Kurdistan Journal of Applied Research (KJAR)
Print-ISSN: 2411-7684 | Electronic-ISSN: 2411-7706

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Laborer's Efficiency of Gypsum Plastering in Sulaimani City's Projects

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Volume 4 - Issue 2 | December 2019

DOI: http://doi.org/ 10.24017/science.2019.2.3

Received:
31 August 2019

Accepted:
01 October 2019

Abstract

In this study the Laborer's Efficiency (LE) in building projects in Sulaimani City practically on field sites were investigated for Gypsum plastering (GP). Accordingly, four constructional different buildings as Multistory, commercial and houses were considered. Overall 11 main important factors during 30 practical records on field sites were practically observed.

As a result, for the first time the Laborers' Efficiency (LE) was measured and classified in to three categories high, medium and low for two specific heights which were 0-2 m and 2-3 meters height of walls. On the other hand, concluded that the LE for the height of 0-2m affected on LP from 15.18 to 21.35 m2/hr., with a proportion of 40.6%. In addition to the LE affected-on LP for the height of 2-3m and varied the LP range between 13.33-15 m2/hr., with a proportion of 12.5%.

Keywords:
Gypsum plastering, Interior finishing works, Laborer's efficiency, Labor productivity, Skillful, Skillfulness, Powerful, Powerfulness.

1. INTRODUCTION

The construction field was growing up in the last decades in KRG, the Labor productivity (LP) in some fields of construction was considered by previous researchers, especially in the fields of concrete forming. The LP affected by several factors which considered by previous researchers as summarized in Table 1 and shown in Figure 1, but there was an important factor which was not visible and not measurable affected LP which was call by Laborer Efficiency (LE).

Gypsum plastering considered as one of the most popular finishing works that used in construction fields. Gypsum plastering was an economic material to cover the walls, workable, easy obtaining any were, fast result, nice finished decoration. Therefore, the gypsum plastering was selected in this study to find out the LE. The building's materials and types of the walls were built by hollow block concrete, and the ventilation was in an open are and free ventilation. Finding the LE was depended on fixing variables and find out various results.

1.1. Limitations And Hypotheses

Limitations and hypotheses of the study summarized as following:

1. The study was limited to find the laborer efficiency of the first coat of the gypsum plastering, because it was the most popular use in the Sulaimani City.
2. The gypsum materials, was rounded up near to the work place by the owner before starting the works.[1].
3. The LP were not considered for (roundup the materials, transportation, cost of materials and equipment).
4. Gypsum material provided from Bazian Gypsum Factory with coordination (35.632561° N, 44.964601° E)
5. The research depended on site measurement to find LP for the GP1_Iq, finding the LE and classifying the LE to three classes. Moreover, practically onsite the effects of LE that were indicated on LP.
6. The statistical data analysis was depended on analysis of variance (ANOVA)test, which is a statistical equation to test the variance of the data from the mean of overall the data.

1.2. Study aim

The aim of the study was to:

Study the actual LE practically on field sites, for first coat of gypsum plastering in Sulaimani City. On the other hand, classify the LE to three classes and defined the LP_{range} of each class.

2. BACKGROUND

2.1. *Definitions*

2.1. ***Efficiency****:* is the ratio of the existing work experience of the laborer to the minimum required work experience. Skillfulness is specified based on the ratio of the existing work experiences of the laborer to the minimum required work experiences. [2]. Collins English Dictionary defined the Skilled laborers the job that demanded skill which the worker usually had to be trained for, or the workers that provide this Laborer. [3]. Skillful, skilled, expert, efficiency refer to readiness and skillfulness in a work, craft or art. Skilled implies having had a lot of experience and thus having acquired a high degree of proficiency. Expert laborer's means who have highest degree of proficiency; it may mean much the same as skilled or skillfulness [4] [5].

2.2. ***Productivity****:* In construction projects, the productivity commonly is a unit of work that is located or produced per man.hour. Productivityis defined in many ways the inverse of definition for labor productivity, which is man.hours per unit (unit rate), is also frequently used. Productivity is the ratio of output to all or part of the resources that were used to produce that output. The output can be homogenous or heterogeneous. Resources comprise: Laborer, capital, energy, and raw materials. [6]. Labor productivity is the physical advancement of the work per man.hr. [7]. There is no a standard definition in

previous researches of the labor productivity and existing confusions about the definition of productivity seem to un availability or lack of a typical terminology [8], [6]. Labor productivity is the most widely used to measure working efficiency. Labor productivity is the ratio of output work per labor. [9]. Labor productivity is also known as the proportion of production (output) to the required time to proceed [10]. [6]

2.2. *Literature Review*

Factors affecting LP:

According to previous researches, LP is affected by more than 108 factors. In this study only 47-factors are included and considered, only those who has come up three times or more in the previous researches considered as summarized in Table 1 and shown in Figure 1. Some factors had a direct and dramatic effect, but the other some had a slight effect on the LP. [11]

Classification of factors: Factors that affecting construction productivity are classified into 2 categories: external and internal. External factors represent those outside the control of the firm's management, and the internal are those originated within the firm. External factors include the nature of the industry, client knowledge of construction procedure, weather, and level of economic development. Internal factors include management, technology, laborer, and laborer unions. Meanwhile Adnan Enshassi, classified the that affect construction productivity to technological and administrative factors [12]. Serdar Durdyev, Jasper Mbachu, Gerges and Michael classified the factors affecting LP in to two categories; External Constrains of (Statutory Compliance, Unforeseen Events and Other External Forces), and Internal Constrains of (Finance, Workforce, Technology, Characteristics and Management) [13], [14].

