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Factors Affecting Labor Productivity on Construction in Kurdistan of Iraq: Web Survey

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ABSTRACT

This study was set out to investigate factors affecting labor productivity on construction in the north of Iraq (Kurdistan) and to rank all the factors based on engineers, contractors, and designer's opinions. 76 factors were analyzed based on previous literature and a pilot study. Next, by using online Google Form, a questionnaire form was created and sent to people who have experience in the construction industry. Afterward, the questionnaire form was sent to targeted people by email and social media apps. Factors were divided into nine groups "Management, Technical and Technology, Human and Workforce, Leadership, Motivation, Safety, Time, Material and Equipment, and External". However, 202 respondents participated in this study, and they were asked to give weight to the factors using the Likert scale from 1 to 5. Finally, the Relative Importance Index RII was used to determine the factors statically with MS Excel 2015. In brief, all the respondents agreed upon "Economic condition in the country" is the first ranking factor. While "Site complication" was the last factor that affect labor productivity in construction. Last but not least, the "Motivation" group was the first ranked group. Apart from the factors, respondents agreed that Site Engineers have more effect on construction projects than Contractors and Designers.

Keywords: Productivity, Construction, Kurdistan, RII, and Labor.

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العوامل المؤثرة على انتاجية عمال البناءفي كردستان: دراسة عبر الانترنت

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الخلاصة

وضعت الدراسة للتحقيق في العوامل التي تؤثر على إنتاجية عمال البناء في شمال العراق (كردستان) وتصنيف جميع العوامل بناءً على آراء المهندسين والمقاولين والمصممين في الموقع. في هذه الدراسة ، تم تحليل 76 عاملاً، بناءً على البعوث السابقة و الدراسات تجريبية. بعد ذلك ، باستخدام نموذج **Google** عبر الإنترنت ، تم إنشاء نموذج استبيان وإرساله إلى الأشخاص الذين لديهم خبرة في مجال البناء. بعد ذلك ، تم إرسال نموذج الاستبيان إلى الأشخاص المستهدفين عبر البريد الإلكتروني وتطبيقات الوسائط الاجتماعية. تم تقسيم العوامل إلى تسع مجموعات "الإدارة ، والتقنية والتكنولوجيا ، والعامل البشري والقوى العاملة ، والقيادة ، والتحفيز ، والسلامة ، والوقت ، والمواد والمعدات ، والعوامل الخارجية". ومع ذلك ، شارك 202 مستجيبًا في هذه الدراسة ، وطُلب منهم تقييم للعوامل باستخدام مقياس (**Likert scale**) من 1 إلى 5. علاوة على ذلك ، تم استخدام مؤشر الأهمية النسبية **RII** لتحديد العوامل بشكل ثابت باستخدام **MS Excel 2015**. بشكل مختصر، اتفق جميع المستجيبين على أن "الوضع الاقتصادي في الدولة" هو العامل الأول. بينما كانت "مشاكل الموقع" هي العامل الأخير الذي يؤثر على إنتاجية عمال البناء. أخيرًا وليس آخرًا ، احتلت مجموعة "التحفيز" المرتبة الأولى ضمن المجموعات. بصرف النظر عن العوامل ، اتفق المستجيبون على أن مهندسي الموقع لديهم تأثير أكبر على مشاريع البناء من المقاولين والمصممين.

الكلمات الرئيسية: الانتاجية, البناء , كردستان, RII, **العمل**

1. INTRODUCTION

Since the building construction started, the labor productivity issue started shoulder to shoulder with it. Whether it's a small, medium, or large organization the issue still affects organizations all around the world. In ancient times the rulers used lots of labor to build a project ignoring the skills they had or their strengths and most of them were from low-income families without any education. Uruk modern Warka in Iraq is an example, where life began more than 5000 years ago and first writing emerged. It was one of the most important places in southern Mesopotamia. It has been estimated that 1500 laborers were working ten hours a day on average for above five years to build this ancient place. The last major revetment (stone facing) of its massive underlying terrace (the open areas surrounding the White Temple at the top of the Ziggurat). Although, the laborers who worked there believed that they were inspired by religious beliefs while some were forced to do so and be involved as a Slave (German, 2015). The present Kurdish construction sector is facing major difficulties and problems which impact the Kurdistan construction industry. As Iraq is one of the developing countries and studying factors that affect this country can affect increasing the rate of productivity in the construction industry's sector, and as Kurdistan is a region of this country, the same factor analysis can be applied to it to increase this rate. The main anxiety has been cost, time, productivity, and quality for the majority of the projects. Today, one of the main concerns of any organization is to improve its productivity, rather than efficient and efficient transfer of resources

