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Exploratory study on the Effect of Location on Project Cost within the Ghanaian
Construction Industry

by

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(BSc. Construction Technology and Management)

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DECLARATION

I hereby declare that this submission is my own work towards the MSc. Construction Management and that, to the best of my knowledge, it contains no materials previously published by another person, nor material which has been accepted for the award of any other degree of University, except where due acknowledgement has been made in the text.

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ABSTRACT

The cost of a project varies from one place to another and the effect of this variation is due to the difference in pricing of construction resource input from one region to the other. The study embark on an exploratory study on the effect of location on project cost within the Ghanaian construction industry. In achieving the aim for the study, perception of construction professionals regarding the effect of location on project cost in Ghana were gathered. The method selected to collect data for this study is survey questionnaire. A research population considered 41 quantity-surveying professionals who directly deal with cost of construction resource input in various quantity surveying institutions as the targeted group for information. Frequency tables, percentages, pie charts, and relative important index (RII) was used to present the results. Results from the study noted that location of a project has effect on the cost level of Construction resource input. In addition, Cost of transportation is the most influenced factor affecting cost of construction resource input. The study recommends that Ghana Institution of Surveyors (GhIS) and Architectural and Engineering Service Limited (AESL) should come together to outline the process and method, as well as providing information for developing this new index.

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DEDICATION

This thesis is dedicated to Dr. Gabriel Nani and the entire family for their love, prayers and support.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

The construction industry could be defined as an integral division of economy, which take care of planning, designing and constructing of physical infrastructure such as roads, hospitals, schools, housing and enhanced facilities for other industries. Construction is a service market, responsible for the obtaining its inputs from various sectors which are mostly interrelated and interlinked in a complex manner (Ofori, 1980). Construction has its end products to be site related and include deliverables that go through various process of putting together resources such as materials, labour and plant over an expected duration (Owusu-Ansah, 2014). Quartey (2013) asserted to the fact that the industry can be responsible for up to 20% of the national economic growth and employs up to 12% of the total labour force.

The total cost of construction projects is mostly established by summing the cost of materials, construction plant and equipment, labour, overheads and profits (Seeley, 1995). Normally, potential clients depend on construction expertise to determine the possibility and practicability of an intended project. Cost estimation serves as one of the essential activities performed in order to satisfy clients' search for project cost (Rowings, 2003). If the initial cost estimate is expensive, it will discourage the client from continuing further with the project and if it is too low, it is perceived that no quality works would be done and most cases it may end up in dissatisfaction on the part of the client (Kissi et al., 2015). As soon as project ideas are conceived, cost estimation is used to define the necessary financial commitment needed to build the facility. Estimates are not just prepared but

reviewed frequently as the project scope and demands increases, and for most situations, used throughout the entire construction process.

To answer the most asked question, “What would be the cost of this project?” estimate must be prepared. Obviously, the exact cost of project cannot be determined unless the project is completed. For investors to be aware of the extent of their investment, some form of approximate expected costs of construction project should be established. The success of most construction project somehow-someway relies on the accuracy of construction costs estimation. Conventionally, cost estimates play an important role when it comes to measuring construction costs before their occurrence and evaluate their feasibility and profitability.

According to Abdou et al. (2004), construction cost estimation is an important task in cost management processes but it is often carried out under settings of uncertainty. The costs accompanying construction projects of tomorrow around the world are both varied and unpredictable. The erratic conditions of commodity prices change of government and currencies fluctuations conspire to make project investment and development decisions highly complicated and burden with risk (Neal and Rawlinson, 2016).

The more negligible an estimate’s variance with respect to the actual cost of the project, the more reliable the information provided becomes and the better decision-making processes can be tackled on the project site. The accuracy of cost estimate will rely on available information and tools used at each phase of the project (Kehinde et. al, 2006). The performance of every construction project is dependent on its cost models. Therefore, in order to make good judgement on project design and cost, it is necessary to use an appropriate cost model (Hakan and Elcin, 2007).

Additionally, the Cost Indices endeavour to ascertain the mean variance in the project cost incurred by clients for a fixed resource (Gonglin and Xiangrong, 2010).

Kyeong et al. (2008) asserted that though construction projects' do not change in terms measure and use, their final account is changed by location, client's specification, economic condition, time, site, technological advancement and alternative components. With regard to time, building cost indices may be used to assess the differences in cost of project at different dates (Gichunge et al., 2010).

1.2 PROBLEM STATEMENT

Rising cost of construction input resources has been one of the major setback for indigenous contractors in Ghana. However, it is a well-known fact that instability and uncertainty in the prices of construction resource input increases the risk of contractors in fixed-price contracts and may settle at bid inflation as well as price speculation (Ilbeigi et al., 2014). According to Hakan and Elcin (2007), as the construction sector matures, projects are getting more sophisticated and their sizes are getting bigger. Hence, it is becoming more challenging to complete the projects within estimated cost limits and on time. Construction professional are faced with risk and uncertainties during the construction process which have resulted in some difficulties, thus the decisions to be taken on project may be deferred (Hakan and Elcin, 2007).

The Building and Road Research Institute (BRRI) a divisional department of Council of Scientific and Industrial Research (CSIR) which was established 1968 provides updates on relative price changes of construction input resources. Adorbor (2014) asserted that

CSIR-BRRI used to publish monthly construction cost indices developed with the local price adjustment formula (LPAF) using four component parameters of the unit rate. These component parameters are; foreign exchange of all inputs, local raw material input, local labour input and fuel cost. The Ghana Statistical Service (GSS) on the other hand published the Prime Building Cost Index (PBCI), used by Consultants in evaluating fluctuation on abandoned or delayed construction project.

There are indeed several timeline approaches in adjusting cost of construction. These construction cost fluctuations adjustment procedures are mostly influence by time but not location. To gauge the reasonable construction cost adjustment escalation in relation to variation in major building material, plant and labour prices, it is therefore essential to investigate into locational factors affecting project cost.

The Researcher strived to find out if location play a role in project cost variance using data from professionals within the construction industry with in-depth knowledge regarding construction resource input that best reflect the actual cost to the stakeholder.

1.3 RESEARCH QUESTIONS

The research questions, which will guide the study, will be as follows:

- i. What are the perceptions of construction professionals regarding location and project cost?
- ii. How do construction professionals adjust project cost due to locational variation?
- iii. What are the difficulties faced by construction professionals regarding application locational factors on project cost?

1.4 AIM

The researcher aims to embark on the effect of location on project cost within the Ghanaian construction industry.

1.5 OBJECTIVES

1. To document the perception of construction professionals regarding the effect of location on project cost in Ghana.
2. To document the procedure adopted by construction professional in the adjustment of project cost due to locational variation.
3. To identify the key challenge in the procedure documented in objectives.

1.6 JUSTIFICATION OF STUDY

The construction industry is a sector of the economy characterised with an issue of lack of effective cost planning processes at inception stage, during and after construction projects (Kissi et al., 2015a). There have been several research and development of framework on the accuracy of estimating variances in construction costs across the country but no geographical factors were inclusive. It is important that construction specialists deal with the issue of cost planning using all indicators. The benefits of this paper will primarily be felt in enhancement of knowledge and methods of cost estimations for construction professionals and reduce cases of project cost overruns. The findings of this study would help establish geographical variables, which may play a major role in developing geographical indices for the Ghanaian construction industry. Contractors as

well as cost engineers will have fair knowledge on how to adjust project cost using locational indicators.

