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Investigating and Ranking Labor Productivity Factors in the Egyptian Construction Industry

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Abstract: This article sets out to investigate and rank the factors that affect labor productivity in the Egyptian construction industry. To achieve this, a quantitative research methodology is adopted and it entails the use of structured survey questionnaires. The data obtained was analysed using the relative importance index. The results from the analysis revealed ten major factors affecting labor productivity in the construction industry in Egypt. These factors are: tools and equipment shortages; delay in material delivery on site; payment delay; undisciplined labor; material shortage; rework; labor expensive and skills; low quality of raw material; waiting for equipment to arrive; and on-site accident. Consequently, these findings would serve as a useful tool and a basis to make recommendations to governmental and construction personnel regarding the productivity of labor in the Egyptian construction industry.

Keywords: Construction industry, Egypt, delay, labor productivity, relative importance index

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1 INTRODUCTION

The construction industry has changed significantly due to the use of advanced tools, technology, management skills, material, and heavy equipment. The importance of the industry can be measured by how much the sector adds to the country's economy through its contribution to the Gross Domestic Product (GDP) and the portion it takes in any nation's employment population (Sweis et al. 2009). The industry has become more complex due to new business demands, challenges, large numbers of parties as clients, contractors, consultants, stakeholders, shareholders, regulators, and others. Laborers are a very important part of the construction phase of any project, since they are the ones who are actually responsible for building the project. All construction projects rely on the productivity of equipment and workers to achieve good results.

The loss of construction labor productivity can be attributed to various factors, and understanding how much these factors affect labor productivity is crucial to improving project performance, increasing profit, and overall project success.

The construction industry in Egypt is a multibillion-dollar industry and it contributes approximately 15%-17% of the GDP (Gross Domestic Product), with an investment expected to reach US$21bn by 2017 (UKTI 2013). Being the largest country in the Middle East with the 4th largest economy, the Egyptian construction industry has been facing a range of difficulties since the 2011 revolution.

With the high rate of population increase at 1.7% per annum (World Bank 2012), construction work in Egypt is increasing rapidly to meet the needs of the growing population through the expansion of portable water systems, residential housing, hotels, sanitary drainage facilities and various infrastructure project (Mack et al. 2009).

Most of the construction workers in Egypt come from Upper Egypt (the southern part of the country). They usually move to Cairo for high wages, regular work, a more exciting life, lack of rural job opportunities, and most importantly it gives them the chance to remit cash in order to support family members at home in the village (Zohry 2002).

The aim of this paper is to identify the factors contributing to the decline in laborers' productivity in the Egyptian Construction Industry, and thus affect project performance.

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2 RESEARCH METHODOLOGY

Thorough literature review of previous studies indicated that four major factors contribute to labor productivity. These factors include management factors (e.g. planning, incentive programs, and competency of labor supervision), human factors (e.g. labor experience, skill age, and education), external factors (e.g. training sessions, design changes, payment delays, and government law), resource factors (e.g. poor site conditions, material storage location, and violation of safety rules) and miscellaneous factors (accidents during construction, shortages of water and power supply (Jarkas and Bitar 2011).

This research is therefore based on a questionnaire survey designed to gather all necessary information aimed at: (1) Understanding productivity challenges to construction laborers; (2) Understanding the Egyptian Construction Industry; (3) Identifying factors that impacts the productivity of laborers in Egyptian Construction projects; and (4) Proposing strategic drivers that will enhance labor productivity. However, it was agreed that the type and style of questionnaire should not use lengthy questions; it should not use confusing questions that can be easily misunderstood, resulting in a low participation rate. In addition, Arabic translation was used to ensure the questionnaire was properly understood clearly.

2.1 Pilot Study

A pilot study was conducted to validate and improve the questionnaire. According to (Hertzog 2008) sample size for pilot study can be considered as 5% of the questionnaires distributed. A draft of the questionnaire was given to 13 (5% of 258 distributed questionnaires) construction project managers in Egyptian construction projects, who have more than 10 years of experience. The aim of the pilot study was:

1. To test the questionnaire based on its format (layout)
2. To test the wording of questions
3. To validate the list of factors being surveyed
4. To test the measurement scale
5. To test the accuracy of the Arabic translation

The draft questionnaire was collected back from respondents, and certain changes were made to the factors list and to the questionnaire. It was then approved before being circulated. The Factors were reduced from 53 to 41, Arabic grammar and spelling of the questionnaire was corrected, and the overall design was also improved.

