Trends in productivity improvement in construction projects in Palestine

Tendencias para optimizar la productividad en los proyectos de construcción en Palestina

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Fecha de Recepción: 19/04/2013

Fecha de Aceptación: 20/06/2013

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Abstract

Labor productivity in construction industry is gaining increasing attention as the industry faces multiple problems related to its workforce. Most of construction projects in the Gaza Strip were suffering from declining productivity and thus causing projects delay, and cost overruns. The aim of this paper is to 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 firms 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. 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. Training can increase productivity, morale, reduce the load on supervisors, improve safety, and increase organizational stability and flexibility.

Keywords: Construction, contractors, improvement, productivity

Resumen

La productividad laboral en la industria de la construcción está ganando una creciente atención en cuanto la industria enfrenta múltiples problemas relacionados con su fuerza laboral. La mayoría de los proyectos de construcción en la Franja de Gaza sufre una disminución de productividad provocando demoras y exceso de costos. El objetivo de este artículo es determinar las perspectivas de los contratistas hacia factores de optimización de la productividad ya identificados, de acuerdo a su importancia relativa en proyectos de construcción en la Franja de Gaza. Se realizó una comparación con otros países desarrollados y en vías de desarrollo. Ochenta y tres factores de optimización de la productividad fueron considerados por el cuestionario y categorizados en once grupos. Se realizó una encuesta entre empresas constructoras de la Franja de Gaza para clasificar los factores, de acuerdo a su grado de influencia sobre la productividad de los proyectos de construcción. Noventa cuestionarios fueron distribuidos al azar entre contratistas locales, mientras que setenta y tres cuestionarios válidos fueron contestados localmente. Los descubrimientos de este estudio indicaron que los factores de optimización de la productividad más relevantes son: el cierre, dificultades económicas, situación política, tiempos de entrega, administración en obra y disponibilidad de material. El grupo de circunstancias externas que más afecta la optimización de productividad en la Franja de Gaza es la atmósfera de inestabilidad política que daña la industria de la construcción. Se debe establecer una relación proactiva entre las partes para instaurar planes de optimización a la productividad. Se espera que al identificar y clasificar los grandes problemas que afectan la productividad en la construcción, se facilitarán soluciones adecuadas a los contratistas, y a su vez se determinarían los potenciales factores para la optimización de la productividad. La industria requiere colaborar más con las universidades e instituciones de investigación para planificar una estrategia eficiente, a través de la cual se pudiera optimizar la industria de la construcción. El entrenamiento puede aumentar la productividad, la motivación, reducir la carga a los supervisores, optimizar la seguridad e incrementar la estabilidad y flexibilidad organizacional.

Palabras Clave: Construcción, contratistas, optimización, productividad

1. Introduction

The flow 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.

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Roads, infrastructure projects (sewage and water), governmental buildings and Gaza airport have been constructed to facilitate the life for the Palestinian citizens. Until 2000, contractors enjoyed very good business and achieved satisfactory profits. However since then, uptight tense political climate affected in winding down of many plans for development which in turn created what was perceived to be a recession in the construction industry in the Gaza Strip. The contractors' profits margins as well as the demand for construction have been in decline. This situation affected the local contractors to become more competitive in order to survive and remain in the market. Construction market in the Gaza Strip forced many contractors to look for other alternatives or to improve their abilities by using proper managerial tools to stay within the circle of competitiveness. 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). Data compiled by Gisha (2007) showed that Gaza's industry is collapsing. Out of the 3,900 factories in Gaza producing food, pharmaceuticals, construction materials, wood, paper, craftwork, engineering materials, metals, plastics and rubber, more than 2,900 factories have ceased to produce.

Productivity is one of the significant components of every company's success and competitiveness in the construction market. A construction contractor stands to gain or lose, depending on how well his company's productivity responds to competition. Construction companies may gain advantage over their competitors by improving upon productivity to build projects at lower costs; yet, most contractors do not systematically and properly address this strategic issue or evaluate its impact on the project's profit (Mojahed and Aghazadeh 2007). Productivity is a significant issue in the construction industry in large areas of the world. In Palestine like several other countries, productivity in construction industry still suffers from lack of accurate measurements and effective strategies to enhance construction productivity. The low interest in productivity in the Gaza Strip caused disruption in many projects as well as uncontrollable construction process. Increased productivity can have a large impact on the overall construction process and consequently results in significant cost and time savings. Any opportunity to achieve productivity improvements over the historical norm will require better planning. The aim of this paper is to determine contractors' perceptions towards the identified productivity improvement factors according to their relative importance in construction projects in the Gaza Strip. This will assess contractors to eliminate or minimise productivity problems, hence improve productivity.

