		Stat	SD	Stat	SD
18 - 25	Skewness	0.184	0.365	0.264	0.365
	Kurtosis	-1.222	0.717	-1.021	0.717
26 - 35	Skewness	1.158	0.184	0.276	0.241
	Kurtosis	-0.261	0.478	-1.187	0.478
36 - 45	Skewness	0.517	0.260	0.771	0.257
	Kurtosis	-0.602	0.514	0.026	0.508
45 - 55	Skewness	0.056	0.378	0.369	0.378
	Kurtosis	-0.602	0.514	0.171	0.741
56 and Above	Skewness	0.891	0.756	0.520	0.752
	Kurtosis	-0.610	0.741	-2.117	1.481

Normality of Assumption value: Skewness = between -0.5 and + 0.5; Kurtosis = 3 (Balanda and MacGillivray, 1988; Blumer, 1978).

Consequently, Kruska Wallis H, a non-parametric, test statistic was used for the analysis and the results are presented in the *Tables 4.16* and *4.17* below. The Kruskal-Wallis H test shows that there is a statistical significant difference (χ^2 (4) = 16.057, p = .003) in the age groups responses to the items relating to the obsolescence due to wear with a mean rank response of 162.50 for age 18-25, 115.25 for age 26-35, 140.78 for age 36-45, 158.83 for age 46-55, and 162.31 for age 56 and above. There was also a statistically significant difference in the age groups response on items relating to the obsolescence due to atrophy, χ^2 (4) = 21.031, p = .000, with a mean ranking response of 177.44 for age 18-25, 144.37 for age 26-35, 111.40 for age 36-45, 141.82 for age 46-55, and 186.13 for age 56 and above as shown in *Table 4.16* below. In both cases, the idea that obsolescence has the same distribution across the age groups is rejected at $p>.05$ level of significance. Therefore, the occurrence of the obsolescence due to wear varies per age bracket.

As a result, a follow-up test, a pairwise comparison as shown in *Table 4.17* below**,** was performed to evaluate pairwise differences among the age groups. The results of the pairwise comparison of the age groups on the obsolescence due to wear indicated that there is a statistically significant difference ($p = 0.033$) between 26-35 and 46-55 age groups. There was also a statistically significant difference ($p =0.011$) between the age group 26-35 and 18-26. Other paired groups showed no statistically significant difference ($p > .05$). Similarly, the results of the pairwise comparison of the age groups on the obsolescence due to atrophy as shown in *Table 4.18* indicated that there is a statistically significant difference ($p = .049$) between the 26-35 and 46-55 age groups. The result also indicated statistically significant differences ($p =.011$) between the age groups 26-35 and 18-25. There was no statistically significant difference ($p > 0.05$) between other paired groups.

Table 4.16
Kruskal-Wallis Mean Rank of Highest Education/Training, Wear and Atrophy Variables

	Age	N	Mean Rank
Wear	18-25	42	162.50
	26-35	100	115.25
	36-45	86	140.78
	46-55	39	158.83
	56-Above	8	162.31
	Total	275	
Atrophy	18-25	42	177.44
	26-35	100	144.37
	36-45	88	111.40
	46-55	39	141.82
	56-Above	8	186.13
	Total	277	

Table 4.17

Kruskal-Wallis H Test Pairwise Comparisons of Age Groups on Wear Variables

Sample 1-Sample 2	Test Statistic	Std Error	Std. Test Statistic	Sig.	Adj. Sig
26-35-36-45	-25.529	11.564	-2.206	.027	.273
26-35-46-55	-43.583	14.845	-2.936	.003	.033*
26-35-56-Above	-47.062	28.892	-1.629	.103	1.000
26-35-18-25	47.250	14.459	3.268	.001	.011*
36-45-46-55	-18.054	15.181	-1.189	.234	1.000
36-45-56-Above	-21.533	29.066	-.741	.459	1.000
36-45-18-25	21.721	14.803	1.467	.142	1.000
46-55-56-Above	-3.479	30.520	.114	.909	1.000
46-55-18-25	3.667	17.486	.210	.834	1.000
56-Above-18-25	.188	30.334	.006	.995	1.000

**Significant at $p>0.05$*

Table 4.18

Kruskal-Wallis H Test Pairwise Comparisons Age Groups on Atrophy Variables

Sample 1-Sample 2	Test Statistic	Std Error	Std. Test Statistic	Sig.	Adj. Sig
26-35-36-45	-30.417	15.409	-1.974	.048	.484
26-35-46-55	32.967	11.708	2.816	.005	.049*
26-35-56-Above	61.037	15.023	4.063	.000	.000*
26-35-18-25	-74.722	29.580	-2.526	.012	.115
36-45-46-55	2.549	15.123	.169	.866	1.000
36-45-56-Above	30.620	17.813	1.719	.086	.856
36-45-18-25	-44.304	30.090	-1.425	.154	1.000
46-55-56-Above	28.070	14.729	1.906	.057	.567
46-55-18-25	-41.755	29.432	-1.419	.156	1.000
56-Above-18-25	-13.685	30.900	-.443	.658	1.000

**Significant at $p>0.05$*

4.11. Research Question 10

How do workers in different years of work experience brackets experience obsolescence?

Answers to this question were provided by computing the respondents' response to years of work experience item which has a response category of 0 - 5, 6 - 10, 11-15, 16 – 20, and 21 and above against obsolescence items. A test of the assumption of normality for the sample population distributions to the years of work experience categories was performed. A result of a Shapiro-Wilk's test (p> .05), skewness and kurtosis as shown in *Tables 4.19* and *4.20*, and a visual examination of the histogram, box-plots and Q-Q-plots indicate a violation of normality of assumption for both wear and atrophy variables.

Table 4.19
Shapiro-Wilk's Test of Normality of Assumption on Distribution of Respondents in the Years of Work Experience

Obsolescence	Years of Work Experience	Shapiro-Wilk		
		Statistic	df	Sig.
Atrophy	0-5	.965	42	.230
	6-10	.884	66	.000
	11-15	.918	91	.000
	16-20	.939	45	.020
	21-Above	.893	30	.006
Wear/Tear	0-5	.884	42	.001
	6-10	.867	66	.000
	11-15	.793	91	.000
	16-20	.880	45	.000
	21-Above	.937	30	.075

Significant at p>0.05

Table 4.20
Skewness and Kurtosis of Normality of Assumption Test on Distribution of Respondents in Years of Work Experience on Obsolescence

Years of Work Experience		Wear		Atrophy	
		Stat	SD	Stat	SD
	Skewness	0.0427	0.365	0.174	0.365
0 – 5	Kurtosis	1.106	0.717	0.169	0.717
	Skewness	0.816	0.295	0.888	0.295
6 – 10	Kurtosis	0.294	0.582	0.230	0.582
	Skewness	0.845	0.253	0.356	0.253
11 – 15	Kurtosis	0.780	0.500	-1.180	0.500
	Skewness	0.344	0.354	0.093	0.354
16 – 20	Kurtosis	-1.407	0.695	-1.097	0.695
	Skewness	0.100	0.427	0.786	0.427
21 and Above	Kurtosis	0.834	0.833	0.500	0.833

Normality of Assumption value: Skewness = between -0.5 and + 0.5; Kurtosis = 3 (Balanda and MacGillivray, 1988; Blumer, 1978).

Consequently, a non-parametric test, Krustal-Wallis H test statistic was performed. The result indicated that there was no statistically significant difference (χ^2 (4) = 1.888, p = .756) between years of work experience with a mean rank of 147.18 for 0 -5, 132.41for 6 -10, 133.2111 - 15, 146.36 for 11 -15, and 146.37 for 21 and above, years of work experience brackets for obsolescence due to atrophy as shown in *Table 4.21*. This implies that being in any age bracket does not affect how practitioners in the industry experience obsolescence resulting from atrophy. Similarly, the result also indicated a statistically significant difference (χ^2 (4) = 18.368, p =.001) between years of work experience with, as also shown in *Table 4.22,* a mean rank of 150.89 for 0 -5, 140.86 for

6 -10, 110.43 for 11 - 15, 164.06 for 16 - 20, and 153.62 for 21 and above, years of work experience bracket, and obsolescence due to wear. This means that there is a variance on how obsolescence due to atrophy is experienced in the various age brackets. However, a follow-up pairwise comparison was computed to evaluate a pairwise difference between the years of work experience breakouts. As shown in *Table 4.19*, the result indicated that years of work experience bracket 11-15 and 16-20 are the only group that has statistically significant (p =0.002) difference among all the paired groups. Other paired groups have no statistical significant (p< 0. 05) difference between the groups.