2.2 Sample Size

The contractors will be the ones who are registered in the Egyptian Federation of Construction and Building Contractors (EFCBC). Being registered in the EFCBC means that the contractor holds a license to work legally (El-Behary 2013). There are more than 16,400 contractors registered with the EFCBC in 2014, compared to 41,000 contractors in 2010 (El-Behary 2013). That huge drop was either a result of contractor bankruptcy or change of career. All contractors are divided into seven groups. These groups differ based on the annual income, number of employees, projects size, tool and equipment rented or owned, number of engineers, and years of contractor experience.

The researcher has decided to target contractors within the first three classes. The first class included 188 contractors; the second includes 276 contractors, and the third 312 contractors. The three classes add up to a total of 776 contractors. The researcher has used the formula (El-Gohary and Aziz 2013) have used and cities as (Hogg et al. 2010):

$$n = \frac{m}{1 + (\frac{m-1}{N})} \tag{1}$$

n= sample size of limited population
m= sample size of unlimited population
N= available population

The only unknown in this equation is the value of m, which can be calculated using the following equation.

$$m = \frac{Z^2 * P * (1 - P)}{\varepsilon^2} \tag{2}$$

Z is the statistical value of the confidence level used i.e. 2.575, 1.96 and 1.645 for 99%, 95% and 90% confidence levels. Since P is unknown, Sincich et al. (2001) stated that value of 0.50 should be used as sample size. ε is the maximum error of the point estimate. Using 95% confidence i.e. 5% significance level, the unlimited sample size of the population "m" is approximately calculated as following:

$$m = \frac{1.96^2 * 0.50 * (1 - 0.50)}{0.05^2} = 385 \tag{3}$$

For the total number of targeted contractor under first, second, third class in EFCBC, N= 776, the representative sample size was calculated as follow:

$$n = \frac{385}{1 + (\frac{385-1}{776})} = 257.5 \tag{4}$$

=258 contracting companies

Based on the following equation a total number of 258 contracting companies in Egypt will be surveyed as a sample to represent a sample of a total of 776 contractors. The respondents vary from project managers, construction managers, supervisors, engineers, architects, and consultants in their organisations.

2.3 Primary Data Analysis

For analysing the data, relative importance index technique was used and is calculated using the following formula:

Relative importance index(%)

$$= \frac{5(n5) + 4(n4) + 3(n3) + 2(n2) + n1}{5(n1 + n2 + n3 + n4 + n5)} * 100 \quad (5)$$

The relative importance index was used to rank the factors. Where n1, n2, n3, n4, and n5 are the total number of respondent who selected "1" Strongly not important, "2" Not Important, "3" Neutral, "4" Important, "5" Very Important, the factors were ranked based on an average of the experience of the professionals targeted.

The factors were ranked using the relative importance index by Microsoft Excel spreadsheet. All the data was inserted into a spreadsheet to rank the factors.

3 RESULTS AND ANALYSIS

Two methods of ranking were used: (1) all ranked factors and (2) group ranked factors. The factors were categorised into four different groups (human/l factors, management factors, external factors, material factors), making a total of 41 factors. Following is a summary of the questionnaire conducted for establishing the factors affecting labor productivity in the Egyptian Construction Industry:

Total questionnaire sent = 258
Number of questionnaire received = 227
Type = Hard Copies
Time taken to collect data = 60 days
% of questionnaire received = 87.98%

Table 1. Number of respondents and their professions

Respondent	Number
Engineers	98
Foremen	33
Site Supervisors	32
Construction Managers	27
Project Managers	18
Quantity Surveyors	12
Architects	7
Total	227

Table 1 shows the percentage of the professions surveyed, out of the 227 questionnaires received. All contractors are divided into seven groups.

