

# **CONSTRAINTS TO PALESTINIAN CONSTRUCTION CRAFTSMEN PRODUCTIVITY**

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## **ABSTRACT**

The construction industry in Palestine is one of the most important sectors in the country's economy whose level of activity is an indicator of the general economic performance of the country. The recent development in Palestine has led to a boom in construction activities leading to shortages of construction materials. Labour is the most important factor influencing the performance of the construction sector since it is basically labour intensive. The welfare of national economies, as well as that of individual enterprises, is widely regarded as being dependent on a country's natural resources and on the ingenuity and productivity of its people. The objective of this paper is to identify and rank constraints factors on construction craftsmen productivity in Palestine according to their relative importance index. Data were collected through a structured questionnaire survey of 110 construction craftsmen. Results indicated that the five highest ranking problems are: lack of materials, safety, delay in payment, inspection delay, and lack of proper tools and equipment. The results revealed that the main reason for non-availability of materials was borders closure due to tense political situation. It was found that the greatest amount of rework is attributed to poor engineering drawings and design. By identifying the current weakness, it is hoped that the productivity should be improved. Training programs for both craftsmen and professionalism are essential for the improvement of productivity in the construction industry in Palestine.

## **KEYWORDS**

Craftsmen, improvement, productivity, performance, rework.

## **INTRODUCTION**

The construction industry in Palestine currently contributes 11% of the country's gross domestic product (GDP) and it employs 12 % of the total workforce (PCBS, 2012). The industry has exhibited strong growth in 1994 (The GDP growth rate was 21.2 %). This was as a result of the peace agreement between Israel and the Palestinian National Authority (PNA) and the financial contribution of many international donors in the reconstruction of the Palestinian territories. However, in the last few years construction industry has been on decline mainly because of the political instability as donor funds has been dramatically reduced.

A variety of researchers have reported that there is a decline in construction productivity. Reasons for the decline include management failure to provide required tools, material, instructions, training, and schedules to permit the work to be

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completed without delays, insufficiency, and cost overruns (Enshassi et al 2007a). Modified use of traditional productivity improvement techniques of preplanning, work sampling, and recording techniques can reverse the trend and help eliminate inefficiency caused by management failures. Unless the decline in productivity on construction projects can be reversed, the ability of economy to fund the increased cost of necessary construction projects will be threatened, causing a decline in volume of construction. Traditionally, attempts at work improvement have focused on three techniques: preplanning, activity sampling, and recording techniques. These methods, in turn, have focused on studying the craftsman to define methods improvement.

Productivity is a complex issue in construction because of the interaction of labour, capital, materials, and equipment. Improving labour productivity should be a major concern for a research and for the industry. Observing and understanding constraints on construction craftsmen, productivity is a starting point for seeking improvement. Enshassi et al (2007b) indicated that the main factors negatively affecting labour productivity are: material shortage, lack of labour experience, lack of labour surveillance, misunderstandings between labour and superintendent, and drawings and specification alteration during execution. The objective of this paper is to identify constraints on construction craftsmen productivity in Palestine.

#### **LABOUR PRODUCTIVITY STUDIES**

Construction projects are often turbulent because of the number of variables involved, the labour intensive work, the unique character, and occurrence of unpredictable events (Arditi, 1985; Thomas and Yoakum's, 1987; Thomas et al, 1990; Horner and Talhouni, 1995; Kaming et al, 1996). These factors are major causes of stagnation in the industry in terms of low profitability and productivity. Manufacturing has increased its productivity by more than 100% in the past 30 years whereas construction is in decline (Choromokos and McKee, 1981; Briscoe, 1988). Variability has been shown to be a key factor in the study of construction labour productivity behaviour (Lema and Price, 1996; Radosavljevic and Horner, 2002).

