CRAFTS SKILLS GAPS IN THE CONSTRUCTION INDUSTRY IN ZAMBIA

By

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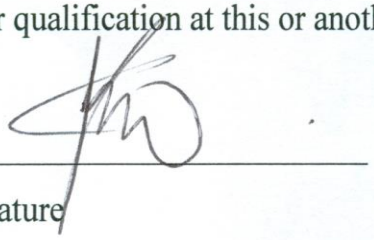

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ABSTRACT

The construction industry in Zambia grew rapidly in the period between 2005 and 2015. The growth in infrastructure development resulted in a construction boom. The boom had catalysed increased demand for construction artisans. Hiring artisans with the right skills and experience has been an ongoing challenge. Contractors need skilled artisans to effectively deliver projects of high quality. A model that enhances effective artisan skills supply to the Zambian construction industry was developed after establishing factors that lead to skills shortages and how that contributes to construction defects and low productivity. Apprenticeship training was considered and evaluated as a mitigation pathway for construction crafts skills gaps.

Interviews, questionnaire survey and three case studies were used to collect data. The study established skills shortages in Zambia's construction sector. The identified crafts shortages were among tilers, shop fitters, air-conditioners technicians, and plasterers, building foremen, carpenters, painters, plumbers, bricklayers, electricians, steel fixers and steel fabricators. Identified causes of skills shortages included: lack of co-ordination between industry and trade schools, low number of trade schools, un-attractive conditions of service. The impact of skills shortages were poor workmanship, low efficiency and reduced effectiveness of industry workforce.

Apprenticeship Skills Flow Chart Model (ASFM) was developed and apprenticeship has been recommended as a possible approach to alleviating skills shortages. The proposed model recommends duration of 2 years minimum for apprenticeship training where apprentices should learn 20 percent theory on important construction topics. The implementation of ASFM could lead to more quality artisan labour in the industry and better productivity improvements in project delivery. Future research should be extended to road construction and manufacturing industry of construction related materials.

Keywords: *Skills gaps, Artisans, Defects, Productivity, Apprenticeship*

DEDICATION

To all my children, this work is dedicated to you; work hard and achieve more than I did in my time.

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I wish to thank the almighty God for supporting me spiritually during the period of study. I would also want to extend my gratitude to Prof. M. Muya for his patience and guidance during the course of study. I was greatly inspired by his immense knowledge and experience in research work.

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LIST OF ACRONYMS

ACEZ: Association of Consulting Engineers of Zambia

AIDS: Acquired Immune Deficiency Syndrome

ASFM: Apprenticeship Skills Flow chart Model

CQC: Construction Quality Control

CSA Construction Standards Authority

CSO: Central Statistic Office

EFZ: Evangelical Fellowship of Zambia

EIZ: Engineering Institution of Zambia

FIR: Frequency Index Response

GDP: Gross Domestic Product

GRZ: Government of the Republic of Zambia

ILO: International Labour Organisation

IPC: Interim Payment Certificate

JICA: Japan International Cooperation Agency

LVTC: Lusaka Vocational Training Centre

MoFNP: Ministry of Finance and National Planning

NAPSA: National Pension Scheme Authority

NCC: National Council for Construction

PMBOK: Project Management Body of Knowledge

SPSS: Statistical Package for Social Sciences

TEVET:	Technical Vocational and Entrepreneurship Training
TEVETA:	Technical Vocational and Entrepreneurship Training Authority
ZIA:	Zambia Institute of Architects

CHAPTER 1: INTRODUCTION

1.1 Background

Construction industry in Zambia has been experiencing shortage of crafts skills which is recognised as a constraint to national competitiveness (AfDB, 2013). The construction industry grew rapidly in the period between 2005 and 2015, with Gross Domestic Product (GDP) estimated at US$ 26.8 billion in 2014 (World Bank, 2014). The good economic growth rate in the last decade; recorded a construction boom that has exposed crafts skills gaps because of increased infrastructure development in terms of construction of roads, schools, hospitals and housing. The country needs more infrastructure to meet the demand of the growing population standing at 14,373,601 (CSO, 2012).

Technical Vocational and Entrepreneurship Training Authority (TEVETA) has low capacity to train many eligible candidates in construction related careers. TEVETA is a statutory regulator, for both public and private training providers offering technical and vocational education in crafts skills developments in Zambia. As a result of this, all training providers, regardless of ownership, are required by law to register with TEVETA (TEVETA Act No.11 of 2005). The number of both craft persons and technicians graduating from the TEVETA accredited schools cannot meet the demand for the industry. Labour force survey at national level indicated that only 6.8 percent of working population received skills training (CSO, 2012). There are other reasons that could have contributed to the shortage of artisans. The current young generation of graduates from colleges are unwilling to do strenuous jobs in construction, but rather do other jobs which give better salaries because construction is associated with poor working conditions and low wages, though it demands high input of person-hours (ILO, 2012)

Generally, the construction industry needs good skills to develop infrastructure needed for human development. The skills are important for operation of equipment, achieving quality, productivity and to maintain safety standards on site. The skills and good workmanship of site personnel contribute to the success of the project. Good skills in construction brings about innovation in the workforce and lower costs on

projects (Dainty et al., 2004). The challenges that contribute to skills gaps are the mismatch of the skills demanded by the employer and those available in the construction industry for hire.

The majority of students who leave college have little understanding of the high standards required by industry. This scenario can be addressed through the implementation of the apprenticeship training, running side by side with the normal Technical Vocational and Entrepreneurship Training (TEVET) system. There are two types of apprenticeship training: informal and regulated. Informal apprenticeship is learning by way of observation and imitation from a mentor and the learner acquires the skills of the trade without receiving certification, while regulated apprenticeship is formal and is guided by legislation. The apprentices are paid wages while learning that takes place both at the site and off the job for theoretical subjects. The apprenticeship training has a specific duration and at the end of the programme apprentices are given industry recognised certificates (Hilary, 2012).

Wolter and Ryan (2011) reported that 'apprenticeship' is a training that is both work and school based and lead to recognised formal qualifications. This argument by Wolter and Ryan could help recognise apprenticeship qualification by professional bodies such as the Engineering Institution of Zambia (EIZ) and broaden membership. The *EIZ constitution* (2013) approves admission of "Technician and Craft" persons for membership only to those applicants who have attended approved college and hold certificates. EIZ is a professional body that promotes the general advancement of engineering, related sciences and allied disciplines and their applications; to promote competiveness in a technologically driven and globalised economic environment (*EIZ Act No.17 of 2010).* Apprenticeship qualification would also help the industry and EIZ to strength the code of practice for its members by introducing better controls.

The training of skills through apprenticeship improves competency and knowledge in executing of projects to international standard. Apprenticeship is common in many countries but with varying duration and skill levels of those who are enrolled in training (Aivazova, 2013). Germany is a country with long standing and very well developed "apprenticeship programme" which has been successful. Its apprenticeship success is attributed to the good a 'dual' education system governed by the *National*

Legislation Act of 2005 (Aivazova, 2013). This law supports the closed co-operation among the Government, private firms and trade unions. It strengthens and enables apprentices to gain exposure and deep experience to meet the demand of work and increased prospects for good performance. According to Hilary (2012) apprenticeship training activities take place within the company and a "dual" system refer to apprentices receiving structured training from an employer along side with general education in Technical Vocational schools.

Construction projects in the country have experienced shortage of craft skills; as a result there is high material wastage on site, frequent re-working on the same tasks due to wrong measurement, resulting in delayed project completion. Manelele (2008) reported 82 percent lack of skilled labour and this affected procurements of community based construction projects in Zambia. The study reported in this dissertation attempted to establish the causes and effects of skills gaps on construction sites and proposes mitigation mechanisms by developing an apprenticeship model.

1.2 Justification for the study

The shortage of labour is evident mainly in skilled trades. The shortages lead to increased inefficiency in project execution and poor workmanship. TEVETA in Zambia has very low in-take capacity to train many eligible students in construction related crafts skills. TEVET institutions admit less than 2% of the output from secondary schools (*AfDB*, 2013).

The graduates from TEVETA accredited schools are needed by the contractors to competently execute various projects in the country. National Council for Construction (NCC), during 2014 registration period registered 4,000 contractors and 96 percent of the companies were Zambians while 4 percent foreign owned (TEVET, 2014). NCC is the statutory body mandated and in charge of promotion and development of construction industry, registration of contractors and conducting training of persons engaged in construction or activities related to construction (NCC Act No.13 of 2003). With many registered and practicing contractors in business, need more skilled labour to develop the increased infrastructure demand in the

country, as seen by the high budgetary allocation to the construction sector in roads, schools and hospital projects in the 2015 national budget as shown in Table 1-1.

Table 1-1: Infrastructure development projects budget

Project name	**Amount budgeted** (*Zambian Kwacha in million*)
Road Infrastructure	5,626.51
Medical Infrastructure (District Hospitals)	541.00
Education Infrastructure	1,069.53
Construction of trade training Institutions	79.60
University, Infrastructure (Student Hostels)	650.00
Total	**7,966.64**

Source: *Zambia; Ministry of Finance and National Planning budget (2015)*

This demand has resulted in unqualified persons to be hired for many projects in order to fill vacancies because of the shortage of right qualified personnel. The practise has caused a number of problems for various projects such as poor workmanship, low efficiency and low productivity. The majority of school leavers at both Grades 9 and 12 join the construction industry as general workers, and learn skills from friends and relatives, then gradually become *self-made* craft persons without any form of recognised training. The contributing factors to the hiring of unqualified personnel such as bricklayers and carpenters are based on the culture of using previous projects the candidate worked on before as criteria for qualification. The continued hiring of these types of "self-made" labour has contributed too many problems the construction industry is experiencing. The flowchart in Figure 1-1 highlights the relationship of the problem. Skills gaps is when employers are hiring crafts skills who are not qualified because of shortage in the industry (Shah and Burke, 2003).

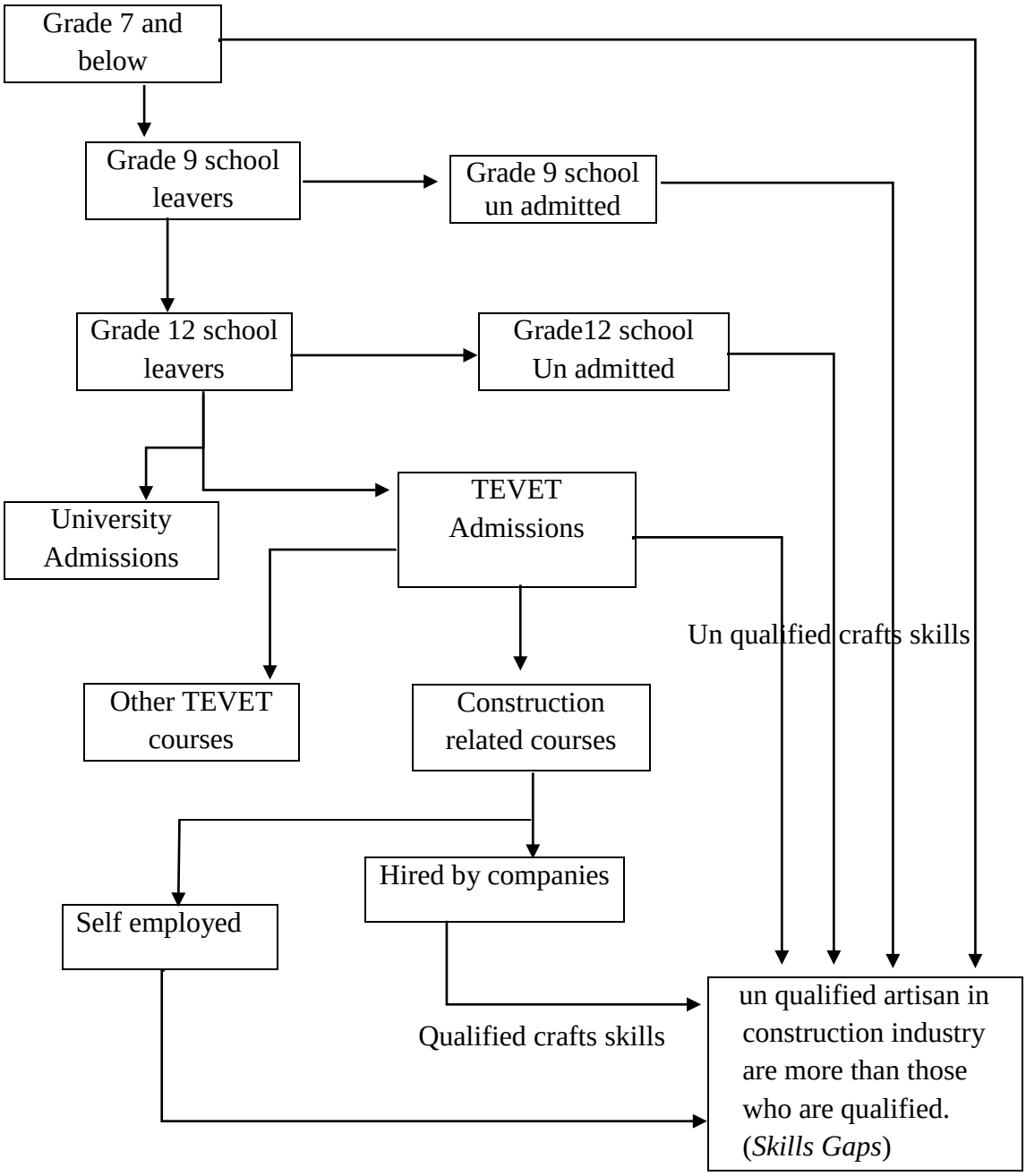


Figure 1-1: *Outlined skills gaps relationship diagram*

In order to mitigate this problem of hiring unqualified skills, school leavers who are directly employed in construction industry could enrol for apprenticeship training. Previous studies show that the training of skills through apprenticeship has several benefits. Smith (2013) reported that apprenticeship provides competitive labour-force

skills and this form of training is more affordable to government, since the cost of running apprenticeship is shared with private companies. This type of training brings

about efficiency and effectiveness in the project management delivery system. Muya et al., (2003) wrote that the future effectiveness of the construction industry of any country depends on quality of workforce it educates and trains.

Apprenticeships teach a wide range of tasks that include classroom training in theory as well as practical applications. Apprentices in construction industry are introduced to multiple skills and specialised tasks, and most studies find high rates of benefits to those who graduate in artisan apprenticeship training skills. The countries that place exclusive emphasis on college training only end up with weaker human capital than those with a mixed strategy of college and apprenticeships programmes, because adaptation to the requirements of the construction industry, which is still a labour intensive industry takes long to achieve (Lerman, 2013).

1.3 Objectives

1.3.1 Main objectives

The main aim of this study was to; develop a model that enhances effective skills supply to mitigate shortage of artisans in construction industry in Zambia.

1.3.2 Specific objectives

To achieve the main objective, specific objectives for the study were to:

a) establish factors that lead to shortage of required skills in building construction industry;
b) determine how limited skills affect number of construction defects, productivity and their overall impact on the project performance; and
c) evaluate apprenticeship training as a mitigation pathway for the shortage of required skills in construction industry.

1.4. **Scope of study.**

The research mainly covered construction artisan skills working in *building construction* sector

1.5 **Structuring of the dissertation.**

The report is structured in seven chapters.

Chapter 1 outlines the background, justification, aim and objectives of the study. It also presents the scope of the study.

Chapter 2 lays a foundation of the study through the review of literature relevant to the study on skill shortage, defective works, productivity and apprenticeship.

In Chapter 3, highlights of the various research methodologies and the justification for the method adopted for the study is presented.

Chapter 4 presents the results of the research survey through questionnaire and structured interviews. The findings of the study was presented and interpreted in this chapter.

Chapter 5 presents a focus on three case studies by examining in details of the shortage of artisan on projects and analyse its affects.

Chapter 6 discusses, the development of a model for application in construction industry, based on gathered information .Before finalising the model, was validated via a questionnaire by selected construction industry stake holders

The dissertation ends with *Chapter 7* which presents the conclusions, limitations and recommendations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The previous chapter presented an introduction of shortage of artisan skills in the construction industry in Zambia. In this chapter literature on: *skills shortage, construction defects, productivity and apprenticeship* is reviewed. The review critiqued, identified gaps in literature and explored research methods and theories.

2.2. Skills shortage

Skills shortages in construction are pressing concerns for policy makers in several countries as established by Faria and Almeida (2014). Skill is defined by Shah and Burke (2003) as an ability to perform a "productive task'' with a certain level of competence. Skills are often associated with a qualification and its acquisition is considered to be through formal education and training. The general skills include that are known as "generic" which include basic literacy and numerical as suggested by Shah and Burke, (2003). However Euler (2013) indicated that good skills are applicable to a wide range of settings which allow individuals to be employees in a variety of businesses.

According to Shah and Burke (2003) *skills gap* occur when employers are hiring workers whom they consider to be under-skilled relative to the desired levels of qualification; *shortage* occurs when the demand for worker's particular occupation is greater than the supply of those who are qualified. Further, Shah and Burke (2003) suggested that "economic theory" is the main driver for the changing of skills requirements due to demographic, organisational, social and technological changes. The population and technological change has had an effect on skills requirements in order to fulfil organisation demand.