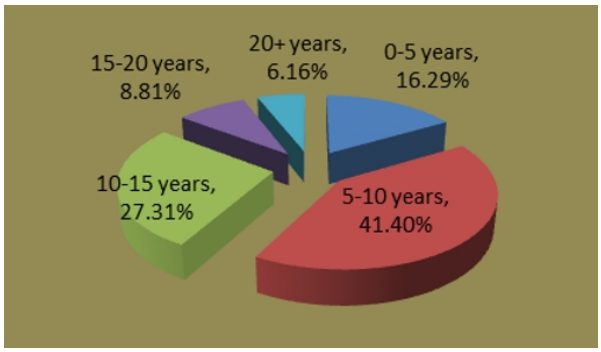

Figure 1. Experience of the respondents

The ranking of the groups are very close to each other, with all group factors have a relative importance index above 70% this might be due to bias in the questionnaire, error in understanding the questionnaire, and respondent are busy so they fill the questionnaire quickly without reading it carefully.

Table 2. Group of factors affecting labor productivity

Factor group	Average relative importance index	Rank
Human/Labor Factors	77.73%	1
Material Factors	77.62%	2
Management Factors	73.65%	3
External Factors	73.10%	4

3.1 Human Labor Factors

3.1.1 Undisciplined Labor

From Table 3, "Undisciplined labor" was ranked 1st with a relative importance index of 82.63% and ranked 4th in overall ranking. This factor is mainly as a result of the nature of the Egyptian laborers; they tend to be very undisciplined by chatting away rather than carrying out the work, they tend to go away for unscheduled breaks at regular intervals.

Table 3. Factors related to the human/labor group

Factors	Relative importance index (%)	Rank
Undisciplined labor	82.63%	1
Labor experience and skill	81.96%	2
Personal/family problems	80.37%	3
Working 7 days a week without rest	79.47%	4
Absenteeism	79.21%	5
Labor motivation	77.62%	6
Arguments between workers	75.67%	7
Physical fatigue	74.47%	8
Labor age (old/young)	74.27%	9
Communication problems between labor and supervisor	71.58%	10
Labor motivation	77.62%	6

3.1.2 Labor Experience and Skill

Similarly, "Labor experience and skill" was ranked 2nd in the group and overall ranking 7th between 41 factors with a relative importance index of 81.96%, this validated why most of the laborers where undisciplined. This ranking was further supported by Durdyev and Mbachu (2011) where labor productivity was measured in New Zealand and Enshassi et al. (2011) where labor productivity was also measured in Gaza both research indicated that the experience of laborers affects the work done on site. Furthermore, Kalsum et al. (2010) also stated that "laborers migrated to other countries after the breakdown of the soviet union" for a better income. The same circumstances are found in Egypt, the majority of the experienced and skilled laborers have travelled to the Gulf countries for a better income, after 2011 and 2013 revolution. As a result contractors have employed young aged and inexperienced construction laborers to carry out these jobs. This usually results poor quality work, cost overruns as a result of rework and delays in the project schedule.

3.1.3 Personal/Family Problems

Personal/Family problems was ranked 3rd in the group with a relative importance index of 80.37% and an overall ranking of 13th between the 41 factors. This result is similar to the results obtained by Zakeri et al. (1996), where personal/family problems where ranked 3rd out of 10th factors affecting labor productivity in Iranian construction projects. Zakeri et al. (1996) reported that "most large and developed projects are located in remote and less developed areas, with poor access and insufficient facilities". Whilst the majority of the laborers come from rural areas there are not seeing their families for days, plus the economy crises the country is facing, add more pressure to the laborers meeting their families' needs.

Although this factor "Personal/Family problems" affecting labor productivity in Egypt is different from the result obtained by Ailabouni (2007) where "Personal/Family problems" where ranked 10th out of 11 factors affecting labor productivity in UAE. While in Enshassi et al. (2011), it ranked 8th out of 45.

3.1.4 Working 7 Days a Week without Rest

Ranked 4th in the group and 15th overall with a relative importance index of 79.47% is "working 7 days a week without rest". The outcome supports the findings reported by Jarkas and Bitar (2011), Durdyev and Mbachu (2011) and Enshassi et al. (2011) that working 7 days a week without rest creates an adverse effect on the motivation and physical strength of labor. Furthermore due to the schedule pressure by the government and private sector after the 2013 revolution to get construction projects completed on time, both laborers and construction professionals have been working more than 5 months without any time off, which may lead to a decrease in motivation and morale.

