

## Trends in productivity improvement in construction projects in Palestine

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### ABSTRACT

*The aim of this paper is to Labor productivity in construction industry is gaining increasing attention as the industry faces multiple problems related to its workforce. Most of determine contractors' perceptions towards the identified productivity improvement factors according to their relative importance in construction projects in the Gaza Strip. A comparison was made with other developed and developing countries. Eighty-three productivity improvement factors were considered in the questionnaire and categorized into eleven groups. A survey was conducted among construction forms in the Gaza Strip to rank these factors by their degree of influence on productivity of construction projects. Ninety questionnaires were randomly distributed among local contractors whereas seventy three valid questionnaires were collected from respondents. The findings of this study indicated that the most significant productivity improvement factors are: closures and economical difficulties, political situation, delivery on time, field management, and material availability. External circumstances group was found the most important group which affects productivity improvement in the Gaza Strip as the unstable political atmosphere affects badly the construction industry. A proactive relationship has to be established among all parties in order to allocate effective productivity improvement plans. It is hoped that, by identifying and ranking the major problems affecting construction productivity should help contractors to facilitate proper solutions as well as determining potentials for productivity improvement.*

**Keywords:** *Construction, contractors, improvement, productivity*

### INTRODUCTION

The fowl of monetary aids to the Gaza Strip through the World Bank, EUC, USAID and others, contributed to create an ideal climate to improve many sectors like construction, education and investment. The growth in different sectors in the Palestinian society required the support of effective construction industry.

Roads, infrastructure projects (sewage and water), governmental buildings and Gaza airport have been constructed to facilitate the life for the Palestinian citizens among these tools; controlling construction productivity became an effective way to improve the contractor's abilities and to facilitate the performance of their projects.

The Palestinian Authority (PA) is highly dependent on two sources of income. The first is annual aid package from western donors of about \$1 billion per year. In year 2005, donors gave the PA \$1.3 billion, for humanitarian and emergency (\$500m/38%), for development, (\$450m/35%), and for budgetary assistance (\$350m/27%), much of it now suspended. The second is a monthly transfer by Israel of \$55 million in customs and tax revenues that it collects for the PA, a source of revenue that is absolutely critical to the Palestinian budget and totally suspended. In fact, Israel is now withholding close to half a billion dollars in Palestinian revenue that is desperately needed in Gaza (Roy, 2006). Unemployment in Gaza is close to 40% and is set to rise to 50% (Palestinian Bureau of Statistics 2007). The private sector-that generates 53% of all jobs in Gaza has been devastated, businesses have been bankrupted and 75,000 out of 110,000 workers are now without a job. At present, 95% of Gaza's industrial operations are suspended because they cannot access inputs for production nor can they export what they produce. The construction industry is paralyzed with tens of thousands of labors out of work (OCHA, 2007). The agriculture sector has also been badly hit and nearly 40,000 workers who depend on cash crops now have no income (World Bank, 2008)

## **LITERATURE REVIEW**

Construction productivity improvement is a key issue for businesses and nations to increase profitability, reduce costs, create and sustain competitive advantage. To remain world-class players in a highly competitive global market, construction decision makers must promote individual productivity strategies that match business needs (Flanagan et al., 2005; Productivity Commission of the Australian Government, 2005). Several researchers studied the factors affecting construction productivity in order to find the potentials for productivity improvement. A survey of top contractors conducted by Arditi and Mochtar (1996), in Indonesian indicated that certain functions including procurement practices, cost control, scheduling and management integration need much improvement. The functions that were identified as needing more improvement were prefabrication, new materials, value engineering, specifications, labor availability, labor training, and quality control, whereas those that were identified as needing less improvement than in the previous surveys were field inspection and labor contract agreements (Arditi and Mochtar 2000). Construction tasks are generally complex and hard to quantify when assessing and measuring productivity (Janssen, 2008). In many countries the construction industry attracted criticism for low productivity and poor quality (Eriksson and Westerberg 2011).

Improving productivity is a management issue, and the introduction of new techniques or technologies may be a necessary but not a sufficient condition.

