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Assessing the Impact of ICT Application to Material Management Processes on Labour Productivity in Ghanaian Construction Industry

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Abstract

The Ghanaian construction industry is (local contractors) are faced with severe construction materials management problems due to much uses of manual materials management processes in the industry. Mohammed and Stewart (2003) as cited in Sekou (2012, P.5) stated that the obvious contests of the Ghanaian construction industry today are that, majority of the construction process information and data continue to rely heavily on traditional means of documentation and communications such as face-to-face meetings and exchange of paper documents such as drawings, specifications and site instructions which seriously contribute to inefficiency in the materials management system. Anecdotal evidence suggests that majority of Ghanaian register contractors do not have the requisite knowledge as expected to undertake projects as well as how best to manage the materials supply chain to their site. Hence, Materials management processes are the greatest challenges that confront them. Tracking of materials issued becomes very difficult due to lack of systematic approaches and these allow room for materials theft, double-handling, luck of accurate specification, project delays, cost overrun just to mention but few. Onyegiri et al. (2011) granted that information and communication technology (ICT) can actually control project processes to put stop to some challenges in the construction works, like project delay, time overrun, cost overrun and most especially materials waste, theft and double-handling of materials. These will enable the project to be built and maintained. However, Enshassi, Mohammed, Mustafa and Myer (2007) assessed that researchers have not agreed on a universal set of factors with significant influence on labour productivity and no agreement has been reached on the classification of these factors. On the basis of this knowledge published in previous literature, main contributions were collected by Robles, Stifi, Jose and Ponz-Tienda (2014), determining a summary of factors affecting CLP in different countries with exception of Ghana.

Keywords: Materials Management Processes, Ghanaian Construction Industry, Critical Barriers to ICT Application & Labour Productivity

1.0 INTRODUCTION

Materials management is considered as a means to achieve better productivity, which could be translated into cost reduction. Though, materials management plays a significant role in the success and productivity of construction project, it has its relative problems or challenges, such as shortages, delays in supply, prices fluctuations, damage, waste and lack of storage space. Kasim (2011) speculated that construction activities can generate an enormous amount of waste and Materials waste has been recognized as a major problem in the construction industry. However, tighter materials planning can reduce waste and can directly contribute to profit improvement and productivity. Haddah (2006) contended that materials management functions are often performed on fragmented basis with minimal communication and no clear established responsibilities assigned to owner, engineer or contractor. Timely availability of materials and systems for management are vital to successful construction. Hence, it is important for the project manager to consider that there may be significance difference in the date that the materials were requested or date when the purchase order was made, and the time, of which the material will be delivered, thus materials management is a key of project management. Ashwini, Patil and Pataskar (2013) concurred that materials constitutes a major cost component in any construction project and the total cost of installed materials may be 50% or more of the total cost of the project. Therefore, materials management should be a matter of concern to material managers in the construction field.

However, Kasim (2011) contendedit is plausible that information and communication technology ICT implementation may be the answer to overcome the challenge of materials management in the

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construction industry. Equere and Tang (2010) supported that Automation of materials handling and tracking process provide a more accurate and timely working system. Furthermore, Asabre, Oppong and KusiSarpong (2012) granted that in various services providing companies and organizations worldwide, information and communication technology (ICT) play a role in the process of providing effectively, efficient services, products and packages to better satisfy their clients.

The government in Ghana undertakes various construction projects for infrastructure development to meet the higher demands of the population growth. These projects are mostly characterized with challenges using traditional or manual method. Waste has a cost. This simple relationship has historically been overlooked. The critical point at which contractors and sub-contractors can influence waste is when buying materials for project, as this activity determines the materials that are supplied to site. Ampadu-Asiamah and Ampadu-Asiamah (2013) argued that those projects funded by the government of Ghana are plagued by time delays. They further grant that two hundred and forty-nine projects were awarded, only sixty-seven (67) representing (27%) were within the proposed time scheduled and one hundred and eighty-two (182) representing (73%) had delayed. This has resulted in disruption to the development plans of the government. Materials management was identified as one of the key causes of time overruns. Onyegiri, Nwachukwu and Jamike (2011) maintained that ICT is responsible for the entire construction processes by enabling the project to be built and maintained. Given this significant role and the rising interest of ICT in the construction industry today, the Ghana construction industry cannot be left out in this market place.

2.0 LITERATURE REVIEW

2.1 Materials- Management Related Problems.

Navon and Berkovich (2006) maintain that the problems associated with materials management can be divided into two categories: Problems relating to the purchasing and supply of the materials this category include scheduling the supply of materials to the site, and disparity between the order and the materials actually arriving to the site. Logistical problems, such as monitoring materials onsite, follow up the movement of materials around the site and hauling of materials.

2.2 Problems Relating to the purchasing and Supply of Materials

Problems in this category have sometimes caused work stoppages and last minute orders. As a result, not only cost escalates, but if the material is not available, additional delays are caused. The problems found in this category as stated by Navon and Berkovich (2006) are:

- Materials arriving on site at the wrong time. Late arrival causes a delay to a specific activity, or to the subsequent activities. Early arrival, on the other hand, requires additional storage spaces, double handling and, sometimes additional equipment. Double handling can damage the materials and increases waste and handling costs.

- Materials that do not match the purchase order. If unsuitable materials are discovered on time, they can be changed and the damage is minimal. If, on the other hand, upon arrival they are stored without checking and retrieved just when needed, the work can be delayed until the correct materials arrived.

- Forgetting to order materials. Due to the dynamic nature of construction projects and the stress under which construction personnel operate, sometimes materials are not ordered. The effect of not ordering materials is similar to the one of late arrival.

- The wrong quantity of materials arriving to the site. If the quantity of the materials arriving to the site is smaller than the needed quantity, the effect is similar to late arrival of materials. If, on the other hand, the quantity is higher, either the excess has to be sent back or stored for later usage. In the latter case, the effects are similar to early arrival.

- Information regarding the status of the orders is not available. All too often project management does not have accurate and up-to-date information regarding expected arrival of materials.

Additionally, sometimes the suppliers decide to supply different materials, which are thought to be equally suitable. When these materials arrived to the site, or worse still, when they are needed for use, it turns out that they are not suitable. This state-of-affairs makes planning very difficult and disrupts work planning and activities.

- Incomplete or erroneous definition of materials. When materials are not defined accurately, the supplier may misinterpret the order, and hence supply the materials in the wrong quantity or adhering to different specifications.
- The specific conditions of the site are ignored when ordering materials. Ordering materials has to take into account all the specific conditions of the site at the time of the expected arrival of the materials. Conditions such as the availability of hauling equipment, accessibility and weather affect the ordering of materials, e.g. nonavailability of a crane on-site will require that the materials are brought to the site by a truck having its own unloading capacity; access roads which might be suitable in the dry-season may need different equipment in the raining-season.

2.3 Logistical Problems: Warehousing

Formosa et al (2002) indicate that even when the purchasing and supply of materials are managed properly, there still might be problems relating to on-site control. The problems identified were:

- Wastage of materials – the main reasons were: unsuitable storage conditions, double (or even multi) handling of materials, theft and loss of materials.