1.7 METHODOLOGY

The results and conclusions of the research were affected by this section. The research presented a fundamental survey aiming to pinpoint major issues affecting project cost due to change in location. The main instruments for data collection was a structured questionnaire, which was designed to answer the objectives. The research applied quantitative methodological approach of data collection. On the quantitative data method, views from firms and professionals who are working on developmental projects in Ghana were collected through a questionnaire survey (Amoako, 2011).

Although the study seeks to investigate on the geographical effect on project cost within Ghanaian construction industry, the region used for research is the Greater Accra Region of Ghana.

Quantity Surveyors within Ghanaian construction industry were chosen as the unit for data collection since the research focus on cost. In this regard, the research employed purposive technique to consider quantity-surveying professionals who directly deal with cost of construction resource input in various institutions.

1.9 RESEARCH ORGANISATION

The study was structured into five chapters. Chapter One is an introduction to the research. It provided an overview of the context in which the research was conducted. The background and justification for undertaking the research, key questions for the research aim and the objectives are also presented in the chapter.

Chapter Two involves review of literature of other works which relates to the study. The chapter looked at overview of Ghanaian construction industry, Perception of construction professionals regarding location and cost of project, Cost adjustment procedures adopted by construction professional due to locational variation, Estimation and Key challenge in the procedures documented in objectives.

Chapter three described the approach of data collection, method of analyses and the techniques used in achieving the objectives for the research.

Chapter Four reported on the data analysis and discussion. Chapter Five presented the conclusions of the study and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is devoted to review literature in relation to impact of location on project cost. Relevant literature under this section of the study include; Overview of Ghanaian construction industry, Perception of construction professionals regarding location and cost of project, Cost adjustment procedures adopted by construction professional due to locational variation, Estimation and Key challenge in the procedures documented in objectives.

2.2 GHANAIAN CONSTRUCTION INDUSTRY - OVERVIEW

In most developing countries, construction is a solid sector of the economy, which take care of planning, designing and constructing of physical infrastructure such as roads, hospitals, schools, housing and enhanced facilities for other industries (Hillebrandt, 1985). The Ghanaian construction industry performs a large role in the economy, and also give assistance to the attainment of sustainable development goals (Anaman and Osei-Amponsah, 2007). Isa et al. (2013), in a publication said that the construction industry is an attractive area for research in enhancing the effectiveness of government works towards sustainable economic development. Nicco-Annan (2006) asserted that the Ghanaian construction industry in its small space inhabits an important portion in the national economy.

The industry is indeed a significant front for sustainable development through job creation opportunities, developmental activity and nature of its operation (Isa, et al, 2013).

Mosaku et al. (2006) noted that construction is one of the major industrial contributor in measuring GDP. The role of construction industry in the growth of an economy is a significant one for developing countries (Isa et al., 2013). The construction industry contributed 11.8% to Gross Domestic Product – GDP, (Ghana statistical service-GSS, 2014). Globally, infrastructure has been the backbone of economic sureness and success. To compete in the global marketplace, it is imperative to deliver construction projects in a well-structured manner. The CAN-2008 soccer Africa cup of nation was a breakthrough that brought about significant change to the Ghanaian construction industry.

Clients, consultant and contractors are the key stakeholder in the construction industry, (Smith et al., 2006). According to Ofori (2015), the industry will be able to perform effectively and efficiently, if its' key features are considered and understood. He suggested that the construction industry should rather place more emphasis on ICT implementation as well as corporate policies for human resource development (Ofori, 2015).

In Ghana, different categories exist for Construction and engineering firms (Eyiah and Cook, 2003). The Ministry of Water Resources, Works and Housing classifies building and civil engineering firms into class such as D1, D2, D3 or D4 and K1, K2, K3 or K4. The alphabet 'D' represents general building works and alphabet 'K' for civil works (Konadu, 2014). The Ministry of Roads and Highways on the other hand classifies contractors into categories A, B, C and S. Contractors in each category are further grouped

into financial classes 1, 2, 3 and 4 based on their level of technical expertise, financial stability, experience, and equipment and plant holding capacity (Laryea, 2010).

The Public Procurement board in Ghana is the legal body assigned duty to investigate and query tenders submitted for execution of public projects (Konadu, 2014). A Procurement entity is a body with legal mandate for administrative and procurement activities (Awal, 2010). Procurement activities and interactions are required to be completed in a reasonable and pre-determined order (Konadu, 2014).

The failure rate in construction industry is higher than another sector (Donkor 2011). One of the key problems confronting the Ghanaian construction industry is payment default. Other contributing factors include; poor book keeping, lack of technical personnel, inadequate equipment holding and technology strength and complexity and risks in contracting (Donkor 2011). Hyiaman (2014) indicated that Ghanaian construction industry is considerably underdeveloped and plague with numerous constraints. It would be difficult to add onto the growth of an economy with such a weak developmental framework and ill-equipped construction industry.

2.3 CONCEPT OF COST MANAGEMENT

2.3.1 RESOURCE PLANNING

Mohammed-Abu (2012) explained that construction projects are mostly successful when construction resources are managed effectively. Vital resources are used over long period to produce construction products at various stages (Ofori, 1980).

In general, construction activity of high value, and employ resource input such as labour, material, plant and equipment, money and time that contributes to the accomplishment of projects (Nagaraju et al., 2012).

The process of resource allocation may be improved by developing a Resource Responsibility Matrix (RRM) after completion of the Works Breakdown Structure (WBS). The project manager can use the WBS to create a matrix to assign resources according to the key deliverables of the project. Emrath, (2010) asserted that the costs of the labour, plant and materials needed for building project play an obvious role in determining prices.

2.3.1.1 Material as resources

Research has shown that construction materials constitute 60 to 70 % cost component in any typical construction project (Mohammed-Abu, 2012). The greater percentage of construction materials in construction project costs make it a key area which has an effect on construction cost and principally the affordability of proposed construction projects (Windapo et al., 2012). According to Quartey (2013), materials may constitute about 52%

or more of the total cost of construction project. It is therefore imperative for every construction company to maintain an efficient and effective way of obtaining material in order to reduce administration cost, and to keep alert of the market condition for procurement of materials at the right price, place, quality and time (Mohammed-Abu, 2012).

2.3.1.1.1 Material resources planning

Material Requirements Planning is characterized by a time based priority techniques that seek to calculate material requirements and programme supply to meet all products demand (Moustakis, 2000).

The purchase price plus allowance for delivery to site, off-loading, storage and placing in position are some contributing factors of price of material. In addition, allowances may have to be made for the handling and breakages, site and storage losses (Adorbor, 2014).

2.3.1.1.2 Major materials used in building construction

Construction materials are generally grouped into two main sources, the natural and artificial resources (Quartey,2013). Naturally occurring materials may include clay, sand, wood, rocks, leaves that have been used in building construction whereas synthetic materials may also include cement, plastic, glass, aluminum sheet, reinforcement, paints, adhesive and many others.

2.3.1.2 Labour resources

In Ghana, labour market consists mainly of skilled and unskilled labour and this represents a greater percentage of the populace. The employed people constitute the majority of the economically - active population (Kissi et al., 2015a).

The construction industry is considered the most labor-intensive industries in the world (Elbeltagi, 2011). The time taken for an artisan to complete an assigned work item is obtained from an estimator of a firm or from credible institutions publication. This is normally expressed as in a ratio of work output of work per time or per day in some cases. The total labour costs associated with an item of work is obtained by multiplying cost of labour against the hour or day spent (Adorbor, 2014).

2.3.1.3 Plant and equipment

Elbeltagi (2011) asserted that utilization of machinery to accomplish complex construction task has become the norm for modern construction firms. Generally, construction machineries are priced on the same basis just like labour as if the plant is used for a predetermine assignment. For example, an excavator performing its designed function is likely to be priced based on the quantum of work it could do in an hour (Adorbor, 2014).