Rex Asibuodu Ugulu, Stephen Allen, investigated the effect of age on LP and found out that increase in Age affected LP by 73%, and that confined space affected %53 [15]. Further, Yebichaye Dires claims the experience and skillfulness of the client affect LP [16]. Kumaraswamy, Daniel W M Chan and Nohan M, also studied the effect of contractor's experience on LP and found out that it affects LP by RII 76.3% [17]. While Farnad Nasirzadeh and Pouya Nojedehi Effect believe that the working area, skillfulness, weather and temperature are the most important factors that affect LP. They found skillfulness is depend on the ratio of the existing work experiences of the labor to the minimum required work experiences. On the other hand, they found that the lack of working area negatively affects LP. [2].Two different studies measured gypsum plastering LP by previous researches in a practical way as 4 m^2/hr., for suspended slab with thickness 15 mm[18], [19].

Summary of previous studies and literature reviews

The result of the survey of the previous studies indicates that it is difficult to find studies measuring LP in a practical way. Moreover, is difficult to find studies depending on practical tests and measurements on the project sites. It is also noticed from the references [1] to [30] except [17] and [18], there is a gap in the previous researches and studies due to lack of implementing practical ways for measuring and finding out LP on the works' sites.Various studies depended on questionnaires survey to collect data. According to previous studies[11], [12], [17],[20],[21],[22], [23], [24], [25],[26].47-other factors had been indicated, and they were sorted out in this study according to their RII% that were measured.

In different countries the researchers conducted researches and included the same factors that are mutual with this study. The 6-most important factors were selected and sorted out according to their RII% from highest to the lowest which were (Years of Experience, Age, Skillful of Laborers, height of walls, Working Space and Crew size) and the RII% were (85.8, 73.4, 72.5, 65.4, 59.2, 58.9 % respectively) as they were shown in Figure 2. [11], [12], [17],[21],[22], [23], [24], [25],[26]

Table 1: Factors affecting on LP and their RII% in view of previous researches, mutual with this study's factors and considered 3 or more times in their studies

Ser. No.	Reference No.		[20]	[21]	[22]	[23]	[24]	[11]	[25]	[26]	[12]	[17]	
	Title	10-Countries	ESTIMATE OF Laborer PRODUCTIVITY IN SUDANESE CONSTRUCTION INDUSTRY	FACTORS AFFECTING Laborer PRODUCTIVITY IN BUILDING PROJECTS OF PAKISTAN	Critical factors affecting construction Laborer productivity in Egypt	Factors Influencing Construction Laborer Productivity: An Indian Case Study	Laborer Productivity in the Construction Industry-Factors Influencing the Spanish	Factors affecting Construction Laborer Productivity in Trinidad and Tobago	Factors Influencing Construction Laborer Productivity in Egypt	STUDY OF FACTORS AFFECTING Laborer PRODUCTIVITY AT A	Factors affecting Laborer productivity in building projects in the Gaza strip	A comparative study of causes of time overruns in Hong Kong construction projects	Frequency
	Author		Abdulaziz Taj Elsir Mohamed Osman, Yousif Hummaida Ahmed	MUHAMMAD ASADULLAH TAHIR, HASHIMHANIF, ZUHAIB ASLAM SHAHID,	Sherif M. Hafez, Remon F. Aziz, Enas S. Morgan, Madeha M. Abdullah, Eman	Anu V. Thomas and J. Sudhakumar	G. Robles, A. Stifi, José L. Ponz-Tienda, S. Gentes	Brent G. Hicksona and Leighton A. Ellis	Khaled, Mahmoud El-Gohary and Remon, Fayek Aziz	Mahesh Madan Gundecha	Adnan Enshassi, Sherif Mohamed, Ziad Abu Mustafa & Peter Eduard Mayer	Daniel W M Chan and Mohan M Kumaraswamy	
	Year	Average RII%	2017	2015	2014	2014	2014	2013	2012	2012	2007	1997	
	Country		Sudan	PAKISTAN	Egypt	Indian	Spanish	Trinidad and Tobago	Egypt	USA	Gaza	Hong Kong	
	Factors		RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	RII (%)	
1	Experience of laborers*	85.81		89.0	84.0		83.2	90.0	93.3	88.0	84.2	74.8	8*
2	Lack of Laborer supervision	84.00			84.0		70.2	95.0	87.4		83.4		5