Kazaza and Ulubeylib 2007, Thomas and Horman 2006, Mojahed and Aghazadeh 2007, Rojas and Aramvareekul 2003, Shash and AL-Amir 1997). Poor productivity is a concern because of its effect on costs and competitiveness, the viability of the work in hand and ultimately on the industry itself (Enshassi et al., 2007, Williams, 2005). Labor can account for up to a third of the total productive or non-productive time on construction sites (Adrian, 2003). Its component in cost of construction has even risen in recent years as the employers are always met with demands for a higher base pay and increasing fringed benefits. The accuracy of information on labor productivity rates is therefore crucial for the determination of the direct relationship between these rates and subjects such as estimating, cost control, scheduling and resource management

(Herbsman and Elis, 1990). Productivity of labor is of particular concern to construction operations because they are heavily labor intensive (Productivity Commission of the Australian government, 2005). Ruddock and Ruddock (2009) reassessed productivity in the construction sector to reflect hidden innovation and knowledge economy.

Rojas and Aramvareekul (2003) presented the results of a survey instrument applied to determine the relative level of relevance of construction labor productivity drivers and opportunities. Management skills and manpower issues were identified as the two areas with the greatest potential to affect productivity according to survey respondents. A model for automated control was developed and verified in the field by Navon and Goldschmidt (2003) in order to demonstrate that labor inputs can be automatically measured and controlled. The results show a decrease in productivity as the number of hours worked per week increase and/or as project duration increases. Abdul Kadir et al. (2005) evaluated and ranked the importance, frequency and severity of project delay factors affect the construction labour productivity for Malaysian residential projects.

Lbbs (2005) studied the impact of construction changes on productivity. Project change is disruptive and detrimental to labor productivity. If changes are necessary, they should be recognized and incorporated as early as possible. Moselhi et al. (2005) conducted a study to investigate the impact of change orders on construction productivity and introduced a new neural network model for quantifying this impact.

Factors contributing to the adverse effects of change orders on labor productivity were identified and a new model is expanded to account primarily for the timing of change order, among other factors. Kazaz and Ulubeyli (2007) have studied the factors affecting productivity among members of the construction workforce in Turkey. The results show that monetary factors remain pre-eminent in influencing productivity, but that socio-psychological factors appear to be of increasing importance in this developing economy. Tran (2011) conducted a thorough study into labour productivity in the New Zealand construction industry. He stated that productivity growth is strongly correlated to economic growth and increase welfare. Productivity growth in the construction sector may have significant effect on the affordability of housing in the country.

## **METHODOLOGY**

### ***Research population***

The population in this research included contracting forms registered in the Palestinian Contractors Union (P.C.U) records. Contractors are classified, according to the Palestinian Contractors Union, into five major categories depending on their size, financial strength, experience, equipment owned by the company, and qualifications of staff. First Class describes largest contractors whereas fifth class designates the smallest. The fifth class contractors were excluded due to the small size of their companies which would not give convincing response regarding construction productivity as a result of their poor practical experience. The targeted population was the contracting forms that have a valid registration in the PCU in the following fields: building, infrastructure work and electro-mechanics.

The respondents were asked to rate their level of agreement regarding the identified productivity factors. The questionnaires were sent to top management as well as key persons to assess the most important factors affecting construction productivity in their organizations.

The total number distributed to contractors was 90 questionnaires. The total number of valid returned questionnaires was 73. The number of valid questionnaires was 73 although number of collected questionnaires was 80. Seven questionnaires out of eighty were unqualified to be included in the analysis process. These invalid questionnaires were either uncompleted or filled using one scale.

### **Questionnaire design**

An extensive literature has been reviewed in order to extract the most significant productivity improvement factors (Arditi and Mochtar 1995, Shash and AL-Amir 1997, Makulsawaudom and Emsley 2001, Thomas et al., 2002, Rojas and Aramvareekul 2003, Hanna et. al., 2005, Thomas and Horman 2006, Mojahed and Aghazadeh 2007, Kazaza and Ulubeylib 2007). A draft questionnaire has been built using the factors extracted from literature review. A pilot test was performed for preliminary questionnaire. Ten experts were involved in this pilot test. They have at least 15 years experience in the construction industry. They were asked to critically review the design and structure of the questionnaire. Their valuable comments were used to revise the research questionnaire. Additional factors have been added to some groups; namely are labor, machinery, material, IT applications and contracting groups. Additional two main groups related to company characteristics and external circumstances have been added to the questionnaire. Also some factors have been modified in order to be consistent with the local conditions and circumstances in the Gaza Strip.