into marketable products and business profitability accounts. However, up to today construction industry is still facing various problems related to low productivity.
The Kurdistan region consists of five different cities Erbil, Sulaimani, Kirkuk, Duhok, and Halabja. According to Kurdish Regional Government (KRG), the unemployment rate in Kurdistan is lower than in the rest of Iraq as well as that in Turkey, Egypt, and Syria as shown in **Fig.1**. According to KRG, 48.9% of labor work in the private sector, and 50.4% of labor works in the Government sector **(KRG, 2020)**

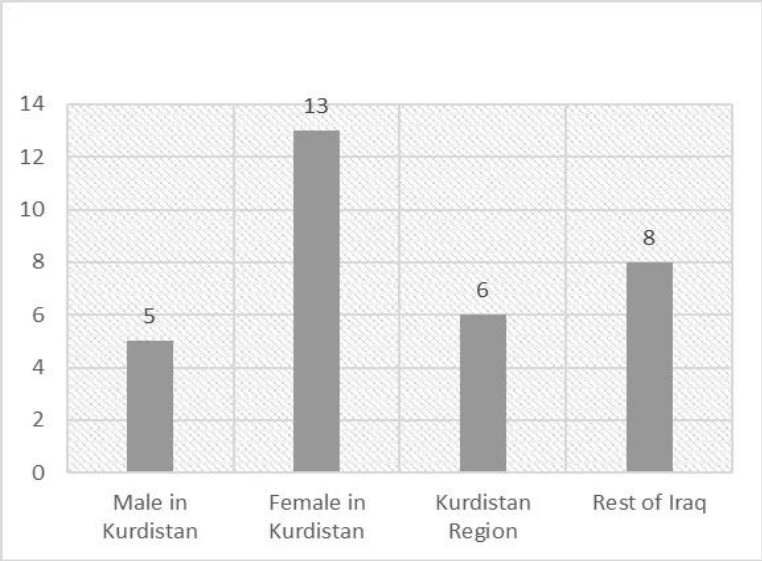

Figure 1. Percentage of Labor force Unemployment in Kurdistan Region and Rest of Iraq.

1.1 Productivity

Productivity has different definitions regarding the different areas, and usually, all have the same meaning in the result. It can have different meanings to different people. Productivity, mathematically speaking is a ratio of outputs over inputs. Output means the quantity of the product used and input means different or various resources used in that production. In construction, productivity is related to labor, which is a unit of work produced over a man-hour. Hence, productivity is the ratio of output to all of the resources used to produce that input which can be heterogeneous or homogenous. Resources comprise (raw material, labor, energy, capital, etc.) **(Attar, 2012)**.

$$Productivity = \frac{output}{input} \quad (1)$$

Construction projects are mostly labor-based with equipment and basic hand tools, as labor comprises 30% to 50% of overall project costs (Agrawal, 2016). Therefore, while numerous construction labor productivity research studies have been undertaken, only a few have addressed the productivity problems in developing countries. Productivity in economics refers to the measure of output from the production process per unit input. Productivity may be conceived of as a measure of production's technical or engineering efficiency.

Horner and Talhouni stated a popular concept in the USA, and increasingly in the UK, which is the concept of earned hours. It depends on the establishment of a set of standards outputs for each unit operation, concluded that a number of the establishments of earned hours are associated with each unit of complete work **(Attar, 2012).**

Productivity can be a good indicator of the efficiency of any input. As, if a firm has good productivity which means it produces more output with a given amount of input which means that it is utilizing the resources and time as well. Productivity is a good comparative or indicator tool for companies, managers, engineers, politicians, economics, …etc., which compares production at a different level.