Labour intensive work, unique design, the number of factors affecting on-site work and other variables make the construction industry unstable in its performance. These variables create many undesirable events that threaten planned budgets and cause major delays. Thus, often the budget is exceeded in order to meet the clients' requirements and complete a project within specified period. Consequently, improving labour productivity should be a major concern for research and for the industry (Kazaz and Ulubeyli, 2004; Tan 2000, Enshassi et al 2006). The complexity in construction originated from a number of sources: resources employed, the environment in which construction takes place, the level of scientific knowledge required, and the number and interaction of different parts of the work flow. Gidado (1996) distinguished between two main categories of complexity. One is related to uncertainty and deals with the components that are inherent in the operation of individual tasks and originate from the resources employed or the environment. The second type of complexity stems from interdependence among tasks, and represents those sources of complexity that originate from bringing different parts together to form a workflow.

The uncertainty in the undertaking of individual activities has four causes: management is unfamiliar with local resources and the local environment; lack of complete specification for the activities at the construction site; lack of uniformity of materials, and teams with regard to place and time; and unpredictability of the environment. The second determinant of complexity is associated with operational interdependence in construction. Gidado (1996) pointed to three factors, the number of technologies and the interdependence among them; the rigidity of sequence between the various main operations, and the overlap of stages or elements of construction. Recent studies in the UK, Scandinavian countries, and US suggested that up to 30% of construction is rework. Labour is used at only 40-60% of potential efficiency, accidents can account for 3-6% of total costs, and at least 10% of materials are wasted (Datta, 2000). Total ineffective time was due to management's shortcomings, design changes, lack of equipment, lack of manpower, lack of materials, and poor working conditions (Shouqing, 1999).

Training has been defined as the systematic development of the attitude, knowledge and skill behaviour pattern required by an individual in order to perform adequately a given task or job. Training had significant effects on the productivity of construction craftsmen (Olatunji and Ajibola, 2000). Training of construction craft craftsmen is not very common in developing countries, and when they are available, they may not be adequate (Uwakweh, 2000). Other factors such as planning, control and supervision of craftsmen also had their effects on the productivity (Olatunji and Ajibola, 2000). Management complicates progress in productivity within the construction industry. Past studies found that poor management was responsible for over half of the time wasted on a job site. Good management is required for profitability and success (Haas, 1999). Causes of below-budget labour productivity have been categorized as follows: overstaffing, interference with other crews, workforce management, insufficient work to perform, weather, equipment, design error, rework, conversion technology, materials (Ballard et al., 2004).

The University of Texas has conducted a study of craft productivity on large construction projects for the US department of energy in 1979. The study concluded that labour lost 28 hours out of each 40-hour work week due to lack of materials, lack of tools, crew interference, overcrowded work areas, lack of instruction, and inspection delay (Garner et al, 1979). In a survey by electrical contractor, 64% of the electrical contractors responding said that they were not happy with the level of field productivity in their company (Electrical construction, 1982). Continuing decline in construction productivity will affect future construction projects. As productivity declines, the time and cost necessary to complete a building increases. Construction activities will be slower and contractor's overhead costs will increase. The results of the survey of 25 contractors in US indicated that, more than 80% of the respondents mentioned that planning, estimating, scheduling and communications have either high or medium potential for productivity improvement. In management, 50% of the respondents indicated that supervision has the highest potential for productivity improvement. In materials, delivery (supply-chain) and standardization have more opportunity for productivity improvement. Under the labour category, 50% of all respondents indicated training, quality control and availability of labour have high potential, and 41.7% have medium potential. In the category of equipment, about

50% of respondents indicated that equipment has a medium effect on productivity improvement (Banik, 1999).

## METHODOLOGY

In the view of low productivity in the construction industry and its relation to the national economy, the author conducted a quantitative survey to identify and investigate constraints on construction craftsmen productivity in Palestine. Data for the study were collected via a structured questionnaire survey of 110 construction operators in 25 sites in the Gaza Strip. Various internal and external factors affect craftsmen productivity was identified. Some common factors were selected from a literature review of productivity studies (Kazaz and Ulubeyli, 2004; Tan 2000; Olatunji and Ajibola, 2000; Ballard et al., 2004; Enshassi et al 2006; Enshassi et al 2007a, b), and craftsmen were asked to identify those constituting problems of their projects.

The questionnaire covers basically three parts. The first part was designed to record causes of poor productivity. The second part recorded main causes of non-availability of materials on site. The third part was designed to record causes of rework. The respondents were requested to assign an appropriate rating from very high to very low on a scale of 5 to 1, to reflect the importance of the causes in each question (weights: very high=5, high=4, medium=3, low=2, very low=1).

