EXAMINING THE FACTORS AFFECTING THE PRODUCTIVITY IN THE LIBYAN CONSTRUCTION COMPANIES

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ABSTRACT

This study aims to examine the productivity constraints in the construction companies in the city of Ajdabiya, which is located in the central northern area of Libya. Moreover, it aims to propose any strategies that can improve productivity in construction companies. A questionnaire survey was used to collect data from project managers, executives, and managers who are working in construction companies. Of the 203 questionnaires dispatched to the selected respondents, only 149 were completed and returned, yielding a response rate of 73.4%. Almost all companies used the 36 factors used in the survey. Drawings and specification alteration during execution, lack of labor experience, material shortage, rework, and supervisors' absenteeism are the factors which strongly affect productivity in the construction companies. If these factors are taken seriously, then the performance and productivity level will definitely show positive results and encourage progress in these companies. Strategies to improve productivity in the construction companies in Ajdabiya are proposed in this research. Several recommendations to help increase the productivity level in the Libyan construction industry are provided. These recommendations include encouraging more organizational training for lower-level supervisors who are directly responsible for the people who are handling the tools, providing training, mentoring front-line supervisors, and improving the project planning phase, including organization, clear division of responsibilities, and identifying the scope of work for all parties involved. Other recommendations are managing construction activities with proper sequencing, e.g., timely equipment arrival and material and proper planning, and providing sufficient resources on-site to coordinate contractors.

Keywords: *Factors, Affecting, Productivity, Construction companies, Libya*

1. INTRODUCTION

The analysis of productivity of companies is very important to indicate and define their performance. Productivity and efficiency growth have long been recognized as important drivers of economic growth and determinants of international competitiveness of a country in relation to others (Krugman, 1994). This globalization market has created an international and competitive environment. To meet competition and demand of internationalization, the firms must launch strategies to operate more efficiently in order to stay competitive (Grimwade, 2009). This globalization context necessitates that a country's regulatory agencies respond positively to international competition and globalization challenges. Consequently, the Libyan government has announced a deregulated industry environment consistent with the international competitive environment. The survival of companies and firms in this deregulated and open market depends on high productivity and efficiency in their business operations. It follows that information regarding firm's efficiency and productivity would assist companies and firms and the relevant authorities to develop policies and plans to sustain performance and competition.

The construction and manufacturing industry is as important as the banking sector to support the economic growth. Upon review of the literature on Libyan construction sector, no study has been found to analyze the factors affecting the productivity level in the construction industry. This sector is considered vital although it contributes about 5 percent to GDP and employs about 20 percent of the 1.6 million of the total workforce (Central Bank of Libya, 2004). The low figures may be the result of low-level of performance; hence this study seeks to examine the factors lead to a low-level of productivity as well as to fill the gap in the literature relating to a study on the construction industry in Ajdabiya city. The low-level of productivity in construction industry sector can be explained by some factors which affect their performance. Among them are inabilities to take advantage of scale economies and the difficulties they face in getting resources in terms of qualified human capital Report C/A (2006). In the Libyan case, there have not been any recent empirical studies validating or rejecting the explanation of this phenomenon (MHU, 2011). This study aims to examine those factors that affecting the productivity levels of Libyan construction industry. The companies work at low-level of operational efficiency and with a poor progress and achievement and finishing. This leads to poor quality of infrastructure and low productivity rate of the construction industry even though efforts have been made by the government to lift up the industry through consecutive Libyan Economic plans. The low productivity of construction companies and firms still persists. In addition, the poor performance of Libyan construction companies has been criticized by many economists and policy makers. Public companies and firms have become popularly associated with inefficiencies (HLD, 2010). It is claimed that the public construction companies in Libya are owned and controlled by the state that caused low efficiency and productivity because of low competition, also led to the wastage of investment resources, is increase the government's fiscal burden and slowed down economic growth (John, 2008). Most researches have focused on organization efficiency and productivity at different levels. Much has been done in this area while less research has been emphasized on the factors affecting the productivity in the construction industry. Nevertheless, several issues related to productivity have begun to receive recent attention. Policy makers are interested in productivity given the fact that productivity growth is a major source of economic growth and welfare improvement. Since productivity influences by many factors including economic, social, technical and environmental factors, these factors should be examined. This investigation will address productivity at the construction companies' levels in the city of Ajdabiya by using a quantitative method. Many researches have addressed the issues on productivity of developed countries. However, not many have covered on developing economies; this study is a contribution to the literature of a developing country with strong focus on the construction industry in Ajdabiya city, especially the impact of government policy on productivity before and after the change (MHU, 2011).