2.3.2 COST ESTIMATING

Cost estimating involves the summation of the costs material, labour and plant required to achieve project deliverable. Moreover, estimating may include finding and considering various costing substitutes. The cost of the additional design work, which is likely to offset the expected savings, should be considered during cost estimating processes.

2.3.3 COST BUDGETING

Cost budgeting refers to the forecast procedure that is used to appraise firm's investments over a long period. The general concept is that the principal-funds are mostly channeled into other endeavors that will enable the firm to make money across years into the future.

2.3.4 COST CONTROL

Procedures for project control and bookkeeping are crucial tools to construction professional at the execution phase of a project (Otim et al., 2006).

Cost control aim at increasing profit by limiting activities or behaviours that will cause over expenditure. Cost Control normally begins from the early phase of the project life cycle- conception stage through to the construction stage and beyond. Logically, the time at which good cost savings could be made is during the infant stage in which no major cost expenditures has been committed (Bahaudin et al, 2012). The quantity surveyor at some stage performs advisory roles regarding cost, which may have no direct relationship with the method used for tendering. The advice is critical at the infant stages of project inception (Ashworth, 2010).

2.4 ANALYSIS OF ESTIMATION

Estimation is the process of evaluation the future cost of project deliverables. In building construction, an estimate is an attempt to ascertain the cost of some building work before the work is done. Rowings (2003) explained that estimating is a complex process that represents one of the most significant activities performed and involve collection of available and pertinent information relating to the scope of a project, expected resource consumption, and future changes in resource costs. Project feasibility always commerce cost estimation. Other phases of estimation include preliminary design and detailed design phases, building production process, and finally ending with the completion of the project (Tas and Yaman, 2005). Ensuring accuracy at the primary stage of cost estimation is key factor in the success of every construction project. Nevertheless, when drawings, specifications and other project documentations are not complete at the planning stage it become difficult to quickly and accurately estimate construction costs. When project information is limited, construction professionals adopt various techniques to accurately estimate construction costs at early stage of the project (Gwang-Hee et al.,2013).

According to Buerthey (2012), estimating and budgeting has been one of the tough and personal tasks in project cost management. Adobor (2014) provides a list of information necessary for preparation of an estimate. These include drawings, specifications (including performance specifications if required), schedules, technical reports, historical data, and program work period for major nominated sub-contractors and bills of quantities.

2.5 PERCEPTION AND IMPLICATION OF LOCATIONAL EFFECT ON PROJECT COST

According to Ofori (2012), the construction industry in Ghana faces lot of challenges, which require immediate response. The construction industry's performance in terms of cost, time, quality, safety, health, durability and satisfaction of its stakeholders, is in despair (Kissi et al., 2015a). Understanding the role of location is becoming central to better deal with competitive issues across the construction industry (Javier et al., 2003). The quest for price indices for construction industry arises from the necessity to measure real variations in the final product of individual construction related activities, which could not be derived exclusively via reference to regular building and construction statistics (OECD, 2013). Cunningham (2013) asserted that the geographical position of a project would affect its cost. Each location in space is characterized by various factors such as soil conditions, geographical position, and others (Thisse, 2011).

Geographical concept that encompasses every types of economic activity taking place in geographic space, have been bases for locational factors (Kissi et al., 2015b). There are lot of scholars who have put in effort to show the impact of price changes in many industries on societal welfare (Yadav, 2010). This cannot be said of construction since the literature on differential pricing in the construction industry is scanty (Kissi et al., 2015a). As changes occur in local material prices, labor rates and equipment hiring rates, the impact of these changes affect the entire construction cost (Adobor, 2014). Data collected in relation to price differential of construction commodities in different geographical areas play a vital role for economic research and decision making. Scholars have proven that

the failure to capture price variances could have effects on the project cost from location to location (Carrillo et al., 2012)

The Statistics Directorate of Organisation for Economic Co-operation and Development-OECD (2003) in a publication stated that there exist various tools, which are used to quantify price changes taking place within a given market. Consumption habits of household's goods and services are mostly measure over time in average retail prices of a fixed basket using Consumer price indices (CPIs), Producer price indices (PPIs); take care of average movements of producers of commodities prices over a given period. In calculating PPIs, cost of transport, commercial mark-ups, as well as consumption taxes are not included. It should be noted that Producer price indices are not measurement of average price stages, or production cost (OECD, 2003). Determining the structure of a country is sometimes dependent on Price indices. Taking an economic decision, establishing the purchasing power of the members, determining costs and wages, and establishing retail prices of goods and services purchased by consumers and determining the changes of these prices in time benefit from price indices (Adobor, 2014).

2.5.1 FACTORS AFFECTING MATERIAL RESOURCES PRICING

Cost of construction resources input in market conditions varies, and could be adjusted accordingly for geographic differences. These geographic adjustments are intended to ensure that payment to service providers reflects the local costs of specified services, so that the clients do not overpay in certain areas and underpay in others. A careful review of academic literature identified key factors that are cited most often as affecting material prices in Ghana. The idea of discrepancy in pricing is based on the financial concept of

price discrimination, which involves a profit-maximizing behavior in which a manufacturer sells its products to different consumers at different prices such that the price differences reflect the differences in the capability of each consumer to pay for the product (Yadav, 2010).

Below are established factors that contribute to differentials in construction resource prices:

i. Availability of raw materials at project location:

Geology and geography obviously has a primary influence on the building materials available in any one region (Lambourn, 2006). Nevertheless, the ability to source materials in the locality is an important factor in determining cost of product (Cunningham, 2013). Enshassi et al. (2009) concluded that construction materials monopoly in some specific locations contribute to change in prices by some suppliers.

ii. Supply and demand of a material at project location:

According to Glaeser and Gyourko (2003), demand and supply issues influence material prices. High material price is an indicator for high consumer demand for a particular area and vice versa. Ortobals (2004) noted that the effects of demand and supply within a given market conditions may also bring about change in construction resource price levels. Rakhra and Wilson (1982) explained that under monopoly market conditions, building material prices are likely to increase rapidly as compared to competing market (Windapo et al., 2012).

iii. Cost of transportation:

Sinclair et al. (2002) acknowledged that increased construction resource input prices especially material resource, is due to the high cost of hauling of materials from location to location. Transportation charges increases as the distance increases. Windapo et al. (2012) making reference to Mathews (2009) noted that high transportation costs have been identified as one of the major factors influencing the upsurge of building material price in most developing countries.

iv. Energy Costs of production:

Bureau of Economic Research (BER) in their publication (2008), confirmed that high-energy costs contribute immensely when it comes to building material prices. In order to curb the situation final product prices are increased to equalise the increases in high-energy costs (Windapo et al., 2012).

v. Locational Inflation:

A survey conducted by Frimpong et al. (2003) and Kaliba and Mumba (2009) established that inflation is a contributing factor of price, differences in Ghana. Inflation is the general rising movement of prices of commodities within a given economy market, which in effect reduces the purchasing power of a currency. It establishes how the prices of goods and services intensify over time (Fichtner, 2011). The principle behind locational inflation is how general prices of building material changes within a specific geographical area (Rakhra and Wilson, 1982).

vi. Crude Oil Prices:

In some part of the world, changes in price of materials and goods are triggered by changes in the price of fuel. The balance between world demand and supply determined the price of crude oil in the world market (USGAO, 2005). Stats SA (2011) and BER (2008), noted that in developing country just like Ghana, increase in diesel costs influence the production price of various materials.

vii. Seasonal Effect:

Certain products, materials or goods have cyclical request. To equalize the seasonal-demand fluctuations, price levels and pricing regulations should be modified. In top season, demand is high; while in slack period, demand falls significantly. Moreover, discount, credit sales, and price allowances are important issues related to seasonal factor (Jaideep, 2015).