- Lack of space for storage – this problem is becoming increasingly serious in urban projects. The solution is normally just-in-time (JIT) delivery strategies, which are very sensitive to delivery delays and changes in the work schedule. These strategies are problematic and require higher managerial resources.

- Lack of complete and up-to-date information regarding on-site stocks – this is a typical problem on large projects where materials are not concentrated in one location. It is all too often that appropriate materials are available onsite, but because information about supply and location is not available, the same materials are ordered again, resulting in waste.

- Incomplete, or erroneous, information regarding all the materials arriving at the site – the materials arriving at the site are sometimes not registered or they are logged erroneously. As a result, when the vendor's bills arrive, additional resources have to be used to check what exactly arrived (sometimes this is not trivial, or even possible), causing delays in payment and subsequent problems with the suppliers.

- Untargeted materials – sometimes materials arrive to the site and no one knows who ordered them or what their destination is. The person who receives the materials does not know whether to accept or return the materials. For economic receipt and storage of materials, Okorocha (undated) assessed that the following points should be noted and adhered to:
    - There should be smooth traffic flow (internal / external)
    - Adequate handling facilities and equipment should be in place
    - Delivery schedules should be planned to avoid bottleneck
    - Immediate verification checks on goods delivered should be done\
    - Make available the right amount of space required (not too small or large)
    - Efficient stock location system should be put in place
    - Adequate security should be in place
    - Some areas should be guaranteed to maintain quality standard
    - Access should be restricted to authorized persons only.

Research has shown that construction materials and equipment may constitute more than 70% of the total cost for a typical construction project. Therefore, the proper management of this single largest

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component can improve the labour productivity and cost efficiency of a project and help ensure its timely completion. Patel and Vyas (2011) concurred that one of the major problems in delaying construction projects is poor materials and equipment management. To alleviate (at least) some of the above-mentioned problems, Navon and Berkovich (2006) defended that an automated model for materials management and control was developed. The model deals with purchasing functions, it tracks materials and gives reports and alerts relating to the status of purchase order (OP), materials arriving to the site and their movement about the site, materials consumption and others.

Fig.2.5: Wasted materials on classroom block
Author"s field note 2015

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2.4 Manual or Traditional Materials Management Flow chart

The process by which construction materials are managed manually are indicated in the Flow chart at Fig. 6 to Fig. 8

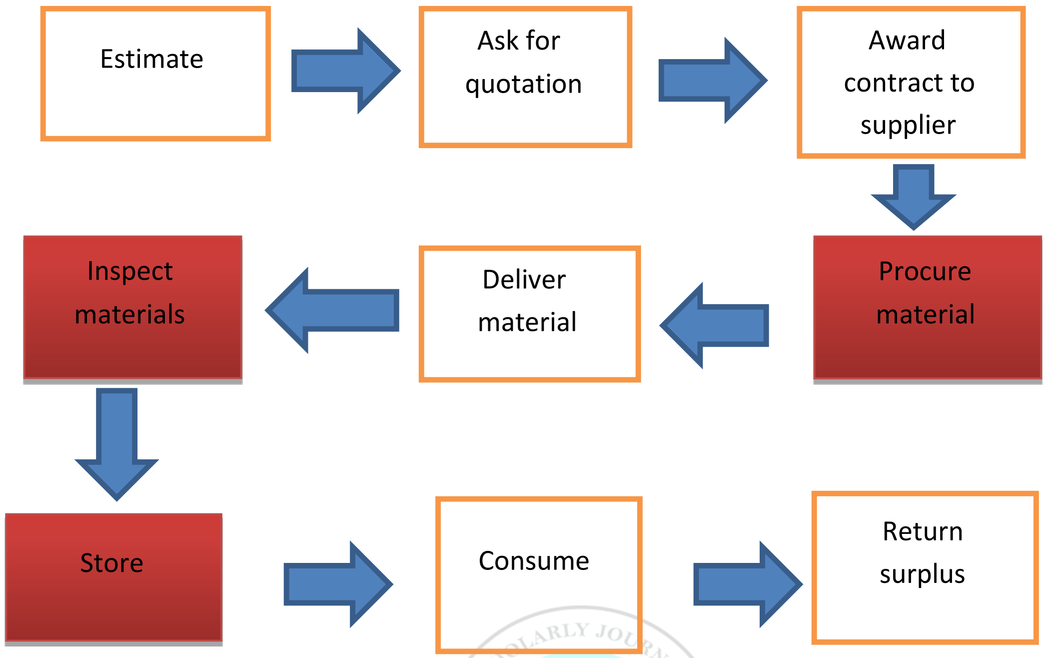

Fig. 2.6: Material management flow – Contractor A

- Project Manager (PM) is in charge of all the releases based on schedule
- Store keeper coordinates with PM directly if problems arise and PM contacts vendor
- Materials stored on site directly till the time they are consumed, no proper storage facility.

Source: Patel and Vyas (2011)

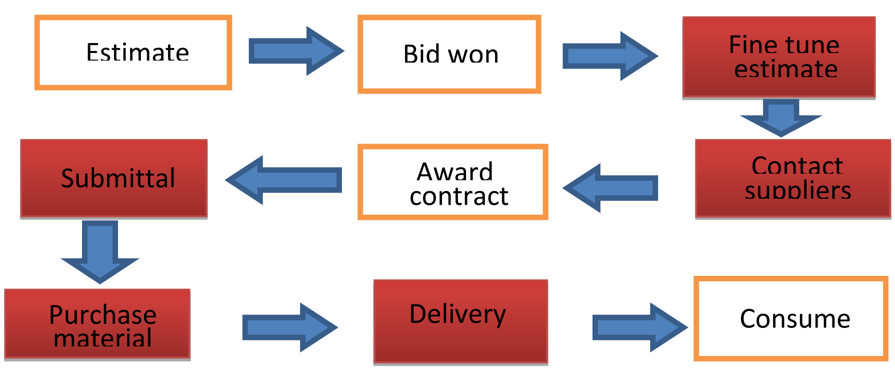

Fig. 2.7: Material management flow – Contractor B

- PM revises estimate and creates a list of detailed quantities for materials
- PM clarifies scope along with purchase department on site, no involvement of the head office
- Buying less than estimated
- Delivery to site directly.
- No automation, lack of proper materials inspection system (MIS), lack of coordination with other projects departments.