2. LITERATURE REVIEW

Several approaches have been adopted in relation to the classification of factors affecting construction productivity. A United Nations report (1995) stated that in ordinary situations two major sets of factors affects the site labour productivity requirements: organisational continuity and execution continuity. Organisational continuity encompasses physical components of work, specification requirement, design details etc. Execution continuity relates to the work environment and how effectively a job is organised and managed. Management aspects include weather, material and equipment availability, congestion and out-of-sequence work. Lim and Alum (1995) studied factors affecting productivity in the construction industry in Singapore. Their findings indicated that the most important problems affecting productivity were: difficulty with recruitment of workers; high rate of labour turnover; absenteeism from the work site; and communication problems with foreign workers. Heizer and Render (1990) classified factors influencing site productivity into 3 groups: labour characteristic factors; project work conditions factors; and non-productive activities. Olomolaiye et al. (1998) stated that factors affecting construction productivity are rarely constant, and may vary from country to country, from project to project and even within the same project, depending on circumstances. They classified factors influencing construction productivity into 2 categories: external and internal, representing those outside the control of the firm's management and those originating within the firm. External factors included the nature of the industry, construction client knowledge of construction procedure, weather and level of economic development. Internal factors included management, technology, labour and labour unions. Studies by (Enshassi et al., 2006, Enshassi et al., 2007) stated that among the problems which the Palestinian construction industry is facing are material supply schedules and project scheduling techniques. Although a number of training courses were conducted to local contractors, these training efforts did not focus enough on the abilities to use project scheduling techniques such as Microsoft project and Primavera. Therefore, training effort should also be tailored to improve methods of studying productivity and ways of productivity improvement on construction sites. Gannoruwa (2008) conducted a study and found that the average direct effective working time (tool time) of two commercial construction job sites in Calgary was just 53.17%. Moving around the site was the largest portion of non-tool time activities. The category "walking" includes looking for materials, looking for foremen, carrying tools and equipment, just walking in itself, and walking to the office, wash rooms, and stopping to chat with fellow co-workers. After working continuously for a long time, it is necessary to have short breaks for smoking, idling, using washroom facilities, but if these breaks last more than 10 minutes then the productivity at that period can be seriously affected (Noor, 1992). Hewage and Ruwanpua (2006) broke down a normal each trade worker's time in detail. The following figures (Figure 1and Figure 2) show the detailed breakdown in carpentry work, which basically shows how the time is spent and that there is a room for increasing the working time. Liu and Ruwanpura (2007) developed a "Ten-Week Testing Model" to improve tool time and construction productivity on a high-rise building site by reducing waste in on-site resource management. Aduagyei and Ruwanpura, (2008) identified some of the significant situations that create congestion and reduce the productivity of resources in the work area. Some of the critical situations were over stacking of trades, improper activity sequencing, excessive on-site prefabrication and storage of material in the work area and improper planning of the activities with regards to movement of resources in the work area with the progression of the work. Da Silva and Ruwanpura (2006) on a study to improve productivity of slab concreting operations on four commercial construction sites in Alberta, indicated that productivity losses during concreting operations were mainly caused due to variability in the pouring rates and site layout factors restricting the movement of concrete trucks on site during concreting. Hewage (2007) conducted another research based on Liberda et al.'s (2003) fifty-one factors affecting productivity. These factors were prioritized and clustered into nine categories. These categories are: design and changes, worker motivation, inadequate communication, worker skills, non-availability of information, lack of planning, congested work areas, inadequate supervision, and adverse weather conditions.

Extensive multiple-handling of materials, improper storage of materials, waste due to negligence or sabotage, obstruction of access to material storage area, lack of materials, and late fabrication/deliveries are a few instances of how material may affect the productivity of construction work (Zakeri et al., 1996; Rojas and Aramvareekul, 2003a). Makulsawatudom and Emsley (2001) ranked lack of materials among the top factors for influencing productivity of construction projects in Thailand. One reason cited for late delivery of material was late payments to vendors; material suppliers retained materials until a full payment was received. Another reason cited was lack of prioritization by project managers, who procured non-critical materials while losing sight of critical materials for procurement. In a case study of three projects, poor material management involved poor site storage practices, running out of material, late deliveries, out-of-specification material, fabrication errors, and out of sequence deliveries; these practices contributed to more than 50% overrun in labor work hours. Other causes for lack of materials were dependence on foreign imports and poor communication between the office and the field (Thomas and Sanvido, 2000b). Project managers perceived lack of materials to be the most important problem facing craftsmen in Indonesia (Kaming et al., 1996). Causes of material unavailability in Indonesia were identified as the following: difficulty in transporting materials to jobsites (jobsites were locating in highly populated urban areas), inadequate storage areas for material, excessive paperwork requests (bureaucracy), and inadequate planning. Improper sorting and handling of material, obstructing access, and movement of materials were among other instances of adverse material management (Kaming et al., 1997a).

Experience, skill and training were proven by the previous studies as important factors that affecting the productivity in the industry including the construction. A research by Allen (1984) found that the major source of productivity decline in construction between 1968 and 1978 was reduction of the skills level of the average worker. The reduction in skill levels of workers resulted from shifting the mix of output from large-scale commercial, industrial, and institutional projects to single-family houses. Education and experience were two elements represented in increased skills (Adrian, 2002). The top factors in construction productivity were workers' experience, quality, and diversity of performed work, according to respondents to a survey. Therefore, proper selection of skilled labor could improve productivity of a project (Rojas and Aramvareekul, 2003a). If a worker lacks experience in a particular operation, it would be beneficial to train the worker before assignment to task by means of activity training. Activity training refers to education provided to workers for performing a task. Better understanding of activity requirements leads to more efficient worker performance of the task (Rojas and Aramvareekul, 2003a). Overtime was also proven to be an important that had a role in affecting the productivity. A normal 40-hour work week consists of 8-hour work days from Monday to Friday excluding weekends. Additional hours worked beyond the normal 40-hour week or 8-hour day are generally considered overtime and overtime impacts the productivity of every hour of the day or week. Productivity losses due to scheduled overtime are related to development of fatigue in workers and decreased motivation (Halligan et al., 1994; Cooper et al., 1997). Occasionally, decisions to have crews work overtime are made regardless of negative physical and psychological effects on workers as well as any impact on overall productivity. Thomas and Raynar (1997) studied 121 weeks of labor productivity data to quantify the effects of scheduled overtime. The results showed losses of efficiency of 10-15% for 50 and 60 hours per week work schedule over a three to four-week period (short-term overtime). Adrian (1987) had also observed that a 5-day 10-hour work schedule would negatively affect productivity approximately at a rate of 9% for each hour. Long-term overtime or consecutive overtime schedules of longer than three to four weeks may cause development of more fatigue and further losses of productivity, yet overtime is a frequent occurrence at construction projects.