2.6 SIGNIFICANT VARIANCE OF LOCATIONAL EFFECT ON PROJECT COST

Since the 1970's geographical cost indices have been used in various profession including education and health (Lofgren ,2007). There is an important dynamic associated with cost adjustments within construction industry (Fowler and Monk, 2001). The selling prices of commodities located in primary production zones are mostly lower than units located outside these “production sensitive” regions (Harrison et al., 2000). Variations in

commodity prices could have serious effect on the economy (EUROSTAT, 2013). According to Ottensmann et al. (2008), 10-kilometer Mean distance or 10 minutes haulage duration had greater effects on sales price. The application of market basket models to the development of cost indices written by Walter McMahon and his colleagues placed emphasis on making adjustments that stem from differences in the cost of obtaining resource from one location to another (Fowler and Monk, 2001).

The benefits or costs associated with location-based resources are often with the motive of informing public policymaking bodies to address issues related to construction activities (Ottensmann et al., 2008). There are many variations for individual housing resource units within some locations (Aluko, 2011). The geographical adjustment of resource price is essential to achieving the goal of ensuring that construction cost allocation is adequate and appropriate in all geographical locations (GAO, 2005). The purpose of a geographically based price index is actually having to do with finding out how much more it costs one place relative to another place to obtain construction resource input (Fowler and Monk, 2001).

2.7 COST ADJUSTMENT PROCEDURES ADOPTED BY PROFESSIONALS

There are various medium for reviewing cost planning practices within Ghanaian Construction Industry. In as much as cost planning takes an inevitable position in the construction processes, it demonstrates a reliable solution for achieving stakeholders' expectations (Kissi et al., 2015c). Standard forms of construction contracts incorporate fluctuation clauses as a mechanism to evaluate changes in prices of construction resources. Though the incorporation of these clauses are not mandatory, the inclusion of

the clauses as a reasonable compensation against variation in prices of inputs helps in the administration of the contract in a fair, equitable and just manner (Adobor,2014).

2.7.1 CONSUMER PRICE INDEX (CPI)

Measuring the average change in the prices for a fixed market basket of goods and services, CPI could be considered as an option (Gonglin and Xiangrong, 2010). CPI-based formulae are used for evaluating fluctuations in construction contracts. Some of these include Osborne and Haylett formula for building works, the Engineering formula for civil works and Baxter formula for civil works that are expected to last for more than 24 months (Adobor, 2014).

2.7.1.1 Method for calculating CPI

Msokwa (2012) making reference to Lowe (1823) described one of the simplest approaches determining the price index formula in detail. Consumer Price Index (CPI) was adopted in 1925 by the Second International Conference of Labor Statisticians (ICLS); and subsequent revised resolutions were adopted by the Sixth (1947), Tenth (1962), Fourteenth (1987), and Seventeenth (2003).

2.7.1.1.1 The Laspeyres formula

The theory behind the standard Laspeyres' formula is expressed as;

$$I_{STD} = \frac{\sum_{i=1}^n p_{it} q_{i0}}{\sum_{i=1}^n p_{i0} q_{i0}} \times 100$$

Where p_{it} is the price of an item i at current period

p_{i0} is the price of an item i at period o (base period)

q_{i0} is the quantity of an item i at period o (base period),

q in equation above acts as weight to the prices in both periods. This implies that the denominator in the equation remains constant for a period until a new q_{i0} is found. What keeps on changing is the figure (value) of the numerator that is affected by changes of p_{it} s from one period to another (Msokwa, 2012)

2.7.1.1.2 Paasche Price Index

Paasche price index is equally reasonable but it is useful to consider taking an evenly weighted average of fixed basket price indices as an estimator of price change between the two periods (Msokwa, 2012). The Paasche index is challenged for devaluing the

inflation, as it does not reflect the choice of goods under the base period prices (Adobor, 2014).

2.7.1.1.3 Fisher Ideal Index

The mean of Paasche and Laspeyres indices give rise to Fisher index. In order to determine which of these fixed basket indices or which averages might be best, desirable criteria, tests, or properties are needed for the price index (Anghelache and Marinescu, 2011). As mentioned above, since the Fisher Index is an average of the Laspeyres and Paasche indices, it is of the general formula below;

$$\sqrt{\frac{\sum_j p_{tj} \times q_{0j}}{\sum_j p_{0j} \times q_{0j}} \times \frac{\sum_j p_{tj} \times q_{tj}}{\sum_j p_{0j} \times q_{tj}}}$$

At this point, the fixed basket theory to index is transformed into the test procedure to index number theory (Anghelache and Marinescu, 2011).

2.7.2 BUILDING COST INDEX

Building cost index is based on various factors such as wages, material prices, plant costs, rates, rents, overheads and taxes, which measures the actual costs incurred by the builder, (Goh, 2016). According to Hassanein and Khalil (2006) where the cost of the project is

comparatively higher in percentage to the total costs, building cost index serves as a general indicator for measuring price movement for the projects.

Factor cost indices method utilizes changes in the costs of inputs of labour, materials, plant and equipment to the contractor to build up an index for a specific item of category of work or building. This allows these inputs to be weighted in accordance with their significance in the final costs so as to account for their importance in the overall total costs of the building (Gichunge et al., 2010).

2.7.3 PRIME BUILDING COSTS INDEX (PBCI)

The weighted average of selected construction materials and labour are normally computed to establish the Prime Building Costs Index (PBCI) as published by the Ghana Statistical Service. Materials included are cement, sand, roof material, steel material, stone, timber and miscellaneous materials. Skilled and unskilled labour is also included. Adobor (2014) referred to Public procurement Act (2003) indicated that the index value should be deemed to take account of all changes in cost due to fluctuations in costs.

2.7.4 TENDER PRICE INDEX

According to Kissi et al. (2016), consistent prediction of tender price index is critical to stakeholders in terms of decision-making. Tender prices represent the cost a client must pay for a building. They include building costs but also take into account market considerations such as the competitive state of the industry, productivity and profitability (Goh, 2016). Nevertheless, it is clear that the method of repricing of current tenders

involves the use of a bill of quantities that contains many items, each item individually priced by the contractor (Goh, 2016).

2.7.6 INPUT PRICE INDICES

Input price indices only provide a reflection changes in the price of inputs to the construction process by monitoring separately the cost of each factor. This normally involves the gathering of a weighted index of the costs of wages and materials. Input price indices measure changes in the prices of construction resource inputs. The indices produced are production cost rather than production price indices (OECD, 2013).

2.8 THE FORMULA ADJUSTMENT METHOD ADOPTED BY PROFESSIONALS

The purpose of the formula method therefore is to reduce the amount of time spent by the project team in evaluating fluctuations and to overcome some of the disadvantages of the traditional methods (Adobor, 2014).

Three types of formula methods used in Ghana for adjusting construction contract price;

- The Local Price Adjustment Factor (LPAF) previously published by the CSIR-BRRI and currently by the Construction Industry Efficiency Improvement Group of Ghana (CIECG-G),
- The Construction Price Adjustment Formula published by Ministry of Roads and Transport for use in road contracts.

- The Prime Building Cost Index (PBCI) published by the Ghana Statistical Service used for building works.