Source: Patel and Vyas (2011

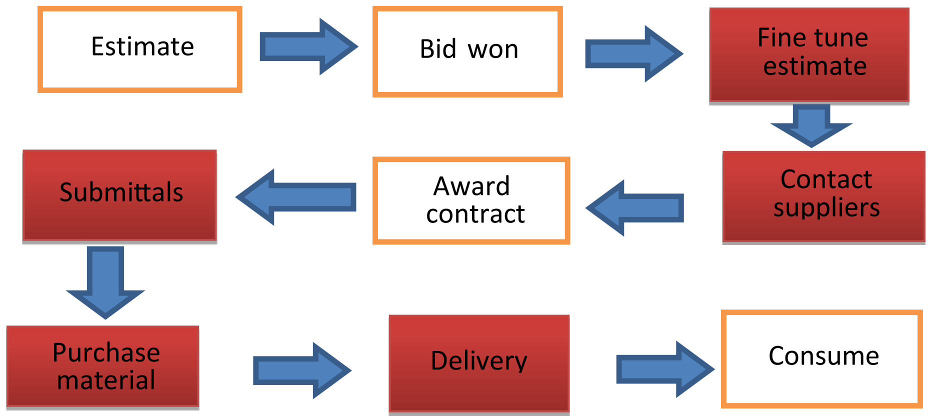

Fig. 2.8: Material management flow – Contractor C

- Purchase department and stores department working as two entities, requirement of a coordinating authority.
- No temporary purchase orders created as cushion
- In house materials inspection system (MIS) present, co-ordinating with central stores department.

Source: Patel and Vyas (2011).

3.0 METHODOLOGY

This chapter discusses the methodology adopted for the study base on following sections; Research Design, Population, Sampling Technique, Data Collection and Analysis of Data.

3.1 Research Design

The design is the structure of any scientific work. It gives direction and systematizes the research, the method selected will affect results and how the findings are concluded. Creswell (2009, 3rd Ed.) admits that research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. Also, the overall decision involves which design should be used to study a topic. Therefore, in order to achieve the objectives of this study, the research design adopted is based on survey. There are types of survey designs to mention but few, Qualitative, Quantitative and Mixed Methods (Cohen, Manion & Morrison, 2011; Creswell, 2009). Creswell and Clark (2007) apparently opine that qualitative research is the means for exploring and understanding the meaning individual or group ascribe to a social or human problem and those who engage in this form of inquiry support a way of looking at research that honors an inductive style. In contrast, quantitative research is a means for testing objective theories by examining the relationship among variables. These variables in turn can be analyzed using statistical procedures. Unlike qualitative research, those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations and being able to generalize and replicate the findings (Creswell, 2008). On the other hand, Creswell (2008) holds that mixed method research, involve the use of both qualitative and quantitative approaches and mixing of both approaches in a study. Thus it is more than simply collecting data and analyzing both kind of data; it also involves the use of both approaches in tandem so that the overall strength of study is greater than either qualitative or quantitative research.

Having carefully assessed the characteristics of the survey research designs, and the objectives of this study, quantitative research design is adopted for the study. Integral to this approach is the

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expectation that the researcher will set aside his experiences, perceptions and biases to ensure objectivity in the conduct of the study and conclusion that are drawn. Key features of many quantitative studies as assessed in the literature are the use of instruments such as questionnaire test or survey to collect data and reliance on probability theory to test statistical hypotheses that correspond to research questions of interest. In addition, quantitative strategies have involved complex experiments with many variables and treatments (e.g. factorial design and repeated measure design). They have also included elaborate structure equation models that incorporate causal paths and the identification of the collective strength of multiple variables (Creawell, 2009). Pretty much, the choice of quantitative research design was based on the review of empirical work done on construction materials management by Babatunde and Olusola (2012), Jeruto and Mutwol (2012), Sadroud (2012) and Kasim et al. (2013) using face-to-face structured interview, qualitative approach and content analysis, case study using questionnaire. These previous works have actually failed (to the best of my knowledge) to consider various relationship of the factors identified using quantitative, census approach method and multiple regression to determine how the factors identified relate to each other and contribute to labour productivity in the construction industry.

3.2 Population

Kothari (2004) described a population as all the items under consideration in any field of inquiry. In order to achieve the objectives of the study, the construction companies that are registered with Association of Building and Civil Engineering Contractors of Ghana (ABCECG) are selected as the population for the study. The literature indicates that construction activities on going in the country (Ghana) are more concentrated in the two regions, Greater Accra and Ashanti Region due to the population and demands on infrastructure, these have led many experience contractors to have their company registered in the two regions. Therefore, it will be representative in nature if these two regions are used as the population for construction companies that registered with ABCECG with good standing in the regions. The target population in order to achieve the objectives of this study is the Site Engineers/Project Managers currently working with the registered construction companies with good standing in Greater Accra and Ashanti Region.

3.3 Sampling Frame

The study drew its sample frame from the Association of Building and Civil Engineering Contractors of Ghana (ABCECG) registered list of good standing contractors in the Head Office, Accra (Darkuman Junction off Kaneshie Odorkor Road). There were 1,230 registered members as at 27thFeb. 2015, at 16:25 GMT when the data was obtained.

Table 3.1: Association of Building and Civil Engineering Contractors of Ghana (ABCECG) Registered List of Good Standing Contractors

Regions	Number of Registered Members	Percentages (%)
Greater Accra	300	24.39
Ashanti Region	150	12.10
Western Region	150	12.10
Eastern Region	150	12.10
Brong Ahafo Region	80	6.50
Northern Region	70	5.69
Upper West Region	60	4.88
Upper East Region	70	5.69
Central Region	100	8.13
Volta Region	100	8.13
Total	1230	100

Statistically, from the Table 3.1, Greater Accra and Ashanti region represent 36.59% of the Total registered members in the (ABCECG) and the same 36.59% for Western Region and Greater Accra likewise Eastern Region and Greater Accra whereas the remaining eight Regions in Ghana account for 63.4% of contractors registered with (ABCECG) if any paired of these regions is to be considered as the site for the study. In appendix II, List of Ghanaian regions by population, ranked according to the latest census, which took place on 26 September 2010. Past census data (1960, 1970, 1984, and 2000) is included for comparison. The record indicated that Ashanti and Greater Accra region have the highest population. These could be a driving factor for most experience construction companies to work in these regions since the population demands on infrastructure, such as Shops, Buildings, Factories, Road- Networks and other construction related project, will certainly be high. Therefore, the researcher conveniently selected registered contractors in Greater Accra and Ashanti region from the list of ABCECG membership of the ten (10) regions for the study. The characteristic of these construction companies (site engineer's/ project managers) could hold a representative view of other construction companies in the regions due to different kinds of job availability in the regions. Based on this, the study was limited to these two regions in Ghana.

3.4 Sampling Technique and Sample Size

The sample size of this study was determined using census approach method. This was deemed to be necessary because, the researcher consulted PWD, Ghana Highways, Urban-Road and Feeder-Roads in the two regions in other to use the contractors that registered with them. It was revealed that the contractors were very many and majority were not having offices in other to locate them easily to answer the questionnaires so it was more convenient dealing with a sizable population of contractors that have a characteristic of representing other contractors in the region (Greater Accra and Ashanti). Therefore, contractors registered with ABCECG in Greater Accra and Ashanti with total population of (450) construction companies, were used to enable the researcher to generalize the findings for the whole population of construction companies in the two regions respectively. United Nation report (2010) indicated that a survey on the census method is vital for providing information about the population in order to present a full and reliable picture of the population. It also provides essential information for policy development and planning for managing and evaluating programme activities across a broad range of sectoral application.