Common conditions prompting overtime are necessities on a job to accelerate the schedule to recover lost time; however, the inability to provide materials, tools, equipment, and information at an accelerated rate also may lead to losses of efficiency. Working overtime to accelerate the schedule without providing an adequate backlog of work and expedited deliveries may be a formidable challenge for contractors (Thomas and Raynar, 1997; Thomas and Sanvido, 2000a). As a result, when a worker is paid a higher premium (normally one and half times higher his regular rate) for 2 hours each day and yet the worker is not more productive, increased wages with no gain in production will adversely influence the cost effectiveness of project. In a comparison of labor management among French, German, and English contractors, it was found that French contractors achieved higher levels of productivity and efficiency with an average of a 40 hour, 5-day weekly schedule which allowed operators better recovery time (Proverbs et al., 1999c). Another concern with overtime is the potential impact of increased accident rates. Since workers develop fatigue and boredom when working overtime, they are not as attentive as usual; therefore, there is a risk of having safety lapses, resulting in more accidents and subsequent periods of non-productivity.

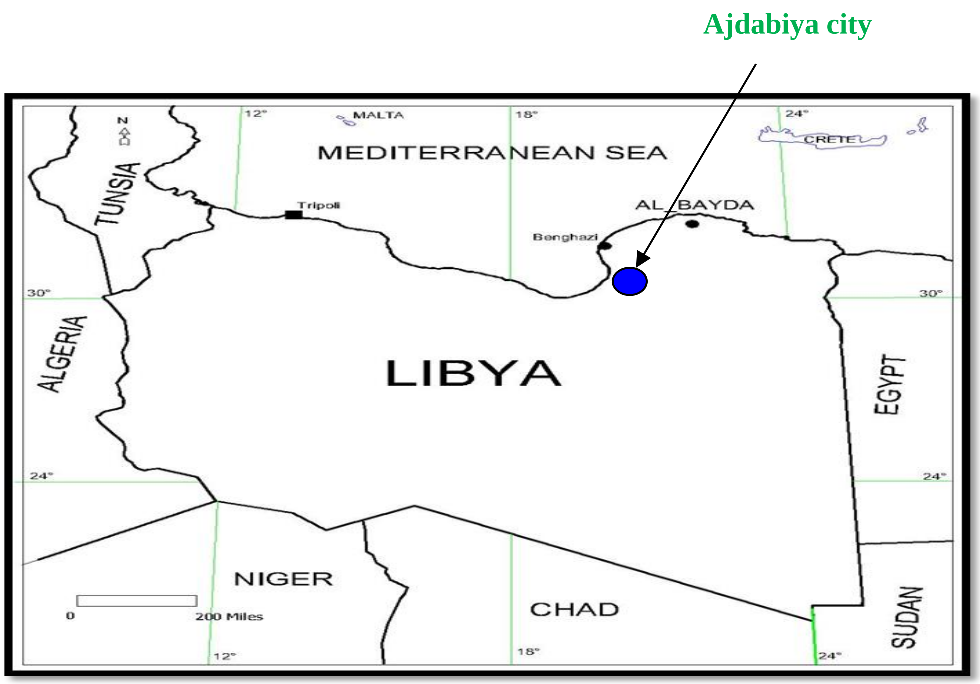
Productivity can also be affected by several environmental factors. Generally, construction work takes place in an open environment; thus, environmental conditions may impact the conditions of jobsites as well as workers. It has been estimated that half of all construction operations are weather-sensitive (Oglesby et al., 1989). One study attributed as much as a 30% decline in productivity due to adverse weather conditions (Thomas et al., 1999b). For example, highway construction projects are so sensitive to rainfall that complete suspension of operations may occur as a result of saturated or unworkable soil and paving conditions (El-Rayes and Moselhi, 2001). This means that productivity will suffer unless management devises a method for compensating for it or at least mitigating its effects (Christian and Hachey, 1995). Likewise, the thermal environment has physiological and psychological effects on the human body. Working in temperatures out of the comfort zone may reduce productivity. Three different regression equations were developed for predicting productivity caused by changes in the thermal environment. These models indicated that productivity reaches its optimum at the optimal thermal comfort that reflects an index where workers feel most comfortable and thus perform their work most efficiently. Productivity declines with variation from this optimal range (Mohamed and Srinavin, 2002). Few examples of adverse weather conditions affecting construction projects tend to include high winds, snow, rainfalls, heat and cold. However, some researchers studied the impact of heat, cold, and noise on productivity in greater detail, which will be reviewed in the following sections. Workers must often redo work due to change orders that may occur as a result of design error, fabrication error, and/or field errors. Under these circumstances, productivity of work is decreased (Oglesby et al., 1989). Change orders may also cause the learning curve to suffer if the workers must stop the scheduled work and shift their efforts to different tasks, prompted by change orders.