For analyzing the data a relative importance index (RII) technique was used. The relative importance index was computed using the following equation:

$$RII = \frac{\sum_{j=1}^5 W_j * f_{ij}}{c \sum_{j=1}^5 f_{ij}}$$

Where  $W_j$  is the weights of the degree of importance  $j$  of causes (5, 4, 3, 2, 1);  $f_{ij}$  is the corresponding frequencies of the degree of importance  $j$  of factor  $i$ ;  $\sum_{j=1}^5 f_{ij}$  is the total number of respondents; and  $c$  is constant expressing the ranking rate, in this study ( $c=5$ ). The ranking of the causes were then based on the above calculated indices. The higher the index, the higher is the ranking.

## RESULTS AND DISCUSSION

The results of this study indicated that lack of materials, safety, delay in payment, inspection delay, and equipment breakdown, lack of proper tools and equipment, design changes, improper plan of work, absenteeism, and rework are the ten most important ranked productivity problems (Table 1). A brief discussion of these problems is reported below:

### LACK OF MATERIALS

It can be shown from Table 1 that lack of materials emerged as the most crucial on-site productivity problem with a relative index of 0.83. Materials shortage can be traced mainly to increased construction demand due to the reconstruction programme of the newly developing Palestine following the peace agreement, including houses, schools, hospitals, power stations, roads, water and waste water projects.

Complicating the shortage problem further is the lack of natural resources of raw materials and high dependence on other countries. In addition, the political situation (border closures) and restrictions on material movement from one area to another have a great impact on the availability of materials.

Table 1: Ranking Order of Poor Productivity Causes

| Causes of poor productivity                               | Total Num. | Effects' Degree |      |      |     |          | Total Score | RII  | Ranking |
|---|------------|-----------------|------|------|-----|----------|-------------|------|---------|
|   |            | Very high       | High | Med. | Low | Very low |             |      |         |
| Lack of materials   | 110        | 53              | 22   | 31   | 4   | 0        | 454         | 0.83 | 1       |
| Restrictions on movement                                  | 110        | 5               | 24   | 41   | 33  | 7        | 317         | 0.58 | 15      |
| Weather and site conditions                               | 110        | 2               | 10   | 48   | 42  | 8        | 286         | 0.52 | 16      |
| Design changes  | 110        | 17              | 27   | 47   | 14  | 5        | 367         | 0.67 | 7       |
| Lack of proper tools and equipment                        | 110        | 18              | 40   | 32   | 11  | 9        | 377         | 0.69 | 6       |
| Inspection delays   | 110        | 37              | 31   | 24   | 11  | 7        | 410         | 0.75 | 4       |
| Absenteeism   | 110        | 28              | 21   | 23   | 23  | 15       | 354         | 0.64 | 9       |
| Safety (accidents)  | 110        | 49              | 30   | 21   | 6   | 4        | 444         | 0.81 | 2       |
| Improper plan of work                                     | 110        | 22              | 28   | 24   | 27  | 9        | 357         | 0.65 | 8       |
| Rework  | 110        | 11              | 35   | 33   | 20  | 11       | 345         | 0.63 | 10      |
| Change crew size  | 110        | 14              | 22   | 33   | 34  | 7        | 332         | 0.60 | 13      |
| Interference of work                                      | 110        | 16              | 35   | 42   | 14  | 3        | 377         | 0.69 | 6       |
| Poor communication  | 110        | 16              | 25   | 34   | 23  | 12       | 340         | 0.62 | 11      |
| Delay in payment  | 110        | 41              | 33   | 25   | 10  | 1        | 433         | 0.79 | 3       |
| Lack of motivation  | 110        | 11              | 29   | 33   | 30  | 7        | 337         | 0.61 | 12      |
| Low wages   | 110        | 27              | 25   | 39   | 13  | 6        | 384         | 0.70 | 5       |
| Lack of craftsmen experience                              | 110        | 23              | 34   | 35   | 12  | 6        | 386         | 0.70 | 5       |
| Working overtime and craftsmen tiredness                  | 110        | 5               | 13   | 38   | 40  | 14       | 285         | 0.52 | 16      |
| Lack of respect between the craftsmen and their employers | 110        | 17              | 24   | 31   | 26  | 12       | 338         | 0.61 | 12      |
| Relationship between craftsmen and their employers        | 110        | 16              | 19   | 26   | 41  | 8        | 324         | 0.59 | 14      |
| Social relations among craftsmen                          | 110        | 13              | 17   | 36   | 32  | 12       | 317         | 0.58 | 15      |