Baffour, et al (2013) confirmed that, the census is also the best, if not the only, source of information on small population groups in terms of area or membership. Additionally, the census is a pivotal part of the official statistics produced by a country because it, typically, provides the benchmark for the population count at national and local levels. Finally, a country"s census information is used by international organisations in projections of the world population, and relatedly, it underpins national accounts which allow the understanding of international credit risk. The census has a unique role in both the national and international statistical system.

3.5 Data Collection

The strategy and approach to employ in collecting data are very important for effective and reliable data to address the purpose of the research. Research strategy is defined as the way in which the research objectives can be questioned (Naoum, 2001). There are three types of research strategies, and this includes quantitative, qualitative and mixed method (Creswell, 2009). For this study, quantitative strategies were used in order to give a broad generalized set of findings concisely and parsimoniously by measuring reaction of large number of contractors to limited questions. These, according to Zhang, (2000) helps in comparison and statistically aggregating of data and it requires the use of standardized instrument so that the varying perspectives and experience of people can fit a limited number of predetermined response categories, to which numbers are assigned and measured statistically. The approach to be adopted for collecting data in social science research depends on the nature of the investigation and the type of data and information that are required and available. This includes experimental, archival, case problem solving and survey (Naoum, 2001). This study was based on survey because; it enabled the researchers to use smaller groups of people to make inferences about larger groups which was prohibitively expensive to study (Holten & Burnett, 1997). Otherwise, earlier researchers on construction materials management such as Wong and Norman (1997), Gopalakrishnan and Sundaresan (1977), Navon and Berkovich (2004), Kasim (2011) used surveys in their studies.

3.5.1 Questionnaire Development

The data for this research was collected through the use of questionnaires targeting Site Engineers/Project Managers working with Contractors in Association of Building and Civil Engineering of Ghana (ABCEG)

- To identify major enabling factors to the application of ICT tools in materials management processes in Ghanaian construction industry;
- To assess the impact of ICT application to material management processes on labour productivity in Ghanaian construction industry;
- To identify the critical barriers to ICT application in materials management processes in Ghanaian construction industry; and
- To recommendation on ICT application variables that lead to high labour productivity in materials management processes in Ghanaian construction industry.

3.5.2 The Questionnaire is in two Parts, A & B

Part A was developed to elicit information on demographics of respondents. Part B was also developed to address objectives one (i) to four (iv). Part A is to identify the types of companies and the kind of personnel (Demographics) from whom information was being sought and indeed this was to establish the credibility of the data. The information included in Part A was Age category, Gender, Qualification, Organizational role Number of year practicing. Project awarded in year and. Part B covers questions on four (4) key areas of materials management processes (MMP)and these included ICT tools use in materials management in the organizations, factors that enable the application of ICT tools in materials management, barriers to the application of ICT tools in materials management, Benefit derived, Labour productivity in the organization and last but not the list indicators of ICT tools application.

3.5.3 Construct and Instrument Development

Regarding the development of the instrument for the quality factors (construct) of MMP, the method adopted by Mojtahedzadeh and Arumugam (2011) was chosen for the study. This method was developed by psychologists and it has been widely accepted in the development of an instrument for measuring variables in social sciences (Conca, et al, 2004). For this research, the method was pursued in three stages namely,

- Stage 1-identification of critical success factors
- Stage 2 –measurement of construct by selecting initial quality items
- Stage 3 –performing reliability, detailed item analysis and constructs validity measurement.

Stage 1: Stage one deal with review of literature in order to identify critical success factors on MMP. The process of developing the questionnaire was based on the review of empirical works done by Wong and Norman (1997), Naik, Aditya and Naik (2011), Ademeso and Windapo (2008), Martin (2011), Phen and Chuan (2001), Lamber, et al (1998), Sardroud (2012), Kasim et al. (2013), Alvrez, (2005), Arditi and Mochtar (2000) as cited in Santosh and Apte (2014). Six constructs were developed.

Stage 2: Stage two involves ensuring that the instrument covers all the relevant aspects of MMPs and the whole proposed survey instrument is well worded and understood. Thus, content validity. An instrument has content validity if researchers agree that the instrument is made up of a group of items covering the issues to be measured (Conca, et al, 2004). Content validity is judged by the researchers subjectively.

3.5.4 Validity of Instruments

Validity of instrument is often defined as the extent to which an instrument measures what it purposed to measure (Kimberlin & Winterstein, 2008). An initial questionnaire was sent to Five (5) experts on the subject, thus pilot questionnaire, to check the comprehensiveness of the items under each construct. The feedback from these experts was used to improve the content as well as ease understanding to eliminate ambiguity and duplication of test. The questionnaire was measured within a five point using a scale of1 to 5: strongly disagree (1), disagree (2), uncertain (3), agree (4), and strongly agree (5)

3.5.4.1 Construct Validity

Construct validity is also statistical tool that measures the extent to which the items in a scale measures the same construct (Flynn, Schroeder & Sakakibara, 1994) and can be evaluated by the use of factor analysis. There are two forms of factor analysis; exploratory factor analysis and confirmatory factor analysis (Hair, Anderson, That-am and Black, 2007). According to Hairet al. (2007) factor analysis condenses or summaries the information into a smaller set of new composite dimensions (factors). However, with this study exploratory factor analysis was used. There are two methods of exploratory factor analysis; Principal Component Analysis (PCA) and Common Factor Analysis. PCA is appropriate when researcher is primarily concerned with the number of factors. Therefore, PCA was used in this study.

3.5.5 Reliability

Reliability refers to whether you get the same answer by using an instrument to measure more than once (Zhang, 2000). Reliability is a statistical tool to measure how reproducible the surveying instrument data is (Zhang, 2000). Four methods are used in measuring reliability namely; the split-halves, test-retested, alternative form and internal consistency methods (Zhang, 2000: Hair et al. 2007). For the purpose of this research internal consistency method will be used because it is the most widely used reliable estimate in empirical research (Zhang, 2000; Conca et al., 2004). It is more reliable because it requires simple administration (Suresh- Chander, Rejendran & Anantharaman, 2001). The internal consistency of each factor will be determined by examining each item inter-correlation and computing the Cronbach"s Alpha. The minimum advisable level is 0.7(Nunnally, 1978; Cronchbach, 1951) although it may be reduced to 0.6 in exploratory research (Hair et al., 2007); Conca et al., 2004) and anything less than 0.6 is usually eliminated (Malhotra and Grover, 1998). The proposed success factors whose calculated Cronbach"s α greater than the critical point of 0.70, is said to be highly reliable and internally consistent. Therefore, based on this study the computed Cronbach"s Alpha is (.933) indicating that the instrument used was highly reliable and internally consistent. See Appendix II.