Poor communication among different entities and individuals in a construction project may negatively affect productivity of a job. Whether it is a simple conversation between two workers on a jobsite or communication of technical and critical information among contractors, owners and engineers, effective communication plays a major role in the success of project. Prompt communication to make instructions and other information available is critical for onetime and proper performance of work. Oglesby et al. (1989) illustrated an example of a concrete dam project where the schedule slipped. Upon analysis of the project, the specialist found that there was only one special wrench available to attach and disconnect the large gang forms, which was shared among three crews. The productivity of the project declined until more tools were ordered. When the foremen and crews were asked why they let the situation continue, they responded that no one asked them the nature of the problem. On most jobs, there is little time spent on communicating project problems, exchanging information, and brainstorming for better ways to get the job done. Poor communication leads to a decline in work productivity and very likely to defective products in the long run. Depending on the degree of complexity and necessity, communication among parties involved in a construction project may be accomplished by phone, email, and mail. Generally, technical information and change orders are better documented in writing for future reference. Respondents to a survey study preferred the use of written documentation for work procedures, manuals, charts, and guidelines in lieu of informal verbal communication (Makulsawatudom and Emsley, 2001). Ali (2012) found that communication plays potential role in increasing the productivity in the Libyan construction industry. Quite number of previous studies study revealed that the factor of rework is a cause of productivity decline (Zakeri et al., 1996; Makulsawatudom and Emsley, 2001, Shinen, 2012). Occasions for rework were mainly attributed to incompetent craftsmen because of insufficient working skills and knowledge of drawings or to incompetent supervisors because of lack of experience leading to deficient supervision. Other causes of rework were attributed to change orders, poor drawings, negligence/sabotage, and improper material application (Zakeri et al., 1996; Makulsawatudom and Emsley, 2001). Rework ranks as the second most important problem affecting craftsmen's productivity in Indonesia (Kaming et al., 1997a). The causes of rework were attributed to design changes, poor instruction, poor planning, poor workmanship, and complexity of design specification. Craftsmen suggested that three ways to resolve rework problems were briefings on every new activity (pre-task planning), clear instructions in written form, and clear and detailed construction drawings (Kaming et al., 1997a; Kaming et al., 1997b). Lack of quality control is also a cause for frequent rework that may adversely affect productivity (Rojas and Aramvareekul, 2003a). Timely inspection is of great importance to ensure effective operation, material quality, and timely progress of the project schedule. Subsequent activities on a construction schedule may not start until the required inspection is completed on preceding tasks. Makulsawatudom and Emsley (2001) cited project managers and inspectors equally as causes for delay in inspection. When a project manager does not coordinate and prioritize tasks that are ready for inspection or if an inspector fails to arrive on time or becomes abusive of his authority, progress may be delayed and work productivity reduced. Similar to inspection delay, waiting for instruction may be crucial for prompt progress of construction activities in project schedule. Waiting for instructions on how to perform the work may slow down the construction progress. A survey study showed that one cause of instruction delay is an inadequate number of foremen or field engineers on the site (Makulsawatudom and Emsley, 2001). Researchers indicated that poor drawings were considered to be another cause for low productivity (Makulsawatudom and Emsley, 2001). A delay may be caused in the construction process when a drawing is incomplete or not available. Incomplete drawings cause waiting time by requiring clarifications and writing requests for information (RFI). Generally, the quality of drawings is poor when insufficient time is spent before the bidding process to develop the design. This happens when the designer is not adequately paid or allowed time to complete the design because the owner rushes the bidding process (Makulsawatudom and Emsley, 2001). Tools and equipment are essential to perform construction tasks. If proper tools and equipment are not available, the construction tasks and progress may be halted. The project would decline in productivity, would not be completed on time and would not satisfy the required quality. Some of the issues related to equipment and tools that influence productivity are lack of proper tools or equipment, insufficient tools or equipment, ignoring maintenance programs or shortage of spare parts, and ignoring capacity of equipment by estimator, or project manager (Makulsawatudom and Emsley, 2001).

Job planning is one of the top factors influencing productivity of construction projects is proper sequencing of work and allocation of crew sizes. Out-of-sequence scheduling of work may cause loss of momentum/rhythm (Rojas and Aramvareekul, 2003a). The unbalanced crew sizes may also have a negative impact on construction work (Kaming et al., 1997a). Effective planning of construction projects requires understanding of details, construction methods, and resource requirements (Proverbs et al., 1999c; Proverbs et al., 1999d). Construction tasks are not isolated. The relationship between construction activities and resources is intrinsic to the construction process. Internal delay may be caused by dependency between construction activities, where one activity cannot be started before the preceding activity is finished. According to respondents in a survey study (Rojas and Aramvareekul, 2003a), the interaction between construction tasks and resources significantly drives productivity. The workforce productivity is negatively affected when a project schedule changes as a result of late material delivery, fragmentation of work activities, reassignment of crew members, and/or out of- sequence work (Marchman, 1988); therefore, proper planning of all phases and components of work is necessary to ensure productivity. Technology has a significant effect on productivity; in fact, technology is considered one of the biggest reasons for improvement in the construction productivity (Goodrum et al., 2000; Goodrum and Haas, 2004). Many construction tasks have been changed through technology in the performance of tasks, which in turn demands different skills from workers (Haas et al., 1999). Tools and machinery have increased both in power and complexity, affording performance of more complex tasks with greater productivity. For example, advances in trenching technologies, such as the introduction of trench shoring devices, have led to a safer work environment and a five to six-fold increase in production rate, compared to conventional wood shoring systems (Abraham and Halpin, 1999). Despite the past proven advantages of technology, the introduction of new technologies in the construction industry must face challenges such as diverse standards, industry fragmentation, business cycles, risk aversion, and low costs of labor. Some firms attempt to avoid the risk of adopting new technology by not being the first innovation adopters in the industry. These firms argue that if new technology proves effective, the innovative firms will gain only a temporary strategic advantage, because other firms will soon follow (Haas et al., 1999). Despite this perception, some construction projects, due to complexity, require greater technological sophistication to build. Projects or facilities that appear to be beyond the current technological frontier may become possible by using innovation (Slaughter, 1998). Innovative technologies provide a company with competitive opportunities and advantages in the marketplace. Such innovation attracts clients whose projects use these techniques (Laborde and Sanvido, 1994). In a study directed at activity level, Goodrum and Haas (2002) considered 200 activities over a 22-year time period to examine the relative impact of different types of equipment technology. They found that activities with a significant change in equipment technology witnessed substantially greater long-term improvements in partial factor productivity than those that did not experience a change. The construction industry is highly labor-dependent and requires workers to do physical tasks in various climates. Serious questions about the efficiency of construction workforce have emerged, due to numerous instances of severe cost overruns and repeated delays (Kaming et al., 1997a). Certain human factors, such as experience and training, motivation, physical fatigue, mental stress, shift work, overtime, and environmental conditions are among the factors that relate to labor and must be considered in planning for productive and safe workplace. The prediction, measurement, and control of labor productivity, and human factors represent critical issues in the construction industry.