The existing literature on skills shortages suggest that there are many factors that contribute to shortages of skills. Studies have shown that skills shortage is associated with acquisition of new technology and equipment due to globalisation (Shah and Burke, 2003; Offei-Nyako et al., 2014). Technological advancement is at a faster rate with high influx of modern tools, equipment and materials which affect most artisans

who have limited knowledge and skills to handle modern technology in the market; this contributes to shortage of skills. Another factor that may affect skill shortage is the increasing number of older workers; aging of artisan who holds good skills is a challenge in construction (Shah and Burke, 2003).

The number of young people who are joining construction trades was reported very low, (Oseghale et. al, 2015). The lack of interest by the young people to take up courses like bricklaying and carpentry as vocational trades is a contributing factor for shortage of artisan skills. Many believe that such courses are for those with less academic achievement. This myth has made some parents become unwilling to recommend a vocational career to their children; also a number of construction firms are not sending their workers for skill upgrade (Oseghale et al., 2015, Offei-Nyako et al., 2014). Skills imbalances lead to substantially inhibited production and in the long term may make a country less competitive in a fast moving global economy.

According to Jordan and Barry (2009) reasons artisans leave the trade was low salary levels. The similar findings was reported by Offei-Nyako et al., (2014),who stated the irregular remuneration was a factor for shortage of artisans in Ghana construction industry. The artisans are hired on temporary basis and on daily wages; salary levels are the main employment factor for retention of artisans. Failure to offer good pay leads to high usage of temporary and un-skilled labour force by construction firms. The problem is further aggravated by the fact that employment is usually on casual and temporary basis, which sometimes results in the non-payment of social security contributions by contractors to the artisans involved.

The shortage of skills in construction have been reported in a number of publications, Hamid et al., (2013) concluded that there was 12 percent shortage of artisan skills on the projects sites in Malaysia. It was also reported that 62 percent of total labour force in the Indonesia construction industry was un-skilled (Adi and Ni'am, 2012). Because of these findings, certification, standards, and training, were recommended as mitigation factors. The findings further suggested construction labour skills should have employment certificates issued by professional associations.

Jordaan and Barry (2009), established reasons artisans were leaving a trade, because training had lagged behind. Most artisans were not preparing themselves for higher positions through formal qualifications training; employers also did not seem to be encouraging artisans to become better skilled. Mateus et al., (2014) did an insight into implications of skills shortage in South Africa and found that the shortage was attributed to not allowing skilled foreigners work with local South Africans; to bring about expertise in the workforce for learners to acquire critical skills that would enable them to be self-reliant and obtain a place in the labour market.

Oseghale et al., (2015) studied skilled labour shortage in construction project delivery for bricklayers and carpenters; it was found that the most severe factors responsible for the skilled labour shortage were high mobility of construction workers and diminishing craftsperson training programmes. According to (Oyegoke et al., 2009), construction lose useful and valuable skills due to Acquired Immune Deficiency Syndrome (AIDS), which affect skills that could have been transferred to next generation of work force.

2.3 Construction defects

The root causes of defects are generally from three sources: design, material and workmanship by contractors. Design defects are caused by poor decision which results in poor drawings and specification; while material defects are caused by poor material quality. The workmanship defects are caused by: poor installation method, poor mixing of materials, wrong use of tools and equipment (Chong and Low, 2006)

Quality in construction is not only looked at as a final product, but also the way materials tools and equipment are used. Lack of understanding about the proper handling technique of tools, selections and use of building materials contribute to construction defects. The monitoring of quality of work on-site is aimed at giving satisfaction to the client with a job that: would result in less rework, fewer delays and mistakes and better use of construction resources. Good quality of works leads to decreased cost and increased productivity. Building defects and failures are caused by low quality of construction materials and wrong construction methods. The use of good and acceptable materials throughout the project produce high quality end

product that satisfy the client. The promotion and practice of good ethical conducts in projects minimise building defects and failures (Ahzahar et al., 2011)

The unethical conducts have a direct and negative impact on the quality of construction and a huge cost on the economy. Contractors are expected to behave with professional integrity and reasonable of care. They should strive to achieve good quality of work as they owe responsibility to the general public. Regulators should closely monitor project implementation to avoid any unethical behaviour among the construction players from happening (Abdul-Rahman et al., 2010)

According to Swiss et al., (2014) a construction defects would result from: defective building materials or a violation of building codes at the time of construction because of failure to build according to accepted trade standards of practise. To avert defects, artisans must attain education and training in order promote quality control programs. Quality Control, also known as "Construction Quality Control," (CQC): is a process in which the quality of structure and methods used in the project, are scrutinized. Before building materials can be used in any building; they are first run through a highly extensive, engineering, testing, and review process. This review process is usually conducted by a vast number of independent testing laboratories and the results are reviewed by professionals on the project (Berawi et al., 2013). The quality and value issues still arise not only at the completion stage, but also during the construction process of a project.

Ali and Wen (2011) reported on the most and significant factors contributing to poor workmanships as lack of experience and competency of labour. This problem includes: poor communication, inadequate information or failure to check information. Others are, lack of technical expertise with skills and inadequate feedback leading to recurring errors. The mitigation is by conducting training in labour skills.

Aiyewalehinmi (2013) reported some factors, which influence building failures. It was concluded that some artisan were not professionally skilled to handle profession jobs. Many research findings agree that insufficient skilled manpower contributes to many construction defects. A number of construction companies prefer to employ

short-term unskilled labour and this creates faults in achieving good quality works; but instead contributes to poor workmanship. Among input factors, labour appears to be the most significant. The shortage of skilled manpower affects construction defects more compared to equipment and material. Both materials and equipment are controlled and managed by good skills. Other factors are contractors' financial difficulties, and too many change orders from the owners (Sweis et al., 2014).

Manelele (2008) studied various risks in the procurement of community based construction projects in Zambia. Impact of lack of skilled labour was rated at 68% and led to poor quality works because of low levels of competencies among crafts skills. Construction site workers need good skills to understand the building standards, regulations and how to read drawings for the quality control. Lack of skills lead to safety standards and procedures being compromised. ILO (2012) reported 487 number of accidents in construction in Zambia, which ranked third behind the mining and quarrying sectors. Cause of accidents was attributed to among other things, poor working conditions. Most of the workers were on temporary contracts, which compelled them to work long hours in order to increase their earnings. The majority of the crafts skills persons in the industry have little understanding of a safety culture to identify risk and manage hazards for lack skills and knowledge. They overlook the safety procedures and still report for work sometimes under the influence of alcohol. This affects safety standards and performance. Sheikh (2014) reported that 15.6% of the population in Zambia drink alcohol of which 43.7% consume alcohol heavily, especially among youths. In another study done in Kanyama and Chinyika compounds of Lusaka found, 19.4% of youths between the ages of 10-21 drank alcohol and the consumption rate among adults stood at 61% (Ngoma, 2011). Alcohol taking is attributed to many factors: lack of recreation and better employment opportunities. Workers who take alcohol heavily tend to develop laziness towards work and this affect productivity negatively in the industry.

2.4 Productivity

Productivity in construction is best understood when the construction process is visualised as a complete system made up of the building project to which, *personnel, materials, equipment, management, and money are input*s. Productivity is defined as measure of input/output, parameter. There two types of input for production function: the person-hour/unit and the cost/unit (Shehata and El-Gohary, 2012). This report focus on labour skills input necessary for effective and efficient way of doing what it is required to be done at a given time and place. The level of skills and experience of the workforce on site is the most important aspect for site productivity in construction industry. Mojahed and Aghazadeh (2008) concluded that skills and experience of the workforce have significant influence on construction site productivity performance. According to Enshassi et al., (2009), an experienced skill improves both the intellectual and physical abilities of labour, and contributes a positive impact to the increased productivity on site.

The construction industry is far more complex than other industries. It is a unique industry and projects often take place in an open environment that changes with every project; repetition of activities is not obvious, it requires different set of skilled workforce at different stages (*PMI, A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (2004)).* The individual skill of each craftsman, the abilities to communicate, make decisions, work with others, and share information, makes the knowledge and skills important tool for productivity. Labour efficiency is the basis of most tender estimates, as well as the benchmark by which performance is measured and monitored by both contractors and consultants. Hicksona and Elli (2014) concluded that shortage of experienced skilled labour; increases idle time because of prolonged learning curve that result in low performance.

The production cycle is the total time that it takes the crew to place one production unit. The production unit is a measurable amount of work that can be visually identified by the observer without much effort: examples of this would be a bucket of concrete, or a row of bricks. Bures and Stropkova (2014) reviewed labour productivity within the context of knowledge, it was reported knowledge serves as value added to labour productivity. The knowledgeable labour force use information,

communication and technology to apply to productivity solutions. The skills and knowledge are important factors perceived to affect labour productivity in construction projects. Sherif et al., (2014) concluded that gap in knowledge affect productivity, and this may be positively influenced by the existence of knowledgeable workers.

Kumar et al., (2014) reported the root cause of low productivity in construction industry was in-consistency of skill ratio: skilled to un-skilled workers on site. When the number of unskilled workers is far greater than the number of skilled workers, productivity gets affected. Improving and maintaining appropriate ratio of skilled to unskilled labour helps in work flow. The component of indirect work decrease with improved work methodology, site layout, training and experience of workers skills.

The delivery of materials and inadequacy supervision affect productivity of labour, it was established (Lamka et al., 2014). These factors can be improved through training in skills: planning, scheduling, materials handling and motivation of workers. A caring, considerate, and friendly person with a sense of humour can help increase productivity. Humour in the workplace puts people in good spirits, relieves stress, and develops teamwork. A creatively thinking person can contribute to increased productivity. Often it is the workers who come up with the best solution to a problem. Workers who demonstrate leadership skills should be encouraged to develop their potential; because construction crews need good leaders to be successful and productive.

The age of the skilled craftsmen engaged affects productivity in building projects (Andawei, 2014). The productivity level of tillers in building projects was achieved differently when subjected to age, and skill level of the tiller. The work performance revealed that age, skill level and the nature of engagement are key success factors that affect the productivity in tiling of craftsmen. Tillers who are hired on fixed tasks performance better than those engaged on hourly basis. The emphasis should be placed on the skill level and terms of engagement on selection of tillers in building projects.

The labour productivity improvements of artisans are increased with workers' participation in minimizing absenteeism; and taking appropriate measures to maintain good relationship with labour unions and managements. The improved labour management practices are powerful strategies for enhancing construction labour productivity through training, because poor attitude based on laziness affect progress of work (Odesola and Idoro, 2014).

2.5 Apprenticeship

Apprenticeship is training that prepares an individual for a career in the skilled crafts and other trades through work based training. There two type of apprenticeships: *informal and regulated apprenticeship*. Informal apprenticeship is learning by way of observations and imitation from an experienced mentor craft person who provides the learner with knowledge and skills, without apprentices receiving certification (Wolter and Ryan, 2011). Regulated apprenticeship is formal and is regulated by legislation. The apprentices are paid wages; while learning takes place at both work place and off the job for the specific duration of 2 to 3 years. At the end of the program, apprentices are awarded certificates as recognition for achievement (Hilary, 2012).

Enshassi et al. (2009) reported that encouraging mentoring by mixing experienced workers with new employees is the most preferred approach for improving skills. Experience plays a major role in quality of works. The career path progression is sometimes an important criterion used by employers in the appointment of site supervisors (Farrell and Gale, 2003). Odusami (2002) concluded that some of the skills can be acquired at school, while others may only be acquired in industry. Farrell and Gale (2003) observed that for craft skills, the four skills affecting their careers were: judgement; self-management; social abilities; and leadership. Competency is related to knowledge, altitude, skill and personal characteristics that affect major performance of a job. Competency can be improved through training. According to (Dante and Ignacio, 2012), an educational program should seek to develop links to vocational training with certification and competences evaluation. It should be aimed towards the development of a gradual process of acquiring knowledge, values, and skills.

Informal apprenticeship is practised in many countries, has existed for decades and is often centred on craft skills. Informal apprenticeship agreements are mostly oral, yet they are embedded in society's customs, norms and traditions .They are considered to be the most important form of skills training in most parts of Africa and Asia (Smith and Kemmins, 2013). Palmer (2008) reported: informal apprenticeship training in Ghana ranged from 80 percent to 90 percent for all basic skills training, compared to less than 10 percent vocational training offered in public institutions. Aggarwal et al., (2010) concluded, that many employers; particularly those in informal construction sector regard informal apprenticeship skill as larger in capacity with superior practical skills than those from the formal vocational education system. Quality of skills became better for those who combine informal and formal apprenticeship training; that make them earn high income (Nubler et al., 2009). Despite the system's strength of providing skills relevant to local markets, informal apprenticeship has a number of weaknesses. Apprentices are subjected to long hours, unsafe working methods, low allowances and no social protection in case of illness or accident .The reputation of a mentor, is a determining factor in getting more apprentices willing to train with the firm; poor reputation of trainers discourages eligible apprentices. ILO reviewed some examples of informal apprenticeship difficulties. Apprentices worked long hours, lacked social protection and were at high risk when a mentor breached the agreement.

Formal apprenticeship is a structure of training that is both school and work-based, which leads to recognised formal qualifications (Wolter and Ryan, 2011). Skill development through apprenticeships is closely suited to the needs of employers and the job market. It reinforces classroom learning with applications of acquired skills at construction site. Apprenticeship provides trainees with a natural mentoring process, and allows them to earn wages while learning occupational skill; this raises the quality of the work force and productivity levels (Hilary, 2012). Apprenticeship helps produce self-confidence, promote good attitude towards work and high self-esteem. The quality of work produced by apprentices on site tends to be better; than non-apprentices, because apprentices are given the correct tools with closely monitored supervision (Hogarth et al., 2005).

In some countries like Australia, companies require more skills of apprenticeship compared to the classroom based training programs; the firms need more practical method of education. Therefore, apprenticeship method allows trainees to learn not only trade principles in a real-world situation, but also to observe the on-site application of productivity and quality standards. These are topics that are more difficult to understand or convey in a traditional classroom format of education (Smith and Kemmins, 2013). Table 2-1 explains the different between informal and formal apprenticeship

Table 2-1: Comparison of informal and formal apprenticeship features

Description	**Informal**	**Formal**
Wages	Pocket money	Yes
Legislative frame work	No	Yes
Work place based	No	Yes
Programme of learning	No	Yes
On job training	No	Yes
Off job training	No	Yes
Formal assessment	No	Yes
Recognised certification	No	Yes
Duration	Varies	Fixed

Source: International labour organisation report, 2012

Many research reports show that apprenticeship has several *benefits*: German company's productivit*y* increases, through acquisition of technical skills by apprentices .Apprenticeship result in enhanced competences because of learned socialisation experiences in workplaces. This results in development of soft skills, good attitude and taking responsibility when doing the actual work. Apprenticeships can also be used as a screening method to reduce the risk of employing bad workers; it lessens possible dismissal costs (Gopaul, 2013). Apprenticeship cultivates entrepreneurship skills: research from the United Kingdom (UK) show that former apprentices between the ages of 25 and 27 are almost three times more likely to set up their own businesses than their peers who followed other education paths (*European training foundation*).

Investments in apprenticeship training are recouped during the training period itself; this is because apprentices contribute to productivity of the firm. Many companies in Germany experience low expenditure costs in labour (Muehlemann and Wolter, 2014). The labour expenses for apprenticeship are factored in the tender for project to be undertaken. The cost is low because apprentices are mostly young people living with their parents, who are willing to accept a lower wage during the training in exchange for the skills acquired. The wages for apprenticeship systems are typically lower than those of full time workers. This is an incentive for employers to take on apprentices because they are cheaper than regular workers. Employers have double benefits from apprenticeship system; it is a source of cheap labour and at the same time they have to invest in training (Lerman, 2014).

German's dual apprenticeship training: trainees split their days between classroom instruction at a vocational school "20 percent" and on-the-job time at a company "80%". The theory they learn in class is reinforced by the practice at site. They also learn work habits and responsibility and understand the culture of the construction company; apprentices learn not just skills but responsibility, on how to solve problems, be thoughtful, self-reliant; and prepare themselves as future employees who understand the company's goals. They learn construction firm culture; methods of working to improvise when things go wrong or when they see an opportunity to make something work better (Smith and Kemmins, 2013)

Germany helps every young person be a productive member of their advanced economy. They introduce the concept of careers to students and their families as early as kindergarten. They knit together educational and vocational programs and practical experience to build numerous pathways for both *blue collar and white collar* careers. German firms not only invest in the latest technologies and equipment, they prioritise skilled labour force training. Firms regularly hire former apprentices, who work closely with trainees and classroom instructors to make sure every young adult successfully passes their programs and attains relevant credentials *(European training foundation).*

The youngsters spend most of their education in the workplace and are treated in companies as young workers, not students; who are there to train in practical works

and acquire needed skills. Apprenticeships require stable business of a firm, and often get affected under changing conditions. Combining job training with days of classroom-based education is practically standard practice for regulated apprenticeship. The absence of classroom instruction makes training look like informal apprenticeships. (*European training foundation)*

Funding of apprenticeship is done through various methods; German use tax breaks for companies that train apprentices and agreed a self-imposed levy on all firms (Smith and Kemmins, 2013). According to (Oyegoke .et al., 2009) funding is said to be a major impediment to skills development. Contractor's cash-flow inhibits training of the workforce, most especially the small and medium enterprises. Muya et al., (2007) reported that craft skills improvements in Zambia needed the introduction of construction specific training levy which would finance the sector. Training levies have been used to raise revenues for public training institutions and firms.