3.5.6 Administration of Questionnaire

Prior to the distribution of the main questionnaires, the researcher piloted it. This stage aimed at minimizing inevitable problems of converting the design of the questionnaire into reality. A little survey was piloted on a small scale in order to ensure the questionnaire"s readability, accuracy, and comprehensiveness to the following participants, two (2) Academician well versed in material management studies, Site Engineers/Project Managers Three (3) with good standing and currently working on site. Their feedbacks including validations and improvements in terms of wording of statements, the overall content, format, layout and suggestions was adhered to before administering the main questionnaires.

The developed questionnaires were distributed to Site Engineers, working in Association of Building and Civil Engineering Contractors of Ghana (ABCECG) in Greater Accra and Ashanti Regions who have active construction sites and of good standing. In other to reach all the respondents in the regions, the researcher sorts the assistance of the various regional secretaries who met the Site Engineers at their regional meetings to distribute the questionnaires. The secretaries retrieved questionnaires in person from the Site Engineers and scheduled with the researcher to pick them. This process of distribution and retrieving of the questionnaires was guided with suggestion made by Ahadzie (2007), that it makes sure that the questionnaires get to the intended recipients and secondly, to help improve the response rate. The questionnaire took a maximum time of 30-35 minutes of respondents" time to answer.

3.6 Data Analysis

Data collected for the study was analyzed base on the research questions using Descriptive statistics including frequencies, percentages, some measures of central tendencies (mean, standard

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deviation) as well as some inferential statistics (Factor Analysis) were employed in the analysis of the data to make meanings to the responded questions from the respondents. Relative Importance Index (RII) together with some descriptive statistics was also used, in identifying the most important indicators and labour productivity variables. Multiple regression analysis was also used to investigate the relationship between the dependent variable (Labour Productivity) and independent variables, Enabling Factors (ICT Application variables) and Critical Barriers, which resulted from the factor analysis in ICT application to materials management processes. The data was presented in tables and others were discussed and actual responses were italicized. Statistical package for social scientist (SPSS.20) was used as a tool for the analysis of the data retrieved from the survey as the research was more of quantitative in nature.
Measurement for reliability was done to determine the measurement scale that had been developed. This would produce consistent results if measurement is done on a repeated basis. This study utilized internal consistency method in determining the instrument reliability with the Cronbach coefficient, Alpha, as the relevant coefficient to evaluate. Construct validity was determined by conducting exploratory factor analysis (through principal component analysis) using SPSS.20.

3.6.1 Exploratory factor Analysis (Principal Component Analysis)

Before conducting principal component analysis, two tests were carried out to screen the presence of multi-colinearity or correlation among the items and then appropriateness of factor analysis. The two tests were Kaiser-Meyer-Olkin (KMO) and Bartlett‟s tests. KMO quantifies the degree of inter-correlation among the variables and the appropriateness of factor analysis (Field, 2005). Bartlett test of sphericity checks for the presence of correlation among the variables and provides the probability that correlation matrix has significant correlation among at least, some of the variables (Hair et al 2007 and Field, 2005). Kim and Mueller (1978) suggested that KMOs in the range of 0.5-0.6 are considered poor, those in the range of 0.6-0.7 are average, those in the range of 0.7-0.8 are considered good, 0.8-0.9 are great and values greater than 0.9 are superb. In regards this study, the KMO‟s values for Enabling factors to the application of ICT tools in materials management processes and Critical Barriers to application of ICT tools in materials management processes based on FA conducted are .870 and .894 respectively and these are considered good.

4.0 DATA ANALYSIS

4.1 Identifying Enabling Factors and Critical Barriers to ICT Application stools in material management processes

In order to achieve these two objectives, identify major enabling factors to the application of ICT tools, and assess the impact of ICT application to material management processes on labour productivity in Greater Accra and Ashanti region, factor analysis was employed to simplify the factors in obtaining the major enabling factors, the critical barriers in the application of ICT tools and to assess the impact of ICT application to material management processes on labour productivity. The major aim of Factor Analysis (FA) is the orderly simplification of a large number of intercorrelated measures to few representative constructs or factors. In applying, FA, three major steps need to be followed and are: computation of the correlation matrix for all variables; extraction of initial factors and; rotation of the extracted factors to a terminal solution. Since factor analysis is based on correlation between measured variables, a correlation matrix containing the inter-correlations coefficient for all the twenty-two (22) enabling variables and the twenty-one (21) variables of critical barriers were also computed. Labour productivity variables were also computed as one variable (depended variable). An observation of the correlation matrix indicates a fairly high correlation for both enabling variables and (21) variables of critical barriers variables.

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4.2 Enabling factors to the application of ICT tools in materials management processes in Ghanaian construction industry

However, the Bartlett"s test of sphericity as shown in Table 4.6 was used to test for the adequacy of the correlation matrix. (i.e. to find out whether the correlation matrix has significant correlations among at least some of the variables). The Bartlett"s test of Sphericity, test the hypothesis that the correlation matrix is an identity matrix, or the variables are independent. From Table 4.4, the Bartlett test of Sphericity yielded a value of 2064.610 and an associated *p-value* of 0.000. Hence by rule, since the *p-value* (0.000) is less than the default level of significance (0.05), we reject the null hypothesis and conclude that, all the variables are dependent or the variables are fairly dependent or inter-correlated among themselves, hence fulfills the major assumption of FA, therefore we can proceed with the application of FA. (See appendix II), for correlation matrix Table

Table2.2 The Bartlett's test of sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Bartlett's Test of Sphericity		
	Approx. Chi-Square	Df	P-value
.870	2064.610	231	.000

The communality section as shown in Table 4.5 presents the proportion of variance in each variable accounted for by each common factors or the communality for a variable is 1 for all variables as shown in Table 4.7. From Table 4.7, at least, approximately 40% or 0.40 of the variance accounted for by each variable in general was accounted for by each common factor.

Table 4.5: Communalities

	Initial	Extraction
The need for effective means of evaluation of suppliers	1.000	.507
The need to offer closer and long term working relationship to suppliers	1.000	.626
The need to manage and encourage the usage of few suppliers	1.000	.555
the need to educate(give Technical Assistance) to suppliers by your organization	1.000	.529
providing clear specifications of materials to suppliers	1.000	.388
Purchasing department to assume responsibility	1.000	.492
Suppliers having programs to assured quality of their materials/services	1.000	.642
The need to assess price of construction materials in the market before order	1.000	.567
Controlling the rate of materials theft and losses	1.000	.634
Supplier's ability to deliver materials on schedule	1.000	.594
The need to effectively manage large volumes of records of materials delivered	1.000	.537
The need to take records of materials issued to workers on site and personal records	1.000	.748
The need to update records of materials usage to materials management team	1.000	.658
Proper identification of materials in store and easy issuing	1.000	.615
Supervision of workers when using materials in production process	1.000	.524

The need for a system in place to track materials movement both on site and outside	1.000	.499
Internal tracking procedure for construction activities per time	1.000	.659
The need to plan materials usage properly to reduce waste in other to enhance productivity	1.000	.596
Giving formal training to employees to acquire requisite skills in managing materials	1.000	.663
The need to document an update your company's policy for lesson learnt	1.000	.660
The need to keep personal records of workers employed and their working schedule with salary	1.000	.721
The need to plan comprehensive working schedule in your company	1.000	.570

Extraction Method: Principal Component Analysis

Table 4.6 presents the number of common factors computed, the eigenvalues associated with these factors, the percentage of total variance accounted for by each factor and the cumulative percentage of total variance accounted for by factors. In deciding on the number of factors to extract to represent the data, the associated eigenvalues with the factors were used. Using the criterion, factors with eigenvalues of 1 or greater were retained to be the extracted factors. From Table 4.6, the first six (6) factors were retained for rotation, being the extracted factors to explain the variables. Also the six (6) extracted factors accounts for almost 60% of the total variance in the data. However, the remaining sixteen factors accounts for approximately the remaining 40%. Meaning larger proportion of the variable/ contribution is being accounted by the six extracted factors hence representative. Therefore, a model with six factors will be adequate to represent the data.