3. THE STUDY AREA

Ajdabiya is a town in and capital of the Al-Wahat District in northeastern Libya. It is some 150 kilometres (93 mi) south of Benghazi. From 2001 to 2007 it was part of and capital of the Ajdabiya District. The town is divided into three Basic People's Congresses: North Ajdabiya, West Ajdabiya and East Ajdabiya (http://en.wikipedia.org/wiki/Ajdabiya, 2012). Ajdabiya is situated in central northern Libya near the Mediterranean Sea coast at the eastern end of the Gulf of Sidra. It is located on an arid plain about 6.4 kilometres (4.0 mi) from the sea and is approximately 850 kilometres (530 mi) from the Libyan capital of Tripoli and 150 kilometres (93 mi) from Libya's second largest city, Benghazi. The city is the site of an important crossroads between the coastal road from Tripoli to Benghazi and inland routes south to the oasis at Jalu and east to Tobruk and the border with Egypt. Ajdabiya lies close to the Sabkhat Ghuzayyil a large dry region below sea level.



4. RESEARCH METHOD

Questionnaires, which total to 203, accompanied by cover letters, were sent out to project managers, contractors and consultants in the above mentioned city. The research supervisor gave background information on the research and the deadline for the return of the questionnaires. The effort was in line with the advice of Watsons (1998) to have a brief but comprehensive cover letter to introduce the purpose of a study. In the end, 149 completed questionnaires were returned. All data were analyzed using the SPSS software (Version 22.0). The alpha level was set at 0.05 to determine statistical significance.

5. DATA ANALYSIS AND FINDINGS

5.1 Analysis of Respondents background of the study

The sample size consisted of 149 respondents of which represented 64 project managers (46.3%), 50 managers (33.6%), and 30 executives (20.1%). As shown in Table (4.1), less than sixteen (N=23) of the companies had an average of less than 20 employees; twenty-five percent (N=37) had an average of 21-30 employees; and 33.6 percent (N=50) had an average of over 20 employees. About twenty-six percent (N=38) of companies self-performed 26-50 percent of the work in contrast to sub-contracting; 17.4 percent (N=26) self-performed 11 to 25 percent of the work; and 34.2 percent (N=51) self-performed 51-75 percent of the work; and 14.8 percent (N=22) self-performed 76-100 percent of the work. Most of the companies responding to the survey were involved in industrial (44.3%), public work (18.8%), and industrial (13.4%) types of construction. The profile of respondents is shown in Table (4.1), nearly 31 percent (N=46) of the respondents were 31-35 years old; 24.2 percent of (N=36) of the respondents were 36-40 years old; and about nineteen percent (N=28) of the respondents were 26-30 years and over 04 years respectively. Concerning the involvement in the construction industry, thirty percent of the respondents (N=45) indicated that their companies were involved in the construction in the construction industry from 6-10 years, twenty-two percent of the respondents (N=33) stated that they were involved in the construction industry for more than 20 years while 14.8% of participants (N=22) were stated that they had been involved in the construction industry from 11-15 years and 16-20 years respectively. With regard the respondents' working experience, the analysis had shown that nearly thirty-nine percent (N=58) of the respondents had been with their present employer had over 10 years; 26.8 percent (N=40) were employed with their present employer for 6-9 years; and 23.5 percent (N=35) of respondents had 2-5 years of experience with their present employer (refer to Table 1).

Table 1. Breakdown the respondents' background

Items	Frequency (percent)
Job description/ position	
Project Manager	69 (46.3%)
Manager	50 (33.6%)
Executive	30 (20.1)
Total	149 (100%)
Number of employees	
Less than 20 employees	23 (15.4%)
21-30 employees	37 (24.8%)
31-40 employees	39 (26.2%)
More than 20 employees	50 (33.6%)
Total	**149 (100%)**
Type of construction work	
Commercial	11 (7.4%)
Residential	20 (13.4%)
Highway	18 (12.1%)
Public work	28 (18.8%)
Industrial	66 (44.3%)
Foundation	4 (2.7%)
Others	2 (1.3%)
Total	**149(100%)**
Percentage of self-performed work	
1-10%	12 (8.1%)
11-25%	26 (17.4%)
26-50%	38 (25.5%)
51-75%	51 (34.2%)
76-100%	22(14.8%)
Total	**149(100%)**
Age of the respondent	
20-25 years old	11 (7.4%)
26-30 years old	28 (18.8%)
31-35 years old	46 (30.9%)
36-40 years old	36 (24.2%)
Over 40 years old	28(18.8%)
Total	**149 (100%)**
Years of experience in the construction industry	
1-5 years	27 (18.1%)
6-10 years	45 (30.2%)
11-15 years	22 (14.8%)
16-20 years	22 (14.8%)
Over 20 years	33 (22.1%)
Total	**149 (100%)**
Years with present employer	
Less than 2 years	16 (10.7%)
2-5 years	35 (23.5%)
6-9 years	40 (26.8%)

Over 10 years	58 (38.9%)
Total	**149 (100%)**

5.2 Factor Analysis

A factor analysis was performed after the imputation procedure to identify relationships among productivity factors and examine the possibility of summarizing these factors to a smaller number of factors. Prior to explaining the results of factor analysis, the Kaiser-Mayer Olkin's measure of sampling and Bartlett's Test of Sphericity are explained to show the suitability of factor analysis method for survey data. In this study, the overall MSA for the data set was 0.817, which according to Kaiser's index is classified as meritorious. The results of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Barlett's Test of Sphericity are summarized in Table (2). The Barlett's Test of Sphericity was conducted to test the correlations among variable and suability of factor analysis. There were two hypotheses asserted in the test. The first null hypothesis asserted that there were no common factors among the data set and the second null hypothesis asserted that 12 factors were sufficient to explain most of the variability in the data set. The test results rejected the first null hypothesis, indicating that the correlation among the variables were significant and confirmed the suitability of data for factors analysis. The results supported the second null hypothesis, indicating that 12 factors are sufficient to explain most of the variability in the data set.