The funding of apprenticeship programmes is necessary: to finance tuitions fees and pay apprenticeship wages. In countries like German, apprentices are paid wages like employees, while in India; they only receive allowances (Smith and Kemmins, 2013). Malawi's levy-financed industrial training fund, focused mainly on supporting the apprenticeship scheme. Three-quarters of levy income was expended on reimbursing apprenticeship wages and allowances which were provided during apprenticeship training period (Ziderman, 2003). In Zimbabwe apprentices initially received a subsistence allowances which gave the first intake group unrealistic expectations and resulted in endless complaints. This funding programme was stopped and apprentices started paying a contribution to cover the costs of training materials for courses at technical training colleges (Ziderman, 2003).

Table 2-2 summaries the literature reviewed in this chapter, it provides objectives of their study, methodology used, comments, critique and conclusion

Table 2-2: Content of analysis of reviewed literature

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Jordan and Barry (2009)	South Africa	Determine factors that lead artisans to leave employment	Questionnaire survey, sample 79	Remuneration remains one of the main factors, reasons for artisan's dissatisfactions	It was established that salaries are low, but the research did not report the minimum amount artisans would be wiling to accept for them to stay in the firms
Offei-Nyako et al., (2014)	Ghana	Identify factors aggravating the skilled artisan scarcity in Ghana	Questionnaire survey. Total sample size 150: made up contractors, professional and artisan	Irregular low wages , low motivation, lack of interest to train carpentry and bricklaying, and technology changes	Salaries were offered on different scales from one company to the other hence difficult to draw general conclusion
Shah and Burke (2003)	Australia	Study of skills shortages	Case study	Review of the concepts, that lead to the shortage of skills	The paper outline in depth study of skill gaps and shortages
Oseghale et al., (2015)	Nigeria	Assessing of skilled labour requirement; causes and prevalence of skill shortage, and effects on construction industry	Structured questionnaire survey	Firms are not training workers who can also recommend vocational career to their children. This has caused low entry of young people in construction. The firms are not paying extra money for labour	Paper stated that firms are not providing training for workers to further their career and this does not inspire their children. The paper also highlight that there no allowances given to workers apart from wages

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Mateus et al., (2014)	South Africa	Examine skills shortages in south Africa	Literature review as source of data collection	Allow foreign skilled workers to work along-side south Africans to learn skills from them	Technological transfer of skills must be promoted; to enhance local capa-city training and adopting of new technologies
Hamid et al., (2013)	Malaysia	Estimate number of shortage of skills in construction	Questionnaire survey at 35 construction sites	On average there was shortage of skilled artisan at sites	The paper did not show break down for artisan shortage by category
Oyegoke et al., (2009)	United Kingdom	Investigate competence development strategies by construction companies	Focus study, chain conferences, unstructured interviews and literature reviews	Long term workforce retention and continu-ous training through strategy planning shou-ld be primary importa-ntace for all companies	The paper focuses only on long term strategies which can work best for big and well established companies only
Abdul- Rahman (2010)	Malaysia	Highlight ethical standards in construction and its effects on quality of works on projects	Questionnaire survey	Concludes that profe-ssional ethics is pre requisites to attaining and acceptable quality in construction	Ethics must be embedded in all workforce starting; from top management to the lowest employee in the company
Chong and Low (2006)	Singapore	Causes of defects in buildings	Survey of 74 buildings	Designers lacked necessary technical knowledge.	Poor design combined with poor workmanship increase number of defects

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Sweis et. al., (2014)	Jordan	Study factors affecting contractors' performance on public projects	Questionnaire survey of consultants, contractors and owners	Contractor's financial difficulties cause, manpower shortages of skilled workers	Contractors miss-apply funds meant for project This create financial difficulties; but though some fund problems are caused by client's failure to meet their contractual obligations
Aiyewalehimin (2015)	Nigeria	Identify factors influencing building functional failures	Questionnaire survey of 150 residential buildings that were commissioned	Artisans were not professionally skilled to handle the professional jobs	Training was required to up grade skills for affected artisans
Ali and Wen (2011)	Malaysia	Investigate workmanship quality performance of construction projects referring to number of defects occurring in new completed buildings	Questionnaire survey of 75	Contributing factor was lack of experience and competency of labour	The paper did not state minimum number of years considered to be adequate experience
Berawi et al., (2013)	Indonesia	Improving construction project performance using quality and value management.	Questionnaire survey	Quality and value issues still arise only at the end of product stage. Quality management should be applied to ensure performance of the project with added value	Quality control should be implemented during the life cycle of the project. Training of skills in construction quality is important

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Ahzahar et al., (2011)	Malaysia	Identify factors contributing to building defects and failures in order to minimise time and cost overruns	Questionnaire survey	Low quality of materials, and unethical practice increase building defects and failures	The paper did not emphasis type of materials that cause defects most
Mojahed and Aghazedeh (2008)		Identify factors influencing productivity in construction projects	Questionnaire survey	Perceived skills and experience of workforce, job planning, workers motivation and material availability are the major drivers of productivity	The author used a word "perceived" in conclu-sion
Andawei (2014)	Nigeria	Determining effect of age, skills and nature of engagement on the productivity of tillers in building project.	Questionnaire survey, sample 60 tillers	Age, skill level and nature of engagement are key success factors that affect productivity	The paper did not report on most productivity age for artisans
Bures and Stropkova (2013)	Czech Republic	Review of labour productivity in context of knowledge society	Case study	Knowledge and skills affect productivity; provides information and, communication technologies for solutions	Communication technologies through use of computers
Sherif et al., (2014)	Egypt	Identify and rank relative factors perceived to affect productivity of labour	Questionnaire survey	Gap in knowledge affects efficiency of utilisation of labour in construction	The paper ranked payment delay and motivation labour as important factor

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Kumar et al., (2014)	India	Analysing labour produc-tivity and relation betwe-en direct work and their productivity in small projects	Interview of site personnel, direct and indirect measuring of work.	Productivity was higher for sites where percentage direct work was high. Any increase in direct work, increase the out put	Assigned number of skilled and unskilled workers on a task depends on the scheduling priority
Odesola and Idoro (2014)	Nigeria	Assessing and comparing the relative effects of labour-related factors on construction productivity across the six regions in Nigeria	Field survey involved stratified random sample of 1,138, building craftsmen and 561 project supervisor	Improved labour manage-ment practices are potent productivity improvement strategies for enhancing construction labour productivity	The sample size was large, study may have been expensive
Hickson and Ellis, (2014)	Nigeria	Study highlight factors, affecting labour productivity of construction	Questionnaire survey	Shortage of experienced labour, low motivation, poor scheduling and poor material management were found to affect labour productivity	Experienced personnel know how to select and manage materials
Gopaul, (2013)	India, Germany, South Africa, Turkey, and the United Kingdom	Assess current apprenticeship and workplace training programmes	Survey interview of academics, private companies and international organisation in six countries	Contribution to resolving the youth employment crisis and the prospect of developing a well-trained and productive workforce	Skills levels of the workforce are improved through apprenticeship

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Smith and Kemnis (2013)	Australia, Canada, Egypt, France, German, India, Indonesia, Turkey South Africa and United States of America	Review international experiences in apprenticeship, and identify good practice principles based on the cross-country analysis	Case study for comparative analysis of national, apprenticeship systems in various countries	Strength and weakness of apprenticeship systems in each country was studied and analysed	Apprenticeship model depends on the skills requirement for the country's need and funding mechanism
Hilary (2012)	Australia, Austria Canada, China Denmark, France Germany, Italy Indonesia, Ireland Switzerland, Turkey United Kingdom, United States of America (USA)	An overview of current existing apprenticeship programmes and their practices in a limited number of countries	Case study in Selected G20 countries	Evidence and lessons drawn from findings, provide motivation for making apprenticeship a more attractive, efficient pathway to productivity. It also help create jobs for more young people	Apprenticeship training duration: is 2 ,3 or 4 years in some countries
Muehlemann and Wolter (2014)	German	Assess training investment cost benefits in firms that offer apprenticeship	Case study and literature review	Apprenticeship training by firms largely depends on economic factors such as costs spent on training and benefits gained	Paper did not expand of factors

Table 2-2: Content of analysis of reviewed literature (continued)

Author	Country /region	Objective(s)	Method	Conclusions	Comments / critique
Muya et. al., (2007)	Zambia	Assess availability and quality of craft skills among construction craft-persons in Zambia	Semi- structured questionnaire interviews	Introduction of construction sector specific training levy, to support craft skills improvement in Zambia was needed	The proposed levy was fixed percentage of contract sum to be paid by client. The paper did not state a figure or define client limit: private or government
Lerman (2014)	USA	Examine high perceived training cost to firms and benefits from a well-structured apprenticeship programs	Case study and literature review	Apprenticeship training in a firm; provide high levels of expertise in skills	Apprentice's contribution to production is large enough to offset most costs to firms
Manelele (2008)	Zambia	Improve management of community based projects by identifying risks	Survey	Lack of skills and poorly trained crafts persons were identified as risks	The research did not name specific crafts skills which were in short supply.
Sheikh (2014)	Zambia	Assess impact of relapse in patience with alcohol dependence	Survey	Reducing the frequency of alcohol consumption help prevent relapse in patients	Report did not highlight on the breakdown on age group that take alcohol
Ngoma(2011)	Zambia	To investigate factors that read to alcohol consumption	Survey	Factors identified were peer pressure and easy access to alcohol outlets	Easy access to alcohol had contributed to low industry productivity by workforce
AfDB(2013)	Zambia	To improve quality and relevance of skills development in Zambia	Case study	Conducted impact evaluation to provide robust evidence of the available skills	The study did not show statistics for construction skills affected

2.6 Summary

The literature reviewed highlighted various factors that cause shortage of skills, construction defects, productivity and apprenticeship.

2.6.1 Shortage of skills

Shortage of skills is attributed to:

i) change in technology;
ii) diminishing training programmes;
iii) aging of workforce;
iv) low wages;
v) poor social security;
vi) AIDS; and
vii) unwilling by young people to join vocational jobs.

2.6.2 Construction defects

Construction defects results from:

i) poor selection of materials;
ii) poor mix ratios;
iii) unethical conduct;
iv) lack of knowledge by designers;
v) poor communication;
vi) poor installation method;
vii) improper use of tools and equipment;
viii) working long hours; and;
ix) alcohol consumption.

2.6.3 Productivity

Productivity depends on the following factors:

i) skills level;
ii) experience and competency of workforce;
iii) knowledge of artisans;
iv) ratio of unskilled to skilled labour on a project;
v) motivation;

vi) age of artisan; and

vii) attitude and laziness.

2.6.4 Apprenticeship

There are two types of apprenticeship: *informal*, which is purely hands on skills and *formal or regulated* in which. apprentices spend about 80% of training time learning practical work in industry and 20% theory. Duration for formal apprenticeship ranges from 2 to 3 years minimum.

There are several benefits that go with apprenticeship training. It teaches practical skills that help improve quality and productivity of workforce because of emphases on responsibility and good work culture for employees. Apprenticeship benefits companies in reducing labour costs.

Funding of apprenticeship differs from country to county. In some countries it is done through industrial levy.

The next chapter deals with research methodology and design undertaken to achieve the aim and objectives of this study.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The previous chapter discussed reviewed literature on shortage of skills, construction defects, productivity and apprenticeship. This chapter outlines the methodology used to carry out the research presented in this dissertation; to achieve the aim and objectives of the study. The chapter examine the various methodologies that can be adopted for research purposes. It further explains how the problem was investigated through the selection of suitable research design, population of study, sample size, sampling frame, research-instruments and data collection methods.

3.2 **Research methodology**

Methodology is strategy or plan of inquiry that links methods for a specific research outcome. Philosophy, strategies and methods when combined; they provide different frame works for conducting research. The methods are techniques and procedures such as instrument developed for the study. The choice of methodology is based on the research problem and questions to be answered (Creswell, 2003).

According to Neumann (2000), research design is a plan, structure and strategy of investigations to collect and analysis data for answering the research questions. The design is tailored by the objectives of the study: constraints placed on time and expenditure. Design is a logical task undertaken to ensure that the evidence collected enables us to answer questions or test theories. Research design was structured in a way that evidence may support our expected theory or disprove our preferred explanations. Scientific methods of logical reasoning are deductive or inductive. Deductive reasoning begins with an expected pattern that is tested against observations, whereas inductive reasoning derives a theory from observations (Wallimann, 2011); Figure 3-1 describes the frame work for the research process adopted.

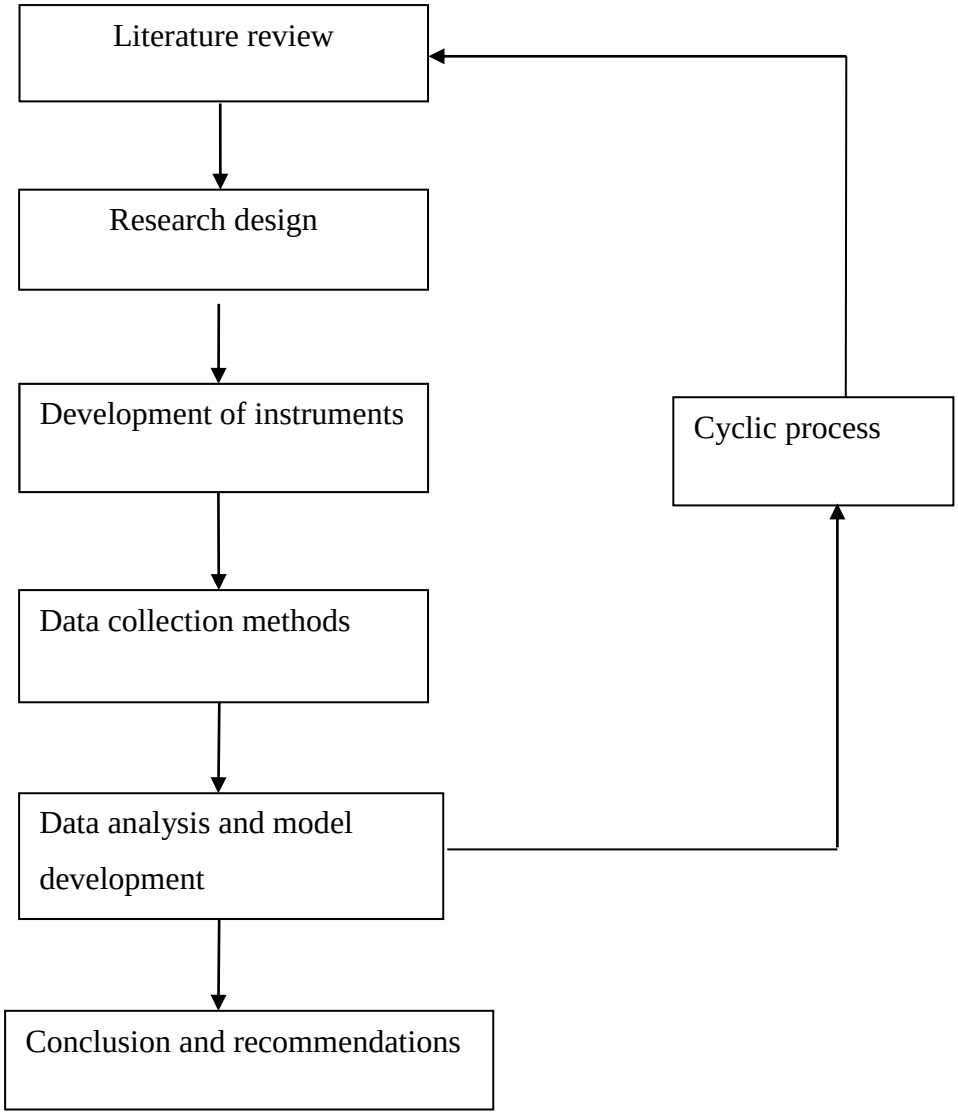


Figure 3-1: *Frame work research process*

(*Source:* Wallimann, 2011)

3.3 Types of research methods

3.3.1 Quantitative methodologies

Quantitative methods quantify data and generalise results from a sample of population of study. They measure the incidence of various views and opinions in a chosen sample. Quantitative approaches are generally based on the deductive reasoning, beginning from accepted theories or theoretical framework, followed by data analysis

(Vanderstopep and Johnston, 2009). Science in quantitative approaches is associated with objective truth, while qualitative research tends to focus on subjective experience (Neuman, 1997). Quantitative data can be measured, more or less accurately because it contains some form of magnitude, usually expressed in numbers. Mathematical procedures are used to analyse the numerical data; all measurements in scientific endeavour are all typical examples of quantitative data. Some of the quantitative methodologies described in this report are survey research, correlation, experimental, quasi experimental and comparative research.

i) Surveys

According to Neumann, (2000), surveys research provides a quantitative or numeric description of trends or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection; then generalising is done from a sample population. There are two sampling methods for testing a subset of the general population for any particular research problem: probability and non-probability methods. In probability methods, theoretically every element within the subset being studied has the opportunity to partake in the sample; in non-probability methods, randomness is not used.

ii) Correlation research

Test a relationship between and among variables, and make predications depending on the out come of a strong relationship among variables .Correlations is often used in survey based research.

iii) Experimental and Quasi experimental

Randomisation is usually viewed as one of the hallmarks of experimental research. A typical experimental study usually uses comparisons or control groups to investigate research questions.

iv) Comparative study

This design is used to explore and test what conditions are necessary to cause certain events, so that it is possible, to understand the likely effects of making certain decisions.