2. 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 researches 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. In order to improve productivity in construction it should be necessary to improve methods, improve training programs, enhance worker motivation, improve strategic management and improve procurement management (Rojas and Aramvareekul, 2003). Thomas et al. (2003) stated that new management thinking, like lean production, has suggested that better labor performance can be achieved by improving the reliability of flows. Lean thinking portrays reliable flows as the timely availability of resources, materials, information, and equipment. Site management fully accepts their responsibility for setting out the key workplace conditions for improved productivity and for maintaining an uninterrupted flow of work. Hence, the quality and authority of site management, the quality of their construction planning and their ability to administer the plan were seen as important determinants of productivity and site management seen as a key profession within the industry (Williams, 2005). DeVilbiss and Gilbert (2005) stated that unresolved conflict is recognized as a significant source of unproductive stress.

In Haskell's view (2004), the potential for further productivity enhancements falls into five categories: information technology, project delivery, automation and prefabrication, workforce development, and materials. Construction method is a significant factor which has an impact on construction productivity (Kim et al., 2005). Mojahed and Aghazadeh (2007) mentioned that improvement in construction productivity is not possible without identifying factors that influence productivity. Previous studies regarding productivity indicated that a broad range of factors affect productivity. These factors may be divided into industry-level, company-level, and project level. Some of the productivity factors at industry-level include governmental interference, regulation burdens, local unions, and politics. Some of the factors that are at project level are labor-related and include motivation, experience, skill, and training. Some of the factors that are at company level are management-related and include planning and direction of project. Adrian (2003) stated that leadership skills contribute to productivity improvement. Kazaz and Ulubeyli (2007) mentioned that improved productivity is also required; if all production inputs are well-utilized, capital improvements and enhanced productivity goes hand in hand.

Several scholars have identified a range number potential factors which may led to an improvement in productivity, They have categorized these factors into 9 groups (Arditi and Mochtar 1995; Hanna et al., 2005; Thomas et al., 2002; Thomas et al., 2003; Makulsawaudom and Emsley, 2001,

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 concept behind this development is that indirect data- workers location measured automatically at regular time intervals can be controlled automatically and converted into labor inputs using computerized algorithms. Lee et al. (2004) proposed relevant indicators to measure labor factors, i.e., worker loyalty and labor resource stability that affect the planned normal workflow. Hanna et al. (2005) provided a comprehensive analysis of the impact of extended duration overtime on construction labor productivity. 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.

3. Methodology

Research population

The population in this research included contracting firms 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 firms that have a valid registration in the PCU in the following fields: building, infrastructure work and electro-mechanics.

Sample size

Statistical formulas were used in order to calculate the sample size for the contractors (Creative Research System, 2009).

$$SS = \frac{Z^2 * P * (1 - P)}{C^2} \quad (1)$$

Where

SS = Sample size

Z = Z value (e.g. 1.96 for 95% confidence level)

P = Degree of variance between the elements of population percentage (0.50 used for sample size needed).

C = Confidence interval (margin of error) (e.g., 8%)

$$SS = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.08^2} = 150 \text{ contractors} \quad (2)$$

Correction for finite population:

$$SS_{new} = \frac{SS}{1 + \frac{SS-1}{POP}} \quad (3)$$

Where POP is the population = 139 (POP represents the overall number of local contractors registered in the P.C.U)

$$SS_{new} = \frac{150}{1 + \frac{150-1}{139}} = 72 \quad (4)$$

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, Makulsawadom 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. This scale illustrates three options as follows:

- If respondents strongly agree, response is given (3) points.
- If respondents somewhat agree, response is given (2) points.
- If respondents disagree, response is given (1) points

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.

Data measurement

In this paper, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the level of effect [1 (low), 2 (medium), 3 (high)] do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. The relative importance index methods (RII) are used to determine the ranks of all performance factors. The relative importance index is computed as (Odeh and Battaineh 2002, Wanous et al 2003):

$$RI = \frac{\sum_{i=1}^3 W_i X_i}{\sum_{i=1}^3 X_i} \quad (5)$$

Where

i = response category index = 1, 2, and 3 for low, medium, and high, respectively.

W_i = the weight assigned to the i^{th} response = 1, 2, and 3, respectively.

X_i = frequency of the i^{th} response given as percentage of the total responses for each item.

4. Results

Characteristics of respondents

Type of entity for the participating contractors

The survey indicated (Figure 1), that about half (50.7%) of the entire participating contractors are corporation contractors whereas 24.7% are family-owned and 21.9% are partnership. The previous results show that the local contractors in the Gaza Strip are mostly of the corporation type.