Table 2. KMO and *Bartlett's* test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy			**0.817**
Bartlett's Test of Sphericity	**DF**	**Chi-square**	**Significance**
	630	2436.229	0.000

Factor 1, named as a group of "material", it had extremely high loadings on late material fabrication and delivery (0.76113). It had high loading on late of cost control accounting (0.74511), moderate loadings on supervision delay (0.67421), safety (0.61443), lack of proper tools and equipment (0.56533), poor construction methods (0.53641), and Lack of material (0.50617). It also had weak loadings on congested work areas (0.44517), equipment breakdowns (0.39312), inspection delays (0.32544), and change orders and reworks (0.31314). Factor 2, it is named as drawings and specifications; it had extremely high loadings on poor drawings or specifications (0.82417) and poor communication between office and field (0.77552). It had weak loadings on poor quality of the construction documents (0.45213), congested work areas (0.36212), insurance costs (0.33348), and change orders/rework (0.31241). Factor 3, which may be interpreted as site supervision, it had high loadings on resistance to change at management level (0.81433) and a supervision delay (0.73254). It also had moderate loadings on poor communication between office and field (0.49236), absenteeism and turnover (0.45601), and a lack of quality control (0.39678), along with weak loadings on a lack of cost control accounting (0.35796) and waiting for instructions (0.33584). Factor 4, which may be interpreted as motivation, it had extremely high loading on incentives (0.76323). It also had moderate loadings on worker motivation (0.49515), ignoring or not soliciting employee input (0.43241), local unions and politics (0.41687) and a lack of quality control (0.40223), together with weak loading on change orders/rework (0.32879).

Factor 5, which may be considered as external, it had extremely high loading on regulatory burdens (0.82412), moderate loadings on insurance costs (0.53122), and inspection delays (0.48578). Factor 6, which can be called tools and equipment, it had extremely high loading on shortage of skilled labor (0.85411), moderate loadings on lack of proper tools and equipment (0.47866), equipment breakdowns (0.39412). It also had weak loading on frequent breaks (0.31741) and inspection delays (0.30115).

Factor 7, which may be called planning, it had high loading on absenteeism and turn over (0.73007), moderate loadings on lack of pre-task planning (0.49312), and job planning (0.43135). It also had weak loadings on project uniqueness (0.37518) and change orders/rework (0.33225). Factor 8, which may be called task skill, it had extremely high loading on lack of workforce training (0.73165). It also had weak loadings on internal delay (0.42351) and waiting for instructions (0.36147). Factor 9, which may be seen as project management, it had extremely high loading on better management (0.75661), and weak loading on pay increase and bonuses (0.37523).

Factor 10, which may be referred as shift work, it was shown that it had moderate loading on poor use of weather conditions (0.65311), and weak loadings on safety (0.41322) and multiple shifts or overtime (0.37236). Factor 11, which may be called construction method, it had moderate loadings on skills and experience of workforce (0.52243) and poor construction methods (0.49541). It also had weak loading on lack of proper tools and equipment (0.35122). Factor 12, which may be interpreted as project features, it had moderate loading on lack of workforce training (0.47366), and weak loadings on waiting for instructions (0.44174) and project uniqueness (0.33412).

Table 3. Loading Factors of the Productivity in the Libyan Construction Industry

Factor	Productivity factors	Loading
Factor 1	Late material fabrication and delivery	0.76113
	Lack of cost control according	0.74511
	Supervision delay	0.67421
	Safety	0.61443
	Lack of proper tools and equipment	0.56533
	Poor construction methods	0.53641
	Lack of material	0.50617
	Congested work areas	0.44517
	Equipment breakdowns	0.39312
	Inspection delays	0.32544
	Change orders and rework	0.31314
Factor 2	Poor drawings or specifications	0.82417
	Poor communication between office and filed	0.77552
	Poor quality of construction documents	0.45213
	Congested work areas	0.36212
	Insurance costs	0.33348
	Change orders and rework	0.31241
Factor 3	Resistance to change at management level	0.81433
	Supervision delay	0.73254
	Poor communication between office and field	0.49236
	Absenteeism and turnover	0.45601
	Lack of quality control	0.39678
	Lack of cost control accounting	0.35796
	Waiting for instruction	0.33584
Factor 4	Incentives	0.76323
	Worker motivation	0.49515
	Ignoring or not soliciting employee input	0.43241
	Local unions and politics	0.41687
	Lack of quality control	0.40223
	Change orders and rework	0.32879
Factor 5	Regulatory burdens	0.82412
	Insurance delays	0.53122
	Inspection delays	0.48578
Factor 6	Shortage of skilled labor	0.85411
	Lack of proper tools and equipment	0.47866
	Equipment breakdowns	0.39412
	Frequent breaks	0.38741
	Inspection delay	0.34115
Factors 7	Absenteeism and turnover	0.73007
	Shortage of Pre-task planning	0.49312
	Job planning	0.43135
	Project Uniqueness	0.37518
	Change order and rework	0.33225
Factors 8	Lack of workforce training	0.73165
	Internal delay	0.42351