The final version of the questionnaire included 83 factors which are believed to affect construction productivity improvement. These factors are categorized into eleven groups: contractor's characteristics, labor, material, management, regulations, contracting, machinery, engineering, labor productivity improvement techniques, IT application in construction and external circumstances. Three-point Likert scale which is commonly used has been adopted in this research.

Type of participating contractors shown in Table 1 three participants have answered this question. The majority of the participating contractors (54.3%) were classified as building contractors in different classes while (45.8%) of the respondents were classified as infra structure and water works contractors.

The previous result is consistent with the type of the projects implemented in the Gaza Strip during the last decade as the building projects including buildings, schools, and universities. Only two industrial work contractors have been registered from the participating contractors. This could be attributed to the fact that the industrial works requires specialized and qualified contractors in order to implement such projects; also the volume of industrial works is inconsiderable in an area like Gaza Strip compared with other works like buildings and infra structure.

### **Respondents' job title**

It is noticed in Figure 2 that (41.1%) of respondents occupied the Site/office engineer position whereas project managers respondents came secondly with a percentage of 30.1%.

### **Years of experience for the respondents**

The number of years in business for the respondents ranges between one year and 27 years, the average is 10.32 years with standard deviation of 5.01 years. The value of standard deviation is relatively low comparing to the

average value which indicating that there is low variability in the collected data (years of respondents' experience).

Figure 3 shows that (38.3%) of respondents have years in business exceeds five years up to ten, on the other hand the number of years in business of (28.8%) of the respondents range from eleven (11) years to fifteen (15) years. That means that the majority of the respondents had spent adequate time in the field of construction in order to give relatively accurate judgment on different factors affecting productivity in the local construction industry.

The annual business volume of the respondents ranges between \$0.1 million dollars and \$10 million dollars, the average is \$1.4 with standard deviation \$1.96 million dollars. The value of standard deviation is relatively high comparing to the average annual business volume which indicating that there is high variability in the collected data (annual business volume). Table 2 shows that the respondents have been distributed to three groups. (29.6%) of the responding contractors have registered that they have annual business volume of less than one million dollar whereas the second group of contractors (33.8% of the overall contractors) revealed that their own annual business volume ranges from one to two million dollars and the last group of respondents (36.6% of all respondents) have an annual business of two million dollar and above.

#### **Years in business for the contractors**

The number of years in business for contracting companies ranges between 3 years and 40 years, the average is 12.34 years with standard deviation of 5.67 years. The value of standard deviation is accepted which mean low variability in the data of years of business. Figure 4.4 shows that the majority of respondents (around 70% of overall respondents) have a period of extended experience that ranges from ten to twenty years. A round 10% of overall respondents) have more than twenty years experience in construction industry. Around 20% of the responding contractors revealed that they have less than ten years of experience in construction sector.

#### **Total sales of respondents**

For the large companies, only 15.1% of the respondents registered that their total sales were higher than twenty millions, on the other hand for the small size contractors, 11% of the respondents mentioned that their own total sales didn't reach one million dollars whereas 6.8% of contractors responded that their total sales were bracketed between one to three million and 13.7% of respondents mentioned the range between three to six millions for their total sales.

Considering the fact that a contractor whose total sales are less than six million dollar is small size company, contractor whose total sales range between six to ten millions is medium-size contractor and contractor whose total sales exceeds ten millions is big size contractor, then as a result 31% of the contractors could be considered as small size company, 27.4% of the respondents could be classified as medium-size contracting companies and the remaining percentage around 40% could be big size companies.