#### *Causes of non-availability of materials on site*

The main reasons that respondents have cited for non-availability of materials are shown in Figure 1. The factor with the greatest impact (relative index 0.93) was borders closure due to tense political situation. The construction sector in Palestine depends upon importing materials (such as cement and steel) from other countries.

However, the frequent closure made it difficult and sometimes impossible to import materials. Consequently, projects progress has been delayed. The second major cause is related to the increase of materials cost, with a relative index of 0.86. Due to political instability in Palestine, materials costs increase dramatically and sometimes reaching more than 100%. This problem can be resolved completely if the political situation improved.

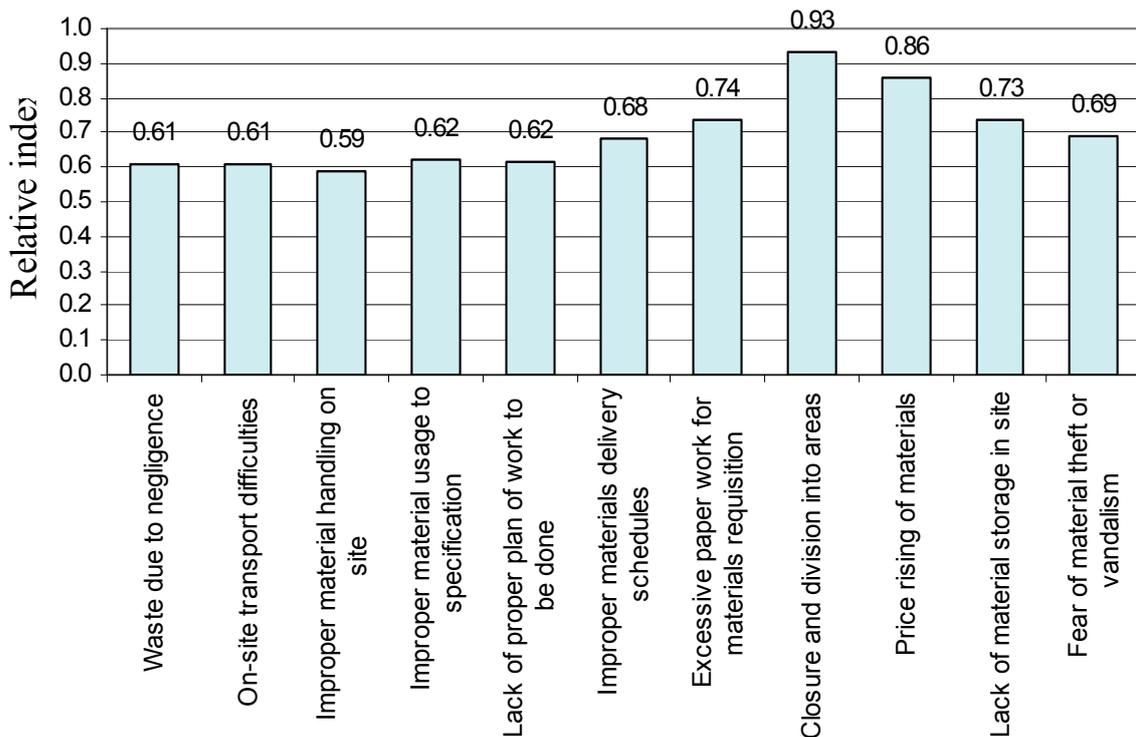


Figure 1: The RII of Main Causes of Non-availability of Materials on Site

Excessive paper work for materials requesting is ranked third, with a relative index of 0.74. Lack of material storage in site, with a relative index of 0.73, ranked fourth. Most of construction firms in the Gaza Strip do not have material storage. Contractors believed that, storage places will cost them extra money which might reduce their profit. Fear of material theft or vandalism ranked fifth, with a relative index of 0.69. This problem makes contractors not to deliver enough materials on construction site. An improper material delivery, with a relative index of 0.68, is ranked sixth, and occurs as a result of unavailability of material in the market. Lack of proper plan of work to be done, with a relative index of 0.62, is ranked seventh. An improper plan of work or ineffective preplanning effort on the part of site managers or general foremen usually leads to confusion and delay, or utilization of materials in non-critical activities. This is particularly crucial in Palestine, with increasing demand for construction materials and scarcity in the market. Improper material usage or application to the specification ranked also seventh, with a relative index of 0.62. On-site transport difficulties, with a relative index of 0.61, are ranked eighth. Congested

working space and/or improperly deposited material generally make movement and maneuverability very difficult.

#### **SAFETY (ACCIDENTS)**

Respondents have ranked this problem second, with a relative index of 0.81. The construction industry is one of the most hazardous industries throughout the world. Preventing occupational injuries and illness should be a primary concern of all employers. Improvements can be of great benefit to the physical well-being of operatives, to morale, and to the progress of the work generally, hence effective safety and health programmes are desirable.

#### **DELAY IN PAYMENT**

This factor, with a relative importance index of 0.79, ranked as third problem overall. The lack of timely payments to local contractors has a negative impact on the craftsmen on site. They are in bad need for their wages due to the harsh economic situation. If craftsmen do not receive their wages on time, they feel unsatisfied, and this may cause lack of loyalty to their work, hence productivity decreases. Delay of payment may occur as a consequence of inadequate financial resources of contractors or delay of fund either from owners or donors. Delayed payment leads in some cases to delays on construction projects.