	Waiting for instructions	0.36147
Factors 9	Better management Pay increase and bonuses	0.75661 0.37523
Factors 10	Weather conditions Safety Poor use of multiple shifts or overtime	0.65311 0.41322 0.37236
Factors 11	Skills and experience of workforce Poor construction methods Lack of proper tools and equipment	0.52243 0.49541 0.35122
Factors 12	Lack of workforce training Waiting for instruction Project uniqueness	0.47366 0.44174 0.33412

6. CONCLUSION

The main aim was to examine the factors affecting the productivity in the construction projects in the city of Ajdabiya, Libya. As findings, amongst 36 factors used in the survey and based on the grouping made by factor analysis test, it found that the top priorities factors affecting the productivity under the group named as "material", were late material fabrication and delivery and late of cost control accounting and for the group named as "drawings and specifications", factors like poor drawings or specifications and poor communication between office and field are the most affecting for the productivity. Concerning the group named as "site supervision", it was found that the factors of change at management level and a supervision delay are the most affecting ones. It was also found that factor like incentives was the top priories affecting factors for the productivity under the group named as "motivation". For the group named as "external", factor of regulatory burdens was the affecting factors for productivity. Others factors such as "shortage of skilled labor", "absenteeism and turn over", "lack of workforce training", "better management", "weather conditions", "skills and experience of workforce and poor construction methods" as well as "lack of workforce training" were also found to be to priorities factors under their groups. The third research objective was to find out which productivity factors affecting most to in the construction companies in the city of Ajdabiya. Based on the analysis, all the used factors such as drawings and specification alteration during execution, lack of labour experience, material shortage, rework, and supervisors' absenteeism have been shown that they are contributing most to the productivity in the construction companies if they parties will seriously consider them, then the performance and level of productivity will definitely show a positive results and progress. However, few factors which are shown in the results seem not to be so effective in the construction companies in the city of Ajdabya but in other countries they did show a positive contribution to improve the productivity level. The study to propose any strategies that can improve the productivity in the construction companies in the city of Ajdabiya. Several recommendations are proposed as below as strategies to increase the productivity level in the construction industry in the city of Ajdabya. These recommendations are:

1. Encourage more companies training for lower level supervisors who are directly responsible for people on the tools. Provide training, mentoring for front line supervision,
2. Improve planning phase of the project including companies, clear division of responsibilities, scope of work, for all parties involved,
3. Manage construction activities with proper sequencing e.g. timely equipment arrival, material and proper planning. Provide sufficient resources on site to coordinate contractors,
4. Include regulatory requirements and maintenance activities for major mobile equipment,
5. Apply flexible and realistic project controls and scheduling,
6. Put in place a good cost and productivity controls systems,
7. Ensure safety program is front and centre providing a safe work environment with a goal of zero incidents. Safety equipment, safety training, safety communication are paramount,
11. Ensure clear understanding and consistent application of management of change during all phases,

7. REFERENCES

[1]. Abraham, D.M. & D.W. Halpin, Safety and Productivity Issues in Utility Trenching, Proceedings, 2nd International Conference, CIB W99, Implementation of Safety and Health on Construction Sites, Honolulu, Hawaii, 1999, 651-658.
[2]. J.J. Adrian, Construction Productivity Improvement. Elsevier Science Publishing Co., New York, 1987.
[3]. J.J. Adrian, Improving Jobsite Production, *Masonry Construction, 15(3)*, 2002, 14-19.
[4]. Aduagyei, F. & J.Y. Ruwanpura, Optimization of Resources in Construction Work area through Effective Process Planning. Proceedings of the CSCE Annual Conferences, Quebec City, QC, 2008.