3.1.5 Absenteeism

As shown in Table 3 Absenteeism is ranked 5th in the human/labor group and 16th overall. The findings agree with Gundecha (2012), where labor productivity was measured in USA, and this factor ranked 18th out of 40. The results also agree with Lim and Alum (1995), where it was ranked 4th out of 17 human factors affecting labor productivity in Singapore. Lim and Alum (1995) further explains that the most absenteeism is caused by laborers who do not turn up, where they are either reported on medical leave or just taking a day off.

3.2 Materials Factors

3.2.1 Tools and Equipment Shortages

From Table 4, "tools and equipment shortages" is ranked 1st but also among the 41 factors. The factor was ranked very highly by respondents, who from discussions have stated that tools and equipment shortages are a major factor that affects labor productivity negatively. In USA, Gundecha (2012) indicated that tools and equipment shortage was also a very important factor to labor productivity and it was ranked 2nd between 12 factors in its group and overall ranking 4th among 40 factors. Furthermore, Gundecha (2012) explains that equipment/tool shortage is a key factor for laborers to be able to complete their work, without them the project will be delayed which results in cost and time overrun. In Iran Ghoddousi and Hosseini (2012) indicate that shortage of tools and equipment is one of the top three factors that affect labor productivity in the Iranian construction projects. The factor was ranked 1st in the material group and overall ranking of 3rd among 31 factors.

Table 4. Factors related to the material group

Factors	Relative importance index (%)	Rank
Tools and equipment shortages	85.79%	1
Delay in material delivery on site	83.42%	2
Material shortage	82.37%	3
Low quality of raw material	81.84%	4
Waiting for equipment to arrive	81.78%	5
Damaged material on site	72.93%	6
Inefficient use of material on site	70.36%	7
Increase of material price	62.47%	8

In Egypt, after the 2011 and 2013 revolutions, contractors have been unsure of the fate of construction hence they are careful in spending heavily on construction equipment. They resort to hiring most equipment and rely on manual labor for most tasks.

3.2.2 Delay in Material Delivery on Site

Delay to material delivery on site is ranked 2nd in this group and overall ranking 2nd among 41 factors with a relative importance index of 83.42%. This result substantiates the results obtained by Zakeri et al. (1996) where it was ranked 3rd amongst 31 factors. Zakeri et al. (1996) stated that "irregular payments lead to poor procurement and remain a serious obstacle in the path of purchasing material on time" in other words poor procurement planning is the main cause for delay in materials delivery on site. Waiting for material is a major factor affecting labor productivity negatively in Egypt, since materials are very important to complete construction tasks, without them the construction process can be on hold. Most of the suppliers have kept their prices the same especially after the revolution to make sure the profit margin is still the same. This then results in long-term discussions between contractors and suppliers to agree the price.

3.2.3 Material Shortage

With a relative importance index of 82.37% Material shortage was ranked 3rd in this group and 5th among 41 factors. An example of material shortage can be shortage of cement, bricks, and steel reinforcement which can be a concern as they cause work disruption on site.

In Gaza, Enshassi et al. (2011) material shortage was ranked 1st in the group and 1st overall between all 45 factors with a relative importance index of 89.47%. Enshassi et al. (2011) justifies the results by stating that in most construction projects that take place in Gaza, the materials have to be imported from Israel, therefore any closure of crossing points between the

two countries causes a delay in material delivered which results in shortage of material. The results were further supported by Kaming et al. (1997) in Indonesia were it was ranked 1st among all factors that affect labor productivity negatively, since materials could cost 50-65% of the construction cost in high buildings in Indonesia. Kaming et al. (1997) calculated that the average time wasted for unavailable materials is as follow; steel 2.25 hours, carpenter 3.51 hours and bricklayer 1.69 hours.

In Egypt this factor was ranked high due to the financial problems the contractors are facing or a shortage in credit facilities which is an issue for material procurement. Another important reason why this factor was ranked high is due to delay of payment from client to contractor which results in contractor delayed in ordering materials. Design and schedule changes were another reason why the factor ranked high by respondents since design and schedule changes cause different material ordering to complete modified designs. Therefore based on the schedule the contractor orders the materials while the recent government policy after the revolution and the paper work on material procurement has also been causing material shortage, since the procedure takes time to be approved by the government.