Figure 1. Type of entity for local contractors

Figura 1. Tipo de entidades dentro de los contratistas participantes

Type of participating contractors

As 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.

Table 1. Type of local contractors

Tabla 1. Tipo de contratistas locales

Type of contractor/ Tipo de contratista	N	Percent/ Porcentaje
Building/ Edificaciones	38	54.3%
Industrial works/ Trabajos Industriales	2	2.9%
Infrastructure/ Infraestructura	17	24.3%
Water works/ Trabajos para Aguas	13	18.6%
Total	70	100%

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%.

Figure 2. Job title of respondents

Figura 2. Puesto de trabajo de los encuestados

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.

Figure 3. Years in business for respondents

Figura 3. Años en la actividad de los encuestados

Average annual business volume for the respondents

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.

Table 2. Average annual business for respondents
Tabla 2. Promedio anual de los encuestados en el negocio

Average annual business volume (\$Million) Volumen del promedio anual en el negocio (\$Millones)	Frequency Frecuencia	Percent Porcentaje
Less than \$1M/ Menos de \$1M	21	29.6%
1-Less than \$2M/ 1-Menos de \$2M	24	33.8%
\$2M and above/ \$2M y más	26	36.6%
Total	71	100.0%

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.

Figure 4. Years in business for the contractors
Figura 4. Años en la actividad de los encuestados

Total sales of respondents

Table 3 that (27.4%) of contractors responded that total sales of their companies since establishing in construction field up to date range from six to ten millions dollar whereas 26% of the contractors revealed that they have total sales ranging from ten to twenty millions dollar.

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 millions and 13.7% of respondents mentioned the range between three to six millions for their total sales.

Table 3. Total sales of respondents
Tabla 3. Ventas totales de los encuestados

Annual Sales (million dollars)/ Ventas Anuales (millones de dólares)	Frequency/ Frecuencia	Percent/ Porcentaje
Under one millions/ Bajo un millón	8	11.0%
Under 3 millions/ Bajo 3 millones	5	6.8%
Under 6 millions/ Bajo 6 millones	10	13.7%
Under 10 millions/ Bajo 10 millones	20	27.4%
Under 20 millions/ Bajo 20 millones	19	26.0%
Over 20 millions/ Sobre 20 millones	11	15.1%
Total	73	100.0%

Considering the fact that a contractor whose total sales are less than six millions 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.

Geographic location of implemented projects

Table 4 shows that the majority of projects implemented by the contractors are located in the Gaza governorate. This result seems to be normal as a considerable number of vital projects were implemented in the Gaza governorate due to its importance and high population.

Table 4. Geographic location of projects
Tabla 4. Ubicación geográfica de los proyectos

Geographic Location of Projects Ubicación Geográfica de los Proyectos	Frequency/ Frecuencia	Percent/ Porcentaje
Northern Area Governorate/ Gobernación Área Norte	14	19.4%
Gaza Governorate/ Gobernación de Gaza	54	75%
Middle Area Governorate/ Gobernación Área Intermedia	3	4.2%
Khanyounis Governorate/ Gobernación de Khanyounis	1	1.4%
Total	72	100.0%

Permanent employees of contractors

Figure 5 show that more than 75% of the respondents have a number of fixed-term employees which is less than 20 persons. That means that majority of local contracting firms 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.

Figure 5. Permanent employees of respondents

Figura 5. Encuestados y sus empleados con contrato permanente

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

Table 5 shows the value of construction machinery that the company has for implementing construction projects. The more the company has dollar value of machinery, the bigger size the contractor could be considered. Around (42%) of all respondents have provided that they have only less than 200.000 dollar value of construction machinery while 41% of contractors have shown that they have construction machinery value of more than 200.000 \$ and less than half million dollars.

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.

Table 5. Value of construction machinery of respondents
Tabla 5. Valor de la maquinaria de construcción de los encuestados

<i>Dollar Value of Construction Machinery</i> <i>Valor en Dólares de la Maquinaria de Construcción</i>	<i>Frequency/ Frecuencia</i>	<i>Percent/ Porcentaje</i>
<i>Under \$200.000/ Bajo \$200.000</i>	31	42.5%
<i>Under \$500.000/ Bajo \$500.000</i>	30	41.1%
<i>Around 1 million/ Alrededor de 1 millón</i>	10	13.6%
<i>Under 3 million/ Bajo 3 millones</i>	1	1.4%
<i>Over 5 million/ Sobre 5 millones</i>	1	1.4%
<i>Total</i>	73	100.0%

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.