3.3.2 Qualitative methodologies

Qualitative methods attempt to gain an understanding of the underlying reasons and motivations for actions and establish how people interpret their experiences. The methods provide insights into the setting of a problem, generating ideas and hypotheses. Qualitative research methods normally entail inductive reasoning, gathering data and derive theories from observations (Creswell, 2003). Qualitative data cannot be accurately measured and counted, and are generally expressed in words rather than numbers.

Essentially human activities and attributes such as ideas, customs and beliefs are investigated in the study of human beings; their societies and cultures. These kinds of data are therefore descriptive in character. According to Mackey and Gass (2005) qualitative research depends on careful definition of the meaning of words, the development of concepts and variables, and the plotting of interrelationships between them. Some of the qualitative methodologies described in this report are: ethnographies, observational, historical and case studies research.

i) Ethnographies study

Ethnographic: strategy of inquiry in which the researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting, primarily, observational and interview data .It is a type of research conducted in field work to observe people engaged in routine behaviours within their natural environment. Ethnographic studies are described as cultural ‘maps’ of human social behaviour (Walliman, 2011).

ii) Observational study

Method of generating data which involve a researcher immersing, himself, and systematically observing dimension of the setting for different type of observations, such as detailed checklist or rating scales. In a less structured observation the researcher relied on field notes for detail description of phenomena being observed.

iii) Historical study

This establishes facts and draw conclusions about past events. It uses primary historical data, such as archaeological remains as well as documentary sources of the past. Apart from informing us about what happened in previous times and re-evaluating beliefs about the past, historical research can be used to find contemporary solutions based on the past and to inform present and future trends.

iv) Case study

According to Creswell (2003) a case study differs from an ethnography that focuses on culture. There are several types of case studies; a researcher chooses to conduct a single case study or a collective case study in depth. A collective case study involves a comparison of several related cases, such as a comparison of several construction companies. A case study can also be focused on one person, and called a biographical case study, or focused on one event, and called a critical incident study. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures.

3.4 Research designs adopted for the study

The survey, quantitative methodology strategy was chosen for the study. The survey research was found relatively cheaper and less time consuming compared to other type of research. The methods used for data collection was questionnaire, structured interviews and case studies. According to Creswell (2003), mixed method of inquiry shapes data collection for the research.

3.4.1 Sample Design

Sample design: refers to the method used to choose the sample from the population of study. Stratified random sample: was adopted to treat biasness in sample selection, by first dividing the population into groups of similar elements called strata. Then conducted a separate simple random sampling (SRS) in each stratum, thereafter, the combined SRS formed the full sample. According to Walliman (2011), the size of the sample is the most important parameter of a sample design, because it affects precision, cost and duration of the survey more than any other factor. The sample size was considered both in terms of the available time and budget. Figure 3-2 illustrates how a sample relates to the population of a study.

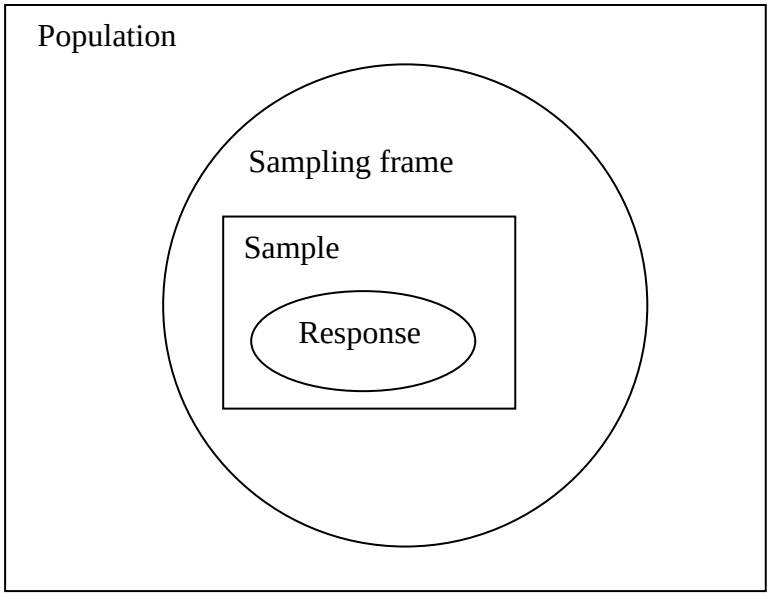


Figure 3-2: *Sampling framework relationship*

(Source: Wallimann, 2011)

3.4.2 Population.

According to Creswell (2003), population in research is a collective term used to describe the total quantity of things that have a similar characteristic and are subject of the study. The population in this study was all contractors registered with National

Council for Construction (NCC) in building category, consultants, and TEVETA accredited schools, offering training to artisans.

3.4.3 Sampling frame for questionnaire survey

The sampling frame was prepared in the form of a physical registered list of contractors from NCC. Population was divided into; contractors in Grade 1 to 6.in building category. The population "register" was randomly sampled to get 20 contractors for each Grade. The totals were added to form 120 population of first strum for contractors .The second strum was 35 registered consultants and the last strum was 20 registered TEVETA schools also randomly sampled from the respective registers. The total population of study became 175 elements.

3.4.4 Sample size,

The sample size was selected as the parameter for stratification to ensure sampling elements was homogeneous and divided into three groups or strata based on their sub sector in construction industry. Proportionate stratified sampling was found suitable.

Standard normal deviation for 95 percent confidence with five-percent marginal error was acceptable for this study. The sample was determined using the following bio statistical formula to estimate sample in a survey

$$\mathbf{N = \frac{Z^2 P\,(100\% - P)}{(E)^2}} \qquad \text{equation (1)}$$

Source: *Sample size calculation*; Rao (2007)

Where: N is sample size required; P is estimated proportion of sample, E: is marginal error and Z: standard normal deviation with factor ''1.96"; relating to 95 percent confidence. The sample was estimated to be fifty (50.)

From the total sample of 175, a proportionate fraction was calculated, by dividing total population into sample size. The strum sample was then computed as presented in Table 3-1.

Table 3-1: Sampling frame for different strata of surveyed respondents

Stratum	Population	Sample size
Contractor	120	35
Consultant	35	10
TEVETA school	20	5
Total	175	50

3.4.5 Geographical area of study

The study was conducted in Lusaka. Lusaka has a population of 2,491,054 (CSO, 2012), representing 17 percent of the total population of Zambia. Many construction companies, consultants and trade schools are registered and based in Lusaka compared to other part of the country. Table 3-2 highlights the distribution of contractors across the country. This justifies why Lusaka was selected as a study area

Table 3-2: Distribution of contractors across the country

Province	Percentage "%" distribution of contractors
Lusaka	45%
Copper belt	28%
Eastern	1%
Luapula	3%
Central	6%
North western	4%
Northern	3%
Muchinga	1%
Western	2%
Southern	7%
Total	100%

Source: National Council for Construction annual registration, 2014

3.4.6 Research instruments

The research instrument used in the study is a questionnaire method. The questionnaire method was selected as it allowed the researcher to collect data systematically and address the research issues in the standardised and economical way. The research instruments were developed based on the gaps identified in the literature review. For structured interviews, a purposive, non- probability sampling method was used for interviews. Twelve (12) professionals with 10 to 35 years experience in construction sector were identified and interviewed based on qualification and experience. Ten managed to take part in the interview. Three case studies were also conducted to verify the authenticity of the results.

3.4.7 Data collection method

Survey research uses several methods to collect data: structured or semi structured interviews, self-administered questionnaires through mail, telephone or posting can be used. For this research, 50 copies of questionnaire were prepared for distributions among the targeted sample. Sampled organisations were located, then questionnaires were administered by hand or e-mail. The completed questionnaires were received after follow up with telephone calls and remainder through e-mails.

3.4.8 Pilot study

Both structured interviews and questionnaires were pilot tested. The three structured interview questions as well as survey self administered questionnaires were pilot tested on an architect consultant, contractor and engineering consultant. The purpose was to determine whether questions and instructions were clear, unambiguous and if the respondents found the questions appropriate .The unambiguous questions were removed or reconstructed. Pilot study help researcher to obtain assessment of validity of questionnaire. According to Basavanathappa, (2009), research instrument should be pilot tested to detect weaknesses or errors in the instrument from the target population.

3.4.9 Ethical considerations in the research

Ethical issues are given lot of importance in research such as voluntary participation, ensuring anonymity and confidentiality. As the firms that took part in a survey had to fill a questionnaire, they were briefed on the objectives of the research and assured of confidentiality of data to motivate them participate voluntarily. The data was collected by making personal visits to the firms or through e-mails. Companies not willing to participate did not respond. The respondents were assured that the data would only be used for the study and no mention of their organisation name or individual will be published. According to Basavanathappa, (2009) information must be handled so that confidentiality and anonymity are maintained. To ensure confidentiality, names of the interviewees were not be disclosed.

3.4.10 Reliability of the instrument

Reliability refers to the stability, accuracy and precision of measurement. Reliability of instruments is a measure that is used to define a research's credibility (Basavanathappa, 2009; Bryman, 2004). It concerns level of consistency, what extent does the instruments deliver the same results on repeated trials; minimising the room for errors and biases in the study. According to Basavanathappa (2009), triangulation method improves a study's reliability.

3.4.11 Validity of the instrument

According to Bryman (2004), validity is a concern with the integrity of the conclusions that are generated from a piece of research and relates to the question of whether what supposed to be measured is achieved. Validity can be divided into internal validity and external validity. Bryman (2004), explains internal validity as concerned with the question of whether a conclusion that holds a casual relationship between two or more variables is consistent. While external validity it is about questioning whether a result of a study can be generalized beyond the specific research context. To ensure internal validity the collected data was analysed and linked to research question. To deal with external validity, Saunder et al., (2003) suggested such triangulation should be considered.

3.5 Summary

This chapter presented the methodology used to carry out the research. Highlights about the various methodologies that could be adopted for research purposes were discussed. The chapter further presented an explanation of how the research was designed. The instrument used to undertake the investigation, the composition of sample used, and geographical area for the study. The next chapter discusses and analyses data collected

CHAPTER 4: DISCUSSION OF RESULTS

4.0 Introduction

The previous chapter discussed various research methods that could be applied in investigating a problem. These approaches were structured interviews, questionnaire survey and case studies. This chapter presents the results of the findings gathered from structured interviews and the questionnaire survey.

4.1 Structured interview findings

Structured interviews were conducted in May 2015, with key professionals working for contractors, consultants and TEVETA affiliated schools. The sample of the interviewees was selected from Association of Consulting Engineers of Zambia (ACEZ), Zambia Institute of Architects (ZIA), National Council for Construction (NCC), and TEVETA Schools. Potential interviewees were contacted either on phone or in person to confirm their willingness to participate. All of them accepted.

The purpose of the structured interviews was to seek clarification over certain issues concerning the extent of shortage of artisan skills in the Zambian construction industry. This would enable the researcher to obtain the full range and depth of information from interviewees. The structured interviews also helped the researcher obtain relevant information by asking questions slowly and sometimes seeking clarification where the explanation was not clear. The data collected was analysed and presented as percentages after frequency tabulation using descriptive statistics.

The results of these interviews formed part of the information utilised in developing of the wider survey for the self administered questionnaire. Before the interviews were held, the structured interview questions were first pilot tested on three (03) interviewees: a consultant architect; a contractor; and an engineering consultant. Attached to this report in Appendix A is a copy of the structured interview questions which were used to gather information.

4.1.1 General information and sample size

Twelve (12) potential interviewees agreed to participate in the study. They were purposively sampled. During the interview process, only 10 were available. This represented an 83 percent response rate. The work experience of these experts ranged from 10 to 35 years in the construction industry. The interviewees were all university graduates, 90 percent with first degrees and 10 percent with a doctorate.

4.1.2 Shortage of skilled artisans

The findings showed that all the interviewees agreed that there was a shortage of skilled artisans in the construction industry in Zambia. From the interview, 70 percent of respondents agreed that the shortage of artisans' skills was high as evidenced by the poor workmanship on buildings projects worked on by crafts persons. The example cited was the high frequency of poor workmanship on a number of projects in the country. This, according to the interviewees, demonstrated lack of artisan skills hired by contractors. Most works were not up to the required standards. Three (3) interviewees representing 30 percent said there was a shortage of artisan skills because it was difficult to find suitable craftsperson's for hire. The majority of artisans found were those with no formal qualifications, who required more close supervision to achieve intended results on construction sites. The level of supervision needed to manage these types of artisans was demanding. It needed more effort and consumed more time than any other management functions on projects.

The study revealed that wages earned by informal artisans were not attractive to qualified personnel. Qualified artisans preferred self employment to regular monthly salaried engagement because of better returns associated with working on their own. Most school leavers shunned the artisan profession in preference to white collar jobs. This resulted in low entry into training programmes that contributed to the shortage of skills in the construction industry. The gaps created by lack of formal artisans joining the industry were taken up by those who held informal qualifications. The wages for informally trained artisans were lower compared to those demanded by trade school graduates.

As a result, contractors would rather hire those with less qualification because they were cheaper and less expensive to projects. Shortages of skilled artisans were identified in the following categories: bricklayers, tillers, plasterers, carpenters, painters, plumbers, and steel fixers, and steel fabricators, electricians, building foremen, shop fitters and air condition technicians. Figure 4-1: summaries the artisan category and number of respondents who identified the shortages.

Table 4-1: Shortage of artisan skills interview responses

Item	Type of artisans	Number of respondent who identified the shortage
1	Bricklayers	9
2	Tilers	6
3	Plasterer	3
4	Painters	3
5	Carpenters	9
6	Plumbers	8
7	Steel fabricators	5
8	Steel fixers	3
9	Electrician	5
10	Building foremen	2
11	Shop filters	2
12	Air condition technicians	3

4.1.3 Effect of conditions of service on availability of artisans

The majority of interviewees said the construction industry did not attract good artisan skills due to low wages paid to them. It was also noted that few young people were interested in pursuing construction related hands-on careers. The structure of re-numeration in the construction industry was deemed to be poor. Firms, as a consequence paid the same wages for both good and poor skilled artisans.

The un attractive conditions of service made young people less interested to train in construction related careers because there was no difference in wages or motivation between those who held trade school qualifications and informally trained artisans.

The motivation was low and this was compounded by less career progression prospects for practising artisans.

In order to cope with poor conditions of service, the study revealed that trained artisans worked on multiple construction sites so that they could meet their social and economic needs. Therefore, improved conditions of service would make the artisanship careers attractive enough for a larger number of young people to enrol on programmes related to these trades than was currently the case.

The interviewees indicated that conditions of service affected the availability of skilled artisans in the construction industry. 80 percent interviewees agreed that conditions of service affected availability of artisans, while only 20 percent did not agree. The reasons given were that most jobs for artisans were short term contracts and based on casual labour employment.

The findings further revealed that contractors cared more about maximising their profits than paying workers for quality because the majority of the people running construction companies had little training in construction related activities. Most of the contractors in the construction industry tended to be business-persons who wanted to maximise profits.

Some interviewees stated that establishment of a minimum wage for artisans who held trade school certificates would encourage young people to participate more in the construction industry. At the time of the study in May 2015, artisans weighed whether getting full time employment or part-time job was beneficial. Interviewees reported that artisans working on their own made more money than those in fulltime employment.

4.1.4 Reasons for high number of informally trained artisans

The interviewees explained the reasons for the high number of informally trained artisans in the construction industry. There were high numbers of informally trained artisans because of cheap labour promoted by contractors. The number of trade schools in the country was also not enough to absorb eligible trainees in construction related fields in the country. The other reason for large numbers of informally trained

artisans was that few young people were getting trained and interested because many projects in the country had short duration. Some projects lasted less than a year and employment for artisans was usually terminated after the completion of most projects. Employment for most artisans is linked to the duration of each project.

The findings revealed that artisan skills could easily be learned on site when there was a high volume of formal construction works taking place in the county, supported by a clear skills acquisition system in place. However, this was not what was happening in the industry. Some skills were comfortably done with job on training on a construction site because certain skills were difficult to learn in a classroom environment. The majority of contractors did not care about certificates as proof of qualification of artisans when employing them as long as the artisans were able to perform required tasks according to drawings and specifications. This encouraged construction firms pay un competitive wages for good skills, but instead promoted a culture of cheap labour. It also discouraged those trained artisans with trade school qualifications not to practise due to poor wages. Some qualified artisans were hired for part-time jobs where they could earn more income or some had completely changed their career to other trades for them to meet their basic needs.