3.2.4 Low Quality of Raw Material

Low quality of raw material is ranked 4th in this group, with a relative importance index of 81.84% and 8th among the 41 factors. The results agree with the findings found in Afghanistan by Kalsum et al. (2010), it was ranked 1st in the material group and 5th among 68 factors with a relative importance index of 83.75%. Kalsum et al. (2010) identified that materials delivered are not to the standard specified which delays the construction process since they have to wait for the required and specific materials to arrive on site. Similarly, in Egypt Low quality material is an issue that has been around for a while in the construction industry. Suppliers either send not specified material or the quality of the material itself is very poor. Some of the suppliers do this to save money, and assume that the required material can be substituted by other standard materials that are cheaper without noticing. Suppliers also change the cement bags with imported cement bags to show a high quality cement is been delivered.

3.2.5 Waiting for Equipment to Arrive

With a relative importance index "waiting for equipment to arrive" was ranked 5th in the group and 9th overall with a relative important index of 81.78%. Examples of equipment can include vibrators, bulldozers, backhoe loaders, cranes, and concrete mixers. Equipment are very important for completely any construction tasks, as laborers cannot work without them. Waiting for equipment can be a serious issue since it can cause delay in daily work and extra cost. With the current situation of the construction industry in Egypt contractors don't book equipment in advance since they are not sure the project will keep going on it, they rent the equipment when they need it, this process then delays work by making laborers wait for equipment to be arrive on site.

3.3 Management Factors

Table 5. Factors related to the management group

Factors	Relative importance index (%)	Rank
Payment delay	82.76%	1
Rework	82.11%	2
Lack of supervision leadership	80.53%	3
Incapability of contractor's site management to organize site activities	79.94%	4
Pick and drop facility	78.68%	5
Late payment from client to contractor	75.79%	6
Design changes	72.63%	7
Unrealistic scheduling	70.46%	8
Offered services for labor (life insurance, medical care)	69.84%	9
Perks (Eid Bonuses, Free Lunch, School books for children)	69.81%	10
Incentive scheme	69.47%	11
Inspection delay	67.89%	12
Lack of periodic meeting with labor	65.79%	13
Lack of training sessions for laborers	65.53%	14

3.3.1 Payment Delay

Payment delay had a relative importance index of 82.76% and was ranked 1st in this group it was further ranked 3rd among all factors explored. The result is in agreement with the finding of Kalsum et al. (2010) in Afghanistan, where it was ranked 2nd in the group and 6th out of overall 68 factors. Payment delays are as a result of unqualified contractors awarded contracts but do not have the financial capacity to carry out those jobs. An example is the case of Afghanistan. Similarly, in India and Gaza, this factor was ranked 2nd in the management group (Soham and Rajiv 2013; Enshassi et al. 2011). The factor was further ranked 6th among 45 factors with a relative importance index of 78.68%. Enshassi et al. (2011) justifies the result that payment delay affects laborers mood and "consequently decreases". As discussion with respondent showed that the problem is not any different in Egypt. Some of the construction projects took up to 8-10 months for payments to go through. The laborers cannot wait more than a week to get paid since they also had family needs. Most of the contractors pay from their own pocket to the laborers until they get payed by the client. When laborers mood decreases, motivation decreases and that results in either decrease in laborer performance or leaving to find another job where they can get paid on a daily basis.

3.3.2 Rework

Rework had a relative importance index of 82.11% and was ranked 2nd in the group and 6th among all factors. This effect substantiates the results obtained by Kaming et al. (1997) in Indonesia were the factor was ranked 2nd out of 9 factors. Kaming et al. (1997) states that

brick-layers and carpenters spending almost double the time reworking than steel fixers, this is either caused by design changes, poor instructions, complexity of design specification, and poor workmanship. In Egypt design changes and unclear instruction lead to rework. Beside laborers are working six or seven days a week without rest which causes physical fatigue, and rework. Respondents stated that rework is caused by unclear drawings, supervisor is unaware of job, design complexity, design changes by client and working overtime. Example of common problem would be revised construction drawings send to subcontractor cause rework due to construction errors. Supervisors and craftsmen have a big role in this factor, since lack of leadership, skills, and knowledge results in incorrect information send to the laborers, where it leads to rework. The time it takes for rework by the skilled laborer and the time it took by the inexperienced, unskilled laborer have caused the project to be delayed.