#### **INSPECTION DELAY**

Worker's respondents ranked this problem fourth, with a relative index 0.61. Response indicated that most construction sites do not have a resident site engineer, and where they do him/her rarely has full authority, experience or knowledge of the job in hand to make effective decision promptly.

#### **LOW WAGES AND LACK OF EXPERIENCE**

These two factors that have led to poor productivity are ranked fifth, with relative index 0.70. Low/unfair payment of wages to craftsmen affects the motivation of craftsmen which reduces productivity and quality of work. Craftsmen respondents confirmed that contractors do not pay fair wages to them. This can be traced to high percentage of unemployment in the country and harsh economic situation due to political instability. Lack of proper craftsmen experience in construction activities has contributed to the decline in productivity.

#### **LACK OF PROPER TOOLS AND INTERFERENCE OF WORK**

These two factors were ranked sixth, with relative indexes 0.69 (Table 1). Responses indicated that lack of proper tools have a significant effect on construction productivity. Old and obsolete construction equipment, shortage of spare parts, improper services and maintenance are some of the causes of this problem leading to delays. Replacing old and outdated machinery would almost certainly enhance productivity. Respondents stated that, interference of work between main contractors and sub-contractors may lead to interruption of work and reduce productivity. A workable work plan is necessary to overcome such problems.

#### **Design CHANGE**

Design, drawings, specification and change order is ranked as the seventh problem, with a relative importance index of 0.67. A lack of experience in local consulting

practice has led to a number of problems, such as: errors in design, contradictions between engineering drawings, contract document specifications contradicting with drawing specifications and too many revision and change orders. These problems were found high in most construction projects in the Gaza Strip. As a result, a number of disputes were noticed in several construction projects between owners and contractors.

**IMPROPER PLAN OF WORK**

With a relative importance index of 0.65, improper plan of work is ranked eight. Planning and pre-planning is essential for productivity improvement and to avoid or minimize unexpected events. Poor knowledge and inexperience of project managers in planning, pre-planning, scheduling, and the procurement process contribute to poor craftsmen productivity.

**ABSENTEEISM**

This factor with a relative importance index of 0.64 is ranked as the ninth problem. It is generally accepted that an increase in absenteeism rate in the Gaza Strip construction projects is considered not to be very high.