2.8.1 Local price adjustment formula (LPAF)

This method was developed by Amoa-Mensah formerly of CSIR-BRRI as a response to the need for a local price adjustment formula that can use readily available local data. A comprehensive analysis of resources of input component of bills of quantities items was undertaken. In the process, an evaluation of the cost constituents of each bill item showed that its unit rate is essentially made of some or all of the following;

- i. Foreign exchange component (F)
- ii. Local raw material component (M)
- iii. Local labour component (L)
- iv. Fuel component (P)

Amoa-Mensah (1996) developed a relationship between a works-item-unit- rate and the four component cost parameters (FMLP) as follows:

$$U = F + M + L + P$$

Where U represents bill item unit rate

F represents foreign exchange components of all inputs

M represents local raw material inputs

L represents local labour inputs

P represents fuel input

2.8.2 Price adjustment formula using schedule of rates

This method entails the selection of a representative sample of construction projects either taking place, or completed, in a given geographical area. By aggregating the prices of all components, a theoretical average price of the entire construction is obtained as though it had been undertaken at the base reference date. This method is widely used in the United Kingdom for producing the tender price indices (Adobor, 2014).

2.8.3 Prime Building Costs Index (PBCI)

The Prime Building Costs Index (PBCI) is published by the Ghana Statistical Service and is a weighted average of selected construction materials and labour. Materials included are cement, sand, roof material, steel material, stone, timber and miscellaneous materials. Skilled and unskilled labour is also included. This method however does not cater for labour productivity, the manner in which the various materials are combined and hence does not adequately capture the real movement of construction costs.

2.9 CHALLENGES DUE TO METHOD ADOPTED FOR COST VARIANCES

The procedures implemented in indices compilation have an influence on the accuracy of the indices produced (EUROSTAT, 1997). However, a balance has to be obtained between producing an index, which will adequately measure changes in prices at minimum administrative cost, and one that will measure the indices more accurately at prohibitive administration expense. In principle, it would be desirable to select both outlets (suppliers of products) and the input resources using random sampling with known

probabilities of selection. This ensures that the sample of items selected is not distorted by subjective factors and enables sampling errors to be calculated (Adobor, 2014).

According to EUROSTAT (2013), the development of construction resources price index has become a challenge in our part of the world due to the following:

- i. Gathering information for price indices mostly depend on comparing the prices for similar items over a period. However, in the context of construction project, each project has a unique location and normally a specific set of structural behaviors.
- ii. Transactions behaviours are unique and unstable from places to places.
- iii. The desired index factor may not be clear or may not be used for different purposes.

2.10 SUMMARY

It is evident that construction cost varies from location to location. The effect of this variation is due to the differential pricing of various construction resource input such as material, labour and plant. Various literature established list of factors contributing to price changes of construction resources input including; Cost of production, Competition, Product substitution, Exchange rate, interest rate, Demographics, Product differentiation, Systematic differences in production costs, Product quality, High Demand of product, Transportation cost of product, Short supply of product, location factor, inflation, crude oil prices, export duties, technological factors and labour accessibility. Moreover, various time related methods have been adopted by construction professional to adjust price fluctuation. An interview with some construction professionals in Ghana indicated that

firms within construction industry, adopt various non-conventional geographical price adjustment methods to buttress those time-related adjustment methods explained earlier. Some of the geographical adjustment methods used include; Percentage guess, Personal intuition, Regional inflation factor, Physical Survey and Historical data. The present study seeks to contribute to the above studies by determining a locational forces affecting project cost from region to region.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

The research methodology, data collection approach, research approach, sample frame and data analysis techniques adopted for the study are explained in this chapter (Owusu-Ansah, 2014). The methods selected in this study was designed based on the nature of research questions being answered by each objective. Various methods of data collection were adopted including the use of questionnaire, BOQ content analysis and collection of prices of construction input resources across major market centers (Adorbor, 2014).

3.2 RESEARCH APPROACH

The research applied quantitative methodological approach of data collection. The views from firms and professionals who are working on developmental projects in Ghana were collected through a questionnaire survey (Amoako, 2011). Although the study seeks to investigate on the geographical impact on project cost within Ghanaian construction industry, the region used for research is the Greater Accra Region of Ghana.

3.4 SOURCES OF DATA

Since the variable behind the research is cost, Quantity Surveyors within Ghanaian construction industry were chosen as the unit for data collection. Literature review relevant to the study depended on information, which were provided in books, journals, magazines and research papers (Zoya-Kpamma, 2009).

3.5 RESEARCH INSTRUMENTS

Questionnaires became the main tool used for data collection. The questionnaires were designed to obtain data on the familiarity of Ghanaian cost professionals, with quantitatively structured kind of questions. Likert scales were also used in gathering some of the data. Space was also provided for the respondents to express their general views about the topic (Yakubu, 2014).

The questionnaire was divided into two main areas; the first part was about the respondents' background or characteristics, the second part dealt with the questions that seek to address the research objectives. A five-point response scale was employed to measure the severity of factors affecting resource input, adjustment methods used by professionals and challenges affecting procedures adopted.

3.6 POPULATION DEFINITION

A research population include group of individuals, persons, objects, or items from which samples are taken with purposes of gathering information (Mugo, 2009). In this regard, the research considered quantity-surveying professionals who directly deal with cost of construction resource input in various institutions as the targeted group for information. The decision to pay attention to these set of professionals was because parliament of Ghana has officially recognised Ghana institution of Surveyors-(GhIS) as a legal professional body to comment and advice on cost related issues. It is therefore satisfactory to ask the opinion of quantity surveying firms under GhIS on the subject matter. Ghana institution of Surveyors in their publication (2015), listed 47 quantity-surveying firms in good standing with majority of 41 firms located in Greater Accra region.

3.7 SAMPLING PROCEDURE AND SAMPLE SIZE

3.7.1 Sampling procedure

It is an important for a researcher to decide how big or small the sample of population should be. A big sample size would positively affect precision in terms of statistical significance. On the other hand, a small sample size would create an impression that the results are not important (Cornish, 2006). Moreover, constraints such as time, finance, and subject matter are important factor, which should be considered when designing a study, but not necessarily dictating the sample size (Cornish, 2006). As a result, the research employed census survey technique to consider Quantity-surveying professionals who directly deal with cost of construction resource input in various institutions.

3.8 DATA ANALYSIS TOOLS

Statistical Package for Social Sciences (SPSS) and Microsoft excel was used to analyse the data. Frequency tables, percentages, pie charts, and relative important index (RII) was used to present the results (Zoya-Kpamma, 2009). Relying on the relative importance index method, the RII values of causes of price differentials of construction resource input in Ghana would be established (Kissi et al., 2015b).

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter present peoples' views regarding the study. The research seeks to establish the framework needed to develop geographical cost index for Ghanaian construction industry paying attention to the resource which contribute greater percentage of the entire cost of a project; thus material resource. In order to achieve research objectives, an approach consisting of literature review, questionnaire survey and interview were adopted. The results captured in this chapter are attained from questionnaires answered by quantity surveying firms within the construction industry located in greater Accra region. The responses from respondents were analysed using the Statistical Package for the Social Sciences (SPSS) to establish how individually designed questions agree to the other.

4.2 Response Rate and Characteristics of Respondents

Out of 41 questionnaires that were sent to respondents, 29 Quantity surveying firms responded; resulting in 70.70% responses rate.

From the analysis, it was established that Quantity surveyors representing the firm had educational level ranging from HND to PhD. Figure 4.1 gives a pictorial representation of educational background of respondents.