3.3.3 Lack of Supervision Leadership

The third ranked factor is "lack of supervision leadership" with a relative importance index of 80.53% and overall ranking 12th among the 41 factors. The outcome supports the findings of Jarkas and Bitar (2011) who identified that lack of supervision encourages operatives (especially those who are under the direct employment method) to engage in unproductive activities, especially when supervisors leave the site for personal matters. Similarly, when supervisors are unaware of how to complete tasks or give instruction this causes lack of leadership and weak control of laborers. Most of the supervisors in Egypt's construction projects are not thorough and the do not have the proper training in terms of project control. They arrive late on site, and, or leave the site early. They also lack leadership skills and generally poor supervision causes all sorts of problems on site. This problems includes rework, laborer attitude problems, problems between workers, and delayed tasks.

3.3.4 Incapability of Contractor's Site Management to Organize Site Activities

Ranked 4th in the group and 14th out of 41 factors overall, with a relative importance index of 79.94% is "incapability of contractor site management to organize site activities". A Site manager is responsible to ensure that site has been prepared for laborers to be able to accomplish their tasks. They should also check the work sequence according to work programme. Inexperienced site managers in procurement, leadership, scheduling and planning slows down work progress. When site managers cannot organize site activities it causes delay in construction process.

3.3.5 Pick and Drop Facility

"Pick and drop facility" had a relative importance index of 78.68% ranked 5th in the group and 17th overall. As stated previously that nearly all the construction laborers come from rural cities that are hundreds of KM away from Cairo such as Asyut, Aswan, Qena, Sohag, Minya and Luxor. They are unfamiliar with Cairo city which therefore not sure how to travel to the construction site. Pick and drop facility is an issue since it causes high percentage of laborers absenteeism. Some contractors send cars to bring laborers to construction site, and class contractors such "Arab Contractors", "Orascom Construction Industry", and "Hassan Allam" have their own buses to pick and drop laborers from their homes to the construction site and back. These pick and drop facility will save time since all laborers will start and be at the construction site at right scheduled time.

3.4 External Factors

Table 6. Factors related to the external group

Factors	Relative importance index (%)
On site accident	81.58%
Access to site	80.79%
Poor site condition	78.38%
Shortage of power supply/water	76.42%
Weather (high wind, hot temperature, rain and sandstorms)	75.00%
Security (crime and theft)	71.32%
Insufficient lighting	68.91%
Regulations change by government	65.26%
Natural disaster (flood and hurricane)	60.31%

3.4.1 On Site Accident

Ranked 1st in the group was "on site accidents" with a relative importance index of 81.58% and overall ranking 10th among 41 factors. It is obvious that on site accidents causes delay in the construction project. The results obtained from this research agree with the results obtained in Gaza by Enshassi et al. (2011). This factor was ranked 2nd out of 7 in the group and overall ranking 13th out of 45 factors. Enshassi et al. (2011) explained that there are three types of accidents 1- Accidents that results in death, 2- Accidents that causes injured laborers to be hospitalized for more than 24 hours 3- small accidents that result from nails and steel, wires and affect productivity in few cases. Laborer's careless, ignorance, negligence, and lack of attention by contractor causes unsafe working environment, which therefore leads to site accidents. When laborers are injured they delay the work of the rest of the gang. In Egypt it was stated by respondents that nearly every week there is an injured laborer, either a small accidents or big accidents. Most of them cause the work to stop since all laborers gather to see what happened and start chatting. Over confidence in laborer's skills has also led to site accidents, where laborers have thought they are aware of all healthy and safety policies on site. They tend to get injured by equipment and tools or falling from height.

3.4.2 Access to Site

Ranked 2nd in the group is "Access to site" and overall ranking 11th out of 41 factors, with a relative importance index of 80.79%. This effect substantiates the results obtained by Gundecha (2012) in the USA whose research placed "Access to site" in the 11th rank among 40 factors.