#### **Permanent employees of contractors**

That means that majority of local contracting forms have this figure of permanent employees. These employees often include engineers, accountants, administrative employees and few of fixed term skilled labors. Actually, having less than 20 permanent employees for 75% of the overall respondents is relatively low. The reason

behind such result might be attributed to the nature of construction sector in the Gaza Strip. The local construction market is unstable due to economic as well as political circumstances; as a result the contractors used to hire engineers, skilled labor or sub-contractors during implementing their projects and release those employees at the end of projects. Such situation may affect badly the development of contractors due to the multiple changes and unstable working staff in the contracting companies.

Also it is shown in Figure 5 that only twelve contractors (16.4% of all respondents) have a number of permanent employees ranging from 21 persons up to 40 ones whereas 8.2% of sharing contractors revealed that they have more than 40 fixed term employees. Indeed, these contractors are classified as large companies and may have other branches except main office or have other additional activities related to construction sector like asphalt plant, tiles or manholes factory or concrete plant.

### **Construction machinery of respondents**

Only two contractors revealed that they have machinery value of more than one million \$. These contractors are the biggest among all the contractors and used to execute different types of projects either in the Gaza Strip or outside. Also Table 6 shows percentage of construction equipments rented by contractors during implementation the course of work. It is noticed in Table 6 that the majority of respondents (around 41% of all respondents) used to rent only less than 25% of machinery required to execute their works with respect to the type of work implemented by these contractors. That means those contractors have the necessary machine required to implement construction work with respect to the type of work implemented by contractors. Around 23% of contractors provided that they have sufficient equipment to implement their projects separately with no need to hire a single machine. Mostly these contractors are large scale contractors, so it is normally for them to own both of heavy type machinery like shovels, trucks, excavators and small equipment like vibrators, plate compactors and other tools. Around 7% of respondents used to rent more than 50% of equipments required to their works up to a percentage reach to 75%. These respondents are usually small size contractors and mostly may have only small equipment and tools.

### **Productivity improvement factors**

Eighty three productivity improvement factors have been studied in this study which is distributed into 11 groups. Ranking of productivity improvement factors have been made twice throughout this research; ranking within each group; and the other one was covering the overall factors.

### **Company characteristics group**

Company characteristics group include seven productivity improvement factors (Table 7). The most important factors will be discussed.

The “Financial Strength” factor occupied the first rank with RII value of 0.913 whereas it was ranked in the 8<sup>th</sup> position among overall the 83 factors (Table 8). Such results ensure increased importance of “Financial Strength” factor in enhancing construction productivity among the overall factors. Indeed, one of the most important drivers in achieving success in any business is the availability of suitable capital. The availability of financial strength together with qualified human resources should definitely bring success, profitability and rapid improvement in any construction company. The case of construction projects is highly dependent on the

contractor's financial strength either in procuring the necessary insurances, bonds or in delivering material and labor required to build the projects.

The "Contractor's Previous Experience" factor was ranked by respondents secondly with relative index value of 0.881 and was ranked in the 11<sup>th</sup> position among the overall eighty three factors. The high rank of "Contractor's Previous Experience" factor either at the level of its group or among the 83 factors, reflects high significance of such factor in improving construction productivity. The more experienced company, the higher productive contractors among others. On the other hand, the poor experienced contractor will face many difficulties in judging the matters and approving right procedures to execute the work and that will reflect bad implications on its productivity rates and projects progress. Mojahed and Aghazadeh (2007) ranked "Skills and experience" factor firstly among many other factors while conducting survey study among the construction contractors in the deep south USA.

With a relative index of 0.877, "Company Policy" factor was ranked as third major productivity improvement factor whereas was ranked in the 12<sup>th</sup> position among the overall eighty three factors. Such results reflect high significance of "Company Policy" factor in improving construction productivity. Company policy include many issues such as setting short and long terms goals with strategies and action plans to achieve them, also machinery of selecting projects, how to select personnel, distribution of work and promotion procedures. The previous components of company policy can affect heavily the projects productivity. "Human Resources" factor came at the fourth rank in the company characteristics group with relative index of 0.854 and was ranked in the 18<sup>th</sup> position among the overall eighty three factors. Construction industry is a labor intensive industry so it became important to concentrate on the matter of human in the construction industry.