Another reason cited for the high number of informally trained artisans in the construction industry was that there were few trade schools offering quality education in the country. In addition, the majority of artisans faced financial difficulties for them to advance their career. With regard to school leavers, they faced two barriers to access training. Firstly, majority of these school leavers did not meet the minimum entry qualifications in formal institutions like universities and colleges. Secondly a cost involved in acquiring these skills from higher institutions of learning was not affordable to everyone. The only easily available option was to get employment in construction, as informal artisans who were in the majority in Zambian construction industry due to lack of qualified ones from trade schools.

4.1.5 Prevalence of material wastage

Interviewees representing 80 percent, rated the prevalence of material wastage in the construction industry as being over 50 percent. The reason advanced for the high

prevalence of material wastage was lack of knowledge on materials by artisans. This tended to affect quality negatively and promoted high wastage of materials on site. In most cases, it was observed that already mixed and made materials on a construction site were left in-complete at knock off time. No efforts were usually made to finish off already prepared materials without workforce being awarded over-time. The study revealed that most informal artisans did not understand quantities and measurements. This increased wastage of materials and works were wrongly done, resulting in breaking and starting afresh on a number of activities .The disused materials were thrown away and new materials were bought and installed, there by increasing cost of the project.

4.1.6 Frequency of defects in construction

The study included gauging the frequency of defects in construction. 60 percent of respondents rated the workmanship by artisans as poor and that artisans needed close supervision to manage construction projects. Most interviewees rated the frequency of defects in the construction industry at more than 50 percent .The genesis of poor workmanship was cited as lack of ethical conduct. Many artisan workers did not consider being part of the firms, because of temporal engagement. Unethical conduct noted in this study included the tendency of artisans to report for work drunk and that stealing was high on some construction sites. The correct ratios of materials were not followed especially when using cement. Wrong quantity of cement compromised the strength of structures. In addition, most workers were said to be more concerned about wages than the quality and productivity of the projects.

4.1.7 Productivity

Included in this study was the aspect of determining the productive artisan age group. The age groups suggested were scored and analysed. Most interviewees gave the age range of twenty to fifty (20-50) years as the productive age group. The most frequent response given on average productive age was early thirties. Only one expert indicated that productive artisans existed who were above fifty years old, especially those trained before 1990.

The interviewees were asked on the importance of skills for productivity. All respondents representing 100 percent agreed that skills were important for productivity. The interviewees gave various reasons why knowledge and skills were important for artisans' productivity. These responses included that Knowledge helped to decide better; skills tended to be sharpened with repeated guided learning. For artisans to develop better skills they needed knowledge to help make better decisions when exposed to different site conditions. Artisans needed to think and plan the activities during work execution because construction projects were said to be different in size and geographically. The construction industry was deemed to be a multi-faceted discipline. In this regard, artisans should know how to solve problems as they arise, able to read a drawing, learn how to use new materials as well as quality control procedures. To achieve these, knowledge was essential. Furthermore, training tended to expose one to various situations which could not be obtained through experience only. A trained person would understand measurements to ensure quality and adherence to standards was achieved.

The findings further revealed that skills improve efficiency & effectiveness in the artisans. Most experts interviewed, felt firms could not produce without skills, because skills tended to reduce loss of time and material wastage. The trained artisans with better skills easily adapted to any type of work that gave them better understanding to read drawings and specifications.

4.1.8 Apprenticeship

When asked to suggest how many years training by apprenticeship should take, 60 percent of the respondents suggested two (2) years, 30 percent suggested apprenticeship should take three (3) years and 10 percent of the interviewee indicated it should take 5 years, because apprentices should be exposed to different projects. Less than two projects were not enough for apprentices to fully develop their skills.

The other aspect covered in this research was the importance of theory in apprenticeship. Most of the respondents, 60 percent said that theory was important in apprenticeship because it assisted apprentices to understand and solve problems

easily. Theory was deemed to improve apprentices' knowledge and understanding of various properties and behaviour of materials. Quality was easily achieved once theories were comprehended. Learning theories was also seen to give an opportunity to those who did not do well at secondary school to improve. It was also noted that spending 20 percent of the time on teaching theory was enough for the apprentices to learn important construction topics and be able to produce. Although qualification, as proof of one's ability to deliver in construction was cardinal, respondents felt that, what clients paid for in construction was the actual work done and/or produced. Therefore it was important for workers to get theoretical knowledge that helped them grasp practical work easily through apprenticeship.

4.1.9 Funding of apprenticeship

This study also dealt with the matter of funding apprenticeship. When asked to comment on the same, 40 percent interviewees suggested apprenticeship should be funded from taxing the industries. 30 percent suggested apprenticeship should be funded through a contract provisional sum on all government projects and these funds should be claimed by those contractors who were conducting training. Two (2) of the interviewees proposed that government should give grants to statutory bodies to conduct training. This could provide incentives in that as trade schools are given subcontracts on government jobs to enhance practical skills of students, institutions would at the same time raise money for training.

The study further revealed that business men were running construction firms and were not willing to spend money on training of skills. Therefore, there was need to raise funds for training through construction levy. It was suggested that this levy should be managed by other independent institutions so that more skills would be produced in the country. Once funding was certain, the industry would see increased enrolment of many young people into construction apprenticeship programmes. In this way, construction levy could be used because industry benefits from skilled trained man power from the government training programmes.

With regard to ease of administration of funding for apprenticeship, most interviewees noted that the contract provisional sum funding system would be easier to manage.

This was due to the fact that it would be easy for construction companies to claim money spent on apprenticeship training and from government projects paid directly to the needy area of training sites. The management and administration of the funds could be through nominated sub contracts on the projects. The contractor or sub contractor conducting apprenticeship training could be nominated and receive payment through monthly interim certificates

Other interviewees suggested funding of apprenticeship through "Tender discount" for companies offering apprenticeship training. It was suggested this would give incentives and thereby, encouragement to a lot more companies to participate in offering apprenticeship to young people.

4.2. Questionnaire survey findings

A total of fifty (50) questionnaires were distributed to the target respondents, thirty nine (39) managed to complete the questionnaire and returned them giving a response rate of 78 percent. The data collected was coded and analysed with Statistical Package for Social Sciences (SPSS) software. The results were presented as percentages after frequency tabulations using descriptive statistics.

The information from questionnaire survey was required to establish the findings which were identified from literature reviews and structured interviews. Attached to this report in Appendix B is a copy of the questionnaire which was used to collect data.

4.2.1 Organisation of respondents

The respondents came from organisations shown in figure 4-1:

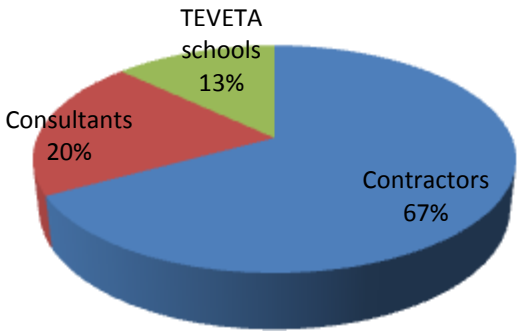


Figure 4-1: Organisations respondents represented

4.2.2 Position held by respondents in the organisation

From the findings, eight-percent of the respondents were in junior management positions; 31 percent were in middle management positions and 61 percent of the respondents held senior management positions.

4.2.3 Level of education of respondents

From the Figure 4-2 it can be noted that majority of the respondents 61 percent from in the construction industry were first degree holders and none were at doctorate level

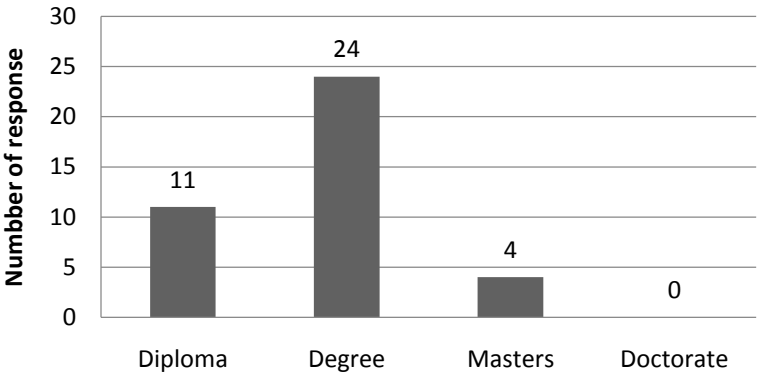


Figure 4-2: Highest level of education for respondents

4.2.4 Experience of respondents in the construction industry

The respondents' years of experience in industry ranged from less than 5 years to over 10 years. Majority of the respondents, 54 percent had more than 10 years of experience. Figure 4-3 presents the overall picture of respondents' years of experience in the construction industry.

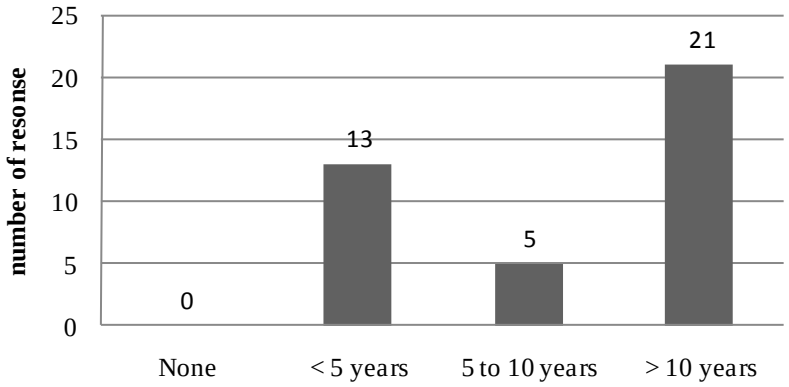


Figure 4-3: Years of experience of respondents

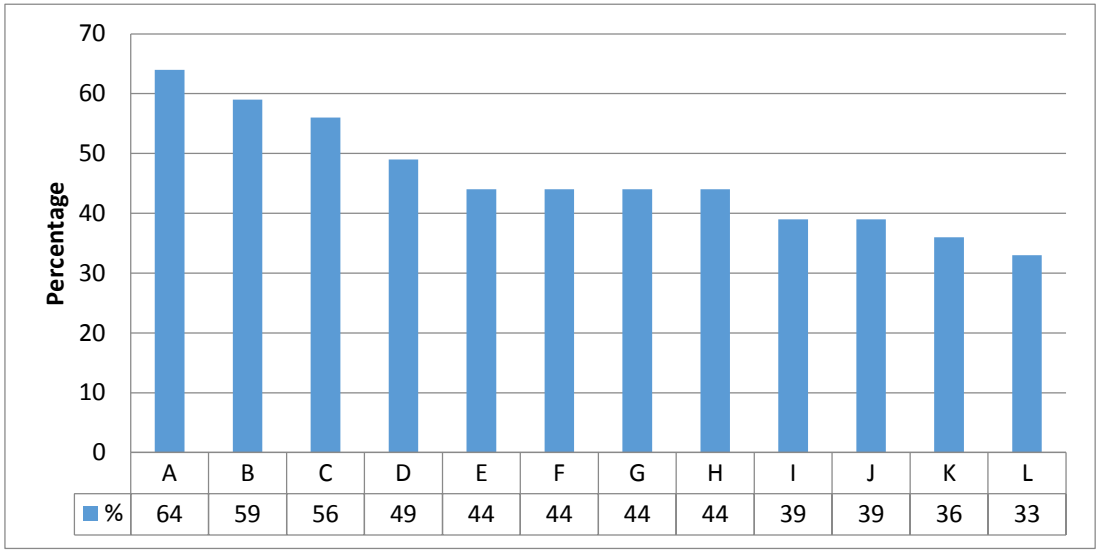
4.2.5 Formal training in construction industry

The majority of respondents, 97 percent, had formal training in construction related fields while three-percent did not have construction related qualifications.

4.2.6 Shortage of artisan skills in the construction industry

The survey revealed that there was shortage of artisan skills in the construction industry, especially that of tilers. This can be seen in that 64 percent of respondents said it was high, while 20 percent of respondent said it was medium shortage. The second ranked shortage of artisan's skills was shop fitters. The respondents 59 percent indicated the shortage of shop fitters, while for the medium shortage it was rated at 23 percent of the respondents.

The third ranked artisan's shortage was air condition technicians. The response was 56 percent who said the shortage was high, while 15 percent indicated the shortage was medium. The findings of the survey revealed that shortage of plasterers, who execute wall finishing on building works, were ranked fourth. The 49 percent of respondents said it was high, while ten (10) out of thirty nine (39) respondents reported the shortage was medium. Figure 4-4 shows the respondents' ranking of shortage of artisan skills in the construction industry.



A-Tilers
B-Shop fitters
C-Air conditioner technicians
D- Plasterers
E-Building foreman
F-Carpenter
G-Painters
H-Plumbers
I- Bricklayers
J-Electricians
K-Steel fixers
L- Steel fabricators

Figure 4-4: Shortage of artisans' skills

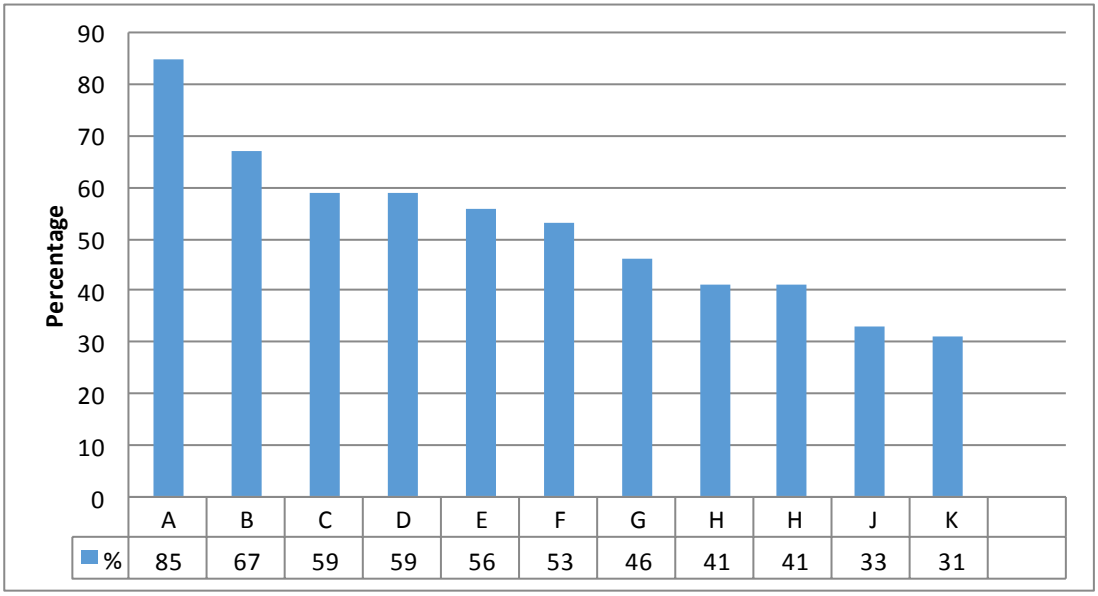
4.2.7 Factors contributing to the shortage of artisans skills

The survey was conducted to asses how factors contribute to the shortage of artisan skills in Zambian construction industry. Lack of co-ordination between industry and trade school was a leading factor identified, with thirty three (33) out thirty nine (39) respondents rating it high. The study also found, low number of training schools, because there were few quality trade schools available in the country, which could train and produce number of artisans required in the construction industry. The other

factor from the study was: poor condition of services which scored twenty three (23) out thirty nine (39) responses. This factor was similar to irregular re-numeration found to contribute for shortage of artisans in Ghana construction industry (Offei-Nyalo et al, 2014).

The unwilling of young people to join construction jobs (Oseghale et al, 2015) was ranked fourth with response rate of 56 percent. Most young people perceived construction jobs as un attractive and low paying jobs, so they disliked joining construction related careers compared to white collar jobs. The factors for poor condition of service and low wages paid in construction industry enlarged the un-willing ness of young people from joining construction jobs, which resulted in shortage of artisan skills.

The survey made known casual contract employment of construction workers as a factor that was rated above average by the respondents. Figure 4-5 shows the respondents' ranking of factors that contribute to skills shortages of artisans.



A-Lack of coordination
B-Few training schools
C-Poor condition of service
D-Un willing to join construction
E-Low wages
F-Casual contract employment
G-Change in technology
H-Poor social security
J-Aging of artisans
K-Disease of AIDS

Figure 4-5: Factors that contribute to shortage of artisan skills

4.2.8 Shortage of skills, defects and productivity factors

The conducted survey findings revealed other additional factors that contribute to the shortage of artisan skills and performance of workforce in the construction industry. Firstly the finding showed that skill and experience of artisan had significance influence of site productivity with thirty nine (39) respondents agreeing to this assertion. This finding was consistent with the study conducted by Mojahed and Aghazadel (2008). Secondly, thirty nine (39) respondents felt gap in knowledge of artisans tended to affect productivity. In addition, thirty six (36) respondents also noted that ethical conduct could minimise building defects and failure.