Table 4.21
Kruskal-Wallis Mean Rank of Years of Work Experience, Wear and Atrophy Variables

	Yrs. of Work Experience	**N**	**Mean Rank**
Wears	0-5	42	150.89
	6-10	66	140.86
	11-15	91	110.43
	16-20	45	164.06
	21-Above	30	153.62
	Total	274	
Atrophy	0-5	42	147.18
	6-10	66	132.41
	11-15	93	133.21
	16-20	45	146.36
	21-Above	30	144.37
	Total	276	

Table 4.22
Kruskal-Wallis H Test Pairwise Comparisons of Years of Work Experience on Atrophy Variables

Sample 1-Sample 2	Test Statistic	Std Error	Std. Test Statistic	Sig.	Adj. Sig
11-15-6-10	30.430	12.671	2.402	.016	.163
11-15-0-5	40.459	14.619	2.767	.006	.056
11-15-21-Above	-43.183	16.499	-2.617	.009	.089
11-15-16-20	-53.621	14.282	-3.754	.000	.002*
6-10-0-5	10.029	15.469	.648	.517	1.000
6-10-21-Above	-12.753	17.256	.739	.460	1.000
6-10-16-20	-23.192	15.151	-1.531	.126	1.000
0-5-21-Above	-2.724	18.734	-.145	.884	1.000
0-5-16-20	-13.163	16.814	.783	.434	1.000
21-Above-16-20	10.439	18.472	.565	.572	1.000

*Significant at p> 0.05

4.12. Findings

Based on the results generated from the analyzed data, the following findings were made:

1. Workers in the Building Construction Industry indicated very little rate of obsolescence due to wear.
2. The rate of obsolescence due to atrophy ranges from “very little” to “little” in most of the skills and knowledge identified in the study.
3. The top three professional retraining practices workers in the Building Construction Industry prefer and engage in for updating knowledge are Job Rotation, Independent Study, and Workshop/Seminar

4. While there is a positive correlation between participation in retraining programs and obsolescence due to wear, there is no correlation between participation in retraining programs and obsolescence due to atrophy.
5. Worker's age has no correlation with wear, but has negative correlation with atrophy.
6. Sequentially, Carpentry, Electrical, Masonry, and Plumbing trades are more vulnerable to wear, and Plumbing, Electrical, Carpentry, and Masonry indicated more vulnerable to atrophy.
7. Years of work experience have no relationship with skills obsolescence.
8. Education/training qualification has no effect on the wear of the building construction practitioners, but do have an effect on the atrophy.
9. The presence or the rate of obsolescence differs according to certain age bracket.
10. Workers in different years of work experience obsolescence differently.

Chapter Five

DISCUSSIONS

This study examined the human capital obsolescence in the Building Construction Industry with a focus on Carpentry, Electrical, Masonry, and Plumbing trades. Specifically, the study investigated the existence of obsolescence in the industry, professional retraining program workers are adopting to mitigate against skills obsolescence, the effect of workers' age, educational qualification and/or training, and experience on skills obsolescence. The study also investigated the occupational areas of the Building Construction Industry that are more vulnerable to skills obsolescence. Ten research questions guided the study. Therefore, this chapter highlights, summarizes, and reviews the results of the study. It discusses each finding of the study in relation to the existing pertinent literature. The chapter also presents a conclusion, implications, and recommendations based on the findings.

Demographic Characteristics of the Respondents

The analysis of the respondents' bio data, which is made up five independent variables used in the study, revealed that 89.21 percent (n = 248) of the respondents were men while the remaining 10.79 percent (n = 30) were women. The construction industry, both in developed and developing countries, is a sector that is highly dominated by men. In other words, women are underrepresented in the industry (Dainty, Bagilhole, & Neale, 2001; Shu-Ling, & Sexton, 2010). This is perhaps because the construction industry "emerges as being both structurally and culturally "male" in orientation, where long working hours and expectations of geographical flexibility support a workplace culture of inflexibility and discrimination" (Shu-Ling, & Sexton, 2010, p. 299).

Furthermore, the lack of many women in the profession may also be attributed to the industry being uniquely labor intensive (Glover, et al, 1999). The job activities in the industry demand physical stamina for lifting, prolonged standing, bending, stooping, (BLS, 2011), and sometimes climbing. Additionally, the industry faces the highest risk of wear due to physically heavy working conditions (de Grip, 2006) that so many women may perhaps not be ready or opt for.

Similarly, older individuals are not attracted to or retained in the industry either, probably because of the working conditions in the industry. The oldest top two age brackets (46-55 and 56 and above) were under represented. The results indicate that workers that are 46-55 years old constitute 14.08 percent (n = 39) while 56 years and above constituted only 2.89 percent (n = 8) of the total population (n=278). The ages of 26-35 years with a representation of 36.10 percent (n = 100) of the population could be considered a prime age working in the industry as workers start exiting the profession from age 35 and above. The subsequent age brackets, which are 36-45 (31.77%, n = 88), 46-55 (14.08%, n = 39), and 56 and above (2.89%, n = 8) indicate a quantum drop in the number of workers within the subsequent age bracket or exit of workers as they grow older. Thus, very few workers remain in the profession until the retirement age of 65 years. This no doubt has some implications on the state of obsolescence in the industry. However, the concentration of workers between the ages of 26 and 45 years is similar to the age distribution of respondents in a recent study conducted by Kum, Cowen, and

Karodia (2014) where the age of the respondent between the ages of 21 and 30, and 40 and above constituted 78 percent and 8 percent of the respondents respectively. This implies that the number of baby boomers in the active workforce is dwindling.

Concerning the distribution of the respondents to the highest level of education and/or training, it is not surprising that Technical College/Polytechnics constituted 33.70 percent (n = 93) as against other levels with a record of 25.72 percent (n = 71) for University (B. Sc.), 17.39 percent (n = 48) for Vocational/Technical School, 19.20 percent (n = 53) for apprenticeship, and finally 3.99 percent (n = 11) for University (Graduate Study). This distribution reflects the availability and accessibility of the human capital education/training programs in the country. It is not surprising that Technical College/Polytechnics attracted the highest of respondents. This is probably because the program is structured towards producing highly skilled technicians with high proficiency as the program in-depth practical skills training. Individuals who went through the program are usually equipped with in-depth knowledge and skills in the areas they profess.

In another development, the distribution of respondents in the years of work experience bracket is of the same pattern with that of age distributions, relatively normal. There was a progressive increase on the number of workers in each increase in the year of work experience. However, after 11-15 years of work experience, the number of workers in the remaining categories (16-20 and 21-above) starts to decrease. Hence, the distribution started 15.22 percent (n = 42) for 0-5 years of experience; increased to 23.91 percent (n = 66) for 6-10 years of experience; increased to 33.70 percent (n = 93) for 11-

15 years of experience; decreased substantially to 16.30 percent (n = 45) for 16-20 years of experience; and finally decreased to 10.87 percent (n = 30) for 21-above years of experience. With this pattern of distributions, suffice it to say that workers start leaving the profession after putting in 15 years of work experience.

Finally, workers in the masonry trade constituted 45.13 percent (n = 125) of the total number (n = 278) of the respondents. In Nigeria, building structures are constructed with concrete and sandcrete block; as a result, masonry trade is more in demand as masonry work lasts longer than other occupational works in any building construction site. Therefore, both in schools and in apprentice programs, masonry trade usually attracts more students than any other trade and translates to having more masonry practitioners in the field.

Research Question 1

This research question seeks to identify the extent of wear, which the obsolescence resulting from injury/ illness and/or the aging process (de Grip & van Loo, 2002). The results that provided answers to research question one indicated that there is obsolescence due to wear in the industry. Among the six items on wear that occurred in the industry with the effects ranging from having no effect on job performance to absent from work for three weeks and above, the result indicated that five of the items have “very little” evidence of wear while the remaining one item has a minimal evidence of wear. However, there was more (M = 2.30; SD = 1.27) occurrence of incidents that resulted in absence from work for one to three days, followed by those (M = 2.23; SD =

1.27), and a minimal (M = 1.14; SD = 0.82). Overall, there is relatively “very little” evidence of wear in the industry.