3	Payment delay	82.67		83.0	87.0		82.5	85.8		79.0	78.7		6
4	Clarity of technical specifications	82.23			79.3		86.4	81.0					3
5	Shortage of materials	79.59	93.8	72.0	72.0	44.0		83.3	90.3	100.0	89.5	71.5	9
6	The extent of variation/change orders during execution	79.05			72.4			81.7		88.0		74.1	4
7	Construction manager's lack of leadership	77.67		70.0	80.0	80.0		88.3	88.4			59.3	6
8	Unrealistic scheduling and expectation of Laborer performance	77.33			68.0		75.1	91.7	74.5				4
9	Motivation of Laborer	77.26		74.0	83.3		77.5	82.5			69.0		5
10	Site restricted access	77.15	90.6		63.3		72.1	71.7		88.0			5
11	Construction method	74.64	84.4	64.0	75.6	75.6	65.5	83.3	86.6		62.1		8
12	Inadequate lighting	74.21	78.1	63.0						91.0	64.7		4
13	Insufficient supervision of subcontractors	73.75					81.0		69.1		71.8	73.1	4
14	Age of laborers*	73.68		81.0					78.1	73.0	62.6		4*
15	Drawings and specifications alteration during execution	73.32		84.0		36.0			76.6	90.0	80.0		5
16	Laborer disloyalty	73.17		74.0						67.0	78.5		3
17	Rain	72.90			68.5		64.4	85.8					3
18	Skill of Laborer*	72.47			86.9	32.0	83.2	87.5	93.3			51.9	6*
19	Inspection delay by the engineer	72.15		60.0	74.8			68.3		80.0	77.6		5
20	High quality of required works	71.67		61.0						86.0	68.0		3
21	Rework	71.60		81.0	73.8	30.0	73.2	84.2		84.0	75.0		7
22	Design changes	70.97							74.3	83.0		55.6	3
23	High Temperature	70.33			76.7		69.5	64.8					3
24	Accidents as a result of poor site safety program	69.47		77.0	69.5	27.6		73.3		97.0	72.4		6
25	Unsuitability of storage location	68.90			73.5		75.4	57.5			69.2		4
26	Unavailability of suitable tools	68.90				28.0		81.7		97.0			3
27	Bad weather condition	68.67		80.0		34.0	63.3		79.7	91.0	64.0		6
28	Unavailability of safety engineer on site	68.07		64.0						87.0	53.2		3
29	Lack of training offered to operatives	67.65		63.0				83.3		74.0	50.3		4
30	Working overtime	67.61		74.0	81.1	22.0	69.8	66.7	74.9	90.0	62.4		8
31	Poor project planning and scheduling	67.14				33.0	78.1		84.5		74.7	65.4	5
32	Rest time(s) during the work day	66.63		65.0			62.7		72.2				3
33	Absenteeism	66.24		78.0		35.0			77.2	86.0	55.0		5
34	Height of the work*	65.57					64.4		73.6		58.7		3*
35	Lack of providing Laborer with transportation	64.67						60.0		78.0	56.0		3
36	Incomplete/revise drawing	63.00		69.0		33.0				87.0			3

37	Poor relations between Laborer and supervisors	62.75		84.0		29.0				75.0		63.0	4
38	Lack of experience of supervisor	62.63				30.6	83.2					74.1	3
39	Inadequate safety plan	62.15		76.0		30.0	75.0				67.6		4
40	Low quality of raw materials	62.08		69.0		30.0				78.0	71.3		4
41	Design complexity level	60.02				25.0	66.9	72.5		78.0		57.7	5
42	Laborer interference and congestion	59.63				25.0	73.9	72.5			67.1		4
43	Space of work*	59.20		70.0		29.0		67.5			70.3		4*
44	Crew size*	58.87			73.8	27.0		75.8					3*
45	Communication problems between site	58.74			29.0	34.0	80.9	85.8				64.0	5
46	Tool and equipment shortages	56.77		63.0		32.0					75.3		3
47	Lack of periodic meeting with Laborer	51.60		71.0		27.0					56.8		3

Note: (*): means that the factor comes up and considered three times or more by previous researches and mutual with this study's factors