Table 6. Construction equipment rented by respondents
Tabla 6. Equipo de construcción arrendado por los encuestados

<i>Percentage of Construction Equipment rented/ Porcentaje de</i> <i>Equipo de Construcción Arrendado</i>	<i>Frequency/ Frecuencia</i>	<i>Percent/ Porcentaje</i>
<i>None/ Ninguno</i>	17	23.3%
<i>Under 25%/ Bajo 25%</i>	30	41.1%
<i>Under 50%/ Bajo 50%</i>	21	28.8%
<i>Under 75%/ Bajo 75%</i>	5	6.8%
<i>Total</i>	73	100.0%

Productivity improvement factors

83 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.

Table 7. RII and Ranks for contractor characteristics factors (group 1)
Tabla 7. IIR y Calificación para los factores características del contratista (grupo1)

Contractor Characteristics Factors/ Factores Características del Contratista	RII/ IIR	Rank within group/ Calificación dentro del grupo	Rank among all groups/ Calificación dentro de todos los grupos
Financial Strength/ Solvencia financiera	0.913	1	8
Previous Experience/ Experiencia previa	0.881	2	11
Company Policy/ Política de la empresa	0.877	3	12
Human Recourses/ Recursos humanos	0.854	4	18
Company assets/ Activos de la empresa	0.735	5	48
Company Size/ Tamaño de la empresa	0.722	6	53
Management Style/ Estilo de administración	0.703	7	58

The “Financial Strength” factor occupied the first rank with RII value of 0.913 whereas it was ranked in the 8th 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 11th 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 12th 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 18th 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.

Table 9. RII and Ranks for factors related to labor (group 2)

Tabla 9. IIR y Clasificaciones para los factores relacionados con el grupo mano de obra (grupo 2)

Labor Factors/ Factores de mano de obra	RII/ IIR	Rank within group/ Calificación dentro del grupo	Rank among all groups/ Calificación entre todos los grupos
Crew Arrangements/ Distribución de cuadrillas	0.886	1	10
Incentives/ Incentivos	0.845	2	21
Work Conditions/ Condiciones de Trabajo	0.817	3	28
Loyalty/ Lealtad	0.813	4	29
Labor Availability/ Disponibilidad de mano de obra	0.808	5	32
Safety/ Seguridad	0.796	6	34
Quality control/ Control de calidad	0.758	7	42
Working Hours/ Horas trabajadas	0.755	8	43
Relations with Forman/ Relación con el capataz	0.726	9	51
Labor Relations/ Relaciones laborales	0.708	10	56
Contract Agreement/ Acuerdo de contrato	0.685	11	64
Local Regulations/ Normativa local	0.676	12	66
Training/ Entrenamiento	0.557	13	79
Project Location/ Ubicación del proyecto	0.53	14	81

“Crew Arrangement” factor was ranked first with RII value of 0.886 among the labor group factors and was ranked in the 10th 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 21st 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.

With a relative index value of 0.817 “Work Conditions” factor was ranked third whereas was ranked 28th among the overall 83 factors. Working conditions in a construction site could be very difficult from those found at another industry, and this can affect the worker’s morale and productivity. Such problems as congestion, changes, site access difficulties, or weather conditions may have an influence on construction productivity. The result obtained in this regard comes consistent with result stated by Rojas and Aramvareekul (2003). Applying efforts and practical solutions in order to minimize the bad effects of such conditions on construction productivity should be considered as a major priority. “Worker Loyalty” factor was ranked fourth among the labor group factors with a relative index value of 0.813 and was ranked 29th among the overall factors. The previous findings suggest that worker commitment and loyalty enhance both labor productivity and financial performance at the firm level thereby highlighting a hitherto neglected channel for improved firm performance. The “Labor Availability” factor was ranked in the fifth position among the factors of labor group with a relative index value equal to 0.808 and was ranked 32nd among all the productivity improvement factors.

With a relative index of 0.796 “Safety” factor occupied the 6th position whereas was ranked 34th among the overall 83 factors. Safety has always a priority at any construction job site because the dangerous nature of most construction works renders them liable to many accidents. Occupational injuries can harm the reputation of a company, decrease productivity, and result in huge costs.

Unsafe working conditions are always due to a lack of both safety equipments and commitment by workers to safety rules. A manager interviewed for the present study stated that construction workers in Gaza Strip 'never care' about safety regulations. Another manager expressed the view that local workers are especially unlikely to take the required safety measures, even if management insists that they do so which in turn contribute to decrease the construction productivity in multiple projects.