The presence of wear in the industry is not surprising. In Nigeria, the Building Construction Industry is loosely regulated in the issues relating to work safety. Poor adherence to work safety can lead to bodily injury/illness and subsequent obsolescence. In addition to working in an environment or culture that has little or no regard to work safety and in arduous activities that characterize the industry, no doubt poses a greater tendency to wear. Thus, the U. S. with her stricter regulation of work safety recorded in 2004 and 2005 that six out of 100 full-time workers in the construction industry were involved in nonfatal injuries and illness (BLS, 2006). In addition, the high labor intensity (Glover, et al, 1999) and physically heavy working condition (de Grip, 2006) that characterize job activities in the industry make workers more susceptible to wear.

Furthermore, the wear in the industry should not be unrelated to the corruption in the country. For example, Oyewobi, et al (2011) reported that corruption has deterred meaningful construction developments and undermined the quality of the product and production processes in Nigeria BCI. Fagbenle and Adedamola (2010) and Oloyede, et al (2010) attributed the collapse of building structures, which invariably led to bodily injury and, sometimes, led to the death of construction workers, and to corruptions emanating from the use of substandard materials and labor. In a construction environment where all these exist, workers are in a high risk of wear. With all these in mind, the extent of the wear in the BCI in Nigeria is relatively lower than expected, but enough to raise some concerns.

Finally, the natural aging process leads to skills depreciation, especially in an industry where job tasks are characterized by very arduous activities. Naturally, as individuals grow older, they lose strength and stamina, which may result in inability to perform some occupational tasks. Invariably, the loss of strength and stamina can expose individuals to occupational accidents and subsequent wear which may occur as a result. Thus, findings in this study indicated that individuals start exiting the profession after the age of 45 years. Therefore, wear is inevitable in every profession, but is more prevalent in a profession like the building industry.

Research Question 2

This research question examined the extent of atrophy in the industry. Atrophy is the obsolescence that occurs because of no or insufficient use of skills and knowledge (van Loo, de Grip, & de Stur, 2001). The results of the analysis indicated that atrophy exists at the extent of "very little" and "little" in almost all the identified skill areas. Put differently, workers, for the past one year, are not using sufficiently some of the skills they acquire during their preparation programs (education and/or training). Among the skill areas, respondents recorded higher atrophy in skills and knowledge in floors, walls, fixing openings, stairs, and finishes. This is worrisome as these areas are of the most common essential basic skills needed for the construction of a residential bungalow. In addition, these areas fall into carpentry and masonry, which are the occupational areas responsible for most of the building construction activities.

In general, just like in any industry or occupation, demands as well as skills and knowledge are changing. In the BCI, designs, materials, and workforce, as well as competition and risk allocations are changing (Edum-Fortwe & McCaffer, 2000). All these changes affect the use of specific skills, as workers sometimes do not have control over which skills will be put into used. But they use the skills needed to perform job activities inherent in the building specifications of the building owners. In other words, the usage of some skills is dependent upon request or needs of the building owners; hence, the evident of skills obsolescence known as atrophy in the industry.

Research Question 3

Training according to Smith and Hayton (1999), is for the improvement of an employee's performance as well as for the improvement of adaptability and flexibility of the entire workforce. The above is also the motivating factor for both individuals and an organization to engage in training. Evidence exists (e.g., Kum, Cowden, & Karodia, 2014; Aguinis & Kraiger, 2009; Smith & Hayton, 1999) that training increases job performance; thus, it increases the quality of the product produced. However, the effectiveness of any training program is dependent upon the training delivery method and the knowledge and skills or tasks being trained (Aguinis & Kraiger, 2009).

The training delivery methods or programs identified in this study that respondents were asked to indicate which they were engaging in for their retraining were workshops and seminars; professional conference; job shadowing; job rotation; mentoring; and independent study. Job Rotation ranked number one (M = 3.20; SD =

1.12) as the training program they often adopt for their retraining. The remaining choices, in the order of preference, were Independent study (M = 3.13; SD = 1.01), Workshop/Seminar (M = 2.95: SD = 1.30), Mentoring (M = 2.86; SD = 1.01), Job Shadowing (M = 2.79; SD = 0.96), and Professional Conference (M = 2.77; SD = 1.08).

Job rotation is on-the-job training (Kum, Cowden, & Karodia, 2014) that entails rotating of workers from job to job in a given time period (Jorgensen, et al, 2005) or rotation of operators between different jobs (Allwood & Lee, 2004). The ranking of job rotation as the number one choice is probably connected with the nature of the job activities in the industry. According to Jorgensen, *et al* (2005) job rotation is an intervention to prevent work-related musculoskeletal disorder in professions where job activities include lifting and lowering, which are the major part of construction job activities. They stated that job rotation is “mainly to reduce exposure to risk factors for work-related injuries and to reduce work related injuries” (p. 1721). Thus, in their study of the characteristics of job rotation in the Midwest US manufacturing sector, of the 178 local manufacturing firms sampled, 42.7 percent reported using job rotation. However, prior to the provision of and engaging in any kind of training, Kum, Cowden, and Karodia (2014) warn that both employer and employee have to work together to determine the training needs and methods that will have an impact on the job.

By the foregoing, job rotation in the context of this study serves dual purposes. First, it has been identified in the literature as a means of acquiring new skills. Therefore, the practitioners in the BCI who engage in job rotation, consciously or unconsciously, learn new skills while performing their job activities. Secondly, it serves as a measure to reducing exposure to work related injuries, thereby sufficing as one of the measures BCI professionals embark on for militating against skills obsolescence. Job rotation, therefore, helps in improving worker's individual job performance and the overall job performance of the industry by being a source of acquiring new skills and minimizing or reducing wear in the industry.

Research Question 4

The answers to the question on whether workers' participation in professional retraining practices has any relationship with worker's obsolescence indicate that there is a weak significant positive correlation between participation in training and wear (sig (2tail) $p = 0.000$) with a positive Pearson's *r* value of .389, at 0.01 levels of significance. Therefore, changes in training variable correlates with changes in wear. The weak positive correlation means that there is a slight increase in workers' wear as they participate in training. Since training activities involve participating in active job activities, expending energy and exposure to risk, workers are bound to develop some wear. So, the more individuals are involved in any kind of job related task, whether designed to combat obsolescence or not, the more the individual becomes obsolete because of wear. This finding, however, does not contradict the findings of some studies (e.g., Kum, Cowden, & Karodia, 2014; Aguinis & Kraiger, 2009; de Grip, 2006; Lee and Hsin, 2004; Pischle, 2001; Smith & Hayton; 1999) on the impact of training in an organization. The findings of most of the studies indicated that training increases job performance and the productivity of an organization as the constructs are different, if not opposite.

Concerning obsolescence because of atrophy, the results also indicated that workers' participation in professional retraining practices has no correlation with their skills atrophy. The reason for this could be attributed to changes in organizational approach to production processes, skills demands and/or involvement of new knowledge and skills. In organizations that emphasize skills specialization (vertical up Skilling) as against skills diversification - horizontal scrolling (Shankar, 2005), and in an industry that the uses of skills are dependent upon the ever changing in demand and designs, workers' participation in training might not correlate with the obsolescence in the skills and knowledge they learned during their preparatory programs. This finding, more or less, supports Arrzola, de Hevia, Risueño, and Sanz, (2004) who assert that there is no direct evidence of the impact of training on human capital depreciation, and further concluded in their study that "when workers receive training, the depreciation rate of human capital diminishes considerably (over 1 percent)." (p. 18).

However, Arrazola, et al focused on estimating human capital depreciation using workers' wages, while in this study, workers were asked questions about the usage of the skills and knowledge they learned during their preparatory programs for the past one year. Probably, during the period, both the organization and individual never had the need to provide and/or participate in training on some of the specific skill areas workers learned during their preparatory programs. Therefore, individuals are more likely to use skills and retrain in some specific skill areas that are required to execute the immediate job tasks in their industry. Hence, the lack of correlation between workers' obsolescence due to atrophy and their participation in professional retraining programs.