Table 4.6: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.052	32.055	32.055	7.052	32.055	32.055	2.384	10.837	10.837
2	1.365	6.203	38.258	1.365	6.203	38.258	2.263	10.284	21.121
3	1.272	5.782	44.040	1.272	5.782	44.040	2.213	10.058	31.179
4	1.239	5.632	49.672	1.239	5.632	49.672	2.203	10.012	41.191
5	1.037	4.715	54.387	1.037	4.715	54.387	2.170	9.864	51.056
6	1.021	4.641	59.028	1.021	4.641	59.028	1.754	7.972	59.028
7	.932	4.238	63.266						
8	.830	3.771	67.037						
9	.806	3.665	70.703						
10	.757	3.442	74.145						
11	.738	3.354	77.498						
12	.707	3.213	80.711						
13	.659	2.994	83.705						

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14	.542	2.462	86.167
15	.520	2.363	88.530
16	.463	2.102	90.633
17	.442	2.008	92.641
18	.401	1.823	94.464
19	.350	1.591	96.055
20	.322	1.464	97.519
21	.291	1.322	98.841
22	.255	1.159	100.000

Extraction Method: Principal Component Analysis.

Table shows the component matrix which represent the unrotated component analysis factor matrix and therefore presents the correlations that relate the variables to the six extracted factors. The coefficients as shown in the Table, also called the *factor loadings* indicate how closely the variables are related to each factor. Unrotated factors results in significant *cross-loadings* (i.e. a variable loading highly with two or more factors at the same time). From the component matrix Table, fourteen (14) of the variables were found to be cross-loaded, hence making the interpretation of the factors difficult and theoretically less meaningful.

Table 4.2: Component Matrix

	Component					
	1	2	3	4	5	6
The need to update records of materials usage to materials management team	.690					
Supplier's ability to deliver materials on schedule	.630					
The need to effectively manage large volumes of records of materials delivered.	.627					
Giving formal training to employees to acquire requisite skills in managing materials	.612				-.398	
Purchasing department to assume responsibility	.610					
Suppliers having programs to assured quality of their materials/services	.602					
The need to assess price of construction materials in the market before order	.599		-.369			
The need to take records of materials issued to workers on site and personal records	.595			-.460		
the need to educate(give Technical Assistance) to suppliers by your organization	.594					
Internal tracking procedure for construction activities per time	.588					.405
The need to plan comprehensive working schedule in your company	.581	-.406				

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Proper identification of materials in store and easy issuing	.577			-.364		
The need to plan materials usage properly to reduce waste in other to enhance productivity	.563				-.371	
The need to offer closer and long term working relationship to suppliers	.552			.370		
The need to document an update your company's policy for lesson learnt	.550	-.413	.347			
The need to keep personal records of workers employed and their working schedule with salary	.544	-.445				
Controlling the rate of materials theft and losses	.525					-.451
providing clear specifications of materials to suppliers	.506					
The need for a system in place to track materials movement both on site and outside	.475					
Supervision of workers when using materials in production process	.458		.471			
The need for effective means of evaluation of suppliers	.437			.477		
The need to manage and encourage the usage of few suppliers	.466				.540	

Extraction Method: Principal Component Analysis. 6 components extracted.

The component matrix in Table 4.8 was therefore subjected to VARIMAX rotation method to maximize the relationship between the factors and the variables, thereby reducing any possible cross-loadings. From Table 4.8, eleven (11) of the variables were cross loaded and by rule they are deleted from the entire data.

Table 4.8: Rotated Component Matrix

	Component					
	1	2	3	4	5	6
The need to keep personal records of workers employed and their working schedule with salary	.813					
The need to document an update your company's policy for lesson learnt	.710					
The need to plan comprehensive working schedule in your company	.626		.344			
Purchasing department to assume responsibility	.379				.347	
Proper identification of materials in store and easy issuing		.682				
Supervision of workers when using materials in production process		.665				
Internal tracking procedure for construction activities per time		.661		.404		
The need to effectively manage large volumes of records of materials delivered	.375	.463	.370			
The need to take records of materials issued to workers on site and personal records			.812			
The need to update records of materials usage to materials management team	.430		.530	.386		

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Providing clear specifications of materials to suppliers		.456			
Suppliers having programs to assured quality of their materials/services			.668		
The need for a system in place to track materials movement both on site and outside			.661		
The need to assess price of construction materials in the market before order		.470	.523		
the need to educate(give Technical Assistance) to suppliers by your organization			.523	.371	
The need to offer closer and long term working relationship to suppliers				.720	
Giving formal training to employees to acquire requisite skills in managing materials				.719	
The need to plan materials usage properly to reduce waste in other to enhance productivity	.449			.573	
Controlling the rate of materials theft and losses		.353			.676
The need to manage and encourage the usage of few suppliers					.634
The need for effective means of evaluation of suppliers				.490	.493
Supplier's ability to deliver materials on schedule	.438				.474

Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 7 iterations.

The bolded statements indicate cross loaded variables

Hence from Table 4.9, the twenty-two variables were reduced to eleven (11) being explained by six (6) extracted factors, Table 4.9, factors1, Factor 6 explains only one variable, factors1, 2, 3, 4 and 5 explains two variables respectively. Factor 1 explains the statements "The need to keep personal records of workers employed and their working schedule with salary" and "The need to document and update your company's policy for lesson learnt" and therefore reflects the policy of the organization and hence can be labeled as *organizational policy*. Factor 2 explains the following "Proper identification of materials in store and easy issuing and "Supervision of workers when using materials in production process" and therefore reflects the broader perspective of material handling and hence labeled as *identification of materials and supervision of workers for usage of store materials*.

Factor three explains the following variables, "The need to take records of materials issued to workers on site and personal records" and "providing clear specifications of materials to suppliers" and can be labeled as *Records taking and specifications of materials*. Factor four explains both "Suppliers having programs to assured quality of their materials/services and "The need for a system in place to track materials movement both on site and outside*"* and therefore reflects provision of system in place for suppliers to be assured of quality materials/services and hence can be labeled as *Tracking of material movement and quality materials to suppliers.*

Factor 5 explains the following variables "The need to offer closer and long term working relationship to suppliers" and "Giving formal training to employees to acquire requisite skills in managing materials" and therefore can be labeled as *working relationship and formal training*.