Material group

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

Table 9. *RII and Ranks for improvement factors related to materials (group 3)*
Tabla 9. *IIR y Clasificaciones para los factores relacionados con el grupo materiales (grupo 3)*

Material Factors/ Factores Materiales	RII/ IIR	Rank within group/ Calificación dentro del grupo	Rank among all groups/ Calificación entre todos los grupos
Delivery on time/ Entrega a tiempo	0.949	1	3
Material Availability/ Disponibilidad del material	0.94	2	6
Material Cost/ Costo del material	0.861	3	15
Procurement/ Abastecimiento	0.819	4	27
Accessories availability/ Disponibilidad de accesorios	0.741	5	46
Storage/ Almacenaje	0.648	6	68
New Products/ Nuevos productos	0.606	7	73
Prefabrication/ Pre-fabricación	0.588	8	75
Transportation/ Transporte	0.563	9	78

"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 15th 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.

Table 10. RII and Ranks for improvement factors related to management (group 4)

Tabla 10. IIR y Clasificaciones de los factores de optimización de productividad relacionados con la administración (grupo 4)

Management Factors Factores de administración	RII IIR	Ranks within group Calificación dentro del grupo	Ranks among all groups Calificación entre todos los grupos
Field Management/ Administración en obra	0.945	1	4
Office Management/ Administración en oficina	0.941	2	5
Planning/ Planificación	0.927	3	7
Scheduling/ Programación	0.889	4	9
Coordination within Company/ Coordinación dentro de la empresa	0.861	5	15
Resource Allocation/ Asignación de recursos	0.858	6	17
Coordination with subcontractors/ Coordinación con sub-contratistas	0.852	7	20
Estimating/ Estimación	0.826	8	24
Cost Control/ Control de costos	0.81	9	31
Coordination with designer & client/ Coordinación con el diseñador & cliente	0.796	10	34
Safety Management/ Administración de Seguridad	0.792	11	37
Quality Management/ Administración de calidad	0.708	12	56
Coordination with Local Authorities/ Coordinación con Autoridades Locales	0.69	13	61
Marketing/ Marketing	0.676	14	65
Coordination with research organizations/ Coordinación con organizaciones de investigación	0.62	15	72

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 play a significant role in planning, scheduling, resource allocation, and preparing purchasing requests etc.

The survey respondents' ranked „Planning“ factor as third one with a relative index of 0.927 whereas „Planning“ factor was ranked seventh among the 83 improvement factors. Results indicated that „Planning“ contributed as a primary factor sustaining productivity. Effective planning of construction projects requires understanding of details, construction methods, and resource requirements. The relationship between construction activities and resources is intrinsic to the construction process. Workforce productivity is negatively affected when a project schedule changes as a result of fragmentation of work activities, reassignment of crew members, and -out of sequence- work. Proper planning of all phases and components of work is necessary to ensure productivity. Veiseth et al. (2003) highlighted the significant role of planning in enhancing construction productivity. With a relative index of 0.861 „Coordination within Company“ factor was ranked fifth whereas the same factor was ranked 15th among the 83 improvement factors. Poor communication among different entities and individuals in a construction project may negatively affect productivity of a job. Prompt communication to make instructions and other information available is critical for on time and proper performance of work. Poor communication leads to a decline in work productivity and very likely to defective products in the long run.

Regulation group

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

Table 11. *RII and Ranks for improvement factors related to regulation (group 5)***Tabla 11.** *IIR y Calificaciones para los factores de optimización relacionados con las normativas (grupo 5)*

<i>Regulation Factors/ Factores Normativas</i>	<i>RII/ IIR</i>	<i>Rank within group/ Calificación dentro del grupo</i>	<i>Rank among all groups/ Calificación entre todos los grupos</i>
<i>Health regulation/ Normativa sanitaria</i>	<i>0.735</i>	<i>1</i>	<i>48</i>
<i>Environmental/ Medioambiental</i>	<i>0.662</i>	<i>2</i>	<i>67</i>
<i>Local Codes/ Códigos locales</i>	<i>0.644</i>	<i>3</i>	<i>69</i>
<i>Taxes/ Impuestos</i>	<i>0.58</i>	<i>4</i>	<i>76</i>

With a relative index of 0.735, the respondents ranked „Health Regulation“ factor as the first factor influencing construction productivity, whereas the same factor was ranked 48th among the overall eighty three factors. Previous ranks put the “Health Regulation” factor as a mediator one in improving productivity. Construction projects can be complex and involve many different trades and occupations. Frequently they also involve high-risk activities. The work is more likely to be done safely and to time if those doing the work have suitable management arrangements in place. The Regulations are aimed at protecting the health, safety and welfare of everyone who carries out construction work. They also give protection to other people who may be affected by the work. Such regulations contribute to enhance satisfactory feeling for labor which in turn reflects a considerable increase in their performance.