Research Question 5

As stated *ab initio*, age is very important when an employer is making any decision about productivity. As a result, the research question five provides information on the kind of relationship age has with obsolescence. The results indicate that there is scientifically significant correlation (sig (2-tail) V =.390; Pearson's r = .052) between an individual's age and his wear. In other words, individual's wear is not a function of age. First of all, it is worth noting that 46 years and above constituted only 16.97 percent of the population of the study and could have influenced the outcome. This notwithstanding, the finding is in contrary to the general assumption that as an individual grows older, he or she becomes more vulnerable to work related wear. The finding also contradicts some findings in the literatures (Janβen & Backes-Gellner, 2009; Allen & de Grip, 2007; Syed, 2007; Alders, 2005; van Loo, de Grip, & De Steur, 2001) in age related studies, which associated old age in the workforce with some negative outcomes. However, it should be acknowledged that many of the studies are not on workers wear, which is a technical obsolescence that occur as a result of workers' aging process, injuries and/or illnesses. On the other hand, this finding is in congruence with a related study on the effect of age and participation in training by Schulz and Roβnagel (2010) who found that there was no scientifically significant difference, F (2, 467) = 8.86, p>0.42, in participating in training as a function of age.

Concerning the atrophy, the result indicates that worker's age has a negative correlation (sig (2-tail) $V = .024$; Pearson's $r = -.135$) at 0.05 level of significance with the worker's skills atrophy. This means that as a worker's age increases, his or her skills atrophy decreases or the tendency of his becoming obsolete due to no or insufficient use of skills decreases. In this particular circumstance, the decrease in skills atrophy with increase in age could be attributed to two things, (1) increase in skills due to increase in professional experience (Arrazola, et al, 2004) and (2) the exit of older workers from the profession before their retirement age. Thus, in this study, individuals start leaving the profession in large numbers at age 45 and above. Consequently, this trend might have affected the result as very few older individuals that are 56 years and older constituted 2.89 percent (n = 88) of the population of the study.

Research Question 6

In general, the BCI is made up of varying degrees of specialized skills workers in different occupations, which includes Carpentry, Electrial Wiring and Installation, Mansory, and Plumbing/Pipe Fitting. The industry is also uniquely labor-intensive (Glover, et al, 1999) with hard working conditions that involve exposure to weather, working in partially enclosed structures, lifting, prolonged standing, bending, stooping (BLS, 2011), and other challenging postures. The exposure, risks, and the effects of these conditions vary according to occupation and the nature of the skill activities inherent in the occupation. Hence, research question six explores the vulnerability of BCI occupations to skills obsolescence.

The findings indicate varying results with regard to obsolescence attributed to wear and that attributed to atrophy. On wear, the results indicate that Carpentry (M = 2.32; SD = 0.99) is the occupation that is the most vulnerable. While the Electrical (M = 1.9; SD = 0.79) is the second and Masonry (M = 1.8; SD = 0.87) the third, Plumbing (M = 1.6; SD = 0.73) brings up the rear. Carpentry being the most vulnerable to wear, it is not surprising because the nature of the job activities in the occupation involves arduous work that includes heavy lifting, climbing, and standing in a balance while working with heavy hand tools. Thus, in the US, the occupation has the highest injuries and illnesses resulting from lifting heavy materials, falls from ladders, and cuts from sharp objects and tools than the national average (BLS, 2014a). Although, it is surprising that Masonry is the third most vulnerable after Electrical when, in the US, Masonry has a higher rate of injuries and illnesses resulting from lifting heavy objects, cuts from tools, and falls from scaffolds, than the national average (BLS, 2014b).

On the atrophy, the results also indicate, in sequential order, that Plumbing has the highest rate of atrophy (M = 3.25; SD = 1.03), while Electrical has the second highest rate of atrophy (M = 2.57; SD = 0.76). Carpentry (M = 2.30; SD = 0.82) and Masonry (M = 2.4; SD = 0.82) are the third and fourth, respectively. Since atrophy is associated with the frequency of use of skills, this result reflects the order of duration each occupation stays active during the building construction period. The longer an occupation is active during the construction period, the less the vulnerability of the occupation to atrophy. Conversely, the shorter an occupation is active during the construction period, the more the vulnerability of the occupation to atrophy. For example, in the U.S. where a bungalow is constructed out of framed wooden walls, Carpentry stays longer (BLS, 2014a), but in Nigeria where it is built with sandcrete blocks, Masonry stays longer. Hence, in sequential order, Plumbing (M = 3.25; SD = 1.03), Electrical (M = 2.57; SD = 0.76), Carpentry (M = 2.30; SD = 0.82), and Masonry (M = 2.4; SD = 0.82) are found to be more vulnerable to skills atrophy.

Research Question 7

Years of work experience or length of service refer to the amount of time an individual worked with an organization (Buckley, 1998). In the process of working in an occupation for years, the individual accumulates human capital while performing job related tasks. Thus, research question seven seeks to find out whether the number of years an individual has worked in an occupation has any effect on his or her skills obsolescence. The results indicate that a worker's years of work experience have no effect on worker's wear ((sig (2-tail) $V = 0.977$; Pearson's r value= 0.002) and atrophy (2-tail) $V = 0.851$; Pearson's $r = 0.011$). This implies that worker's human capital becoming or not becoming obsolete is not as a function of years of work experience. This finding contradicts de Grip (2004) who relates work experience with declining interest in participating in retraining and subsequent loss of human capital. He argued that after 13 years of work experience, workers may start losing their skills because of lack of interest in retraining. The author also added that after 19 years of work experience in the same position, workers suffer from concentration of experience that may lead to loss of job.

Allen and de Grip (2006) concur that concentration of experience in a particular job lead to frustration and stagnation.

Another important experience related finding of this study is the distribution of the years of experience. Workers with years of work experience between 6 and 15 years constituted 56.61 percent (6-10 = 23.91%; 11-15 = 30.79%) of the respondents and the number of workers sharply decreased (16-20 = 16.30%; 21 and above = 10.87%) after 15 years of work experience. This trend depicts a sign of an exit from the profession by some workers after putting in 15 years of work experience. A trend that gets worse after 21 years of work experience. This trend is in line with the distribution of the respondents by age as workers start leaving the profession in a great number after the age of 45 years, which coincides with putting in 21 years of work experience for workers who started at the upper bracket of 18-25 years old.

Research Question 8

Educational qualification and/or training have been a contentious issue when making decision on work related matters. It relates to the number of years an individual spent in education and/or training programs (Arrazola et al, 2004) and types of educational programs an individual passed through. It informs an employer in making decision on hiring, wage placement, training, and very recently on making decision on issues relating to workers' human capital obsolescence. As a result, this research question examines the variance of human capital obsolesce across the highest level of educational qualification and/or training (Apprenticeship Training Program, Vocational/Technical

School, Technical College/Polytechnic, University (Bachelor's Degree), University (Graduate Study)) of the respondents in the BCI.

The results, which was tested at P>0.05 level of significance, however, indicate that there is no statistically significant difference (χ^2 (4) = 8.749, p = 0.066) between educational qualification and/or training and a worker's obsolescence attributed to wear. In other words, educational level has no effect on how BCI workers experience obsolescence due to wear in the industry. This finding supports Arrazola, et al (2004) who in their study that estimated human capital depreciation found that educational level has no effect on depreciation of human capital. On the contrary, the finding did not support Murillo (2011) that indicated that human capital depreciation varies across educational levels being greater at the upper level of educational attainment. The finding also contradicts van Loo, (2007) who studied the speed of obsolescence in the Dutch public sector and found a simultaneously higher rate of obsolescence with higher educational attainment.

Concerning the obsolescence due to atrophy, the results indicate that there is a statistical empirical evidence (χ^2 (4) = 15.941, p = 0.003) that educational qualification and/or training have an effect on workers skills atrophy. Put differently, the distribution of atrophy varies according to educational qualifications. Further analysis indicates that the evidence exists between two subgroups: the graduate of Vocational/Technical School and Technical College/Polytechnic; and the graduate of Vocational/Technical School and University Graduate Study. Specifically, there is a differential distribution of atrophy between workers who graduated from Vocational/Technical School and their Technical

College/Polytechnic and University Graduate Study counterparts. Since Vocational/Technical School is at the lower level of the educational ladder than the other two groups and based on the evidence (e.g., Murillo, 2011; van Loo, 2007; Arrizola, et al, 2004) in the literature that higher rate of obsolescence is associated with higher educational attainment, one is inclined to conclude that workers who graduated from both Technical college/Polytechnic and University Graduate Study have a higher atrophy rate than graduate of Vocational/Technical School.

However, it should be noted that in those studies that these findings supported and/or not supported, the approaches to data collection were different. While this study used a self-assessment questionnaire, others used wage equation. These different approaches could be a source of variation, although variation of findings exist on those studies, too.