### **Labor group**

Labor group includes fourteen productivity improvement factors. Table 8 illustrates the respondents' opinions about the productivity improvement factors related to labor issues.

"Crew Arrangement" factor was ranked first with RII value of 0.886 among the labor group factors and was ranked in the 10<sup>th</sup> position among the eighty three factors. The high rank of "Crew Arrangement" factor among either labor group factors or the overall 83 factor, prove increased importance of such factor in enhancing construction productivity. Indeed, increased productivity can be obtained through the cooperation and collaboration of workers.

"Crew arrangement" is considered a vital proactive management tool through which construction productivity could be optimized. Ghio (2000) highlighted the high significance of "Crew Arrangement" factor in enhancing construction productivity while describes the work conducted to improve productivity during the construction of a shopping centre in South America.

"Incentives" factor was ranked second with a value of RII equal to (0.845) and was ranked 21<sup>st</sup> among all other productivity improvement factors. The use of special motivational programs through financial incentives is common on multiple international construction industries and such programs have been found to be useful and effective. Such programs are considered to be effective in raising productivity, increasing the satisfaction of workers, improving construction quality, shortening project time, and lowering overall production costs. Despite the overall benefits of incentive systems, many construction employers in the Gaza Strip do not apply such

programs in their administration, and they do not always provide an attractive incentive either to the labor or to the other employee. Similar result was obtained by Kazaz and Ulubeyli (2007) while discussing both of economic and socio-psychological factors affecting labor productivity.

### **Material group**

Material group includes nine productivity improvement factors. Table 9 shows the respondents' opinions about the productivity improvement factors related to material.

“Delivery on Time“ factor was ranked first with a relative index of 0.949 and the same factor was ranked third among eighty three factors. The prompt procurement of material could benefit project productivity by allowing work to start and finish on schedule. Frequently in construction projects, the start of a successor activity is dependent on the finish of a predecessor activity. Thus, if the material procurement is not timely, the wait time could cause subsequent activities in the construction project to be delayed. The chain reaction would eventually extend the project completion. In addition, the late arrival of material with the corresponding wait time would reduce the productivity of workers. Rojas and Aramvareekul (2003) revealed that problems with material had been cited as a major cause of productivity loss.

With a relative index of 0.940, the survey respondents ranked "Material Availability" factor as the second factor influencing productivity of construction projects, whereas the same factor was ranked sixth among the eighty three factors.

With effective pre-planning, the availability of materials should be checked before workers are assigned to an area so workers do not start any activity until the materials are available. Care in this respect should improve worker motivation and productivity and help promote a high level of accomplishment. "Material Cost" factor was ranked third with a relative index of 0.861 and was ranked 15<sup>th</sup> among the overall 83 improvement factors. In fact, the material cost affects the availability of such materials in the local market. It comes true that when a construction material is nearly expensive, it becomes difficult to procure such material rapidly by the contractor. Some agent suppliers or manufacturers ask the interested contractor for a period of time in order to arrange these materials. Others claim advanced cash payment from the contractor prior to the delivery of such material. As a result, it becomes urgent to place a scheduled purchasing request in advanced, thus helping the contractor to obtain the required material on time which in turn keep construction site proceeding productively.

### **Management group**

Management group includes fifteen productivity improvement factors. Table 10 illustrates the results of the productivity improvement factors related to management issues.

With a relative index of 0.945, the survey respondents ranked „Field Management“ factor as the first factor influencing productivity of construction projects, whereas the same factor was ranked fourth among the eighty three factors. 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. Waiting for instructions on how to perform the work may slow down the construction progress. Mojahed and Aghazadeh (2007) proved similar result while conducting survey study among the construction contractors in the deep south USA. „Office Management“ factor was ranked second with a relative index of 0.941, while was ranked fifth among the overall improvements factors.

During the preparation phase for a construction project, office management plays a significant role in planning, scheduling, resource allocation, and preparing purchasing requests etc.

### **Regulation group**

Regulation group include three factors. Table 11 illustrates the respondents results of the productivity improvement factors related to regulation applications.