“Environmental Regulation” factor was ranked second, and was ranked 67th 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 neighbouring 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.

Table 12. *RII and Ranks for improvement factors related to machinery (group 6)***Tabla 12.** *IIR y Calificaciones para los factores de optimización relacionados con la maquinaria (grupo 6)*

<i>Equipments Factors</i> Factor Equipamiento	<i>RII/ IIR</i>	<i>Rank within group/ Calificación dentro del grupo</i>	<i>Rank among all groups/ Calificación entre todos los grupos</i>
<i>Capacity/ Capacidad</i>	0.854	1	18
<i>Suitability for work/ Idoneidad para el trabajo</i>	0.84	2	22
<i>Skilled Operator/ Operador calificado</i>	0.826	3	24
<i>Safety/ Seguridad</i>	0.826	3	24
<i>Replacement/ Reemplazo</i>	0.813	5	29
<i>Maintainability/ Mantenimiento</i>	0.799	6	33
<i>Cost Control/ Control de costos</i>	0.795	7	36
<i>Utilization/ Utilización</i>	0.744	8	45
<i>Simplicity/ Simplicidad</i>	0.575	9	77

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 18th 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 22nd 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 24th 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. Table 13 shows the respondents' opinions against the productivity improvement factors related to contract conditions.

Table 13. Improvement factors related to contract condition (group 7)

Tabla 13. Factores de optimización relacionados con las condiciones contractuales (grupo 7)

Contracting Factors Factores Contractuales	R/I IIR	Rank within group Calificación dentro del grupo	Rank among all groups Calificación entre todos los grupos
Payment arrangement/ Disposición de Pagos	0.872	1	13
Incentive/Disincentive Clauses/ Clausulas de Incentivo/impedimento	0.763	2	41
Risk Distribution among Parties/ Distribución del Riesgo entre las Partes	0.749	3	44
Selecting Subcontractors/ Selección de Sub-contratistas	0.731	4	50
Selecting General Contractor/ Selección del Contratista General	0.694	5	60
Insurance/ Seguros	0.689	6	62
Dispute Resolution Methods/ Métodos de Resolución de Controversias	0.689	6	62
Selecting Designer/ Selección del Diseñador	0.621	8	70
Bonding/ Obligaciones	0.603	9	74

"Payments Arrangement" factor was ranked first whereas the same factor was ranked 13th 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.

Information technology group

Information technology group include eight factors. Table 14 shows the respondents' opinions about the applications of information technology in construction industry and its effect on productivity.

Table 14. *RII and Ranks for information technology (group 8)*
Tabla 14. *IIR y Calificaciones para las tecnologías de la información (grupo 8)*

<i>Information Technology Factors</i> Factores Tecnología de la Información	<i>RII</i> IIR	<i>Rank within group</i> Calificación dentro del grupo	<i>Rank among all groups</i> Calificación entre todos los grupos
<i>Scheduling and planning/</i> Programación y planificación	0.785	1	39
<i>Word Log</i>	0.74	2	47
<i>Accounting/</i> Contabilidad	0.721	3	54
<i>Design and Cad applications/</i> Diseño y aplicaciones Cad	0.721	4	54
<i>Estimating and costing/</i> Estimaciones y costos	0.694	5	59
<i>Risks analysis/</i> Análisis de riesgos	0.551	6	80
<i>Internet and electronic mail/</i> Internet y correo electrónico	0.507	7	82
<i>Fields communications/</i> Comunicaciones en terreno	0.47	8	83

With a relative index of 0.785, the „Scheduling and Planning“ factor was ranked first among the factors of information technology group, whereas the same factor was ranked 39th among the overall eighty three factors. Previous ranks ensure high importance of “Scheduling and Planning” factor at the level of its group whereas reflect medial importance when comparing with overall 83 factors. The study revealed that majority of participants use computerized scheduling and prepare time schedules for their projects using different versions of the Microsoft Office Project program. A precedence diagrams, network formats and different reports might not be very common with small and medium sized firms. Working with different alternatives, and hence achieving better decisions-making, was the main advantage of using computers in scheduling. “Word Log” factor was ranked second with a relative index of 0.74 whereas the same factor was ranked 47th among the eighty three factors in different groups. This proves high importance of “Word Log” factor at the level of its group whereas reflect medial importance when comparing with overall 83 factors. It’s predictable that the use of word processing applications is considered of high significance comparing with other computer functions, as most of the contractors report purchasing the computers mainly for using word log.