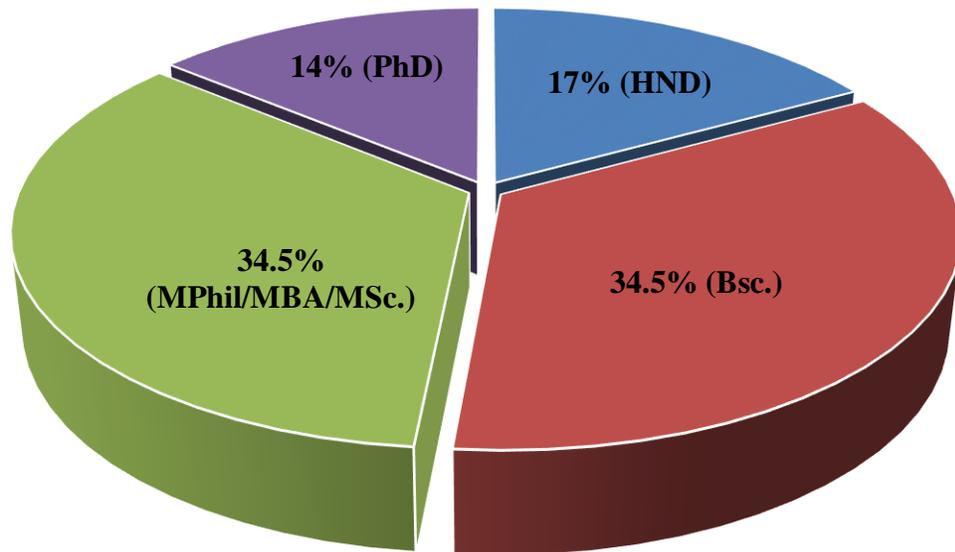


Figure 4.1-Educational level of respondents

Greater percentage of the respondents had construction related experience exceeding 5 years. It was essential to ascertain the working experience of the respondents in order to obtain substantial and practical answers as demanded from questionnaire (See Fig. 4.2). All respondents have undertaken at least a project in the last 5 years (See Fig. 4.3). In summary, the background information of unit for data collection shows that the respondents were highly educated, had experience in the construction industry and therefore are familiar with cost variation issues due to change in location and matters relating to the use of construction cost adjustment procedures adopted within the construction industry.

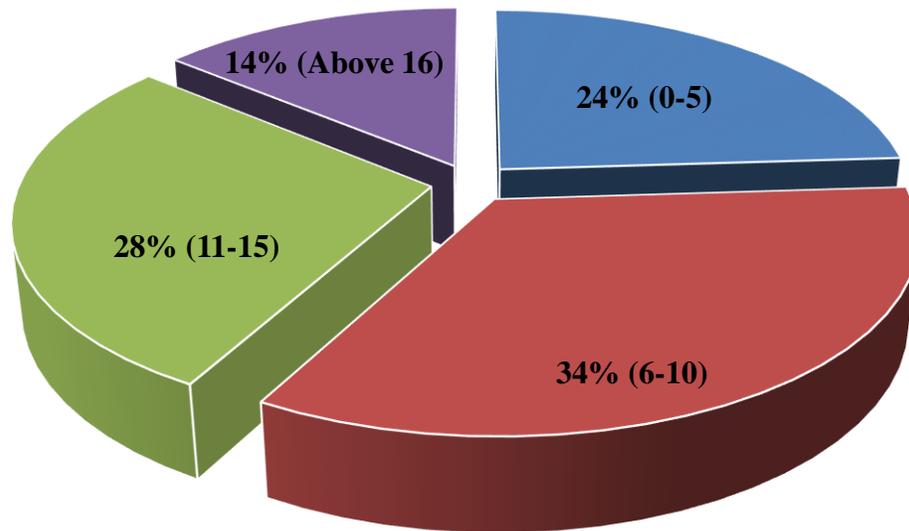


Figure 4.2 Working experience of respondents

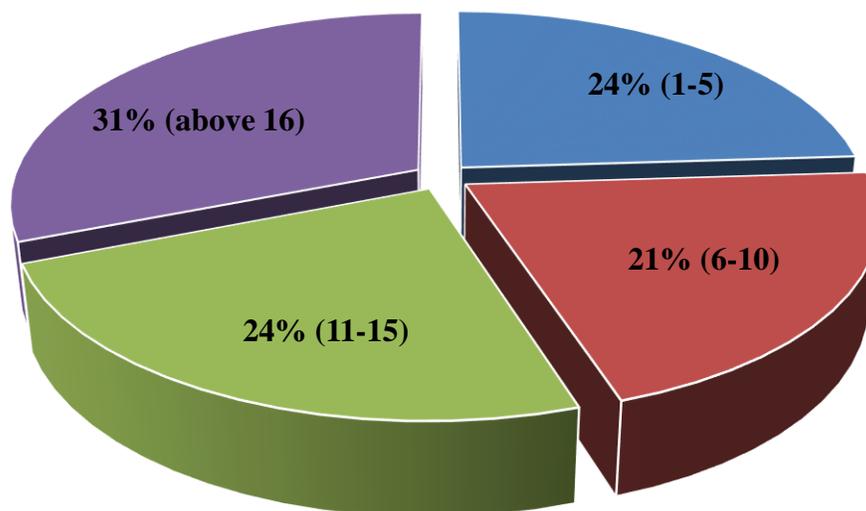


Figure 4.3 Project completed by respondents

4.3 Effect of location variances on the project cost

Quantity surveyors were asked to give response on whether location of a project has effect on the cost level of Construction resource input. 97% responded YES and 3% said NO to the question (See figure 4.4).

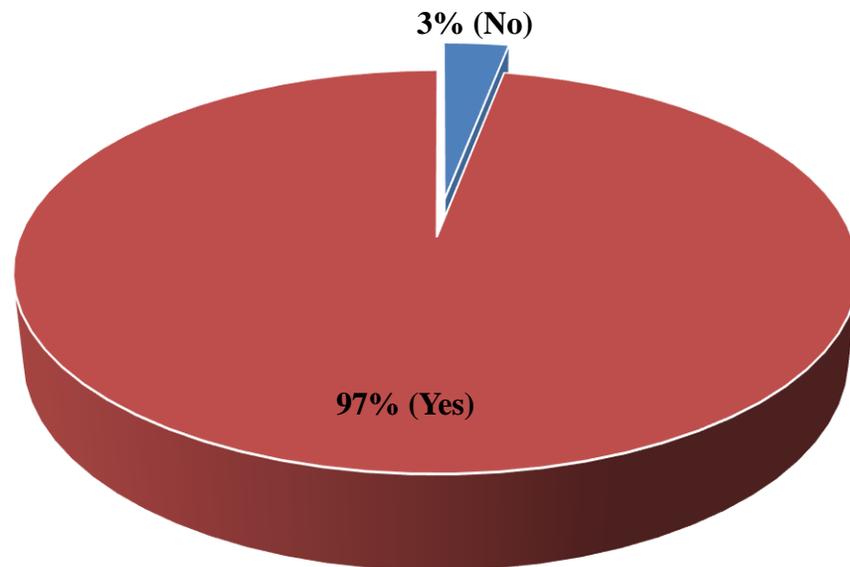


Figure 4.4 Effect of location on the project cost

4.4 Factors associated with price change due to change in location

The respondents were asked to rate their level of agreement or disagreement to the identified factors affecting cost of construction resource input. Out of the analysis from data collected using relative importance index (RII) statistical tool in SPSS software application, it was established that Cost of transportation is the most influenced factor, followed in order of merit by availability of materials at project location, raw material and

input cost, crude oil price, energy cost of production, location inflation, market condition at project location, supply and demand of material Seasonal effect. Table 4.1 shows the ranking for the factors and their respective weighting.