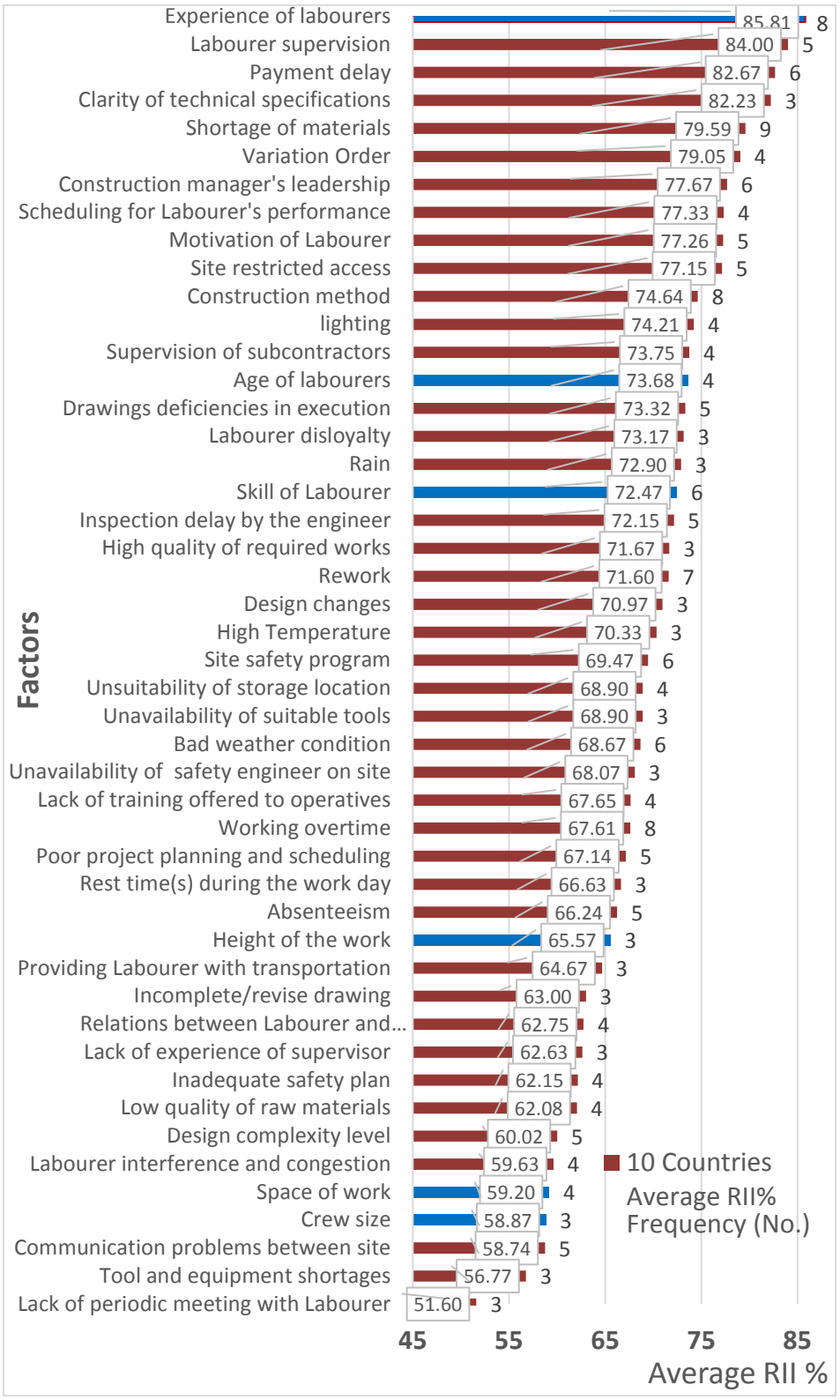

Figure 1: Factors affecting LP and their RII% view of previous researches mutual with this study which considered three or more than three times in their studies.