[5]. Ali, A.H. Determining the Relationship between Communication Dimensions and Organizational Culture in the Libyan Construction Industry. Unpublished MSc Thesis, Universiti Sains Malaysia, Pinang, Malaysia, 2012.
[6]. S.G. Allen, Unionized Construction Workers Are More Productive, *Quarterly Journal of Economics, 99*, 1984, 251-274.
[7]. Christian, J. & D. Hachey, Effects of delay times on production rates in construction, *Journal of Construction Engineering and Management, 121(1)*, 1995, 20-26.
[8]. Cooper, C.L. Sparks, K. & Y. Fried, The effects of hours of work on health: A meta-analytical review, *Journal of Occupation and Organization Psychology, 70(1)*, 1997, 391-408.
[9]. Da Silva, S.P. and J.Y. Ruwanpura, Concreting Productivity Improvements in Alberta on Commercial Construction Projects. Proceedings of CSCE First International Specialty Conference, Calgary, CT-029, 2006, 1-8.
[10]. El-Rayes, K. & O. Moselhi, Impact of rainfall on the productivity of highway construction, *Journal of Construction Engineering and Management, 127(2)*, 2001, 125-131.
[11]. Enshassi, A. Mohamed, S. Abu Mustafa, Z. & P.E. Mayer, Factors Affecting Labor Productivity in Building Projects in the Gaza Strip, *Journal of Civil Engineering and Management, 13(4)*, 2007, 245-254.
[12]. Enshassi, A. Mohamed, S. & S. Abushaban, Factors Affecting the Performance of Construction Projects in the Gaza Strip, *Journal of Civil Engineering and Management, 15(3)* (2009), 269-280.
[13]. Goodrum, P.M. & C.T. Haas, Partial factor productivity and equipment technology change at activity level in U.S. construction industry, *Journal of Construction Engineering and Management, 128(6)*, (2002) 463-472.
[14]. Goodrum, P.M. & Haas, C.T. Long-term impact of equipment technology on labor productivity in the U.S. construction industry at the activity level, *Journal of Construction Engineering and Management, 130(1),* (2004), 124-133.
[15]. Goodrum, P.M., Haas, C.T., Borcherding, J.D., & E. Allmon, Case studies of U.S. construction labor productivity trends, 1970-1998. Proceedings of Construction Congress VI, Building Together for a Better Tomorrow in an Increasingly Complex World, Orlando, FL, (2002) 808-817.
[16]. Haas, C.T., Borcherding, J.D., Allmon, E., & P.M. Goodrum, U.S. Construction Labor Productivity Trends 1970-1998. (Rep. No. 7). Center for Construction Industry Studies, University of Texas at Austin, 1999.
[17]. Halligan, D., Demsetz, L., Brown, J., & C. Pace, Action response model and loss of productivity in construction. Journal of Construction Engineering and Management, *120 (1),* (1994) 47-64.
[18]. Heizer, J., & B. Render, Production and operations management "strategic and tactical decisions". Prentice Hall, New Jersey, 1990.
[19]. Hewage K.N. & J.Y. Ruwanpura, Carpentry Workers Issues and Efficiencies Related to Construction Productivity in Commercial Construction Projects in Alberta. Canadian Journal of Civil Engineering, *33(8),* (2006) 1075-1089.
[20]. K.N. Hewage, Construction Productivity Improvement by Worker Motivation and IT Based Communication. A Thesis Submitted to the Faculty of Graduate studies in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, University of Calgary, Alberta, Canada, 2007.
[21]. Kaming, P.F., Olomolaiye, P.O., Holt, G.D., & F.C. Harris, Factors Influencing Craftsmen's Productivity in Indonesia. International Journal of Project Management, *15(1),* (1997a) 21-30.
[22]. Kaming, P.F., Olomolaiye, P.O., Holt, G.D., & F.C. Harris, What Motivates Construction Craftsmen in Developing Countries? A case Study of Indonesia, Building and Environment, *33(3),* (1997b) 131-141.
[23]. Kaming, P.F., Olomolaiye, P.O., Holt, G.D., Kometa, S. T. & F.C. Harris, Project Managers' Perception of Production Problems – an Indonesian Case Study. Building Research and Information, *24(5)*,(1996) 302-310.
[24]. Laborde, M. & V. Sanvido, Introducing New Process Technologies into Construction Companies, *Journal of Construction Engineering and Management, 120(3),* 1994, 488-508.
[25]. Liberda, M., Ruwanpura, J. & G. Jergeas, Construction Productivity improvement: A study of Human, Management and External Issues. Proceedings of a Conference: Construction Research Congress In Construction - Wind of Change: Integration and Innovation, 2003.
[26]. Lim, E.C., & J. Alum, (1995). Construction Productivity: Issues Encountered by Contractors in Singapore, Journal of Construction Engineering and Management, *126(2),* (1995) 137-141.
[27]. Liu, Xin and J.Y. Ruwanpura, "Ten Weeks Testing Model to Improve Construction Productivity." Proceedings of the Construction Research Congress, May 2007, Bahamas.
[28]. D.A. Marchman, Impact of Late Deliveries on Construction Productivity. ASC Proceedings of the 24th Annual Conference (pp. 76-82). San Luis Obispo, CA. Markets. Minneapolis, MN, 1988, 141-148.
[29]. Ministry of Housing and Utilities (MHU), A Report Issued on Productivity and Efficiency Problem in the Libyan construction projects, 2011.
[30]. Mohamed, S. & K. Srinavin, Thermal Environment Effects on Construction Workers' Productivity, *Work Study, 51(6),* (2002), 297-302.
[31]. Noor, I.A. *Study of the Variability in labour Productivity in Building trades*. Construction Management Research Unit, department of Civil Engineering, university of Dundee, Dundee, 1992.
[32]. Oglesby, C.H., Parker, H.W. & G.A. Howell, Productivity Improvement in Construction (McGraw-Hill Inc., Unites State of America, 1989).
[33]. Olomolaiye, P.O. Jayawardane, A.K.W. & F.C. Harris, Construction Productivity Management (Wesley Longman, 1998).
[34]. Proverbs, D.G. Holt, G.D. & P.O. Olomolaiye, European construction contractors: A productivity appraisal of in situ concrete operations, *Construction Management and Economics, 17(2),* (1999b), 220-231.
[35]. Proverbs, D.G. Holt, G.D. & P.O. Olomolaiye, The management of labor on high rise construction projects: An international investigation, *International Journal of Project Management, 17(3),* (1999c), 195-204.

[36]. Rojas, E.M. & P. Aramvareekul, Labor productivity drivers and opportunities in the construction industry, *Journal of Management in Engineering, 129(2)*, (2003a), 78-82.

[37]. Shenin, L. *Factors Influencing Productivity in the Malaysian Construction Industry: Penang as a Case Study*. Unpublished MSc Thesis, Universiti Sains Malaysia, Pinang, Malaysia, 2012.

[38]. Slaughter, E.S. Models of construction innovation. *Journal of Construction Engineering and Management, 124(3)*, (1998), 226-231.

[39]. Thomas, H.R. & K.A. Raynar, Scheduled overtime and labor productivity: Quantitative analysis. *Journal of Construction Engineering and Management, 123(2),* (1997), 181-188.

[40]. Thomas, H.R., & V.E. Sanvido, Role of the fabricator in labor productivity, *Journal of Construction Engineering and Management, 126(5)*, (2000b), 358-365.

[41]. United Nations, The effect of repetition on building operations and processes on site. New York, 1995.

[42]. Zakeri, M. Olomolaiye, P. Holt, G.D., F.C. & Harris, A survey of constraints on Iranian construction operatives' productivity, *Construction Management and Economics, 14*, 1996, 417-426.