“Environmental Regulation” factor was ranked second, and was ranked 67<sup>th</sup> among the overall 83 improvement factors. Results reflect relatively minor role of “Environmental Regulation” factor in improving construction productivity. During construction most projects pose a significant risk to the environment, which must be addressed by developers and contractors. The risk to the environment is particularly high when work is done near coastal areas, streams and creeks, or along a river valley. When construction occurs near built-up areas, poor practices may result in air and noise pollution which may cause annoyance and affect the health of neighboring communities. Developers and contractors are required to implement sound practices that minimize environmental impacts and eliminate health risks and nuisance to residents near a construction site.

### **Machinery group**

Machinery group include nine factors. It is shown in Table 12 the respondents’ opinions against the productivity improvement factors related to machinery and equipments.

With a relative index of 0.854, the respondents ranked “Machine Capacity” factor as the first factor influencing construction productivity, whereas the same factor was ranked 18<sup>th</sup> among the overall eighty three factors. Results prove the importance of “Machine Capacity” factor among the overall 83 productivity improvement factors in improving construction productivity. Machine capacity describes capabilities of a machine to execute a required volume of work in an hour or a day. As stated by respondents such factor is classified of high importance in achieving better productivity due to the fact that majority of critical construction activities is highly dependent on machine capacity. The more productive machine, the faster project could be implemented.

“Suitability for Work” factor was ranked second among the factors of machinery group whereas the same factor was ranked 22<sup>nd</sup> among the overall factors in different groups. It’s usually recommended by manufactures that each construction machine is design to suit a specific type of work and if the machine used for different types of work, results of work productivity will not be within the accepted ranges, due to the fact that the machine doesn’t work in optimal work conditions. “Skilled Operator” factor was ranked third whereas the same factor was ranked 24<sup>th</sup> among the eighty three factors in different groups. In order to achieve required productivity of a machine, two factors should be considered; first is the machine itself and second is the operator. Machine operator should have the required skills in order to deal with such machine. Operator should be familiar with construction machine; know its capabilities, satisfy manufactures guides and conditions, keep maintenance programs for the machine.

### **Contract conditions group**

Contract conditions group include nine factors. “Payments Arrangement” factor was ranked first whereas the same factor was ranked 13<sup>th</sup> among the eighty three factors in different groups. The amount of the advance payment is commonly somewhere between 10% and 20% of contract price. Where an advance payment is made equal to, say 10% of the contract price, it is quite common for the contract to state that the regular interim

payments which are made as the contract progresses will be reduced by 10% until the advance payment has been recovered in full from those deductions. In such a case it is only reasonable for the guarantee of the advance payment to reduce by the same amount. The progress payment, in which contractors are paid at intervals based on work performed and incorporating agreed variation orders, is designed to ensure smooth and rapid currency circulation and to develop higher quality construction through closer relations between the employer and the contractor. Prompt payment is vital to the stability and efficiency of the construction industry.

### **Engineering group**

Engineering group include three factors. Table 15 shows the respondents' opinions against the productivity improvement factors included in engineering group With a relative index of 0.790, the „Specification“ factor was ranked first, whereas the same factor was ranked 38<sup>th</sup> among the overall eighty three factors. Results ensure high significance of “Specification” factor at the level of its group whereas reflect medial importance when ranking among 83 factors. Drawings and specification alteration during execution could take place in many projects implemented in the Gaza Strip. Changes of specifications and drawings require additional time for adjustments of resources and manpower in order to deal with such changes. Labor morale is also affected by extensive numbers of changes. This result is supported by Thomas (1999), who stated there is a 30 % loss of efficiency when work changes are being performed. Other researchers indicated also 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. 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. “Value Engineering” factor was ranked second with a relative index of 0.785 whereas the same factor was ranked 39<sup>th</sup> among the eighty three factors in different groups.

### **Labor productivity improvement techniques group**

This group includes three factors. Table 16 shows the respondents' ranks against the labor productivity improvement techniques.