Research Question 9

When making decisions about productivity, age is an important factor. So many studies have associated age with some negativities. For example, Keely (2007) stated that older workers are less likely to participate in retraining; Syed (2007) states that training intensity decreases with age; Janβen and Beckens-Gellner affirm that older workers invest less time accumulating human capital associated with recent technology, as a result, they suffer negatively and have less recent vintage of human capital (Allen & de Grip, 2007) and become acute to obsolescence (van Loo, et al, 2001). On the contrary contrary, van Loo, (2007) found that younger workers under the age of 30 years lose an 8 percent yearly average of their skills and knowledge as opposed to 1 percent that exist among workers that are 56 years and older. It is against this backdrop that research question nine was set to find the nature of the distribution of obsolescence across different age groups in the BCI.

The result tested at $p > 0.05$ level of significance indicates that there is a statistical difference (χ^2 (4) = 16.057, p =.003) between the age groups and their human capital obsolescence – wear. Similarly, there is also a statistical difference (χ^2 (4) = 21.031, p = 0.000) between the age groups and their human capital atrophy. Therefore, workers' human capital obsolescence can be the result of age. Following the evidence of the statistical difference in both cases, further analyses reveal that statistical evidence exists between the age groups 26-35 and 46-55; 26-35 and 18-25, for the wear and between the age groups 26-35 and 46-55; 26-35 and 56-above, for the atrophy. In each situation, the disparity exists between age group 26-35 and other identified age groups (46-55, 18-25, and 56-above).

Interestingly, in the absence of difference in wear between 18-25 age group, which is a younger group that can withstand more wear, all other differences are among the older workers. Based on this and evident in the literature concerning the vulnerability of older workers, it could be concluded that the skills and knowledge of older worker suffer more obsolescence than younger workers. Specifically, between the age groups 26-35 and 46-55, the 46-55 suffers more; between the age groups 26-35 and 18-25, the 26-35 suffers more; and between the age groups 26-35 and 56-above, the 56-above suffers more human capital obsolescence due to atrophy. However, the interpretation could be either way, as the analyses were not set to detect the group that has higher obsolescence than the other, but to establish the difference between groups. Finding which age group that has higher obsolescence than others could be a cause for further study.

Research Question 10

This research question was set to find out whether the difference exists on how worker in different years of work experience skills obsolescence in the BCI. The results indicate that there was no statistically significant difference (χ^2 (4) = 1.888, p = 0.756) between the groups of workers' years of work experience. This implies that workers' number of years of experience in the industry do not influence the way they experience atrophy in the industry. However, with regard to the wear, the results show that there is a statistically significant difference (χ^2 (4) = 18.368, p = 0.001) between the years of work experience group brackets. A follow up analysis indicates that 11-15 and 16-20 years is the only pair of years of work experience that has statistically significance (p = 0.002) difference among all the paired groups.

The above difference exists, probably because workers start losing interest in updating of knowledge, which subsequently results in loss of skills after 13 years of work experience (de Grip, 2004). According to the Grip (2004), workers suffer from concentration of experience after being in the same position for 19 years. This invariably leads to frustration and stagnation (Allen & de Grip, 2006). When workers are in stagnation and are frustrated, they might lose focus on the orderly way of performing job activities and the behavior might lead to wear.

Chapter Six

CONCLUSION

This chapter discusses the conclusion based on the findings of the study. It also examines the limitation of the study, strategic implication for practice, and, finally, recommendations.

6.1. Conclusion

The BCI is predominantly a male occupation. Males constitute 89.21 percent of the population as opposed to 10.79 percent that are females. Furthermore, the population of older workers is relatively low, as many workers start leaving the occupation at the age of 45 years. Some workers, too, start leaving the profession after putting in 16 years of work experience. The cause of this attrition is not within the scope of this study. However, de Grip (2004) warned that after 13 years of work experience, workers may start losing their skills because their interest in retraining and updating of knowledge falls, and after 19 years in the same position, they suffer from concentration of experience that may lead to loss of position in a labor market. Allen and de Grip (2006) added that concentration of experience in a particular job leads to frustration and stagnation. Therefore, the attrition of BCI workers after attaining the age of 45 years and/or working in the profession for 16 years might be the result of concentration of experience or probably because of prolonged wear associated with the job activities in the profession.

This study has identified the presence of obsolescence in the Building Construction Industry in Nigeria. Specifically, it identified both wear and atrophy outlining the specific skill areas where the obsolescence is present. Although there is evidence of both wear and atrophy, unlike atrophy, the presence of wear is across the board defying all measures. This supports the fact that wear is a natural phenomenon that occurs as a result of engaging in any activity and occurs more when engaging in more arduous activities like those in the BCI.

In order of importance and preference, Job Rotation, Independent Study, and Workshop/Seminar were found to be professional retraining programs workers are adopting to ameliorate the effect of obsolescence in the industry. The ranking of job rotation as number one could be attributed to the method being one of the best approaches to practical skills learning and for preventing or minimizing work-related musculoskeletal disorders – WMSDs (Jorgensen et al, 2005). It is one of the on-the-job retraining or learning activities that serves dual functions. First, Job rotation encourages learning in a workplace with real life application of materials and tools as used in the industry. It serves as a training/learning model that encourages workers to learn clustered skills within the production cycle. The approach is more in use in an organization that prefers horizontal skilling to vertical or upward skilling. Secondly, job rotation also serves as a model for dealing with boredom and stress associated with performing one kind of job activity for a very long time. In the case of this study, workers resort to job rotation for the purpose of reducing high forces on tissues- disc, ligaments, facet joints, and the muscles of the lower back, which present a high risk of injury (Frazer et al, 2003) thereby minimizing technical obsolescence associated with workers' wear.

The ranking of job rotation as the number one professional retraining program workers are adopting to ameliorate the effect of obsolescence notwithstanding, the study found that participation in retraining programs does not protect workers' skills from obsolescence due to wear, but does protect them from obsolescence resulting from atrophy. Also, workers' level of education and/or training does not relate to workers' wear in the industry. Wear, which is a byproduct of aging process, illness or injuries (van Loo, de Grip, & Steur, 2001) is partly a natural phenomenon that occurs irrespective of any measures an individual takes to avert its occurrence. Therefore, the propensity and vulnerability of developing wear increases with participation in training and other job activities. Hence, there is no evidence found in the study that participating in training or workers' educational qualification prevents or reduces the rate of workers' wear in the BCI, but could rather be otherwise. Furthermore, an individual's age and education and/or training do not affect the occurrence of wear, but affect the occurrence of atrophy in the industry.

Finally, some trades like carpentry and plumbing are more vulnerable to wear and atrophy respectively. In the building construction process, carpentry services last longer than other occupation service. It is one of the occupations that has more strenuous job activities. Hence carpenters in the BCI experience more wear than their counterparts in other occupations.

6.2. Limitations

There are limitations in every study. This study, which was designed to identify human capital obsolescence, among other things, in the Building Construction Industry in Nigeria is no exception as the study has its own limitations. First, although random sampling was used for the selection of the respondents, there is a limited generalization of the findings as with any survey research. The study used a self-subjective reporting questionnaire for the collection of data. As in every survey, the reporting is very subjective; since the data for this study was collected through this method, it will be unfair to generalize, without caution, the findings of this study.

Secondly, the questionnaire items through which the data were generated focused on the basic skill areas needed for the construction of residential bungalows. The skill-needs for the construction of a residential bungalow are interwoven among the skills in some building construction trades and are taught in the institutions in compartmentalized trade subject areas. Consequently, it will be very difficult for a single questionnaire to capture evenly all the skills needed by each occupational area for the construction of a residential bungalow.

Thirdly, the questionnaire, which was used in generating the data for the study was researcher-made. Consequently, there is the tendency for the researcher to have made some impositions when developing the questionnaire. In other words, the researcher makes the decision and assumptions on what is important or not important to include in the questionnaire (University of Surrey, u.d.). Though the validity of the questionnaire was tested and found to be within the acceptable margin, its validity could be lacking in some aspects when compared with a standardized questionnaire.

Finally, there are variations in building structures and approaches to building constructs because of weather, topography, and approaches to construction in different countries. As a result, there are skills that are very relative to geographical location. For example, in Midwestern states in the U.S., the skill-needs and construction details of a residential bungalow are different from that of Nigeria. While most residential buildings in the Midwestern U.S. are constructed with mostly wooden materials, that of Nigeria are constructed with sandcrete blocks; hence, the limited generalization of the findings of this study.