Ethical conduct was revealed as important factor that could affect the workmanship in the construction industry. In absence of good ethical conduct, there was potential to increase poor workmanship in projects. The assessment made on factor: poor workmanship as lack of experience and competency of labour, respondents agreed to this affirmation .The result that showed workmanship was affected with experience and competency of labour that was consistent with the study of Ali and Wen (2011).

The factor: poor selection of materials contributes to causing defects. This was rated with thirty (30) responses for high, while the wrong use of tools and equipment contributing to defects was reported at 69 percent in agreement. The study found that, defects were also as result of use of wrong tools and equipment on the construction sites. The other factor that affected shortage of artisan skills was the dissatisfaction by artisans which caused them to work for multiple construction firms so as to meet other social and economic needs.

Poor attitude of artisans, towards work based on laziness, affected productivity. This finding was also consistent with the study for progress of work conducted by Odesola and Idoro (2014). The 38 percent of respondents were of the view that productivity age for artisans was between 30 and 35 years although there was still a number of productive and hard working artisans in the industry, who were above fifty (50) years of age. Because of laziness, artisan had developed a tendency of job dissatisfaction that made them work for multiple construction firms so that they could meet basic

needs. The study findings infer that, contractors were concerned with only profits than paying their workforce for quality work. As a result of this, few people were interested to train in the construction related careers.

The other findings of the study revealed construction companies had a belief that once they trained their artisans, other companies would poach them; therefore investment in this type of training, would benefit other companies. This assertion resulted in firms not participating in training of artisan skills. Table 4-2 indicates the ranking of various factors that contribute to the shortage skills and affected project performance

Table 4-2: Ranking of factors that contribute to artisan skills

Rank	Factors	Number of respondents who agreed
1	Skill and experience of artisans have significance influenc of site productivity	39
2	Gap in knowledge of artisans affect productivity	39
3	Practise of good ethical conduct minimise building defects and failure	36
4	Poor workmanship is lack of experience and competency of labour	35
5	Poor attitude of artisans based on laziness affect productivity	32
6	Jobs in construction are short term contracts	30
7	Poor selection of materials cause defects	30
8	Contractors are more concerned with profits than paying workers for quality work	27
9	Wrong use of tools and equipment contribute to defects	27
10	Few people are interested to train in construction	25
11	Job dissatisfaction by artisans cause them work for multiple construction firms so as to meet their social and economic needs	24
12	Firms have a belief that once they train artisans, other companies will poach them	24
13	Age of artisan affect productivity	20

Table 4-2: Ranking of factors that contribute to artisan skills (continued)

14	Many qualified artisans don't practise and	18
15	Most productive age for artisan is between 30 and 35 years	15

The findings of the study infer that artisans' workmanship was average, and only few worked according to the drawings and specification .The understanding of concrete mix ratio by artisan engaged on sites was only 18% correct in most cases, and tasks given to the artisan were not correctly done on first attempt. This was because of low efficiency and effectiveness of artisan engaged in the Zambian construction industry. The findings of the study concluded it was not easy for artisans hired to carry out tasks without supervision. Twenty five (25) out of thirty nine (39) respondents felt, artisans in construction needed very close supervision to achieve progress and quality of work on a project.

The study further revealed, the importance of certifying of artisan practising in the construction. The thirty five (35) out of thirty nine (39) respondents agreed with certification of artisans. This process would improve the quality of artisans engaged and reduce the level of supervisions.

4.2.9 Apprenticeship training

In order to alleviate shortage of artisan skills, apprenticeship training was evaluated through considering various factors. The first factor for apprenticeship which scored highest response of thirty six (36) was that apprentices should be examined. Secondly, thirty four (34) respondents agreed that the work based learners should learn theory for twenty percent of training time.

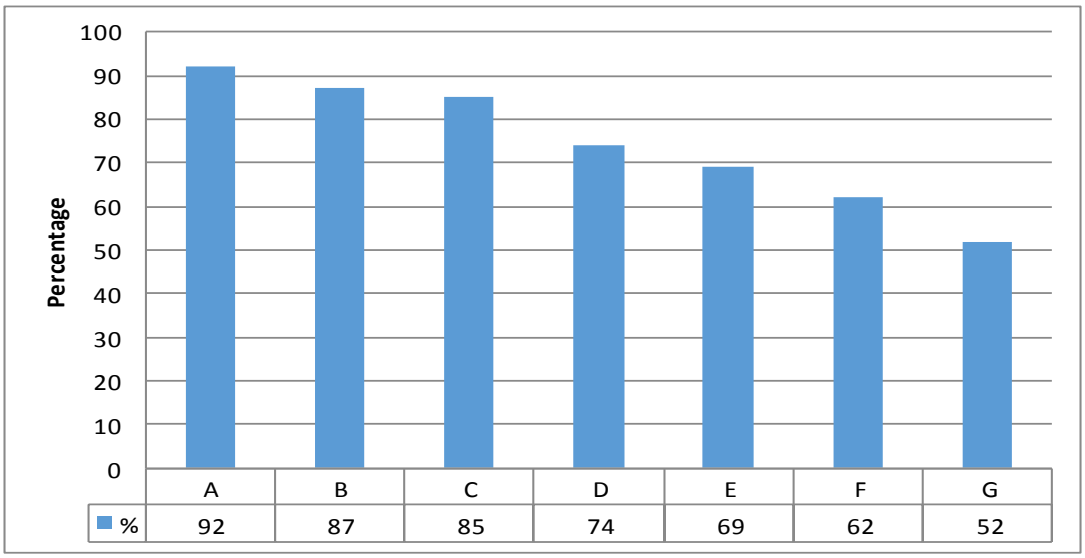
The third factor dealt with the issue of trade schools being given sub-contracts on government funded projects to enhance practical learning for students, with thirty three (33) of the respondents agreeing with this assertion. Minimum entry qualification for regulated apprenticeship should be Grade 9 school certificate, the

respondent were twenty nine (29) who agreed to this factor. Training by apprenticeship should take 2 years minimum had scored twenty seven (27) of the respondents.

Apprenticeship should be funded by contract provisional sum on government projects; this factor was rated by twenty four (24) of the respondents who agreed to this type of funding method of apprenticeship. The final factor which was evaluated was: funding apprenticeship by taxing industries operating in Zambia, only twenty two (22) of the respondents agreed to this method of financing.

The findings of the study infer that trade schools under TEVETA should be awarded sub-contracts on all public works, this could promote quality practical skills for students, and at the same time help the institutions raise resources to finance operation. The trade schools at time of the study concentrated more in teaching theory than practical works. Artisan skills are hand-on job which needed more practical skills for application in the industry. The students who were sent on industrial attachments to private firms were not closely monitored for them to receive effective practical learning. Introducing subcontracts on trade school would over come challenges in teaching practical works.

Training by apprenticeship should take period of 2 years minimum. The period of apprenticeship training finding was in consistent with study by Smith and Kemmins (2013) that recommended 2 to 3 years for the training programme. Comparing the two (02) methods of funding of apprenticeship training highlighted in the study. The contract provisional sum was found easier to manage and implement because the funding would go to nominated contractors conducting apprenticeship training through interim payment certifications. Figure 4-6 indicates the ranking of the various apprenticeship factors based on frequency index significance



A-Apprentices should be examined

B-Apprentices should learn 20% theory

C-Trade schools should be given sub contracts

D-Minimum entry is Grade 9 certificate

E-Apprenticeship training should take 2 years minimum

F-Apprenticeship should be funded by contract provisional sums

G-Apprenticeship should be funded by taxing the industry

Figure 4-6: Apprenticeship training factors

4.3 Further discussion on shortage of artisan skills findings

The number of skilled and experienced artisans was low, the gap needed to be addressed. Zambian artisans tended to have a laziness attitude towards work. This called for increased supervision in order to ascertain the desired quality on projects. More effort should be given to the training of artisans by government and the trained artisans should be able to work with minimum supervision. The findings further revealed lack of experience by artisans in construction caused delays in completing projects because of doing same activities a number of times

Apprenticeship entry point should start at grade 7 certificate level, to give chance to many citizens who may be talented but did not have opportunity to progress academically. At the moment even basic skills like painters, welders were being done

by foreigners. This is to prove that there were few construction skills in Zambia. The findings showed that reduced number of artisans in the construction industry was mainly due school leavers only interested to train in white collar jobs careers. Jobs in construction were perceived to be dirty by the young people. Institutions providing these white collar jobs have a lot of entrants, compared to the trade schools, where enrolment has been reducing year by year. This scenario had forced some trade schools to close certain departments.

The other factor, training of artisan was expensive compared to the other college qualification, since most trade schools were not well funded. They failed to raise money to sustain the trade courses. This made some trade schools to scale down certain departments for artisan training and increase enrolments in business courses. Most respondents said, in order to sustain skill training of artisans, students in trade schools should be given bursaries just like their students in government universities. This would enable and encourage more students take up courses in trade schools to increase capacity. There was need to encourage school levers or those who at least acquire some form of education to take career in construction industry.

Government and private sector should sponsor and promote artisan skills training so as to boost number of artisans' availability in the country. The findings further revealed that, artisan skills training should be tailored to reflect the needs of the Zambian construction industry. Most artisans current hired on construction sites were lazy and drink too much alcohol; therefore they needed close supervisions to achieve results.

4.4 Summary

The chapter presented the data obtained from interviews and questionnaire survey. The analysis of the data elaborated which factors are significant that cause shortage of artisan skills in the Zambian construction industry .Similar factors that cause construction defects and productivity were also assessed. Before considering alleviation of shortage of skills, apprenticeship factors were identified and evaluated. The next chapter, examine three case studies to consolidate the findings of the interview questions and questionnaire survey.

CHAPTER 5: CASE STUDIES

5.1 Introduction

In the previous chapter, interviews and questionnaire survey findings were presented. In this chapter, three case studies are reviewed. Case studies are examples which give an insight into the context of a problem, as well as, illustrating the main point by exploiting one or two instances to show what a situation portrays. According to Yin (2003), case studies capture results of what happened and brings attention to a particular challenge or difficulty in a project through understanding of real-life situations. The three (3) case studies that were examined in this chapter were:

a) bricklaying and carpentry training at Lusaka Vocational Training Centre;
b) reduction in number of artisan trainees at Evangelical Fellowship of Zambia Training Centre; and
c) shortage of formal artisans hired at Millers Construction Limited.

5.2 Case Study 1: Bricklaying and carpentry training at Lusaka Vocational Training Centre

5.2.1 Introduction

In its prospectus, TEVETA (2012) acknowledged the challenges in accommodating the increasing number of school levers in the training of skills. Its vision was to increase capacity of training institutions to accommodate increased numbers of learners. Only about 8% of the training institutions in the skills sector offered technical qualifications, hence creating a problem with skills provision among youths (TEVET, 2011).

Lusaka Vocational Training Centre (LVTC) is one of the 22 public TEVETA affiliate institutions based in Lusaka province. The centre is located in light industrial area off malambo road in Lusaka. The institution was started in 1997 as a joint venture between Japan International Cooperation Agency (JICA) and the Government of the Republic of Zambia. The primary purpose was to train Grade 7 drop-outs in auto mechanics. Later it was decided that trade courses could be offered to both Grades 9

and 12 school levers. Several equipments were bought and installed to commence training of craft skills in: bricklaying, carpentry, auto mechanics and power electrical.

The institution has board members, consisting of professionals from various spheres of society, including bankers and engineers. The management of the institution consists of: a Principal who is the Chief Executive Officer, a Vice Principal who is the training manager, and head of departments. The institute employs 22 lectures and a number of support staff. The maximum number of students is around 550 for both first and second years.

5.2.2 Bricklaying and carpentry trades

Bricklaying and carpentry are the least popular courses at LVTC. Out of 550 students in 2015, less than 20 had enrolled for bricklaying and carpentry at the time of the study. The trend in previous enrolments has been between 2 and 10 students only for each of the two trades, in each of the years of enrolment. In 2013, carpentry had two (2) first year students only and both were self sponsored. The course proceeded with two students only. The programme was accessed to be costly on part of the school to teach two students only. In the 2014 intake, there was a slight improvement in the enrolments. The number of students in carpentry and bricklaying was six (6) and they were all given bursaries by the Ministry of Education, Science, Vocational Training and Early Education while in the 2015 intake, eight (8) had enrolled and were given scholarships by the Ministry as well. These scholarships were meant to assist in training of bricklaying and carpentry skills and at the same time keep these trades' courses active and relevant to the institution.

The number of enrolment in *none construction related programme* was favourable with more than 100 students per class compared to carpentry and bricklaying which had less than 10 students per intake. In order to promote and encourage young people willing to train in bricklaying and carpentry programmes, LVTC had lowered its tuition fees, from three thousand Kwacha (K3,000) to six hundred Kwacha (K600) per term. LVTC paid the difference in cost on behalf of the students. This incentive was not extended to other programmes. Despite the reduced fees, other programmes attracted more enrolment.

The findings of the case study revealed that unless the government puts value to skills like bricklaying and carpentry, by rewarding and recognising those who receive training in these trades, it would be difficult to encourage many young people enrol for these skills. The perception of people about bricklaying and carpentry at the time of the study, were that, the trades were not wealthy for someone going to a trade school to train, because it made no difference between those who held a trade and those without it. Both type of artisans received same wages when working in the construction industry.

5.3 Case Study 2: Reduction in number of trainees at the Evangelical Fellowship of Zambia Training Centre

5.3.1 Introduction

Carpentry and joinery was the only construction trade that the Evangelical Fellowship of Zambia (EFZ) Training Centre was offering in June 2015 when the study was conducted. The carpentry department has been in operation since 1995, while the tailoring department began to function in 2008.

The aim of the carpentry trade was to build capacity in young adults with skills that would help them meet economic and social needs. The training programme was developed after realizing the high number of youths that had failed to complete high school due to socio-economic circumstances. Carpentry has an annual student intake in January as well as a bi-annual intake for those wanting to be enrolled in the six months coursees.

The EFZ Training Centre caters for high number of dropouts at both Grades 9 and 12. The centre is managed by 10 board members who are elected after every four (4) year term by members of the Evangelical Fellowship of Zambia (EFZ) church. The school has employed management, teaching, and support staff.

5.3.2 Declining enrolment of artisans

Since the EFZ Training Centre was opened in 1995, it has graduated a number of artisans. From the year 2000 the number of enrolment was above 45 per class in carpentry and joinery and about 40 students graduated from the carpentry department each year. These either joined construction industry or started their own business. After 10 years, the enrolments of students kept reducing year by year. By the year 2014, the number of enrolment per class reduced to 10 students only. This reduction has affected income for the institution which is private owned as well as contribution of skills to the construction industry and labour market. The Centre has been providing training to different types of people, including the deaf and dumb.

The findings of this case study showed reduced number of trained carpenters has contributed to the shortage of artisan skills in the construction industry. Most of those who graduate in skills trade from EFZ do not join the construction industry but go straight into running their own business ventures.

The decline in enrolments of youths at this trade school highlights the following reasons:

i) majority of students cannot afford to pay the training fee of K2, 850 per term; and
ii) few young people are interested in taking up carpentry career as a vocation.

The Ministry of Higher Education does not provide funding support to private institutions like EFZ to help in skills training, although private centres contribute significantly to training of skills which are absorbed in the construction industry

5.4 Case Study 3: Shortage of formally trained artisans engaged at Millers construction Limited

5.4.1 Introduction

Millers Construction Limited is a private limited company incorporated on 4th December, 1997 and is specialised in building and civil engineering construction. It is the a subsidiary of J J Lowe Superfos limited which was formed as a joint venture between J.J Lowe (Zambia) limited and Superfos Road Construction of Denmark. Millers' construction limited is a Grade 1 B contractor, Zambian citizen owned, and is

registered with NCC. At the time of the study, Millers construction employed 10 senior personnel who were based at the head office in Lusaka, 15 technical personnel based at various project sites, 250 artisan workers and over 750 general workers based on various sites. The number of artisans and general workers varied according to the job demand on site.

The clients for Millers include: the Government of the Republic of Zambia through various Ministries; World Bank; European Union; and the African Development Bank. The awarded projects to Millers construction that were on-going on various sites at the time of the study amounted to approximately K282,224,756 as shown in Table 5-1.

Table 5-1: Value and name of on-going projects for Millers construction as at July 2015**.**

Item	**Name and location of projects**	**Value in Kwacha ZMK**	**Estimated date of completion**	**Name of client**
1	Construction of Kaumba boarding school in Monze	41,944,302	Dec. 2015	Ministry of Education
2	Construction of Nyampande boarding high school in Petauke district-Eastern Province- external works	18,479,768	Jun.2015	Ministry of Education
3	Construction of 5x4 Storey Hostels at UNZA, Lusaka	85,175,340	Sep. 2017	Ministry of Education
4	Construction of 6x4 Storey Hostels Blocks and External works for CBU at Ndola	136,625,346	Aug. 2018	Ministry of Education
	Total	**K282,224,756**		

Source: *Millers construction limited company profile*

5.4.2 Shortage of formal qualified artisans at Millers construction limited

Millers Construction Limited employed 250 artisans on various construction sites. The artisans included bricklayers, carpenters, plumbers, steel fixers, foremen and electricians. About 175 artisans, representing 70 percent who were employed in the company at the time the research was conducted did not have formal qualification. They only had references or record of service from other construction firms, while only 75 employees representing 30 percent had craft and trade test certificates from trade schools.