With a relative index of 0.863, the respondents ranked „Goal Setting“ factor was as the first factor affecting construction productivity, whereas the same factor was ranked 14<sup>th</sup> among the overall eighty three factors. Results prove high importance of “Goal Setting” factor in enhancing construction productivity. A successful program begins with a carefully established goal. Goals should be set at a high but attainable level because low ones lead to low performance. In the construction industry, the best way to set goals is for management to agree on attainable targets, based on the best historical performance for both quality and productivity. “Quality Circles” factor was ranked third with a relative index of 0.621 whereas the factor was ranked 70<sup>th</sup> among the overall factors in different groups. A similar factor named as “Sharing problems and their results” was investigated by Kazaz and Ulubeyli (2007) in Turkey. Similarly to the case of Gaza Strip, the researchers revealed backward rank of such factor in enhancing productivity.

With a relative index of 0.977, the respondents ranked „Closure and Economical difficulties“ factor as the first factor affecting construction productivity and the same factor was also ranked 1<sup>st</sup> among the overall eighty three

factors. "Political situation" factor was ranked second among both the "External Circumstances" group and the overall factors affecting construction productivity. In fact the economical and the political factors are connected together considerably so it will be difficult to deal separately with each factor. According to the World Bank (2008), Palestinians are currently experiencing the worst economic depression in modern history. The opprobrious imposition of international sanctions has had a devastating impact on an already severely comprised economy given its extreme dependence on external sources of finance.

### Summary of groups ranking

"Contractor Characteristics" group was ranked in the second position among the eleventh groups. Contractor characteristics group include many facets of contractor's capabilities such as contractor's previous experience, its financial capability, reputation, company policy and other factors. In dead, these factors are considered as superior factors in improving construction productivity. As mentioned previously a successful implementation of construction projects depend highly on the financial capability of contractors either in delivering material, labors and machinery or submitting required guarantees and insurances. The solvent contractor can facilitate all these requirements which in turn help maintaining productive as well as profitable projects. On the other hand the experienced contractor has the required knowledge to deal with construction projects in a way which brings benefits as well as productive implementation to the contractor. The previous construction experience is considered a major tool which enables any contractor to plan properly, implement successfully and achieve optimal productivity levels in construction projects.

"Management" group was also ranked secondly among the eleventh groups with a relative index of 0.812. Construction management aims to provide professional service that applies effective economical management techniques to the design, planning, procurement, and construction of any project lifecycle. The Project management constitutes important parts of construction form, as it organizes, plans, schedules, and controls the fieldwork and is responsible for getting the project completed successfully as well as productively. While project implementation is influenced by a variety of factors, in most cases, successful project management will handle the project in the most proper fashion. "Equipment" group was ranked in the fourth position among the eleventh groups with a relative index of 0.786. The selection of the appropriate type and size of construction equipment often affects the required amount of time and effort and thus the job-site productivity of any construction project.

The main objective of this study was to study the impact of significant factors on construction productivity in the Gaza Strip as well as to suggest practical recommendations that might help achieving productive implementation in the sector of construction industry. For enhancing productivity in local construction industry, a list of multiple productivity improvement factors was collected from the review of literature and formed a primary productivity evaluation questionnaire. Eighty-three productivity improvement factors were considered in the final questionnaire and categorized into eleven groups.

"Closure and Economical difficulties" factor was ranked firstly whereas „Political Situation“ factor was ranked secondly among the overall eighty three factors. Both factors were listed under the external circumstances group. The reason behind this fact is attributed to the continuous closure imposed on the Gaza Strip in addition to the unstable political situation. The results have shown that the „Delivery on Time“ factor was ranked thirdly

whereas „Material Availability“ factor was ranked sixth among the overall eighty three factors. Both factors were listed under the material group. The scheduled delivery of material is a major component in enhancing project productivity as it allows all construction activities to be completed within time. Management group included four potentials for productivity improvement, namely, „Field Management“ factor which was ranked fourth among the overall factors; „Office Management“ factor which was ranked fifth among the eighty three productivity improvement factors; „Planning“ factor which was ranked seventh and finally „Scheduling“ factor which was ranked ninth. Effective management tools such as proper planning and scheduling, successful field management, and suitable utilization of resources should definitely increase construction productivity.