Table 4.1 Factors affecting project cost due to change in location

Factors associated with price change	Std. Deviation	RII	Rank
Cost of transportation	0.827	0.91	1st
Availability of materials at project location	0.923	0.81	2nd
Crude oil price	0.884	0.79	3rd
Market condition at project location	0.93	0.74	4th
Energy cost of production	1.056	0.70	5th
Location inflation	0.87	0.69	6th
Supply and demand of material	0.91	0.69	7th
Raw material and input cost	1.136	0.63	8th
Seasonal effect	0.889	0.63	9th

Where RII = Relative Importance Index.

Construction cost in basic definition is the monetary value of the all resource input needed to perform an operation (Seeley, 1995). Pricing is essential and has always play a role in marketing decisions (Myers, 1997). As changes occur in local material prices, labor rates and equipment hiring rates, the impact of these changes affect the entire construction cost (Adobor, 2014). Geology and geography obviously has a primary influence on the building materials available in any one region (Lambourn, 2006). Enshassi et al. (2009)

concluded that construction materials monopoly in some specific locations contribute to change in prices by some suppliers. According to Glaeser and Gyourko (2003), demand and supply issues influence material prices. Sinclair et al. (2002) acknowledged that increased construction resource input prices especially material resource, is due to the high cost of hauling of materials from location to location. Stats SA (2011) and the BER (2008) noted that in developing country just like Ghana, increase in diesel costs influence the production price of various materials.

4.5 Opinions of professional on success on geographical cost adjustment methods adopted within the construction industry

Figure 4.4 shows respondent view on whether geographical cost adjustment methods adopted within the construction industry has been successful. Greater percentage representing 66% said YES to the question while 34% responded NO.

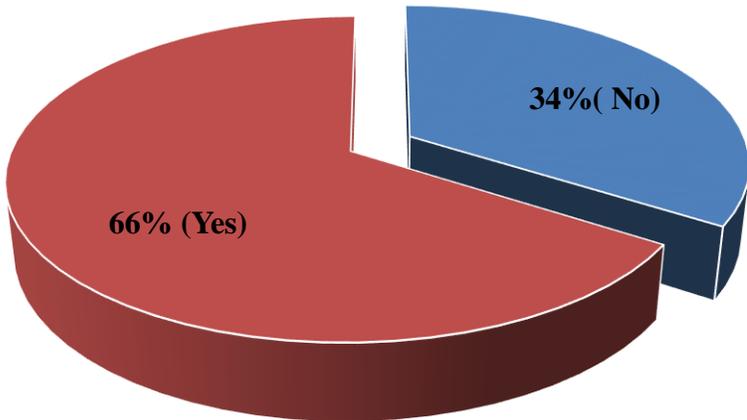


Figure 4.5 Effectiveness of adjustment procedures by professionals

4.6 Cost variance due to change in region

Data collected in relation to price differential of construction commodities in different geographical areas play a vital role for economic research and decision making. Scholars have proven that the failure to capture price variances could have effects on the project cost from location to location (Carrillo et al., 2012).

Respondents were asked if they found significant change in project cost due to change in location. 48% indicated that there was very significant difference in project cost due to change in region. 45% found significant difference while 7% said they found zero significant difference in project cost (See Figure 4.6).

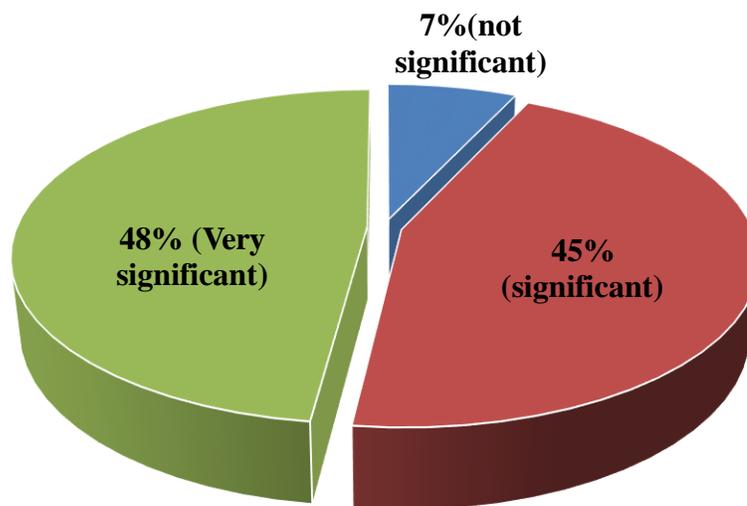


Figure 4.6 Difference between project cost due to change in region

A substantial number of respondent requested for a national wide locational cost adjustment formula-(Geographical cost index). Moreover, 7% indicated that geographical cost index is not necessary (See Figure 4.7).

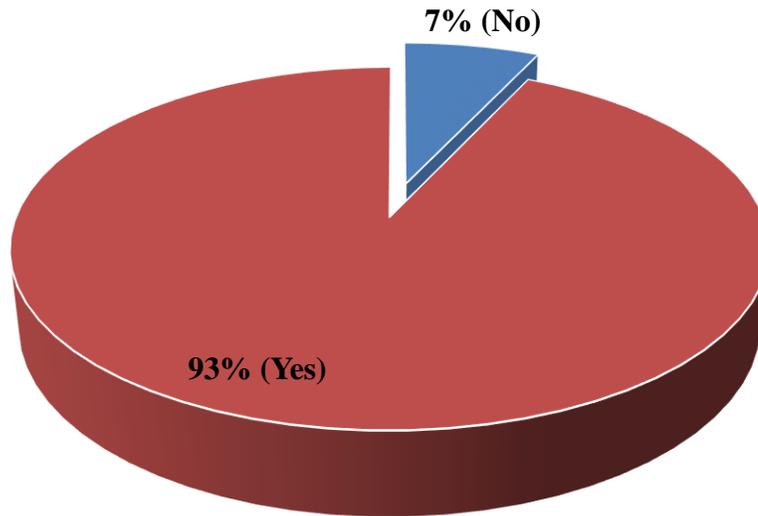


Figure 4.7 Relevance of Geographical cost index

4.7 Construction professional's adjustment procedures due to change in location

The survey indicated that 100% of the respondents adjust project cost whenever project change location. From figure 4.9 below, it could be said that most professional update methods adopted for cost adjustment due to change in region.

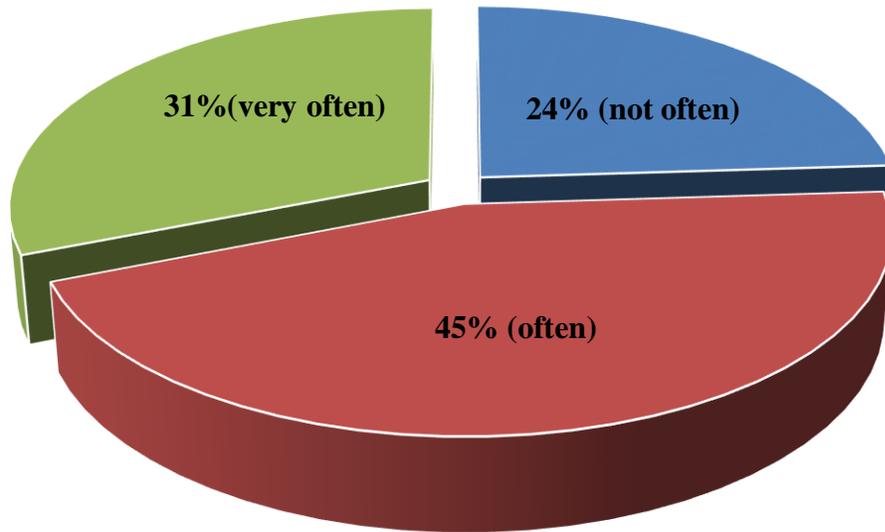


Figure 4.9 Professionals updating adjustment methods adopted

Moreover, out of the analysis from data collected using relative importance index (RII), it was established that most professional adopt physical survey and historical data procedure to adjust project cost whenever project change location or region. Table 4.2 shows the ranking for traditional adjustment methods adopted by professional and their respective weighting.