**REWORK**

This was the tenth craftsmen is ranked productivity problem, with a relative importance index of 0.63. Rework is a deviation to requirements caused by a lack of quality oriented management and craftsmen. Reducing rework will increase company’s competitiveness and result in more work and a higher profit margin. The rework may be caused as a result of poor design, change order, poor workmanship, and negligence, etc. impacts negatively on craftsmen productivity as well as their working morale and attitudes. The most significant causes of reworks as reported by respondents are shown in Figure 2.

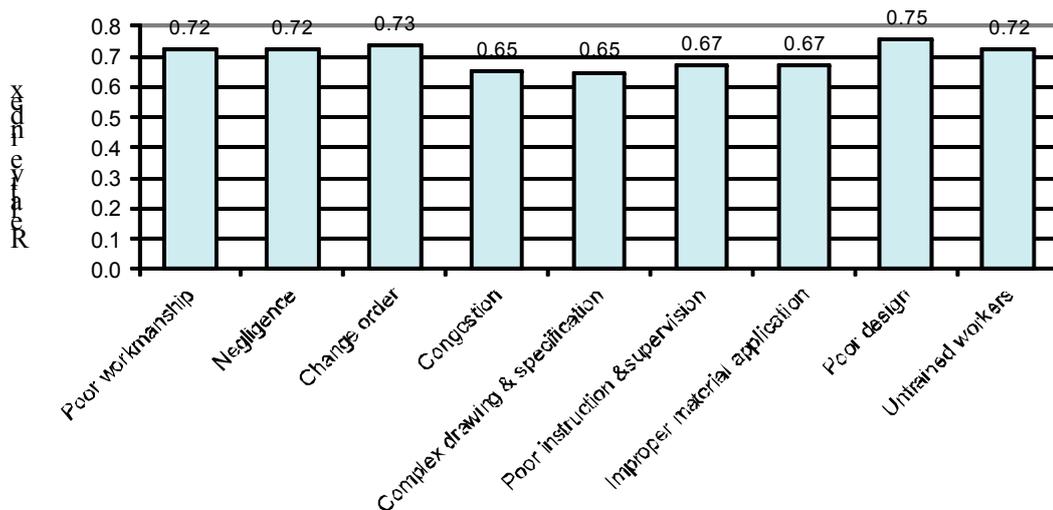


Figure 2: The Relative Index of Main Causes of Rework

The greatest amount of rework is attributed to poor engineering drawings and design. This is due to the lack of proper experience by designers. High rate of revision and change orders is the second-ranked cause which may result from lack of specific construction material in the local market, clients changing their mind, sloppy engineering design with incomplete drawings and/or errors and inconsistencies in the plans. Poor workmanship, which is a function of poor instruction, supervision and control, is the second-ranked cause. Other causes of rework, as seen in Figure 2, may be seen as managerial and supervisory obligation.

## **CONCLUSIONS**

The results of this study indicated that, the ten most problematic constraints to construction craftsmen productivity in Palestine are:

- Lack of materials
- Safety (Accidents)
- Delay in payment
- Inspection delay
- Low wages and lack of craftsmen experience
- Lack of proper tools and interference of work
- Design changes
- Improper plan of work
- Absenteeism
- Rework

The findings indicated that lack of materials is still the major cause of poor productivity in Palestine. A good material control strategy throughout the construction process should be implemented to improve productivity. Borders closure is still the major cause of non-availability of materials on site, which resulted from bad political situation and restrictions on movement of materials to Palestine. The findings revealed that the main cause of rework is poor design was due to inexperienced designer. Effort would still need to be directed at training, and at improving the professionalism of the construction industry in Palestine.

It is recommended that several components must be considered when an effort is made to increase productivity such as, reducing the idleness of the labor force by supplying of a proper materials and provision of adequate work tools and equipment, providing detailed materials delivery schedules, good housekeeping, motivation to enhance construction craftsmen performance, training to improve craftsmen ability and skill, recruiting the skilled craftsmen in the relevant trades, fare and regular payment of wages to craftsmen, using experienced designers to have a high degree of prefabrication, buildability and clearance in drawings and standardizations to avoid the changes which cause the rework and increase time and cost of the project. Finally, good management is required for profitability and success.

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