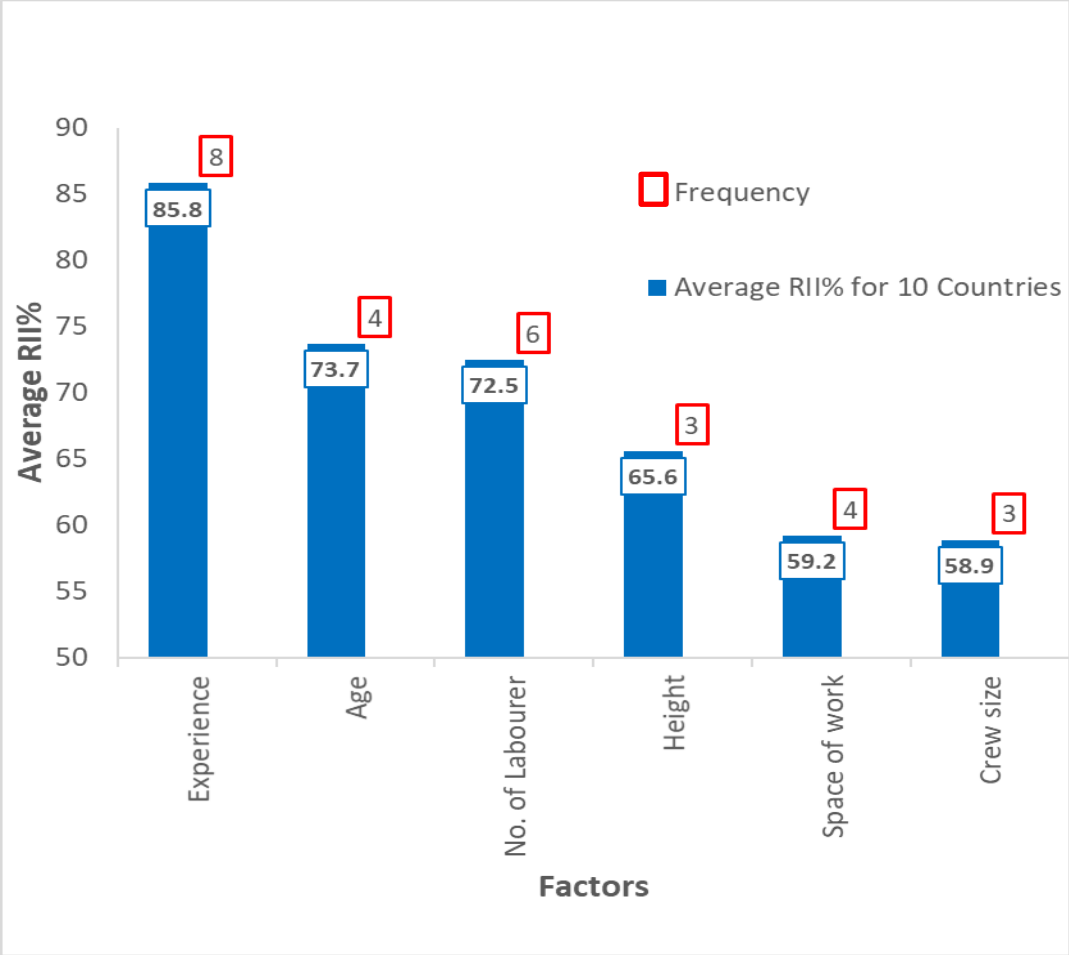

Figure 2: The relative importance index of factors affecting labor productivity for the factors that are mutual in previous and this study which considered three or more than three times in the previous studies.

3. METHODS AND MATERIALS

3.1. *Site measurement:*

1. Four Constructional sites were selected; they were different in types such as (Multistory, commercials and houses). A total of 30 records were collected from the sites. The LP was measured and recorded on the sites.
2. An inspection data sheet was prepared, and used on daily bases to facilitate the recording of all the available data on sites. The gypsum plastering was usually started after 5:00 am and was finished in the different times before 6:00 pm.
3. Gypsum shall be fresh, completely dry, shall not leave residuals on 56 mesh/cm sieve, shall be free from extraneous which may be affected by spontaneous slating. The Gypsum material was kept in a dry area, covered and protected from moisture[1].

At the beginning of work activity, the time span was measured and recorded using stopwatch. The stopwatch was used from the start to the end of each work. Then the dimensions of the product were measured using measuring tape. Other data and factors that had effect on the LP, were also recorded on the inspection data sheet as summarized in Table 2.

The six-main important varied factors were (Age (Ag), years of experience (Ex) of the skilled Laborers, height of walls (h), space of the works (WkS), size of crew (Cz) and the number of skilled Laborers(SkL)). In addition to the five fixed secondary factors were also considered as (country of residential of labors, payment basis, weather, temperature and building walls material type).
The LP for each individual work was calculated dependingon the time durations and product area of each work that were recorded on the inspection data sheet form. Then the LP was calculated for each individual work through using the LP equations no. 1.[8], [27] , [28].

$$LP = \frac{Output}{Working\ hours} \qquad (1)$$

A summary sheet included all factors and the LP was prepared as summarized in Table 2.
LP column for over all the 30 records were compared together, as a result the records selected that their LP was changed while the other factors were kept constant.

Table 2: LP data gathered on field sites for gypsum plastering works.

Zone	Ser. no.	Sample no.	LP (m^2/hr.)	SkL (no.)	Cz (no.)	Age (years)	Ex (years)	Country of residential	Height (m)
	2	5	17.55	1	3	26	5	Iraq	0-2
	1	9	12.65	1	3	28	11	Iraq	0-2
	3	2	23.73	1	4	30	13	Iraq	0-2
1	4	16	15.19	2	3	35	14	Iran	0-2
	5	17	15.50	2	3	35	14	Iran	0-2
	6	15	15.87	2	3	35	14	Iran	0-2
	7	18	15.87	2	3	35	14	Iran	0-2
	8	19	16.30	2	3	35	14	Iran	0-2
	9	20	16.30	2	3	35	14	Iran	0-2
	10	21	16.30	2	3	35	14	Iran	0-2
	11	14	21.35	2	3	35	14	Iran	0-2
	12	4	20.97	1	4	30	13	Iraq	0-3
	13	12	10.80	2	3	35	14	Iran	0-3
	14	8	13.91	2	3	39	6	Iran	0-3
	15	1	9.00	5	17	29.6	8.4	Iraq	0-3
	16	13	2.36	8	9	35	14	Iran	0-3
	20	7	14.62	1	3	26	5	Iraq	2-3
	19	10	10.78	1	3	27	10	Iraq	2-3
	17	6	10.53	1	3	28	11	Iraq	2-3
	18	11	10.76	1	3	28	11	Iraq	2-3
	21	3	16.27	1	4	30	13	Iraq	2-3
2	22	23	13.33	2	3	35	14	Iran	2-3
	23	24	13.95	2	3	35	14	Iran	2-3
	24	27	14.46	2	3	35	14	Iran	2-3
	25	30	14.60	2	3	35	14	Iran	2-3
	26	22	14.63	2	3	35	14	Iran	2-3
	27	28	14.71	2	3	35	14	Iran	2-3
	28	26	14.81	2	3	35	14	Iran	2-3
	29	25	15.00	2	3	35	14	Iran	2-3
	30	29	15.00	2	3	35	14	Iran	2-3

- **Work procedure of the first coat of gypsum plastering in national style (GP1_Iq):**

The walls were covered with gypsum plastering of 2 cm thick. The work was conducted according to the following steps shown in Figure 3: [1].

i. All the walls were washed and cleaned up by water before the covering started.
ii. The walls were rendered with a prime coat usingtrowelsto spread the cement mortar on the wall in a ratio of 1:4 (cement to sand). This would make the wall obtain a rough surface to facilitate the paste of the gypsum plastering.
iii. Vertical gypsum shimming was made by vertical leveled shims 5*2 cm each 60-80 cm with gypsum plastering to ensure the vertical alignment of the walls.
iv. After waiting a day or more,covering the walls with 2-3 cm of first coat of the gypsum plastering were started using trowels.Then after a period of 1-2 minutes, skimming and adjustmentto that layer of the gypsum plastering were performedusingbrown rods and then smoothened by steel trowels[1].