Table 4.2 Traditional adjustment methods adopted by professional

Adjustment Methods Adopted by professionals			
	Std. Deviation	RII	Rank
Physical survey	1.093	0.83	1st
Historical data	0.926	0.80	2nd
Personal intuition	1.1	0.79	3rd
Percentage guesses	1.252	0.79	4th
Regional inflation factor	1.102	0.60	5th

4.8 Key challenge in the procedure documented in objectives.

Respondents were asked if they faced with challenges affecting the development and usage of adjustment procedures adopted within the construction industry. Out of the analysis from data collected using relative importance index (RII), it was revealed that getting access to information for price indices is the most challenging factor, followed in order of merit by project has a unique location and specific set of structural behaviour, desired index factor may not be clear and unique and unstable transactions behaviour. Table 4.3 shows the ranking for the key challenge and their respective weighting.

Table 4.3 Key challenges affecting the development and usage of adjustment procedures adopted within the construction industry

Key challenges in adjustment procedure adopted			
	Std. Deviation	RII	Rank
Gathering information for price indices	1.023	0.85	1st
Project has a unique location and specific set of structural behaviour	0.759	0.77	2nd
Desired index factor may not be clear	0.882	0.74	3rd
Unique and unstable transactions behaviour	0.986	0.70	4th

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter seek to provide conclusion and recommendation for the study. The analysis of the survey has shown findings from respondents designated for this study.

5.1.1 KEY FINDINGS

Summary of findings from the data analysis presented in chapter four are listed below:

- i. It was evident from the study that Quantity surveyors 97% think location of a project has effect on the cost level of Construction resource input but 3% think otherwise.
- ii. It was shown in the study that Cost of transportation is the most influenced factor affecting cost of construction resource input followed in order of merit availability of materials at project location, raw material and input cost, crude oil price, energy cost of production, location inflation, market condition at project location, supply and demand of material, and Seasonal effect.
- iii. Greater percentage representing 66% said YES to whether geographical cost adjustment methods adopted within the construction industry has been successful; while 34% responded NO.
- iv. Respondents were asked if they found significant change in project cost due to change in location. 48% indicated that there was very significant difference in

project cost due to change in region. 45% found significant difference while 7% said they found zero significant difference in project cost.

- v. 93% of the respondents requested for a national wide locational cost adjustment formula- (Geographical cost index). Moreover, 7% indicated that geographical cost index is a nonstarter.
- vi. The survey indicated that 100% of the respondents adjust project cost whenever project change location.
- vii. Relative importance index (RII), indicated that most professional adopt physical survey and historical data as methods for adjusting project cost whenever project change location or region. Other adopted methods include Personal intuition, Percentage guesses and Regional inflation factor.
- viii. It was also shown that 31% professionals update adjustment methods adopted very often, 45% update often and 24% do not update at all.
- ix. Moreover, out of the analysis from data collected using relative importance index (RII), it was revealed that getting access to information for price indices is the most challenging factor with index, followed in order of merit; project has a unique location and specific set of structural behavior, desired index factor may not be clear, and unique and unstable transactions behavior.

5.2 CONCLUSIONS

The findings of the study have shown stakeholders' desire for a geographical cost index. In the process of developing geographical index, it would be necessary to pay attention to the following variables;

- Cost of transportation
- Availability of materials at project location
- Crude oil price
- Market condition at project location
- Energy cost of production
- Location inflation
- Supply and demand of material
- Raw material and input cost
- Seasonal effect

5.3 RECOMMENDATIONS

Firstly, the study recommends that Ghana Institution of Surveyors (GhIS) and Architectural and Engineering Service Limited (AESL) should come together to outline the process and method, as well as providing information for developing this new index.

In addition, much attention was given to materials resource in finding factors influencing variation in project cost due to change in location. It is recommended that other resources such as labour and plant should be highlighted in developing the new index.

Furthermore, recommendation is that other researchers should show interest in this area of study in order to find other causes influencing project variances due to change in location.

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APPENDIX 1:

SURVEY QUESTIONNAIRE FOR RESPONDENT

This questionnaire forms part of an exploratory study on locational effect on project cost being undertaken by a MSc. Student in Construction Management at KNUST.

Your participation by filling the questionnaire will help to achieve the aim and objectives of the study. Your input therefore will be appreciated for the successful completion of this exercise.

Thank you.

SECTION ONE

Background information

Please answer the following questions by ticking / filling the spaces provided

1. Education level:

- A. HND. B. BSc. C. MSc. / MBA /MPhil. D.
PhD.

2. How long have you been in the construction industry?

- A. 0-5 years B. 6-10 years C. 11-15 years D. 16 years and
above

3. What is the average number of projects you have completed in the last 5 years?

- A. 1-5 B. 6-10 C. 11-15 D. 16 and
more

Construction professional’s perception about locational effect on project cost

4. Does the location of a project has effect on the cost level of Construction resource input?

A. Yes

B. No

5. The following is a list of factors associated with price differential of construction (material) resource input. Rank them in order of frequent occurrence a scale of 1 to 5.

1= not frequent

2 =slightly frequent

3 =frequent

4= very frequent

5= extremely frequent

NO	FACTORS ASSOCIATED WITH PRICE CHANGE	RANK				
		1	2	3	4	5
A	Cost of Transportation:					
B	Availability of materials at project location					
C	Market condition at project location					
D	Supply and demand of materials					
E	Energy costs of production					
F	Raw Materials and Input Costs:					

G	Location Inflation:					
H	Crude Oil Prices:					
M	Seasonal Effect:					
	OTHERS					

6. In your opinion, has the geographic cost adjustment methods adopted by construction professional been successful?

A. Yes

B. No

The significant of geographical variation on project cost

7. How significant was the difference between the costs of project from one region to another region?

A. Very significant

B. Significant

C. Not significant

8. Has the geographic cost index been a necessity for the construction industry?

A. Yes

B. No

Construction professional's adjustment procedures due to change in location

9. Is allowance made for cost variance in the initial estimates of project cost due to change in location?

A. Yes

B. No

10. If "YES" to Q.9, The following is a list of location adjust procedures to construction resource input used by construction professionals due to change in location. Rank them in order of frequent usage; a scale of 1 to 5.

1= not frequent

2 =slightly frequent

3 =frequent

4= very frequent

5= extremely frequent

NO	ADJUSTMENT PROCEDURE ADOPTED	RANK				
		1	2	3	4	5
A	Percentage Guesses					
B	Personal Intuition					
C	Regional inflation factor					

D	Physical Survey					
E	Historical data					
	OTHERS					

11. How often do professionals update the geographical adjustment method used?

A. Very Often

B. Often

B. Not Often

Key challenge in the procedure documented in objectives.

12. The following is a list of key challenges affecting the development and usage of adjustment procedures adopted within the construction industry. Rank them in order of frequent occurrence at a scale of 1 to 5.

1 =strongly disagree

2= Disagree

3= Quite agree

4= Agree

5=strongly agree

NO	KEY CHALLENGES IN ADJUSTMENT PROCEDURE ADOPTED	RANK				
		1	2	3	4	5
A	Gathering information for price indices					
B	Project has a unique location and specific set of structural behaviors.					
C	Unique and unstable transactions behaviours					
D	Desired index factor may not be clear					