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Factor 6 explained "The need to manage and encourage the usage of few suppliers" and hence can be labeled as *Management and usage of few suppliers*.

In summary, the six main factors being the enabling factors (ICT Application Variables) to the application of ICT tools in materials management processes in the construction industry are;

- *organizational policy* =ICTOP COMBIND
- *Identification of materials and supervision of workers for usage of store materials* =ICTIDM/SW COMBIND
- *Records taking and specifications of materials* =ICTRT/SM COMBIND
- *Tracking of material movement and quality materials to suppliers*
    - =ICTTM/QMS COMBIND
- *Working relationship and formal training* =ICTWR/FT COMBIND
- Management *of usage of few suppliers*=ICTMAUFS COMBIND

Table 4.9: Rotated component matrix after deletion of cross-loaded variable

	Component					
	1	2	3	4	5	6
The need to keep personal records of workers employed and their working schedule with salary	0.813					
The need to document and update your company's policy for lesson learnt	0.71					
Proper identification of materials in store and easy issuing		0.682				
Supervision of workers when using materials in production process		0.665				
The need to take records of materials issued to workers on site and personal records			0.812			
Suppliers having programs to assured quality of their materials/services				0.668		
The need for a system in place to track materials movement both on site and outside				0.661		
The need to offer closer and long term working relationship to suppliers					0.72	
The need to manage and encourage the usage of few suppliers						0.634

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.3 Correlation between Information and communication Technology (ICT) Application Variables and Labour Productivity in Ghanaian construction industry

The attempt to determine whether or not the ICT application variables and labour productivity correlates, Pearson correlation test which is a parametric was used, at p<0.05on the basis that the underlying assumptions regarding the types of data has been met. According to Oforiand and Dampson (2011) correlation analysis is conducted if the study seeks to investigate the strength and direction of the relationship between two or more variables. Hence this study, based on the assertion, used the Pearson correlation test. The results in Table 4.10 reveal that correlation between *labour productivity and organizational policy has a higher significant at the*

0.01 level (r = 0.464; n = 281; *p*< 0.01). Relatively, the rest of the ICT application variables, *Identification of materials and supervision of workers for usage of store materials* (r = 0.455; n = 281; p< 0.01), Record tracking and supervision of materials (r = 0.376; n = 281; p< 0.01), *Tracking of material movement and quality materials from suppliers* (r = 0.448; n =281; p< 0.01) *Working relationship and formal training* (r = 0.441; n = 281; p< 0.01) and *Management and usage of few suppliers* (r = 0.310; n = 281; p< 0.01). It is therefore very clear to state that the ICT application variables identified by this study based on the construction MMPs, have a high positive correlation with labour productivity in the construction industry in Ghana. Hence, the null hypothesis that states that „There is no significant correlation between ICT application variables and labour productivity" has being rejected. The relationship is unlikely to be due to the operation of chance factors. Therefore, indicating that the more the ICT application increases the more the labour productivity will also increases or achieved.

Table 4.10 Correlation matrix (pearson's *r)* for ICT Application Variables and Labour productivity

Variables compared	N	Corr. coeff.	pvalue	Decision
LP COMB *(Dependent Variables*)				
ICTOP COMBIND	281	.464**	.000	Reject
ICTIDM/SW COMBIND	281	.455**	.000	Reject
ICTRT/SM COMBIND	281	.376**	.000	Reject
ICTTM/QMS COMBIND	281	.448**	.000	Reject
ICTWR/FT COMBIND	281	.441**	.000	Reject
ICTMAUFS COMBIND	281	.310**	.000	Reject

N = Number; Corr. coef. = Correlation coefficient

ICTOP = *Organizational policy*

ICTIDM/SW = *Identification of materials and supervision of workers for usage of store materials*.

ICTRT/SM = *Records taking and specifications of materials*.

ICTTM/QMS = *Tracking of material movement and quality materials from suppliers*

ICTWR/FT = *Working relationship and formal training*.

ICTMAUFS = *Management and usage of few suppliers*.

4.4 The Relationship between a Single Dependent Variable (LP COMB) and Several Independent Variables (ICT Application variables)

In determining the relationship of the variables, dependent and independent, Table 4.11 shows the results, all the six (6) ICT application variables were included in the model as independent variables. This indicates that all the predicting variables went into the equation at once hence forming one model. The predicted variable, *organizational policy, Identification of materials and supervision of workers for usage of store materials Records taking and specifications of materials, tracking of material movement and quality materials to supplier, working relationship and formal training and Management of usage of few suppliers, collectively explained approximately 41% of the variance in labour productivity.* The difference in R2 and the adjusted R2 (0.419 – 0.406) of 0.013 would indicate that the model will lose 1.3% of 41% variance explained in Labour Productivity if the researcher is to generalize the model beyond the sample to the population of contractors registered with ABCECG in good standing in for using ICT tools in MMPs in their companies. Because the analysis employed the forced Entry method, the change statistics do not tell much in terms of the contribution each predictor (ICT Application Variable) made to the statistics. However, the F-ratio is highly significant F (6, 274) = 32.933; p < 0.01, suggesting that the model fits the data very well.

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Table 4.11: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.647[a]	.419	.406	3.479	.419	32.933	6	274	.000

a. Predictors: (Constant), ICTMAUFS COMBIND, ICTRT/SM COMBIND, ICTOP COMBIND, ICTWR/FT COMBIND, ICTTM/QMS COMBIND, ICTIDM/SW COMBIND
b. Dependent Variable: LP COMB

The Table 4.12 presents the analysis of variance (ANOVA) test whether the model is significant better of predicting the dependent variable (Labour Productivity). Comparing the (Mean Square regression = 398.607 with the residual existing after fitting the model to the data (Mean Square residual = 12.104). So, the F-ratio (32.933) and with a probability significant of less than 0.01, it is highly unlikely that such a value was obtained by chance. This confirms that, *organizational policy, Identification of materials and supervision of workers for usage of store materials, Records taking and specifications of materials, Tracking of material movement and quality materials to supplier, Working relationship and formal training and Management of usage of few suppliers* together significantly improves the ability to predict Labour Productivity in the construction industry in Ghana. Hence the regression equation, thus y = b0 + b1 (X1) + b2 (X2) + b3 (X3).....bn(Xn), indicating that the multiple regression equation of Labour Productivity (LP) *= 3.081+0.975 ICTOP +1.066 ICTIDM/SW +0.462 ICTRT/SM +0.938 ICTTM/QMS +0.843 ICTWR/FT +0.411 ICTMAUFS*