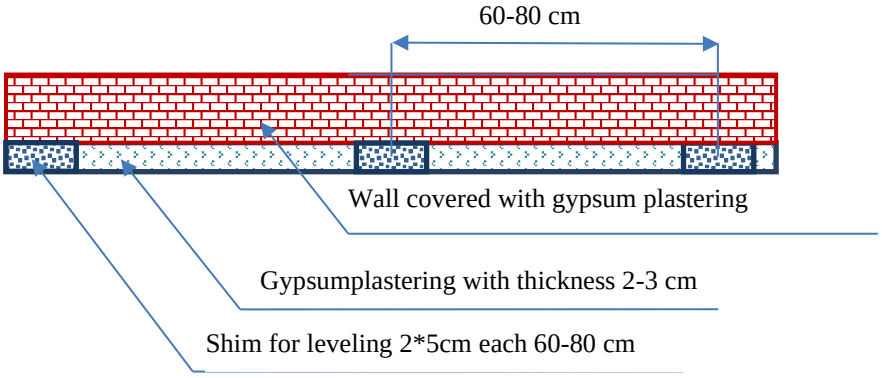

Fig. 3, Typical Section of wall covered by gypsum plastering.

4. RESULTS AND DISCUSSION

Project site work measurement:

4.1 *Effects of Factors on Labor Productivity*

Data analysis depended on statistical analysis tests and equations; ANOVA test was carried out for all the works. The correlation of the LP and the factors was found using Linear Multiple variable equation. The significant F was tested for all types of the works. In addition, two tails f-test, the P-value for all factors were calculated using confident interval 95%.

The study included different types of buildings such as multistory, commercial buildings and houses; besides, different numbers of skilled and non-skilled Laborers, various ages, years of experience and heights of buildings were included. The LP was measured, and standardized for the data of first coat of the gypsum plastering in the national style as follows:

The standardized Statistical Process Control (SPC) was used to check the normality of the data, ±1 Standard deviation (±1 STD), ±2STD, ±2.5STD and ±3STD was indicated on the LP charts with the standardized LP on y-axis for all the samples. The results indicated that:

The data for the LP within the range of ±1 STDV was 73.3%.
The data for the LP within the range of ±2 STDV was 93.3%.
The data for the LP within the range of ±2.5 STDV was 96.7%.
The data for the LP within the range of ±3 STDV was 100.0%.

As all residuals, statistical results of the STD's, outlier points, the point within the range of standard deviations and their proportions were presented for (GP1-Iq,) as summarised in Table

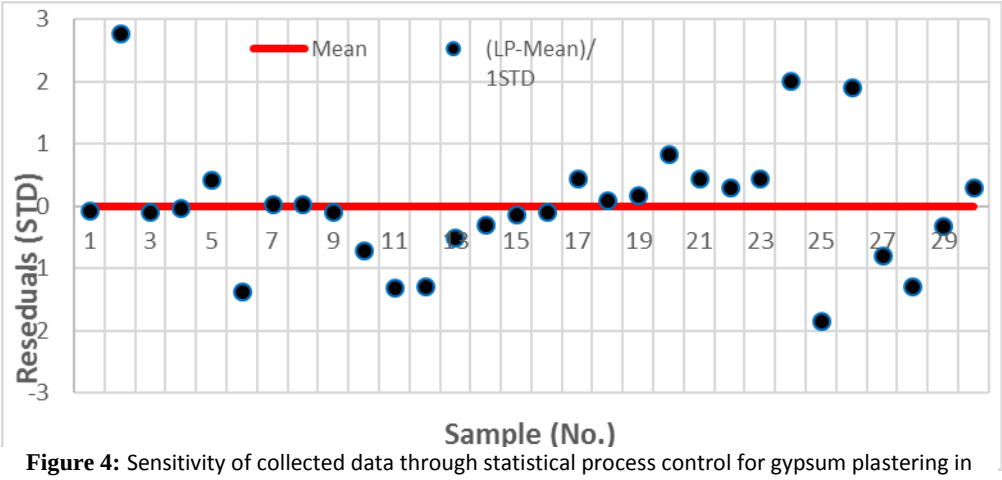

Figure 4: Sensitivity of collected data through statistical process control for gypsum plastering in national style.

Table 3: Statistical process control (SPC), residuals, and the proportion of outlier points for gypsum plastering.