6.3. Strategic Implications for Practice

The findings of this study provide some useful information to practicing professionals, the Building Construction Industry, policy makers, and to the academic researchers. First, the study identifies specific skill areas where obsolescence occurs in the industry. The identification of the areas of needs is the first step toward engaging in any retraining activity for the alleviation of skills obsolescence. Thus, individuals in the industry are now more informed about these areas of obsolescence and can focus their efforts and resources on retraining and updating their skills and knowledge in these areas.

Secondly, with the identification of professional retraining programs that are frequently used by BCI workers, workers in the industry are better informed of the best options when making strategic decisions on retraining programs to adopt for the alleviation of their skills obsolescence. The top two choices of retraining professional programs are Job Rotation and Independent Study. With the availability of this information, some practitioners can make a better choice in choosing the most effective professional retraining program when engaging in retraining activities for updating of skills and knowledge. The information, in the long run, helps in capacitating individuals in performing their job tasks and invariably increasing their productivity, earnings, staying in employment, and increasing their level of job satisfaction. Thus, the local practitioners in the industry remain more competitive in the labor market amid their diminishing opportunities because of the influx of foreign professionals (Mbamali & Okotie, 2012) in the BCI in Nigeria

Thirdly, this study is the first of its kind in the BCI that has provided information on the vulnerability of occupational trades in the industry. Consequently, trades in the industry are more informed on their vulnerabilities to obsolescence; hence, more effective differentiated retraining strategies targeting the trades that are more vulnerable to obsolescence could be set in place. Individual workers in the various trades can use this information to map out their own individual strategies on how often they engaged in retraining programs or when performing occupational tasks that are prone to causing more obsolescence in the industry.

Fourthly, this study provides, for the first time, useful and specific information on the issues relating to age of workers, educational and/or training levels, work experience, and participation in training, and the obsolescence in the industry as a whole and in Nigeria in particular. Both the industry and policy makers can use this information when making decisions and/or policies that are of concern to the industry. For instance, the findings of the study indicate that workers leave the profession earlier than their retirement age. Thus, the industry with the help of this information can create an incentive, such as assigning older workers to less arduous jobs in order to keep them longer and tap into their experience in the industry. Also the findings of the study can inform policies on retraining requirements in the industry. Since there is evidence of variation of obsolescence per occupational trades, age groups, educational qualification, work experience, and anticipation in training, policies on who, when, and how long or often to participate in training could be set in place targeting the areas of need according to the degree and/or vulnerability of obsolescence.

Finally, this study provides a basis for further research. Prior to this study, there has been no documentation of this kind of study. Thus, other scholars can build their research upon the information provided in this study or use this study as a model toward conducting research in a different or similar occupation in the same or another region of the world. Doing so leads to the development and accumulation of knowledge in this field.

6.4. Recommendations

Based on the finding of the study, the following recommendations are made:

1. There should be changes in institutional strategies for the improvement of skills and general working conditions in the industry. Institutions responsible for educating and/or training of the BCI workers should emphasize, during training,

the importance of monitoring skills obsolescence and the application training activities like Job Rotation that reduce obsolescence. There should also be accountability on the side of the employer for providing opportunity for skills improvement and better working conditions, especially for older workers. Day-by-day employment of BCI workers as obtainable in this industry does not commit employers to the improvement of workers.

2. The Building Construction Industry and the workers should intermittently evaluate their skills with the view of finding the specific obsolete skill area and providing training to alleviate the effects of the identified obsolescence in the industry.

   Obsolescence leads to decline in wages and return on investment (Edin & Gustavsson, 2004). Therefore, efforts and cost expended in evaluating the skills obsolescence and providing training amount to an investment (Wolff, 2000) that should yield returns. If otherwise, the outcome will be a decline in skills efficiency among workers in particular and the industry in general.

3. Prior to engaging in a retraining program, workers' effective retraining programs should first be identified. Evidence exists that learning is more effective when the learners are provided with the activities or learning approach that are of their interest. With this in mind, it is important to identify the learning activities that are of interest to the workers and most effective prior to providing and engaging in any training. As indicated in the findings of this study, workers will learn more and alleviate their obsolescence if they are rotated in different job activities.

Therefore, it is recommended that job rotation should be used frequently in the industry.

4. The BCI should provide older workers with incentives and a working environment that is commensurate to their age. This will help in retaining older workers until their retirement age, thus minimizing labor shortage. The approach by the BMW automobile manufacturing industry, which adapted in dealing with an aging workforce by providing them with modified work stations (Roth, 2010), is worthy of emulation. Although the working environment of the BCI and BMW are different, the BCI should have the same propelling interest in retaining older workers. In addition, older workers are treasures in terms of work experience and retraining costs. The industry could save some costs by using older and experienced workers as resource personnel in training new employees and inexperienced workers.
5. Finally, similar study in the BCI should be conducted using the objective testing method in examining the skills obsolescence in the occupational areas. This provides the opportunity of assessing obsolescence based on measuring skills and knowledge through testing as against using a subjective survey questionnaire. This approach provides opportunity of making judgments on the findings and on making decision choosing a research approach in subsequent and/or related studies.

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Appendix A

Technical College Curriculum on Building Drawing and Introduction to Building Construction

Topic/Objectives	Contents
1.0 Standard Practices 1. Recognize and draw commonly used graphically symbols and representation in building drawing. 2. State the standard scales and factors which govern the choice of scales.	1. Graphical symbol. 2. Lettering styles and application 3. Title block – essential information standard layout. 4. Dimensioning methods. 5. Factors which govern the choice of scale e.g. - Need for lucid working information. - Ned to achieve economy of effort and time in drawing preparation. - Nature of drawing. 6. Range of standard scales for the following site plans, floor plans, elevation, component details.
2.0. Draughting Materials and Equipment 1. Recognize various standard sizes of drawing material, explain their uses. 2. Select appropriate instruments and use them effectively in the marking of building drawings	1. Drawing papers – various standard sizes; uses. 2. Triangular and flat scales. 3. Drawing Instruments: - drawing pens, lettering, templates, adjustable set square, instrument set, irregular (French) curves, T-square/parallel ruling straight edge/draughting machine etc. 4. Plan printing machine and device.
3.0 Basic Principles Design 1. Explain the concepts of forms, function and beauty as applied in building design.	1. Building plan. - Form, function, beauty etc. 2. Modern residential bungalow - Basic parts, e.g. dining – room. - Bedroom, kitchen, garage (internal or annex), bath/toilet, launderette and store. - Functional relationship - Design requirements 3. Water and sanitary services - Installation standards, e.g. shower, w.c. sink, bath, water heater, bidet, wash-hand basin. 4. Exterior and interior finishes. 5. Town planning authority regulations.

	6. Site characteristics. 7. Floor plan. - Characteristics e.g. adequate and properly located openings, good functional relationship etc. 8. Design of Residential buildings in Nigeria - Factors influencing the design e.g. site, town planning authority regulations, materials and labor availability, client taste culture, financial ability. - Essential elements of good site plan.
4.0. Preliminary Sketch Design 1. Prepare a preliminary sketch design of a modern bungalow in a surveyor's plot and justify space arrangement	1. Surveyor's plot plan - Characteristics e.g. solar orientation plot size, access road, prevailing wind etc. 2. Preliminary sketch design of a modern 3 – bedroom bungalow. 3. Space arrangement and choice of materials
5.0. Production Drawing 1. Draw the site and floor plans, elevations, and sections of a proposed 3 bedroom bungalow	1. Floor plan presentation. 2. Elevations production, e.g. Front, rear left and right. - Determination and drawing details of essential sections. 3. Foundation plan. 4. Site.
6,0. Components Details 1. Prepare essential detail drawings of components	1. Components – floor, beams, lintels, hood ratings, screen walls, fire place, boundary wall and gate, plumbing. 2. Septic tank and soak-away. 3. Interior elevations - Sections e.g. kitchen Launderette - Details of cabinets and work-top.
7.0. Electrical Service Plan 1. Draw detail plan of the electrical services.	1. Types and location of electrical plan - Steel conduit, PVC conduit - M.I.C.S. (Mineral insulated copper sheathing) - T.R.S. (Tough Rubber Sheating) - I.E.E. (Regulations for Electrical Equipment of buildings).
8.0. Preparation of Schedules 1. Demonstrate knowledge	1. Schedules – meaning of scheduling, uses of schedules, typical subjects for schedules, information in schedule e.g.