The value of running contracts the company had did not represent the required numbers of artisan skills engaged for the works. The company could not find suitable artisans with formal qualifications to be hired for employment. The majority of those in employment at Millers learned their skills through on-the-job experience only.

The high number of infrastructure projects in the country has resulted in high demand for qualified artisans in the local construction industry. Apparently, there is no sufficient capacity and capabilities of artisan skills levels to fulfil the needs of contractors. The lack of interest by the youths to take up trade skills because of unfavourable working conditions of service affects the availability of the artisans.

A consequence of this situation is that the quality of contractors' workmanship is declining as key targets relating to the cost of projects and times of completion are usually compromised. The insufficient training of artisans is seen to be one of the main causes for lack of artisans. Levels of wages are also perceived to be low to attract and retain good artisans.

Millers Construction Limited initially engaged some artisans on casual basis for a maximum of five months, then after wards they were put on a renewable contract. The following considerations were made before the contract was offered and signed with the artisan:

i) *No thefts*: the involved artisan should have a clean record of theft, without stealing any company materials while he was serving a five months probation period;

ii) the artisan should demonstrate good attendance at work, *no absenteeism* from work without proper reasons or permission from the authorised company representative;

iii) *punctuality*: the artisan should demonstrate good responsibility and punctuality when reporting for work; and

iv) *general good behaviour:* artisans must meet minimum standard of good behaviour before they are considered for a contract.

At the time of the study, Millers Construction Limited offered the rates for general workers, semi-skilled and skilled artisans. General worker were being paid K30 per day, semi-skilled received K35 per day and skilled artisans earned K45 per day. The company retained five percent from each artisan for the National Pension Scheme Authority (NAPSA) contribution.

5.5 Summary

In this chapter, three case studies were analysed: bricklaying and carpentry training at Lusaka Vocational Training Centre; reduced number of trainee artisans at the Evangelical Fellowship of Zambia Training Centre; and shortage of formal artisan skills engaged at Millers Construction Limited. The case studies revealed the basis for the shortages of artisan skills through low enrolment and few artisans graduating from trade schools. The industry is currently heavily dependent on informally trained artisan to carry out works in construction companies.

In the next chapter, the development and validation of the Apprenticeship Skill Flow Chart Model (ASFM) to alleviate shortage of artisan skills is presented.

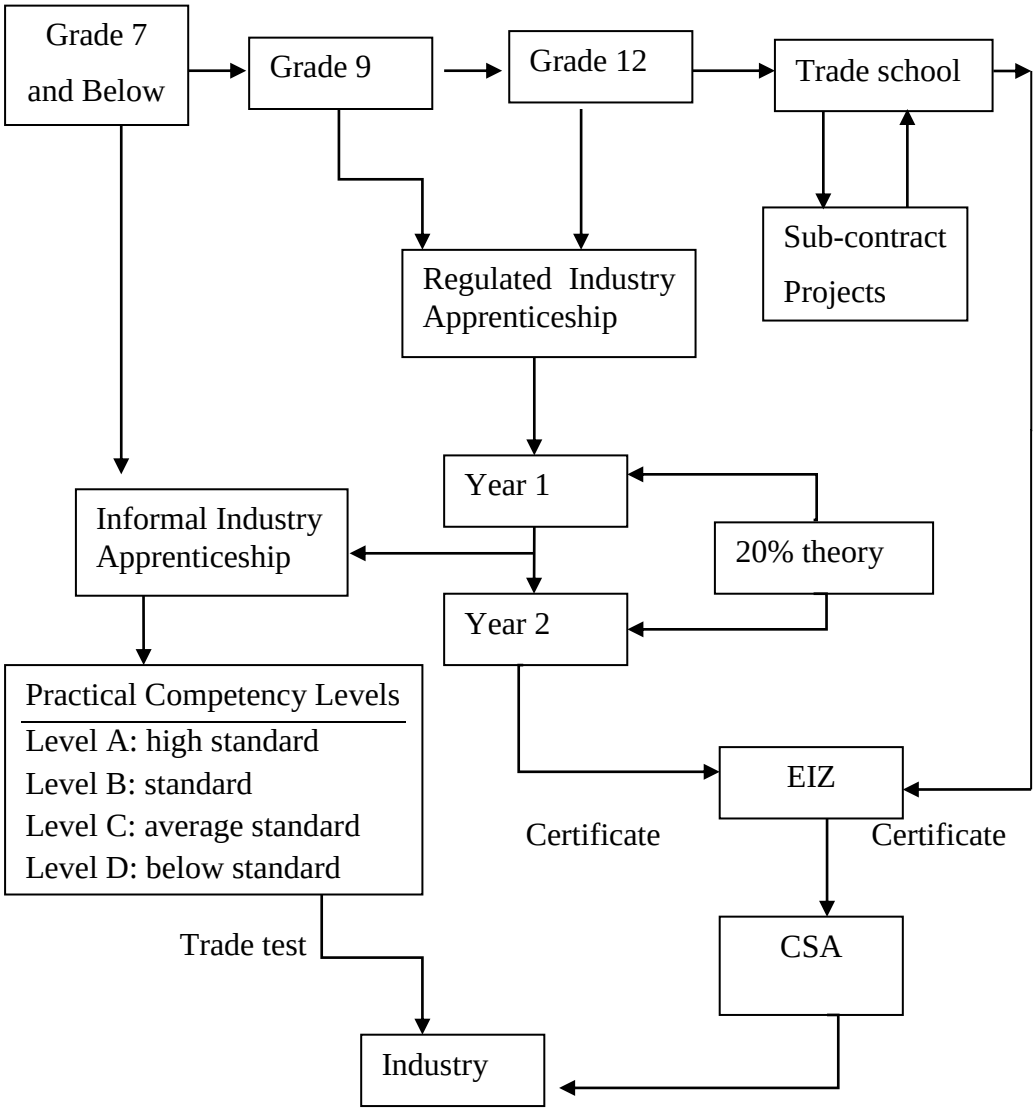
CHAPTER 6: APPRENTICESHIP SKILLS FLOWCHART MODEL AND IT'S VALIDATION

6.1 Introduction

Three Case Studies were presented in previous chapter. In this chapter, development and validation of the Apprenticeship Skills Flow Chart Model (ASFM), meant to alleviate shortage of artisan skills is explained. The model development is based on the need to have steps that are comprehensive, simple, as well as easy to implement by industry stake holders.

6.2 ASFM Model Development

The aim of the study was to develop a model that alleviates shortage of artisan skills in construction industry. The development of the ASFM was based on the results obtained from interview, questionnaire survey findings: consolidated list of significant factors gathered that were perceived to affect skills shortages presented in chapter 4, and highlighted case studies in Chapter 5. The ASFM was built around the theoretical framework of addressing the current heavy dependence on informally trained artisans in construction companies, because of low level of artisan graduates from trade schools. The model tools could be used to increase capacity and quality of skills in the industry. This model would use different pathways of apprenticeship training. The developed ASFM is presented in figure 6-1.



Grade7: Leaving of school certificate of primary education

Grade 9: Leaving of school certificate of junior secondary education

Grade12: Leaving of school certificate of senior secondary education

Trade school: Vocational training institution

EIZ-Engineering Institution of Zambia

CSA-Construction Standards Authority

Figure 6-1: Apprenticeship Skill Flow chart Model

6.3 Explanation of Model

6.3.1 Introduction

The ASFM would use *3-pathway* training structure for artisan skills: *Informal Apprenticeship, Regulated Apprenticeship and Trade school training*. The entry qualification for informal apprenticeship would be Grade 7 and below, and for regulated apprenticeship; Grade 9 or 12, while trade school training would enrol those who can not be admitted into the universities.

6.3.2 Path 1: Informal apprenticeship

Majority of young people in Zambia experience lack of employment, low skills and low income. TEVETA formal training system has only been giving few opportunities to the youths, because of high barriers in terms of entry qualifications, cost and accessibility. Therefore, *informal apprenticeship* remains one of the training pathways that provide skills for construction industry. It is the easiest path for career development, particularly for school drop outs and those from poor families who can not progress academically. Informal apprenticeships training are not formally regulated by authorities, but follow local traditions and customs. They are a socially accepted type of training that provides relevant skills and increases apprentices' employment chances once training is completed with a help of a trainer. The guided learning of informal apprenticeship makes it's an important source of innovation and productivity for the construction industry.

Grade 7 drop outs and below, could enrol for informal apprenticeship, which is 100 percent hands-on career. The apprentices would be guided by *artisan trainers* during training and their progress would be monitored before they could be hired for employment by contractors. The apprentices should be tested for practical trade tests at the end of the apprenticeship levels to determine competency and suitability as established by TEVETA procedures. The levels would range from Level D as a starting point in the industry to level A, which is final and highest standard level for informal apprenticeship. The testing would be frequent and mandatory for continuous assessment of training progress of apprentices before reaching acceptable competency levels recommended by the Construction Standards Authority (CSA).

6.3.3 Path 2: Regulated apprenticeship

Grade 9 or 12 school certificate holders, who can not proceed because of dropping or through financial constraints along the way in their education career, could enrol into regulated or formal industrial apprenticeship .The path gives chance to those who did not do well at Grade 9 to improve and at the same time broaden enrolment, to increase capacity for artisan training. The programme would have emphasis on 80 percent practical lessons of the allocated time. From the questionnaire survey findings, regulated apprenticeship, apprentices should learn 20 percent theory of important construction topics during time allocated for training. After first year, assessment examinations should be taken to evaluate the progress of the learners. Those who fail to qualify to the next level they would be re- directed to join *informal apprenticeship*. The successful ones should progress through the normal route of apprenticeship system.

In second year, another examination should be taken to assess learning progress of the apprentices. The un-successful apprentices would be made to repeat for six months and take examination afterwards. On completion, apprenticeship graduates should be awarded industrial accredited qualification by TEVETA; that would be also recognised by EIZ for craft membership .Those apprenticeship graduates who become member of EIZ, would be issued with practising licences before they are employed in the construction industry. The CSA would be mandated to inspect quality of work performed by artisans.

From the study findings, the advantages of training in apprenticeship programme includes among students acquire practical skills on latest equipment on the market and most recent working method in the industry. Similarly apprentices develop key soft skills such as dealing with clients in the industry.

6.3.4 Path 3: Trade school training

Trade school entrants would follow normal TEVETA enrolment path of recruitment programme. The trade school institution would be mandated to register for sub-contract works on government projects. The sub contracts projects are meant to increase practical skills for student in the trade schools. Previous research findings

reported industry had raised a concern on the calibre of graduates who were coming from the various TEVETA training providers; most of them did not meet the needs of the industry (TEVET, 2010). Through, introduction of sub contract projects the, students would have gained practical knowledge on hands-on skills to enhance, capacity. After completing studies from a trade school, artisans would apply to EIZ for membership and issued with practising license before getting employed in the construction industry where CSA would implement quality control.

6.3.5 Role of Engineering Institution of Zambia in a Model

Stakeholders involved in artisan skills development include EIZ, TEVETA and CSA. Efforts should be made to coordinate between EIZ and other training providers of artisan skills. The research findings revealed lack coordination among the stake holder in the industry. After certification of artisans by TEVETA, EIZ should keep artisan members well informed of the continuous developmental programs, then enforce and administer comprehensive code of ethical standard procedure that would benefit artisan membership. EIZ should issue practising license only to those artisans who qualify through apprenticeship and trade school training. Practising license should contain terms of reference for quality control of works on the project which should be implemented by CSA.

6.3.6 Construction Standards Authority

The study revealed, articulated strategy that should be implemented to improve the skills of construction artisans was certification. Certification is the assessment process which is part of qualification to gain recognition through competency testing and examinations. The purpose of certification is to provide a guarantee of artisan skills, quality and work ability, so as to produce construction products that meet established quality standards in the country. All construction artisans would have practising license prior to employment. The role of CSA is to inspect quality of work performed by artisans and develop standard of practise for the construction industry.

6.3.7 Construction industry

The industry is made up of different sectors, including: clients; contractors, suppliers, and consultants. The study, revealed was lack of coordination among different sectors**.** All construction players should monitor artisans engaged in the industry to generate a standard scheme that measures the quality of work achieved by contractors. The CSA would supervise quality implementation in the construction industry. It should be a requirement that contractors should only engage artisan who are certified and holds practising licences from EIZ. Consultants should exercise their duty of care in performing their works and not resort to unethical behaviour of approving any sub-standard works done by artisans engaged in the industry.

6.4 Validation of Model

Validation of model for alleviation of skills supply to the construction industry was done. Having developed the model, it was essential that it be validated. According to Macal (2005), model verification and validation are essential parts of the model development process for it to be accepted and used to support decision making. Validation is used by researchers to help improve accuracy and credibility of data obtained. Validation should be done by people who are experts in area of study (Eddy et. al, 2012).

The population of 39 respondents from questionnaire survey was used for sampling. The sample size of 10 respondents from middle and senior management were sampled. The targeted respondents were considered to be competent enough to judge and interpret the meaning of model.

6.4.1 Validation process

The first assessment question sought to establish whether the model addresses the shortage of artisan skills in the construction industry. The aim of question was to establish whether the steps in the model would address the main objective of the study and whether apprenticeship skills flow chart model will bring about the needed skills supply to alleviate shortage of artisans. Respondents representing 90 percent agreed

and only 10 percent was neither agreeing nor disagreeing. The category of respondents are summarised in Figure 6-2

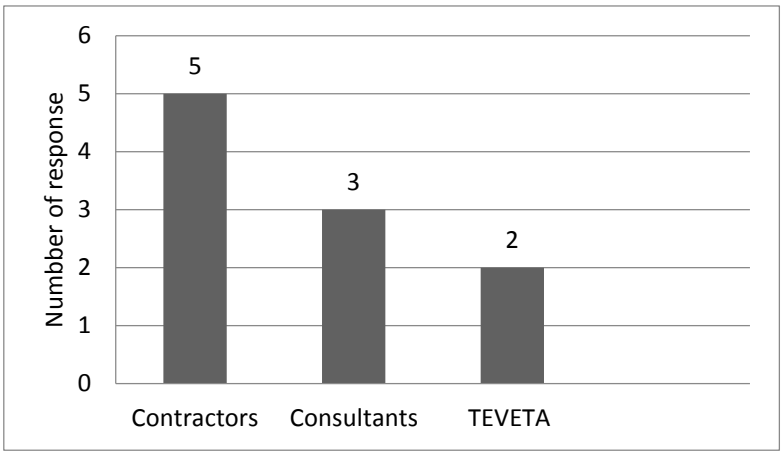


Figure 6-2: Type of respondents

6.4.2 Simplicity of model

The respondents were requested to indicate how the proposed steps in the model were easily understood for implementation by stake holders. All the respondents agreed that the steps in the model were easy and clear to follow for implementation. From these results, the respondents agreed that the model was clear and unambiguous, useful and could be used to increase number of artisans in the industry.

6.4.3 Usefulness of model to construction industry

Ninety percent of respondents indicated that the model was useful to the construction industry in improving skills supply because it uses more than one path way. Only 10 percent was neither agree nor disagree. The model gives the process flow for gaining construction experience and quality control mechanism. Its implementation should address the shortage of artisan skills.

6.4.4 Suggestions

The proposed model if implemented would go a long way in addressing the skills shortage in Zambia. The respondent indicated that model should address continuous career progression from one level to the next level of learning and establish method of identifying and selecting of artisan trainers. The construction industry needs skilled labour, and government should invest in science and technology education .During training, apprentices should be blended with highly skilled personnel; so that there is gradual transfer of skills from one group to the other. The model should also address those below grade 7 qualifications and those who have never been in school.

6.4.5 Summary

In this chapter, apprenticeship skills flow chart model was developed and validated by senior and middle management in construction industry. Respondents stated that the model was clear and unambiguous, useful and could be used to increase the number of artisan skills in the in construction industry. The next chapter will present conclusions, recommendations and limitation to the study.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

In the previous chapter, the model stages were discussed. In this chapter, conclusions, recommendations, limitations to the study and suggestions for further work are presented.

The aim of the study was to develop a model that enhances effective skills supply to mitigate shortage of artisan skills in Zambian construction industry. The specific objectives of the study were to: establish factors that lead to shortages of required skills in building construction industry; determine how skills shortages affect number of construction defects, productivity; and evaluate apprenticeship training as a mitigation pathway for the shortage of required skills in construction industry. The aim and objectives of the study were achieved through: literature review; interviews with experts that had 10 to 35 years of experience in the construction sector; and a questionnaire survey with 39 respondents from construction organisations and training institutions. A model for skills training in construction was developed and validated.

7.2 Conclusions

The interview questions were designed on the basis of the information drawn from the literature review. The questionnaire survey design utilised information from literature review and the results of the interview. The conclusions drawn from the findings of the interviews, the questionnaire survey and case studies in relation to the objectives of the study are presented in the next sections.