Sample no.	Residuals (Variations) = (LP-mean)/STDV	Sample no.	Residuals (Variations) = (LP-mean)/STDV
1	-0.061	16	-0.095
2	2.770	17	0.441
3	-0.087	18	0.091
4	-0.027	19	0.189
5	0.430	20	0.831
6	-1.371	21	0.441
7	0.031	22	0.305
8	0.031	23	0.441
9	-0.083	24	2.024
10	-0.705	25	-1.850
11	-1.300	26	1.903
12	-1.292	27	-0.796
13	-0.491	28	-1.286
14	-0.297	29	-0.310
15	-0.139	30	0.305
Status of data range	**STDV**	**number**	**%**
Within the range	-1>data<+1	22	73.3%
	-2>data<+2	28	93.3%
	-2.5>data<+2.5	29	96.7%
	-3>data<+3	30	100.0%
Outleir	-1<data>+1	8	26.7%
	-2<data>+2	2	6.7%
	-2.5<data>+2.5	1	3.3%
	-3<data>+3	0	0.0%

The linear multiple variable regression was checked. The correlation between LP and the factors was considered a strong relation according to the R^2=97.1%; the significant F=8E-13. The P-Values of the factors (h, SkL, Cz, Age, Ex.) were (2E-04, 3E-13, 1E-12, 3E-13, 7E-11);the R^2, STD and the Coefficient of Variance (C.v). were measured as summarized in the Table 4

Table 4: Summary of SPC for labor productivity and affecting factors for gypsum plastering in national style

(GP1_lq)	Average	Min	Max	Unit	R^2 %	Adjusted R^2 %	Significant F	STDV	C.v	P-Value
LP	15.20	10.53	23.73	m^2/hr.				2.86	0.19	7E-10
High (m)	2.56	0.00	3.00	m				0.51	0.20	2E-04
No. of Skilled Lab	1.32	1.00	2.00	No.				0.48	0.36	3E-13
Crew size	3.04	2.00	4.00	No.	97.1	96.1	8E-13	0.89	0.29	1E-12
Age	32.72	26.00	35.00	years				3.49	0.11	3E-13
Experience	12.68	5.00	14.00	years				2.61	0.21	7E-11
Country										5E-09
Model to Predict LP	LP = (-52.36 - 2.079 * h - 16.168 * SkL + 7.763 * Cz + 3.093 * Ag - 1.709 * Ex - 5.308 * Cty)									

4.2 The effects of laborer's efficiency:

Finding the laborer's efficiency for the gypsum plastering work in national style:

Laborer efficiency for the wall height 0-2m

Finding the minimum and the maximum LE of the wall height 0-2m:

The results are arranged and summarized in Table 2 within zone 1column under the serial number 4 to 11; it shows that the LP has increased from 15.19 to 21.35 m^2/hr., while all other six factors remained constant as SkL:2, Cz;3, Ag;35, Ex;14, Country; in height; 0-2m.Itis concluded that there are another non visible factor affecting LP. This factor is called Efficiency of the laborers. In other words, LE causes variation in the LP between 15.19 and 21.35 m^2/hr., as summarized in Table 5.

Laborer efficiency for the wall height 2-3m

Finding the minimum and the maximum LE of the wall height 2-3m

The results are arranged and summarized in Table 2 within zone 2 column under the serial number 22 to 30. The results showed that the LP increased from 13.33 to 15.00m^2/hr., while all other six factors remained constant; SkL:2, Cz;3, Ag;35, Ex;14, Country; in height; 2-3m, It is concluded that there are another non visible factor affecting LP which is called Efficiency of the Laborers. In other words, the LE caused to variation in the LP between 13.33 and 15 m^2/hr., as summarized in Table 5.

Table 5: Summary of Laborer's efficiency, its effects on LP and it's classification for three classes for h=0-2 and h=2-3m.

GP1_lq	Laborer efficiency Class	LP h(0-2) m	LP h(2-3) m	Effect of LE on LP % h(0-2)m	Effect of LE on LP % h(2-3)m
LP (m^2/hr.)	L	15.18 - 17.24	13.33 - 13.88	13.6%	4.1%
	M	17.24 - 19.29	13.88 - 14.44	11.9%	4.0%
	H	19.29 - 21.35	14.44 - 15	10.7%	3.9%
		Total Effect of LE on LP		40.6%	12.5%
Factors	SkL	2	1		
	Cz	4	2		
	Ex	14	14		
	Ag	35	35		

4.3 *Classification of Laborers' Efficiency (LE)*

Neither the LE for-gypsum plastering was found nor classified by previous other researchers, but in this study The LE for two different heights (0-2) m and (2-3) m was found and classified to three classes:
The results showed that the LP for the height of (0-2) m was between (15.19-21.35) m^2/hr., and LP for the height of (2-3) m was between (13.33-15) m^2/hr.

The Procedure of classification of skilled laborers efficiency for the height of (0-2) m:

Laborer efficiency (LE) has not been found before by other researchers, but in this research the LE, as a unique procedure, was classified to three categories as Low-Class, Medium Class and High-Class categories, as summarized in Table 5, and according to the following procedure:

1. The maximum and minimum LP was indicated as (21.35 -15.18) m^2/hr.
2. The range between high and low LP was found as follows:
    a. $LP_{Rang} = LP_{max.} - LP_{min.} = 21.35 - 15.18 = 6.17\ m^2$/hr.
3. To classify the LP to three categories, the (LP_{rang} 6.17 m^2/hr.)is divided by 3 in order to find the LP_{range} for each of the three categories as follows;
    a. $LP_{Rang\ for\ one\ category} = LP_{Rang} / 3 = 6.17\ m^2$/hr. / 3 = 2.057 m^2/hr.
    b. Limit of LP for each category was found by finding the $LP_{min.}$ and $LP_{max.}$ for each category as follows:
        i. Finding LE of Low-Class LP:
            a. $LP_{min.\ for\ Low\text{-}Class} = LP_{min.} = 15.18\ m^2$/hr.
            b. $LP_{max.\ for\ Low\text{-}Class} = LP_{min.\ for\ Low\text{-}Class} + LP_{Rang\ for\ one\ category} = 15.18 + 2.057 = 17.24\ m^2$/hr.
        ii. LE of Low-Class wasindicated by LP_{min}. and LP_{max}. As follows:
            a. $LE_{min.\ for\ Low\text{-}Class} = LP_{min.\ for\ Low\text{-}Class} = 15.18\ m^2$/hr.
            b. $LE_{max.for\ Low\text{-}Class} = LP_{max.\ for\ Low\text{-}Class} = 17.24\ m^2$/hr.
        iii. Limit of LE for Low-Class of SkL for Gypsum plastering was found as (15.18-17.24) m^2/hr.
4. Finding LE of Medium-Class LP as follows:
    i. $LP_{min.\ for\ Medium\text{-}Class} = LP_{max.\ for\ Low\text{-}Class} = 17.24\ m^2$/hr.
    ii. $LP_{max.\ for\ Medium\text{-}Class} = LP_{min.\ for\ Medium\text{-}Class} + LP_{Rang\ for\ one\ category} = 17.24 + 2.057 = 19.29\ m^2$/hr.
    iii. LE of Medium Class was indicated by $LP_{min.}$ and $LP_{max.}$ as follows:
        a. $LE_{min.\ for\ Medium\text{-}Class} = LP_{min.\ for\ Medium\text{-}Class} = 17.24\ m^2$/hr.
        b. $LE_{max.\ for\ Medium\text{-}Class} = LP_{max.\ for\ Medium\text{-}Class} = 19.29\ m^2$/hr.
        c. $LE_{Limit\ for\ Medium\text{-}Class}$ of SkL for Gypsum plastering was found as (17.24-19.29) m^2/hr.
5. Finding LE of High-Class LP as follows:
    i. $LP_{min.\ for\ high\ class} = LP_{max.\ for\ medium\ class} = 19.29\ m^2$/hr.
    ii. $LP_{max.\ for\ high\ class} = LP_{min.\ for\ high\ class} + LP_{Rang\ for\ one\ category} = 19.29 + 2.057 = 21.35\ m^2$/hr.
    iii. LE of High-Class was indicated by $LP_{min.\ for\ high\ class}$ and $LP_{max.\ for\ high\ class}$ as follows:
        a. $LE_{min.\ for\ High\text{-}Class} = LP_{min.\ for\ High\text{-}Class} = 19.29\ m^2$/hr.
        b. $LE_{max.\ for\ High\text{-}Class} = LP_{max.\ for\ High\text{-}Class} = 21.35\ m^2$/hr.
        c. $LE_{Limit\ for\ High\text{-}Class}$ of SkL for Gypsum plastering was found as (19.29-21.35) m^2/hr.

The same procedure that was used for the classification of the LE for (0-2) m height was also used to find the LE for (2-3) m height. The LP for the height of (2-3) m varied between (13.33-15) m^2/hr. and the results of LE of skilled laborers for the height of (2-3) m were calculated as follows and also summarized in Table 5:

- $LE_{\text{Limit of Low-Class}}$ SkL = (13.33-13.88) m^2/hr.
- $LE_{\text{Limit of Medium-Class}}$ SkL = (13.88-14.44) m^2/hr.
- $LE_{\text{Limit of High-Class}}$ SkL = (14.44-15) m^2/hr.

5. CONCLUSION

First coat of gypsum plastering in National Style (GP1_Iq):
The LE has a significant effect on LP while these factors kept constant (h, WkS, SkL, Cz. Ag, Ex). Moreover, the effect of LE on LP varied between (4.0 - 671.5%).

- LE has a significant effect on the first coat of gypsum plastering LP on the height 0-2 m. When the LE increases from class low (L) to class high (H), the LP increases from 15.18 to 21.35 m^2/hr., or the LP increases by a proportion of 40.6%.
- LE has a significant effect on the first coat of gypsum plastering LP on the height 2-3 m. When the LE increases from class low (L) to class high (H), the LP increases from 13.33 to 15.00m^2/hr., or the LP increases by a proportion of 12.5%.

RECOMMENDATION

To improve future studies in the field of laborer efficiency, it is recommended that the range of factors are expanded to include other areas or other specialties related to the skilled laborers, such as:

- Physical factors, including weight and height of the skilled laborers.
- Sociological factors, including personal problems, family issues or financial means.
- Medical factors, including chronic diseases, depression, diabetes, hypertension and cardio diseases.
- Nicotine and drug factors, including the products that addict human, such as cigarettes, cigars, pipe tobacco, chewing tobacco, and wet and dry snuff and the dried leaves from the tobacco plant.
- Extension of medical situation especially the chronic disease like depression, diabetic, hypertension, cardio diseases.

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