With a relative index of 0.721, the “Accounting” factor was ranked third, whereas the same factor was ranked 54th among the overall factors. Usage of computerized accounting functions in construction firms became very common when compared with other functions that the computer systems may be used for. In the field of accounting the most often use software programs are locally designed to meet the necessary requirements of the contractors business like accounts receivable, accounts payable, accounts of taxes, salaries sheet and producing balance sheets and income statements.

The use of accounting software contributed in keeping accurate records that could be used as basic information in similar future projects. Previous result is similar to result obtained by Shash and AL-Amir (1996) while highlighting IT applications in construction firms in Saudi Arabia.

Engineering group

Engineering group include three factors. Table 15 shows the respondents' opinions against the productivity improvement factors included in engineering group

Table 15. RII and Ranks for engineering group (group 9)
Tabla 15. IIR y Calificaciones para el grupo ingeniería (grupo 9)

Engineering Factors/ Factores Ingeniería	RII/ IIR	Rank within group/ Calificación dentro del grupo	Rank among all groups/ Calificación entre todos los grupos
Specifications/ Especificaciones	0.79	1	38
Value Engineering/ Ingeniería de Valor	0.785	2	39
Design Standards/ Estándares de Diseño	0.726	3	51

With a relative index of 0.790, the „Specification“ factor was ranked first, whereas the same factor was ranked 38th 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 39th among the eighty three factors in different groups.

Previous ranks ensure high significance of “Value Engineering” factor at the level of its group whereas reflect medial importance in improving productivity when comparing with overall 83 factors. Value engineering is a technique for reducing cost and improving productivity. Value engineering is a systematic functional analysis leading to actions or recommendations to improve the value of systems, equipment, facilities, services, and supplies. Its objectives are to improve quality and to reduce cost.

Labor productivity improvement techniques group

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

Table 16. RII and Ranks for labor productivity improvement techniques (group 10)

Tabla 16. IIR y Calificaciones para técnicas de optimización de productividad laboral (grupo 10)

Labor Productivity Improvement Techniques/ Técnicas de Optimización de Productividad Laboral	RII/ IIR	Rank within group/ Calificación dentro del grupo	Rank among all groups/ Calificación entre todos los grupos
Goal Setting/ Establecer Objetivos	0.863	1	14
Time Study/ Estudio de Tiempo	0.836	2	23
Quality Circles/ Círculos de Calidad	0.621	3	70

With a relative index of 0.863, the respondents ranked „Goal Setting” factor as the first factor affecting construction productivity, whereas the same factor was ranked 14th 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 70th 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.

External circumstances group

External circumstances group includes two factors. Table 17 shows the respondents’ opinions against both economical and political situation in the Gaza Strip.

Table 17. *RII and Ranks for impact of external circumstances (group 11)*
Tabla 17. *IIR y Calificaciones para el impacto de las circunstancias externas (grupo 11)*

<i>External Circumstances/ Circunstancias Externas</i>	<i>RII/ IIR</i>	<i>Rank within group/ Calificación dentro del grupo</i>	<i>Rank among all groups/ Calificación entre todos los grupos</i>
<i>Closure & Economical difficulties/ Cierre & Dificultades Económicas</i>	0.977	1	1
<i>Political situation/ Situación Política</i>	0.968	2	2

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 1st 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

Table 18 shows a summary of ranking the eleven productivity improvement groups. Ranking was based on relative index values. RII of each group equal to the average of relative indices values related to the group's factors. The most important groups will be discussed below.

Table 18. *Ranking of all productivity improvement groups*
Tabla 18. *Calificación de todos los grupos de optimización de productividad*

<i>Group/ Grupo</i>	<i>RII/ IIR</i>	<i>Rank/ Calificación</i>
<i>External Circumstances/ Circunstancias Externas</i>	0.972	1
<i>Contractor Characteristics/ Características del Contratista</i>	0.812	2
<i>Management/ Administración</i>	0.812	2
<i>Equipment/ Equipos</i>	0.786	4
<i>Labor Productivity Improvement Techniques/ Técnicas de Optimización de Productividad Laboral</i>	0.773	5
<i>Engineering/ Ingeniería</i>	0.767	6
<i>Material</i>	0.747	7
<i>Labor/ Mano de Obra</i>	0.74	8
<i>Contracting/ Contratos</i>	0.712	9
<i>Regulations/ Regulaciones</i>	0.655	10
<i>Information Technology Applications/ Aplicación de Tecnologías de la Información</i>	0.649	11
<i>ALL Groups/ TODOS los Grupos</i>	0.757

It is shown that the “External Circumstances” group was ranked in the first position among the eleventh groups. That means that the “External Circumstances” group has the highest effect among other groups in improving construction productivity. All development projects have been stopped as the United Nations development stopped all its construction contracts for the infrastructure in the Gaza Strip. Such as rehabilitation of street, water and sewage facilities, with an estimated cost of 60 million US\$, and the UNRWA stopped its program for creating job opportunities at an estimated cost of 93 million US\$ from which more than 16,000 people were supposed to benefit. These exceptional conditions reflect the impact of unstable political and economical situation on local construction industry. Accordingly construction productivity decreased to the lowest level due to suspension of all construction projects.