When comparing findings mentioned previously with results obtained in different countries, it was found that lack of material is the most crucial productivity problems internationally, as the factor was ranked first in every country surveyed (USA, Indonesia, Iran, Nigeria, UK and Gaza Strip) . Both of planning and scheduling factors were considered significant factors affecting construction productivity in those countries whereas respondents in both UK and Indonesia indicated higher level of importance for scheduling factor. Respondents in both USA and Iran highlighted an increased role of construction equipments in improving construction productivity compared with other countries like UK, Indonesia and Gaza Strip.

Identifying major problems affecting construction productivity by all participants should definitely help to facilitate proper solutions as well as determine potentials for productivity improvement. The industry needs to collaborate more with universities and research institutions in order to plan an effective strategy through which construction industry could be enhanced. Large organizations and industry leaders need to participate in the process of building an innovation strategy. To be successful this would include participation from clients, owners and users. Measurements of construction productivity need to be developed that are recognized by all participants are essential for the long-term success of any improvement action plan. Without such measures, the continued support for research and innovation strategies cannot be justified. The Palestinian authorities, namely the Ministry of Public Works and Housing, the Engineering Syndicate, the Palestinian Contractors Union and the other concerned authorities are recommended to promote, preach, and encourage contractors to develop their standards and organizational working system. On the other hand, these authorities are required to establish necessary rules and regulations that assist at improving local contractors capabilities which in turn reflect higher rates of productivity in local construction sector.

This could be done together with legislating effective acts and practical procedures in order to keep safe working conditions in construction projects. In this regard, the role of Labor Ministry should be vital. On the other hand, Labor Ministry and other authorities are required to take the lead in activating the Palestinian labor law and ensuring balanced contract agreements between labor and construction firms. This will definitely enhance fairness feeling among construction labor as well as increase labor satisfaction and loyalty to their construction companies. Accordingly construction labor could be motivated and do their best for implementing productive job.

It is also required to increase government spending in research development field for construction sector. Investment in construction process issues is at present essentially nonexistent. Industry needs to take the lead in diffusing existing and new findings to all, through a designated information network including information on best practices, new technologies and materials, and training opportunities to facilitate technology transfer. At the

end, the governmental role in continuous evaluating as well as applying strategies and action plans to enhance construction sector is essential. Clients and construction organizations should identify, analyze and evaluate all risks that anticipated taking place during the construction phase. An advanced payment should be paid to contractors equal to the cost of all material supposed to be used in the construction process. This should be done together with issuing a bank guarantee from the contractor side to cover this value. This simply if done will enable the contractor to procure the required material in advanced and consequently, secure continuous implementation which in turn reflect higher rates of productivity and enhanced progress. Construction organizations are recommended to adopt professional productivity measurement techniques such as benchmarking. These techniques help to evaluate project performance, make it possible for management to assess where they are in the job and increases their ability to plan current as well as future work.

Accordingly it's required from local contractors to include safety rules in the daily and weekly plans, and then the number of safety violations would certainly be reduced which in turn decrease disruption at working site and increase productivity.

Material shortage was found a considerable problem affecting productivity in the local construction industry. Local contractors are advised to place material purchasing orders in advanced, approve alternative materials and have provisional stocks of basic materials like cement and steel; this could be used in a case of emergency circumstances like continuous closure. Contractors should be required to submit a material supply schedule together with project time schedule, thus enforce contractors to arrange construction material on time. Local contractors are advised to use productive machine and eliminate old or unsuitable one. It's imperative to consider the fact that every construction activity requires a certain type of machines, so it will not be productive to use replacement. It is essential for each contracting company to adopt motivational system through which labor could be encouraged to increase construction productivity. Indeed, local contractors have a limited experience in such field, therefore, they are required to check different motivational approaches in other countries and use suitable programs. It is essential for local contracting firms to ensure that adequate procedures and qualified personnel are assigned every step in the construction process. This can be done by interviews and by having qualified personnel conduction audits to ensure things are working well. Personnel selection methods must be based on the needs of the job.

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