7.2.1 Factors that lead to shortages of required skills in construction industry

The study established shortages of crafts skills; and those with prevalence were among others: tilers, shop fitters, air conditioners technicians and plasters. The identified skills were in short supply to satisfy the requirements of the construction industry. Factors that led to shortage of skills were established in this study that included among others:

i) lack of co-ordination between industries and trade schools;

ii) few number of trade training institutes; and

ii) unattractive conditions of service.

Regular engagement between TEVETA and industry was cardinal. A lot can be learned from countries that are technologically advanced like German, which has a law that promotes the closed co-operation among the training institutions, private firms and trade unions. Similar law can be used in Zambia to, strengthen the training of skills. From the research findings, only below 8% of trade schools were offering training to artisans in the country. In addition, the majority of artisans faced financial difficulties for them to advance their career; they faced two barriers to access training. Firstly, majority of these school leavers did not meet the minimum entry qualifications in formal trade schools. Secondly a cost involved in acquiring these skills was not affordable to everyone. The only easily available option was to get employment in construction as a general worker.

7.2.2 How skills shortages affect construction defects and productivity

The effects of *shortage* of crafts skills were identified:

i) contributed to high number of redo works in the industry resulting from poor workmanship;

ii) majority of workers were not able to work according to specifications and drawings; and

iii) contributed to low productivity levels that requires close supervision of artisans to achieve activity performance.

It was established that the workforce with potential skills and talents were discouraged to train and work in construction related careers, due to perceived poor economic gains such as low wages. The low level of crafts' skills that exist in the industry affect construction defects and productivity. Unethical conduct noted in this study included the tendency of artisans to report for work with hangover. There is a correlation between heavy drinking of alcohol and hangovers exhibited at place of work (Sheikh, 2014) as a result, pilfering of materials was high on some construction sites in order to finance the drinking habits.

The works were wrongly done in most instances; this resulted in breaking and starting afresh on a number of activities. The disused materials were thrown away and new materials were bought and installed, there by increasing cost to the project.

7.2.3 Evaluation of apprenticeship training in construction industry

The apprenticeship makes it's an important source of innovation and productivity for the construction industry workforce. The study findings revealed that apprenticeship take two (2) years minimum for the apprentices to be exposed to different work environment. It was established that spending 20 percent of the time on learning theory was good enough for the apprentices to study important construction topics.

Apprenticeship training offer high quality learning, allowing students to acquire practical skills on latest equipment on the market and most recent working methods in the industry. Apprenticeship training would build up skills in the industry and create loyal workforce that would bring about growth in skills base for construction companies. The creation of new talents through apprenticeship in the industry will result in increased innovation and productivity.

7.3 Recommendations

Various skills shortages were identified in the study. To enhance skills supply in construction industry, apprenticeship training has been recommended as a possible approach for alleviating skills shortages. To implement and actualise apprenticeship training: TEVETA, NCC, EIZ and Government of the republic of Zambia (GRZ) should implement recommendations that have been advanced from the study.

7.3.1 Model for supply of skills in construction industry

The study established that the construction industry experienced skills shortages. A model was developed for alleviation of skills shortages by using different training pathways. The model if implemented in construction in Zambia, could lead to lower incidences of shortages of quality artisan skills. It is therefore recommended that the model be incorporated in TEVETA structures; to help in training of construction skills. It is anticipated that implementation of ASFM will lead to more artisan labour and rise in quality and productivity improvements in project delivery.

7.3.2 Labour contractors

It was observed in this study that contractors were not interested in training of skills but were concerned more with profits. The construction companies had a belief that once they trained their artisans, other companies would poach them; therefore investment in this type of training would benefit third parties instead of the sponsors. This assertion resulted in firms not participating in training of artisan skills. The recommendation is made to introduce labour contractors who should carry out training on behalf of governments and large construction firms. NCC should introduce a registration *Grade* for training companies who should operate as subcontractors in the construction industry.

7.3.3 Funding of skills development

Government should implement construction levy to help finance apprenticeship skills training that should be done by selected construction companies in the industry.

7.3.4 Construction of Trade Institutes

Government should construct at least a trade school institute in every District of Zambia that should mitigated the shortage crafts training schools in the country

7.3.5 Promoting Science and Technology

Trade institutes should promote the teaching of Science ,Technology Engineering and Mathematics (STEM) subjects , to stimulate interest in young people perusing college education so that majority enrol in technical programmes than business courses.

7.3.6 Construction Standards Authority

The study revealed that workmanship of artisans in the construction industry was poor, only few skilled workforces worked according to the drawings and specification. The conclusion was that artisans hired did not find it easy to carry out tasks without very close supervision. To achieve high quality standards, it is recommended Construction Standard Authority is established as a *Division* of the National Council for Construction, and its function should include among other things:

i) promote and develop specifications for the construction industry in Zambia; according to acceptable trade standards of practise;

ii) encourage and conduct country wide education in skills standards among contractors, consultants and infrastructure developers.

7.4 Limitations and suggestions for further work

The study had some limitations that should be considered. The research focused on construction artisans' skills for the construction industry. The findings might vary from construction to manufacturing industry using the same type of artisan's category skills highlighted in this study. Another limitation encountered during the survey was that Chinese respondents, most of whom were contractors, had a language barrier to understand the questionnaires in English, thereby, making it impossible for them to fill in and return questionnaires in most instances. Future research should be extended to road construction and manufacturing industry of construction related materials.

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APPENDIX: A

STRUCTURED INTERVIEW GUIDE: QUESTIONS

The purpose of this study is to obtain a clear understanding on skills shortages, construction defects, productivity and apprenticeship in construction. Please note: answers should be based on your experience in construction of *building projects*, which is the focus of this study. All information provided will be treated strictly confidential, only used for academic purposes.

Section A: Institution Identification Particulars

Name of Institution.....

Type of organisation, choose from below

Contractor.....

Consultant.....

School.....

Others.....

Section B: Personal information

Name of interviewee: …….

Sex.....

Field of specialisation…….

Level of qualification……..

Years of experience ……..……..

Interviewee's job title in organisation……:

Section C: Shortage of artisan skills

1. In your own view, is there a shortage of skilled artisans in construction industry?

a) Yes b) No c) Not sure

Why do you say so…….....

2. In your view, which category of artisans is most in short supply and affects construction quality and productivity in building projects? (*Rank them as; high*

shortage (H), medium shortage (M) or low shortage (L); depending on how you see the problem)

Suggested Artisan Category High=1 Medium=2 Low=3

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

_____ ☐ ☐ ☐

3. Do you think conditions of service affect artisan's availability in construction Industry? 1. Yes 2. No

Skip question number 4 if the answer is no.

4. How do the conditions of service affect artisan's availability in construction industry?

……

……

5. What are the reasons for high informal qualification of artisans, if any, hired in construction industry?

.....

6. In your view are construction firms participating in training of skills?

1. Yes 2. No

If the answer is yes, skip question number 7

7. What are some of the reasons construction firms are not participating in skills training?

……

……

……

…….

Section D: Construction defects

8. How do you rate the prevalence of material wastage on construction sites?

……

……

9. In your opinion, how frequent is the occurrence of defects in construction industry?

…….

10 What is your experience with artisan's workmanship in construction industry?

……..

Section E: Productivity

11 What age group of artisans contributes most to productivity on site?

……

……

…….**.....**

12. Would you describe skills to be important for productivity on site?

1. Yes 2. No

If the answer is yes, go answer question 13

13. Why.....…

14. How do you rate the productivity level when the majority of a workforce has formal skills on construction site?

……

……

……

……

Section F: Apprenticeship

12. How many years should training of skills by regulated apprenticeship take?

……

……

13. Why is it necessary for apprentices to learn a bit of theory, during apprenticeship training?

……

……

…

14. Suggest how apprenticeship training should be funded?

……

……

…….

.

End of interview, thank for time

APPENDIX: B

QUESTIONNAIRE

You have been selected to take part in this questionnaire; your co-operation will be highly appreciated. The study is about shortage of artisan skills in the Zambian construction industry. This survey is purely for academic purpose, all information you provide will be kept strictly confidential

---

Section A: Institution identification and personal information

1. State name of your organisation …….

2. What position do you hold in your organisation?
   A. Junior management
   B. Middle management
   C. Senior management
   D. Others (please state).....

3. What is your level of education?
   A. Grade 12
   B. Craft Certificate
   C. Diploma
   D. Degree
   E. Masters
   F. Doctorate

4 How many years have you worked in the construction industry?
   A: None
   B: less than 5 years,
   C: 5 to 10 years
   D: more than 10 years

---

5. Do you have any formal training in a construction related field?

A. Yes

B. No

Section B: Shortage of artisans

1. Please rate your perceived *shortage* of the following skills in Zambia

	Artisan category	**Very low**	**Low**	**Medium**	**High**	**Very high**
a	Building foremen					
b	Steel fixers					
c	Plasterers					
d	Air condition technicians					
e	Steel fabricators					
f	Carpenters					
g	Painters					
h	Plumbers					
i	Bricklayers					
k	Tilers					
k	Electricians					
l	Shop fitters					

2. Please rate how the following factors contribute to *shortage of artisan skills* (*Please tick one applicable answer in each box)*

		Contribution to shortage of artisans				
	Factors	**Very low**	**Low**	**Medium**	**High**	**Very high**
A	Low number of training schools					
B	Poor condition of service					
C	Low wages					
D	Capacity of a contractor					
E	Casual contract employment					
F	Lack of co-ordination between industry and trade schools					
G	Change in technology					
H	Aging of artisans					
I	Poor social security					
J	Disease of AIDS					
K	Un willing of young people to join construction jobs					

3. Indicate your level of agreement to the following statements on the following page. The following options have been provided, please choose one of them: strongly agree; agree; neutral; disagree; and strongly disagree. (*tick applicable in each box)*

	Factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
a	Few people are interested to train in construction related careers					
b	Jobs in construction are short term contracts					
c	Contractors are more concerned with profits than paying workers for quality work					
d	Firms have a belief that once they train artisans, other companies will poach them					
e	Many qualified artisans don't practise					
f	Job dissatisfaction by artisans cause them work for multiple construction firms so as to meet their social and economic needs					
g	Wrong use of tools and equipment contribute to defects					
h	Poor selection of materials cause defects					
i	Practise of good ethical conduct minimise building defects and failures					
j	Poor workmanship is lack of experience and competency of labour					
k	Skill and experience of artisans have significance influence on site productivity					
l	Gap in knowledge of artisans affect productivity					
m	Age of artisan affect productivity					
n	Most productive age for artisan is between 30 and 35 years					
o	Poor attitude of artisans based on laziness affect productivity					

Section C: Construction defects

In this section please choose one answer from the given options

4. How satisfied are you with artisans' workmanship in the construction industry?
   1 . Very satisfied
   2 . Some what satisfied
   3 . Neutral
   4 .Some what dissatisfied
   5 .Very dissatisfied

3. How often do artisans work according to drawings and specifications correctly?
   1. Always
   2. Frequently
   3. Sometimes
   4. Rarely
   5. Never

4. Please rate how artisans hired in construction understand concrete mix ratios
   1. Very poor
   2. Poor
   3. Fair
   4. Good
   5. Very good

Section D: Productivity

In this section please choose one answer from the given options

5. How often do tasks given to artisans get correctly done on first attempt?
   1. Always
   2. Frequently
   3. Sometimes
   4. Rarely
   5. Never

6. Please rate the effectiveness and efficiency of artisans hired in the Zambian construction industry.

1. Very poor
2. Poor
3. Fair
4. Good
5. Very good

7. Rate how artisans employed in the Zambian construction industry easily carry out tasks with minimum supervision

1. Not very easy
2. Not easy
3. Fair
4. Easy
5. Very easy

Section F: Apprenticeship

In question 8, please choose one answer from the given options

8 How important is certification of artisans practicing in the construction industry?

1. Not important
2. Fairly important
3. Important
4 Very important

9. Please rate the following apprenticeship factors

Item	Apprenticeship factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
A	Work based learners (apprentices) should learn theory for 20% of training time allocated for the programme					
B	Training by apprenticeship should take 2 years minimum					

Item	Apprenticeship factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
C	Apprentices should be examined					
D	Apprenticeship should be funded by taxing industries					
E	Apprenticeship should be funded by contract provisional sum on government projects					
F	Trade schools should be given sub-contracts on government funded projects to enhance practical learning for students					
G	Minimum entry qualification for regulated apprenticeship should be grade 9 school certificate					

Give any other comments you may have on artisan's skills in Zambian construction industry. Please state these in the space provided.

……

……

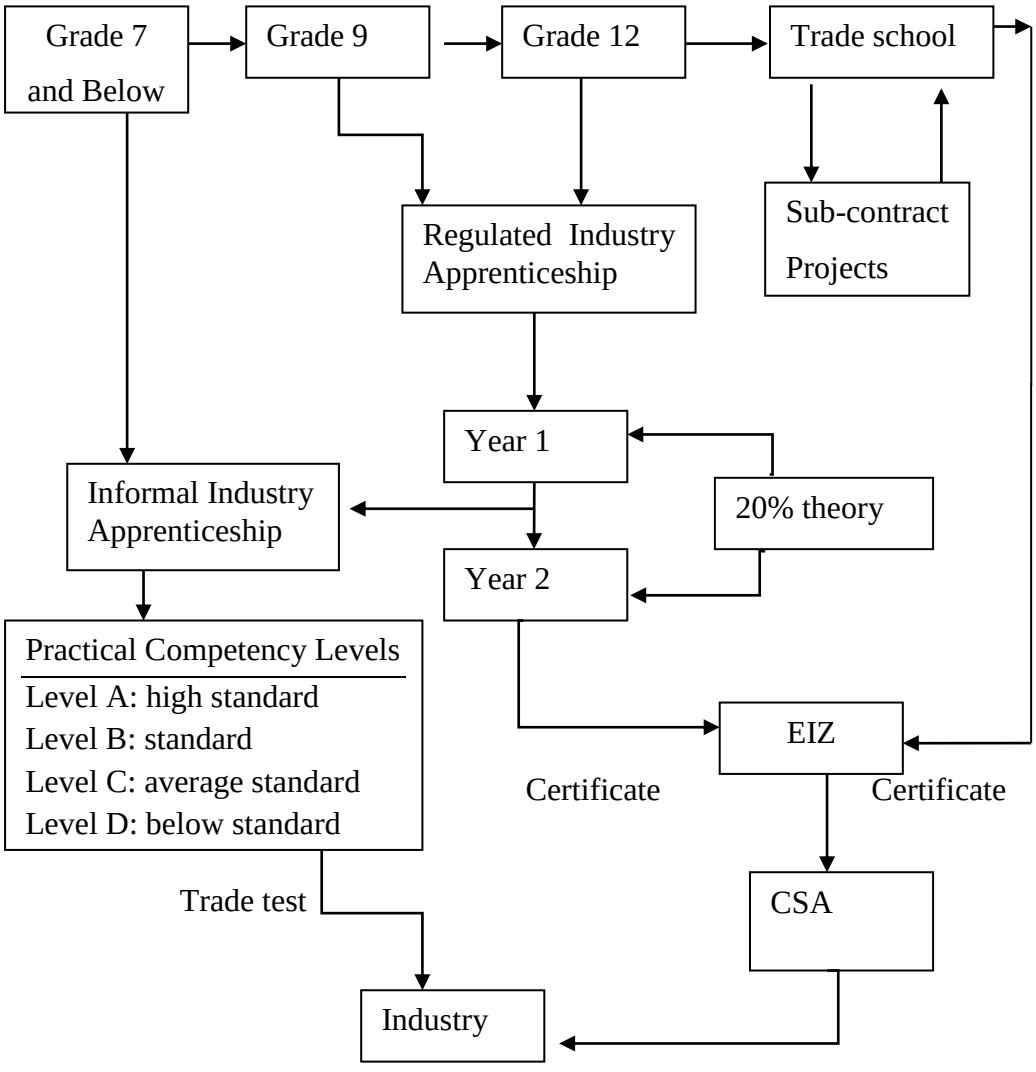
……

Thank you for your co-operation in completing this questionnaire

APPENDIX: C

QUESTIONNAIRE: Model Validation

This questionnaire is for the validation of the proposed model in Figure: A-1 below. The model was developed through data collected from the construction industry in Zambia. All information presented in this questionnaire will be kept confidential. This is only for academic purpose. Please study the model below and complete the questions on next page



EIZ-Engineering Institution of Zambia
CSA-Construction Standards Authority

Figure A-1: Apprenticeship Skill Flow chart Model

Section A

Name of organisation……

Type of organisation: *Contractor, consultant or TEVETA School*

Position of respondent in organisation: *Senior or junior management*

Years of experience of respondent……

Section B

1. This model addresses shortage of artisan skills
    1. Agree
    2. Neither agree or disagree
    3. Disagree

2. Do you think the proposed steps in the model, are easy to understand
    1. Yes
    2. Not sure
    3. No

3. Do you think the proposed model is useful to construction industry
    1. Agree
    2. Neither agree or disagree
    3. Disagree

4. Do you have any comment you would make regarding the model

    ……

    ……

    ……**.....**

    END