Table 4.12: Analysis of variance

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	2391.642	6	398.607	32.933	.000[b]
1	Residual	3316.372	274	12.104		
	Total	5708.014	280			

a. Dependent Variable: LP COMB

b. Predictors: (Constant), ICTMAUFS COMBIND, ICTRT/SM COMBIND, ICTOP COMBIND, ICTWR/FT COMBIND, ICTTM/QMS COMBIND, ICTIDM/SW COMBIND

In order to determine which variables are individually significant predictors of the dependent variable, Table 4.13 present the result. The Unstandardized Coefficients B column, gives the coefficients of the independent variables in the regression equation including all the predictor variables. Though, the enter method has included all the variables in the regression equation even though only four of them are significant predictor, The Standardized Beta Coefficients column shows the contribution that an individual variable makes to the model. The average amounts the dependent variable increases when the independent variable increases (all other independent variables are held constant) is weighted at Beta column. The predictor that is making a significantly largest contribution to Labour Productivity *is Organizational policy* (β =0.219; t = 4.150; p< 0.01) followed by*, Identification of materials and supervision of workers for usage of store materials* (β =0.203; t = 3.745; p< 0.01) *Tracking of material movement and quality materials from suppliers* (β = 0.191; t = 3.584; p< 0.01) and *Working relationship and formal training* (β = 0.190; t = 3.598; p< 0.01) This is an indication, for example, that if *Organizational policy* goes up by 1step, labour productivity increases by 0.219 and this applied to the rest of the predictors because they are all positive. Table 4.15 shows the model summary for which the amount of variance in the depended variable is explained by the independent variables (R Square column). There clearly exists some multi-collinearity among the entered independent variables and the dependent variable (.652a) which is measured as (3.449). The effect of multi-collinearity needs to be taken into account for the process of model estimation and interpretation, because multi-collinearity can have substantive effects on the estimation of the regression coefficients and their statistical significance tests (Hair et al., 1998).

Table 4.13 Coefficient of determination

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	3.081	3.099		.994	.321
	ICTOP COMBIND	.975	.235	.219	4.150	.000
	ICTIDM/SW COMBIND	1.066	.285	.203	3.745	.000
1	ICTRT/SM COMBIND	.462	.302	.083	1.531	.127
	ICTTM/QMS COMBIND	.938	.262	.191	3.584	.000
	ICTWR/FT COMBIND	.843	.234	.190	3.598	.000
	ICTMAUFS COMBIND	.411	.265	.077	1.552	.122

a. Dependent Variable: LP COMB

5.0 CONCLUSION

The results reveal that the p-values for the test using Spearman correlation between the depended variables (labour productivity) and the independent variables (ICT Application variables) is less than the critical p-value (0.05), therefore the null hypothesis was rejected, indicating that there is significant correlation between labour productivity and ICT application variables. It is therefore, explains that the construction companies that registered with ABCECG in good standing in both Greater Accra and Ashanti region use ICT application to assess high labour productivity. In order to investigate the relationship between the dependent variable (LP and the six independent variables (ICT Application variables) which resulted from the factor analysis, the Multiple regression analysis reveals that the regression line predicted by the independent variables explains a significant amount of the variance in the dependent variables F (6, 274) = 32.933; P<0.05. Therefore, the regression is statistically significant. The results show that the independent variable „*Organizational policy*" has the greatest influence towards achieving labour productivity (dependent variable) with a beta coefficient of 0.975 which explains 42.5percent of the variance of the dependent variable (p=0.000).

With a beta coefficient of 1.066, the variable „*Identification of materials and supervision of workers for usage*" has the second largest influence on the dependent variable (p=0. 000). The third and fourth variables influencing the labour productivity were, *tracking of material movement and quality materials from suppliers* with a beta coefficient of 0.938 (p=0.00) and the fourth being *Working relationship and formal training* with a beta coefficient of 0.843 (p=0.00). The results reveal that „*Records taking and specifications of materials*" (beta coefficient=0.462) and „*Management and usage of few suppliers* (beta coefficient=0.411) have less explanatory power of the dependent variable. Also, these regression coefficients are not significant. Though, *Records taking and specifications of materials* relations and *Management and usage of few suppliers* are positively related to Labour productivity but the relationships are not significant.

5.1 Benefits Derived from ICT Application to Material Management

Managing materials is really an issue that hinges so much on avoidance of waste and theft by effectively planning for proper specification, timely delivery of materials, keeping of good records of materials, identification of material and proper co-ordination among the materials management team and the supplier in other to overcome the negative effects of materials cost on project performance. The application of ICT tools in materials management processes as an innovation in the construction industry is to determine whether this could yield any benefits to the construction companies in Ghana. The respondent indicated that ICT tools application in materials management processes actually lead to benefits like, *More cost effective projects are achieved,* this is an indication that the budget prepared for the specific projects as at the time of the project has duly been followed and the expenses involving administration cost of materials management processes, with regards to Planning, procurement, Purchasing, Logistics, Handling, Stock and Waste Control, have been met without any project cost overrun.

In addition, *Expedite purchasing processes of construction material*, also emerged as a driven benefit of ICT tools application in materials management processes. The respondent indicated that ordering and payment of materials processes are tremendously speed up when ICT tools are used for communication or coordination for materials arrival on schedule and on site to avoid keeping the labours idling. This are really achieved using E-mailing, Transfer Protocol and others to speed up communications or co- ordinations.

Furthermore, *Reduction in craft labour cost due to the improved available of materials as needed on site*, also met the approval of the respondent as one of the benefit driven from ICT tools application in materials management processes. It is an indication that implementation of ICT tools in managing materials has actually led to reduction of people that are to work, otherwise works that are to be done by five people, due to ICT tools implementation one person will be able to handle the works and this will lead to reduction of labour cost. *A better standard of work due to quality specification of construction materials and equipment,* as approved by the respondent as one of the benefit, is an indication that materials quality and quantities are well defined or described when ordering for materials to avoid wastage. Also working procedures that involve the uses of the materials are closely monitored using the ICT tools to ensure that quantity of materials issued to workers are properly used in other to achieved good standard of work.

Last but not the least, *Completion of construction works on schedule*, is one of the greatest objectives for construction companies to achieve as benefits. The respondent indicated that using the ICT tools in managing materials processes, contribute greatly to the working procedures or project schedule due to timely availability of materials on site to speed up working processes, by assigning materials to each individual task and the personnel to undertake the task (work breakdown structure, WBS). These benefits go to confirmed the assertion made by "Rethinking Construction" (2000) in the literature review that investment in such systems like ICT tools in materials management processes can be quite beneficial. This will inevitably result in a firm or project experiencing previously unknown increased levels of professionalism and benefits.

5.2 Findings

The study also revealed that when construction materials are well specified and workers, also, well supervised. These will lead to high labour productivity. In the same vein, *tracking of material movement and quality materials from suppliers will* and *Working relationship and formal training lead to* high labour productivity. Also, the result reveals that, „*Records taking and specifications of materials*" and„*Management and usage of few suppliers* have less explanatory power of the dependent variable indicating that though, they contribute to labour productivity, not to that great extent or significant. This may be due to some couples of extraneous variables that could not be accounted for.

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