of the principles and methods of preparing schedules.	(i) A specification of material, component or activity. (ii) The location of these specifications.
9.0. Reproduction 1. Reproduce drawings through tracing and printing.	Plan production: - Inking and tracing - Printing plan from printing machine. - Assessment of quality.
10.0. Working and Site Safety 1. Enumerate various hazards in workshop and on construction sites, state their causes and methods of prevention.	1. Various hazards in the workshop construction sites. 2. Dangerous construction tools. 3. Dangerous gases and liquids. 4. Factory Act on the safety of workers. 5. First Aid. 6. Purpose of safety. 7. Safety Regulations.
11.0. Hand Tools 1. Identify and state the functions of basic hand tools of various trades and maintenance.	1. Identification and uses - Plumbing hand tools. - Bricklaying/Blocklaying hand tools. - Carpentry/Joinery hand tools. - Painting and decorating tools. 2. Maintenance of tools.
12.0. Basic Processes in Carpentry and Joinery 1. State the characteristics and uses of various types of timber. 2. Describe the different states of timber processes.	1. Types of Nigerian Timber e.g. Mahogany, Iroko Obeche, Agba, Opepe, Black Afara. 2. Location, characteristics and uses. 3. Conversion and seasoning. 4. Wood preservation. 5. Manufactured boards, e.g. plywood, laminboards, hardboards. 6. Carcase construction.
13.0. Site Preparation Describe site preparation procedures prior to setting out.	1. Tools, equipment and machinery. 2. Clearing and disposal of unwanted materials. 3. Levelling techniques – out and fill. 4. Site Investigation. 5. Soil Investigation. 6. Soil classification. 7. Subsoil drainage. 8. Hoarding and Hutments.

14.0. Setting Out Explain the principles and the methods of setting out buildings.	Setting out methods - By instrument - Using 3:4:5 method - Optical square method - Cross staff method - Using a builder's square
15.0. Foundation 1. Describe the functions of different types of foundations. 2. Explain batching and mixing concrete. 3. Describe with sketches temporary supports to side of the trenches.	1. Purpose of foundation. 2. Types of foundation – strip, pile, raft, pad, etc. 3. Factors influencing choice of foundation. - Nature and type of soil. - Type of structure. - Proximity to existing structure. - Equipment and methods used in concrete mixing. 4. Choice and types of supports to foundation trenches. 5. Timbering to trenches - In firm soil 6. In moderately firm soil, - In loose soil.
16.0. Floors 1. Describe the functions of various types of floors and their methods of construction.	1. Functions of floor. 2. Preparation of solid and suspended floors. 3. Floor finishes. - Tiling - Granolithic - Mosaic work - Wood blocks, terrazzo tiles and in situ P.V.C. Tiles. 4. Laying, treatment and preservation of floors.
17.0. Walls 1. List types of wall units and describe functions of walls. 2. Describe procedures and precautions involved in mixing concrete and mortar. 3. Explain the functions and the method of placing D.P.C. in walls.	1. Types of walls: Internal and external; load bearing and non-load bearing. 2. Walling materials and their characteristics – stone, sandcrete blocks, sheet metals, clay bricks. 3. Methods of constructing walls e.g. bonding, nailing, use of bolts, welding, riveting. 4. Concrete and mortar mixing. 5. Damp proof course.

18.0. Fixing of Openings 1. Identify Nigerian timbers suitable for window and door construction. 2. Describe various types of door and window ironmongery and state their uses 3. Explain with sketches the need for the provision of weathering structures at openings.	1. Types of timber for window and door frames. 2. Timber felling and transportation. 3. Conversion and seasoning. 4. Openings and walls. 5. Functions of doors/windows. 6. Types of doors, e.g. panel, flush metal. 7. Parts of doors and frames. 8. Sizes of doors. 9. Fixing doors: method of fixing doors using hinges, fixing of hasp and staple, barrel bolts, mortise locks and using hand tools. 10. Windows (i) Types; sash, louver, casement. (ii) Fixing of louver frames, casement (iii) Locating and fixing burglary proofing. 11. Weathering structures.
19.0. Roofs 1. Identify parts of a roof and explain terms associated with roofs. 2. Describe the materials, maximum allowable span and construction of various types of roofs.	1. Roof types and profiles, e.g. beam a slab as in concrete flat roofs, lattice and similar girders, trusses (Home truss, double home, fan truss, truss rafters, standard fink French truss, North light truss, couple, umbrella, bow string etc.) Portal frames, shell roofs, folded plates etc. 2. Parts of a roof-hip end, hip rafter, soffit, ridge, jack-rafter, valley rafter, common rafters, purlins, verge, gable and caves, fascia board, wall plate. 3. Functional requirements of roofs, weather resistance, strength and stability, thermal insulation, sound insulation, fire resistance durability. 4. Factors affecting choice of roof structure type of building, span, loads to be imposed, lighting requirements, accommodation for services, possible alternations, speed of erection, economy and aesthetic considerations.
20.0. Stairs List various types of wall, ceiling and joinery work finishes	1. External and internal finishes – facing brick tiles, use of mosaic colored mortar, decorative precast concrete panels etc. 2. Rendering: preparation of wall surfaces, rendering materials mixes, additives,

and explain their applications	proportioning, and effects of warm and dusty weather (Harmattan) on external rendering. 3. Tyrolean finish selection of materials advantages and disadvantages, proprietary mixes. 4. Texcoate finishes. 5. Pointing and jointing. 6. Spatter dash. 7. Finishes for Joinery works. 8. Ceilings – parts, i.e. struts, Noggins, battens, ceiling materials, Joists Hangers Runners for suspended ceiling construction steps.
21.0, Services 1. Use sketches to illustrate the construction details of drainage system and installation of sanitary wares. 2. Describe the different methods of supply and installation systems of electricity in dwellings. 3. Identify various electrical fixtures, state principles and their functions.	1. Drainage – surface water drainage, subsoil drainage, principles of drainage, materials used, ventilation and interception. 2. Method of testing leakages. 3. Water supply system – cool and hot water supply; sanitary wares and fittings. 4. Materials used in plumbing, solder, nails and nailing, pipes (clay, metal Asbestos, concrete, pitch fiber, plastic). 5. Acoustic insulation – the need for acoustic insulation, materials used for insulating buildings. 6. Lighting design – Types of lighting design (natural lighting, Artificial lighting), Lighting design procedure, types of lamps used for interior lighting (Incandescent lamps, fluorescent tubes. 7. Electrical Installation Systems – various electrical fixtures, electrical safety regulations, circuit symbols and drawings.

***Appendix* B**
Questionnaire Consent Form

UNIVERSITY OF MINNESOTA, TWIN CITIES, UNITED STATES

CONSENT FORM

Human Capital Obsolescence in the Building Construction Industry: Strategic Imperatives for Nigeria

Dear Respondent,

You are invited to be in a research that studies skills deterioration in the Building Construction Industry (BCI). You were selected as a possible participant because your construction manager, supervisor, and/or colleagues have identified you as a practitioner in the industry. I ask that you read this form and ask any questions you may have before agreeing to be in the study. The study is being conducted by Agbo, Benjamin C. D., Department of Organizational Leadership, Policy, and Development, University of Minnesota Twin Cities, United States

Background Information

The purpose of this study is to compare skills deteriorations within the BCI trades, namely Carpentry/Joinery, Electrical, Masonry, and Plumbing (CEMP) trades in Nigeria. Specifically, it will investigate skills deteriorations due to individual wears/tears, no use of skills, professional practices workers are adopting to ameliorate skills deteriorations, and the effect of training on skills deteriorations.

Procedures

If you agree to be in this study, you will be given a questionnaire titled "Human Capital Obsolescence in the Building Construction Industry Questionnaire" and would be asked to respond freely, carefully, and honestly to the items to the best of your knowledge and ability. At least two weeks will be given to respond to the items and the questionnaire will be collected thereafter.

Confidentiality

There is no personal identifier to information you may provide and records will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researcher will have access to the records. Study data will be encrypted according to current University policy for protection of confidentiality.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is Agbo, Benjamin C. D. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at +1-651-771-7632 or at agbox003@umn.edu. You may also contact my advisor, Park Rosemarie (PhD) at +1 612-625-6267 or at parkx002@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650 or at irb@umn.edu.