Gundecha (2012) justifies the findings that poor access reduces the free movement of labor and consequently, reduced labor productivity.

The majority of the laborers live far away from the construction site. Getting access to site either because of transportation or security reasons can be a key element that affects labor productivity negatively. Another important reason why the factor was ranked high was due to holes and barricades and time spending finding alternative routes. For security reason the majority of the laborers are to provide their ID before entering the site.

3.4.3 Poor Site Condition

Poor site condition is ranked 3rd with a relative importance index of 78.38% and ranked overall 18th among 41 factors. Poor side condition can be land height, shape and ground conditions. Some examples of different site conditions occur when a contractor performs earth excavation and different soil types that weren't previously seen. Each site is different than another and poor site condition can cause difficulties and unsafe working environment, which can result in accidents and delay. Most of the site conditions are outside the hands of the project managers control but contractors should take care of it before the start of the project, which can cost the contractor extra money.

3.4.4 Shortage of Power Supply/Water

With a relative importance index of 76.42% "shortage of power supply/water" ranks 4th in the group and 20th overall, one of the main contributes to large productivity gap between developed and developing countries is low quality infrastructure. Power supplies in many African countries have the reputation for high distribution costs, and unreliability that affects efficiency and competitiveness (Abdul Kadir et al. 2005). After the revolution shortage of electricity and water supply has been an issue; this is as a result of the bombings of major power station during the revolution. Most of these problems are out of the contractors hands. If power and water were available there might be also other problems such as underground power cables being stuck by excavators, and water pipes are burst during excavation work. Gundecha (2012) states that proper lighting is one of the basic requirements for obtaining fair labor productivity with any construction work, failure to have adequate lighting may lead to different consequences, such as misplacing a particular job, or even a serious accidents and deaths.

3.4.5 Weather

The fifth ranked factor was "weather" (high wind, hot temperature, rain and sandstorms) with a relative importance index of 75.00% and ranked 23rd overall. The majority of the construction work is done in open atmosphere and can be seriously affected by unexpected weather conditions. To understand why the factor was ranked highly by respondents a closer look to Egypt's climate was looked at. Most of the African countries are hot and dry. In Egypt the temperature averages between 26.7^oC and 32.2^oC in the summer and up to 43^oC on the red coast. In winter the temperature varies on an average between 13^oC and 21^oC. In general the weather in Egypt is hot, dry and humid in the delta coast along the Mediterranean. Humidity increases in July and August and spreads through all Cairo.

The majority of North Africa and the Middle East are hot and dry with an average temperature between 29^oC-35^oC where laborers are used to working in such conditions but get tired quickly and need breaks for water and food. In UAE, Ailabouni (2007) found that weather condition affects labor productivity negatively. The temperature in UAE goes up to 42-45^oC and a relative humidity varying from 40-90 and some cases 95%. The government makes a mandatory break for all construction workers between 12:30-3:30pm from the period of June to September to assure the safety of the workers. The same case was found in UAE's neighbour Kuwait. Where findings in Kuwait done by Jarkas and Bitar (2011) has ranked the factor 11th overall out of 45 factors. The temperature in Kuwait can reach up to 50^oC between the periods of June-August where the government then bans work in open environment between 12:00 -16:00. The rest of the months are normally pleasant with mild temperatures ranging from low 20^oC to low 30^oC.

100% productivity can be reached when the temperature is between 5^oC and 25^oC and a relative humidity is below 80% (Zakeri et al. 1996). Since weather cannot be controlled by contractors, contractors can overcome the problems by pre fabricating some of the work.

3.5 Overall ranking

All the factors identified from the survey are ranked based on their percentage of relative importance. This is shown in Table 7.

4 CONCLUSION AND RECOMMENDATIONS

This study described an investigation into different factors affecting the productivity of labor in Egyptian construction industry so as to improve the performance of the industry. 41 factors were identified based on extensive literature reviews and these factors were further grouped in 4 major categories: (1) Human/Labor Factors; (2) Material Factors; (3) Management Factors; and (4) External Factors.