“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 away which bring 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 firm, 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.

It is therefore important for site managers and construction planners to be familiar with characteristics of different types of equipments commonly used in construction. In order to increase job-site productivity, it is beneficial to select equipment with proper characteristics and a size most suitable for the work conditions at a construction site. While the standard production rate of a piece of equipment is based on «standard» or ideal conditions, equipment productivities at job sites are influenced by actual work conditions and a variety of inefficiencies and work stoppages. As one example, various factor adjustments can be used to account in an approximate fashion for actual site conditions.

Comparison of productivity problems with other countries

Several researchers have carried out investigations into productivity problems in different countries, all of which have used different factors. Away from political and economical factors, five crucial factors have been selected and compared with results obtained by other authors; ranking of these factors is shown in Table 19. The results have shown that lack of material is the most crucial productivity problems internationally, as the factor was ranked first in every country surveyed. Considering differences between countries, it is fair to say that both developed and developing countries have fewer problems in field management than Gaza Strip. Meanwhile, all experience the impact of planning factor at about the same level. Scheduling factor was considered a significant factor in all countries whereas respondents in both UK and Indonesia indicated higher level of importance for this factor. The significant role of construction equipments in both USA and Iran was more effective in enhancing construction productivity compared with other surveyed countries.

Table 19. Comparison of productivity problems with other countries

Tabla 19. Comparación de problemas de productividad entre países

Factors affecting productivity/ Factores que afectan la productividad	Indonesia	Iran/ Irán	Nigeria	Gaza Strip/ Franja de Gaza	UK	USA
	Rank/ Calificación	Rank/ Calificación	Rank/ Calificación	Rank/ Calificación	Rank/ Calificación	Rank/ Calificación
Lack of material/ Falta de material	1	1	1	1	1	1
Planning/ Planificación	2	4	2	5	3	3
Scheduling/ Programación	3	5	6	7	2	5
Field Management/ Administración en obra	6	N/A	4	2	4	4
Equipment/ Equipamiento	5	2	3	-	5	2

(Cited in Makulsawatudom and Emsley 2001)

(Citado por Makulsawatudom y Emsley 2001)

5. Conclusion

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.

Among the eleven groups, “External Circumstances” group, represented by the economical and political factors, was ranked in the first position. Construction projects in Gaza Strip are still suffering from continuous closure and material shortage. On the other hand, the unstable political atmosphere affects badly the construction industry in Gaza Strip. “Management” group was ranked secondly among the eleventh groups. Management activities have the highest effect in enhancing construction productivity. Management is responsible for getting successful implementation as well as productive work. On the other hand, “Contractor Characteristics” group was also ranked by respondent in the second position among the eleventh groups. Contractor characteristics group, represented by contractor’s capabilities, previous experience, its financial capability, reputation, company policy and others has a superior role in improving 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.

It is imperative to bring attention to the fact that very little has been done on contractor prequalification and other areas related to contracting. The Palestinian Contractors Union and other construction organizations are required to establish new mechanism through which construction firms could be prequalified honestly based on technical as well as financial considerations. Accordingly unqualified contractors could be eliminated or drawn back to lower classifications, thus help minimizing the bad effects of intensive competition among contractors, keep only qualified construction firms in the circle of competition and establish for a balanced local construction market. Consequently, construction productivity could be enhanced. Labor Ministry, clients, construction organizations and other related authorities should promote to highlight the significant role of safety and quality in enhancing construction productivity.

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 non-existent. 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.

Construction organizations are recommended to have a monitoring role on labor agreements. Labor union representatives should go and monitor what is said and what is written down and agreed to. These agreements should be valid for a period of time and must be understood by all parties. Such agreements create a balanced relationship between contractor and labor and enhance labor loyalty to the construction firm thus helping reduce inherent conflicts between labor and contractor and sustain construction labor productivity. Construction organizations, consultants, clients and labor union in the Gaza Strip are required to highlight the significant role of safety in construction projects and enforce local construction firms to follow up safety regulations.

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 conducting audits to ensure things are working well. Personnel selection methods must be based on the needs of the job.

6. Acknowledgement

The authors would like to thank DAAD in Germany for supporting this research.

7. References/Referencias

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