You will be given a copy of this information to keep for your records.

Statement of Consent

I have read the above information. I have asked questions and have received answers. I am aware that participation is free, that I am free to withdraw consent at any time, and to discontinue participation in the study without prejudice to me. I consent to participate in the study.

Signature: ________________________________ Date: __________________

Signature of Investigator: ______________________ Date: __________________

Appendix C

Questionnaire for the Collection of Data

HUMAN CAPITAL OBSOLESCENCE IN THE BUILDING CONSTRUCTION INDUSTRY QUESTIONNAIRE

SECTION A: PERSONAL DATA

Instruction: Please check in the space provided for each item as applicable to you.

1) SEX: ______ Male ________ Female
2) AGE
   (i) ____ 18 - 25
   (ii) ____ 26 – 35
   (iii)____ 36 – 45
   (iv)____ 46 – 55
   (v) ____ 56 and above
3) HIGHEST EDUCATIONAL QUALIFICATION OR TRAINING
   (i) ___ Apprenticeship training Program.
   (ii) ___ Vocational/Technical School
   (iii) ___ Technical College/Polytechnic
   (iv) ___ University (Bachelor's Degree)
   (v) ___ University (Graduate Study)
4) WORKING EXPERIENCE IN YEARS
   (i) ___ 0 - 5
   (ii) ___ 6 – 10
   (iii)___ 11 – 15
   (iv)___ 16 – 20
   (v) ___ 21 – above
4) AREAS OF SPECILIZATION – check as apply to you
   (i) ___ Carpenter
   (vii)___ Manson (Bricks, Blocks, and Stones)
   (viii)___ Plumber
   (ix) ___ Electrician
5) WORKING HOURS PER A SHIFT
   (i) ___ 1-6
   (ii)___ 7-8
   (iii)___ 8 and above

SECTION B

Instruction: This section contains a list of response options. Items 6 - 11 are items relating to personal occupational injuries/illness. Indicate with a check (√) on each item as it applies to you.

KEY: Very Much Often (V); Much Often (M); Often (O); Rarely (R) and Never (N)

"Within last one year, how often have you been involved in job related injury/illness or wear that has resulted to?"	Response Options	

		V	M	O	R	N	
6.	No effect on job performance						
7.	Placement on lighter job responsibility						
8.	Absent from work for 1-3 days						
9.	Absent from work for 4- 6 days						
10.	Absent from work for 1-2 weeks						
11.	Absent from work for 3 weeks and above						

Item 12 –70 are items relating to some knowledge and skills in construction industry. Indicate with a check (√) on each item in response to the question below:

“How much of the knowledge and skills you acquired during schooling and/or apprentice can you still apply on your current job?”

KEY: Very Little (VL); Little (L); Quite Some (QS); Fairly Much (FM); Very Much (VM); and Not Applicable (NA) – if there was no initial training on the skill.

		VL	L	QS	FM	VM	NA
12.	Graphic symbols, lettering, and their applications						
13.	Title block – essential information, layout and dimensioning methods.						
14.	Scale and range of scales for site plans, floor plans, elevation and component details.						
15.	Uses of drawing pens, lettering templates, draughting machines, etc.						
16.	Plan printing machine and devices.						
17.	Use of Computer Assisted Design (CAD)						
18.	Form function; beauty etc of building plan.						
19.	Basic parts (bedroom, kitchen, bath/toilet etc.) and functions of modern residential bungalow.						
20.	Installation standard of water and sanitary services						
21.	Site characteristics and characteristics of floor plan – e.g. adequate and properly located openings						
22.	Factors (site regulations, materials, labor etc.) influencing design of residential building.						
23.	Preliminary sketch designing of modern bungalow in a surveyor’s plot plan justifying space arrangements.						
24.	Site, floor, foundation and roof plan, and elevations of 3-bedroom bungalow.						
25.	Detail drawings of component parts, e.g. floor sections, door						

	sections, roof sections etc						
26	Determination and drawing of details of essential sections – hood railing, plumbing, septic tank/soak-away etc						
27.	Preparation of detail plan of electrical services.						
28.	Concepts, principles and methods of preparing schedules.						
29.	Specification and location of material components or activity.						
30.	Production of drawings through tracing and printing.						
31.	Causes and prevention of hazards in workshop and construction sites						
32.	Identification, uses and maintenance of hand tools in building trades						
33.	Characteristics and uses of timber						
34.	Different stages of timber processes, e.g. conversion, seasoning, preservation, manufactured board, etc						
35.	Site preparation procedures, e.g. tools, equipment and materials used in site clearing, leveling techniques, site and soil investigation, hoarding/hutments, etc						
36.	Principles and methods of setting out building.						
37.	Functions and different types of foundations.						
38.	Equipment and methods used in concrete mixing.						
39.	Temporary support to trenches – timbering.						
40.	Scaffolding and other temporary supports						
41.	Functions of various types of floor and preparation of solid and suspended floors.						
42.	Characteristics and construction of hardwood floor						
43.	Floor finishes and laying, treatment and preservation of floors.						
44.	Types of wall, functions and walling materials.						
45.	Methods of constructing walls.						
46.	Rendering						
47.	Siding						
48	Painting and general finishing						
49.	Concrete mortar mixing and Damp Proof Course (DPC).						
50.	Identification of timber and other materials suitable for doors and window construction						
51.	Types/functions/construction of doors and doorframes						
52.	Types/functions/construction of windows and window frames						
53.	Sketch illustration of methods of fixing doors/frames and windows/frames.						
54.	Uses of various types of door and window iron mongery.						
55.	Needs and provision of weathering structures at openings.						

56. Identification of types and parts of roofs, roof terminologies and functional requirements of roof.						
57. Materials, maximum allowable span, construction and factors affecting choice of roof structures.						
58. Sketch illustration of various types of stair and their basic principles of design and construction.						
59. Types of wall, ceiling and joinery finishes, and their applications.						
60. Sketch illustration of constructional details of drainage system and installation of sanitary wares.						
61. Different methods of supply and installation system of electricity in dwellings.						
62. Identification of various electrical fixtures, their principles and uses.						
63. Production and interpretation of electrical plans						
64. Project supervision – at all stages of construction						
65. Project estimating and tendering						
66. Health and safety in construction industry						
67. Techniques in reinforcement of structures						
68. Dismantling of temporary structures (e.g. scaffolding, hoarding and formwork						
69. Demolition of unwanted structures						
70. Progress evaluation						

Item 71 – 76 contain some options on issues relating to workers in-service training for updating of knowledge and skills in construction industry. Indicate with a check (√) on each item in response to the question below:

"Within the last year, how often have you engaged in any of the training program below for updating of knowledge and skills in construction industry?"

<u>KEY</u>: Very Much Often (VMO); Much Often (MO); Often (O); Rarely (R); and Never (N)

	VMO	MO	O	R	N
71. Attending trade workshop for demonstration and application of related skills					
72. Attending trade union or professional conference that discusses theory and practice of your trade.					
73. Watching, observing, and imitating a more experienced worker.					
74. Performing different specialized job related activities					
75. Being under the supervision and guidance of more experienced worker on job related skills and other issues.					
76. Engaging in self-directed learning/training on job related skills.					

Appendix D

Protection of Human Subject – IRB – Exempt Study Notification

Benjamin Agbo <agbox003@umn.edu>

1310E44904 - PI AGBO - IRB - Exempt Study Notification

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irb@umn.edu <irb@umn.edu> Thu, Oct 31, 2013 at 10:12 AM
To: agbox003@umn.edu

TO : parkx002@umn.edu, agbox003@umn.edu,

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #2 SURVEYS/INTERVIEWS; STANDARDIZED EDUCATIONAL TESTS; OBSERVATION OF PUBLIC BEHAVIOR.

Study Number: 1310E44904

Principal Investigator: BENJAMIN AGBO
Title(s):
Human Capital Obsolescence in the Building Construction Industry: Strategic Imperatives for Nigeria

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This e-mail confirmation is your official University of Minnesota HRPP notification of exemption from full committee review. You will not receive a hard copy or letter.

This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

Research that involves observation can be approved under this category without obtaining consent.

SURVEY OR INTERVIEW RESEARCH APPROVED AS EXEMPT UNDER THIS CATEGORY IS LIMITED TO ADULT SUBJECTS.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at http://eresearch.umn.edu/ to view further details on your study.

The IRB wishes you success with this research.