Survey questionnaires were handed out based on the factors identified a total of 258 hard copy questionnaires were handed out and 227 were collected back. The data from the survey was analysed and the factors were ranked based on their relative importance index. The results revealed that these 10 factors ranked between RII = 85.79% and RII = 81.58% are the major factors affecting labor productivity in Egypt. These factors include: (1) Tools and equipment shortages; (2) Delay in material

Table 7. Overall ranking of all the factors

Factors	Relative importance index (%)	Rank	Factor group
Tools and equipment shortages	85.79%	1	Material
Delay in material delivery on site	83.42%	2	Material
Payment delay	82.76%	3	Management
Indiscipline labor	82.63%	4	Human/Labor
Material shortage	82.37%	5	Material
Rework	82.11%	6	Management
Labor experience and skill	81.96%	7	Human/Labor
Low quality of raw material	81.84%	8	Material
Waiting for equipment to arrive	81.78%	9	Material
On site accident	81.58%	10	External
Access to site	80.79%	11	External
Lack of supervision leadership	80.53%	12	Management
Personal/family problems	80.37%	13	Human/Labor
Incapability of contractoraŕs site management to organize site activities	79.94%	14	Management
Working 7 days a week without rest	79.47%	15	Human/Labor
Absenteeism	79.21%	16	Human/Labor
Pick and drop facility	78.68%	17	Management
Poor site condition	78.38%	18	External
Labor motivation	77.62%	19	Human/Labor
Shortage of power supply/water	76.42%	20	External
Late payment from client to contractor	75.79%	21	Management
Arguments between workers	75.67%	22	Human/Labor
Weather (high wind, hot temperature, rain and sandstorms)	75.00%	23	External
Physical fatigue	74.47%	24	Human/Labor
Labor age (old/young)	74.27%	25	Human/Labor
Damaged material on site	72.93%	26	Material
Design changes	72.63%	27	Management
Communication problems between labor and supervisor	71.58%	28	Human/Labor
Security (crime and theft)	71.32%	29	External
Unrealistic scheduling	70.46%	30	Management
Inefficient use of material on site	70.36%	31	Material
Offered services for labor (life insurance, medical care,,,,)	69.84%	32	Management
Perks (Eid Bonuses, Free Lunch, School books for children)	69.81%	33	Management
Incentive scheme	68.95%	34	Management
Insufficient lighting	68.91%	35	External
Inspection delay	67.89%	36	Management
Lack of periodic meeting with labor	65.79%	37	Management
Lack of training sessions for laborers	65.53%	38	Management
Regulations change by government	65.26%	39	External
Increase of material price	62.47%	40	Material
Natural disaster (flood and hurricane)	60.31%	41	External

delivery on site; (3) Payment delay; (4) Undisciplined labor; (5) Material shortage; (6) Rework; (7) Labor expensive and skills; (8) Low quality of raw material; (9) Waiting for equipment to arrive; and (10) On-site accident.

From these findings the following recommendations are made as ways of improving and reducing the factor that affect labor productivity, they are:

1. Investment in people is very valuable especially in a country like Egypt with a relatively high population and an abundance of manpower. Government policy should pay attention to secondary technical education and apprentice programs.
2. Government need to provide rules and regulation which will help create a safe working environment for laborers such as obliging companies to provide minimum wages and insurance coverage against accident during work. This can be agreed with the "Egyptian Trade Union Federation" to make sure the laborers are under the umbrella of working in safe environment. Government could also provide industry wide seminars and workshops that promote Health and Safety issues. In this way accidents on site will reduce due to the laborers are more familiar with the Health and Safety regulations.
3. Contractors should support laborers for regular training and for the craftsmen to keep them up to date and aware of skills which have to be improved.
4. Improve labor motivation by paying them a fair wage that they and their families can live from with the cost is increasing. That could be done by developing an Incentive scheme programs were workers will know that tasks completed on-time with the standard required will result in bonuses and will also increase laborer's loyalty and moral of laborers. This can also be done by developing good work schedules that respect workers home needs both local to area and external to area. This means provide balance between safe site and happy life.
5. Stakeholder should adopt collaborative construction procurement approaches such as

Design and Build Alliances. This would enhance the constructability of the design thus facilitate the production process; enhance communication and coordination between project parties in which turn enhances the flow of activities.

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