For many years, the International Labor Organization (ILO) has promoted an advanced view of productivity, which refers to the efficiency and effectiveness of all resources, material, energy, capital, land, time, and information, in addition to labor. In promoting such a view, one must combat some common misunderstandings about productivity **(Prokopenko, 1987)**;

- First, productivity is not labor efficiency only (or labor productivity), although labor productivity statistics are still useful policy-making data.
- The second misunderstanding is that it is possible to judge performance by output. The letter may increase without any rise in productivity. For example, changing the output compared with previous years should be considered if input costs increase irregularly. Such a process is often the result of being process-oriented at the expense of paying attention to the final result. This is widely used in all bureaucratic systems.
- The third misunderstanding is the confusion between profitability and productivity. For instance, in real life profit may be obtained from price recovery even through productivity is heading downward. In other words, productivity does not go with high profit always, even if it is efficiently produced since it's not necessarily in demand.
- The fourth misunderstanding is the confusion about the efficiency. By definition efficiency, it's producing high-quality goods in the shortest possible time.
- The fifth misunderstanding or mistake is that some believe that decreasing the cost will improve productivity, which may make it worse **(Prokopenko, 1987).**

Productivity has different definitions, as mentioned above. Last but not least, productivity is complex and it is not only a managerial, technical or financial issue. It is a matter of concern to the government sector and bodies, trade organization unions, and other organizations and social institutions. Although, the definition of productivity can be different base on their goals. However, if let's say all the social groups agreed on a common goal more or less, then the definition can be unique for them and for the institution in that region or country. Hence, the main indicator of improving productivity is decreasing the ratio of input to output at improved quality. Overall, productivity can be considered, as a comprehensive measure of how sectors or organizations are satisfying the following;

- Objective
- Comparability
- Effectiveness
- Efficiency

1.2 The Important Role of Productivity

The role of productivity in increasing national prosperity is well known nowadays universally. No activity does not get benefit from improved or increased productivity. Physical productivity is the

quantity of output produced by one unit of input within one unit of time. An increase in physical productivity directly affects labor's value, which raises wages. Moreover, that's why employers look for education and training to increase knowledge and experience which makes the human capital more productive **(Dozzi & S. M., 1993).**

1.3 Problem Discussion

Iraqi construction has faced many challenges, and one of the major challenges is labor productivity (Al-Rubaye & Mahjoob, 2020). North of Iraq, Kurdistan is as well can't be away from that lack of productivity. The lack of productivity in this region has made planning and estimating site activities unpredictable. At the macro level, the building industry is considered to be one of the keys to the general economy. The construction industry or sector typically comprises 8-10% of the Gross Domestic Profit (GDP) of a western economy **(McGeorge & Zou, 2012)**.

Facts about construction productivity **(Gundecha, 2012)***;*

- ✓ Friday has been proven to be the least productive day.
- ✓ Tuesday is the most productive day of the week studied.
- ✓ The least productive time frame for labor is right before the finishing time.
- ✓ 10 a.m. is proved as the most productive time of the day.
- ✓ Labor is approximately capable of lifting about 94 pounds (42.5 kg) on his own.
- ✓ If the laborer is engaged in performing the same task repeatedly, there is a chance of low productivity after 1 hour of performing the same task.

1.4 Aim and Objective of the Study

In the construction industry productivity loss is a severe problem. The initial aim and objective of this study are to confirm that the Kurdistan labor productivity issue in construction projects exists and to determine the current level of productivity in the construction sector **(Fischer, 2009)**. Through an online questionnaire survey, the issue is introduced to the people working in this industry (Contractors, Engineers, and Consultant) and they were asked to assign a weight to each of the factors mentioned in the survey. The next aim is to acquire the weight of importance for each factor. Once these weights are established, a future study will further break down each factor into its components by measuring the RII. Furthermore, this study will widen the Kurdish research library about productivity in construction to help future studies about the same topic. Moreover, to find which of the factors are more affectable and which ones can be ignored. Finally, this study can be used to improve labor productivity in the Kurdish construction industry and the knowledge can be used to improve the current state of productivity in developing countries like Iraqi Kurdistan. Understanding and conducting the productivity level in the Kurdish construction sector will allow not only better productivity but also a better working environment for all the parties working in this sector. Keep in mind that this study is not intended to serve as a remedy for all problems that take place in the construction sector but as a necessary tool for success.
The main objectives are:

- To identify a list of factors affecting labor productivity within the construction industry today.
- To give weight to the factors affecting productivity on a construction based on the RII method.

- To study and discuss the factors affecting labor productivity in construction.
- To analyze and calculate the RII of these factors.
- To analyze the Kurdish productivity level in the construction industry.

1.5 Scope of the study

The coverage of this study is to define the factors affecting labor productivity in Kurdistan of Iraq, and determine the effect level for each factor based on people who work in the construction sector, especially site or project engineers, contractors, and designers. By using the Likert scale experts can rate the effect level and then by using MS Excel the mean and RII level will be determined. Furthermore, samples from different cities in Kurdistan were taken to be more precise. Finally, by the result of this study, experts can understand the causes and the factors behind the low productivity in the Kurdistan region.

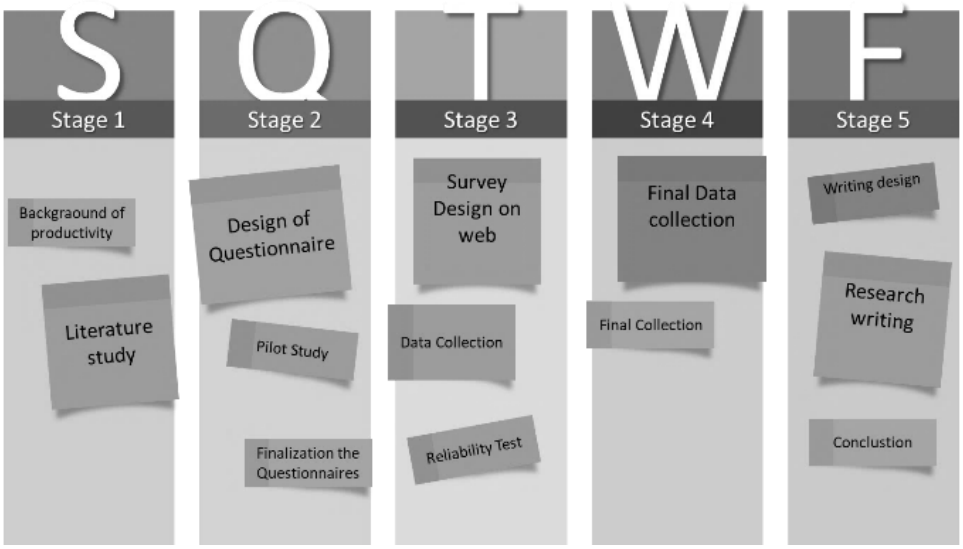

Figure 2. Research Structure.

2. RESEARCH DESIGN AND METHODOLOGY

2.1 Literature Study

A deep study of literature has been conducted to understand the factors that affect construction labor productivity, and some of the factors based on the relation between the countries have been chosen to be tested in the Kurdish construction industry. According to different researches from different countries, each location can be affected by different factors concerning time. **Table.1** shows the summary of the literature review base on different locations and times. It must be notice that most of the 1st ranked factors are different according to the time and location but generally are different in effect level which changes from time and location effect.

Table 1. Summary of Literature Review.

No.	Authors	Location	Total Number of Factors	1st Ranking Factor	Method
1	**(Gundecha, 2012)**	Fargo, North Dakota	40	Lack of required construction material	RII
2	**Kuykendall (2007)**	US	12	Management skills	Delphi Method
3	**Hassan (2013)**	Malaysia	6	Project management skill	Descriptive Statistics (Mean value)
4	**(Soekiman, 2011)**	Indonesia	113	Lag of material	RII
5	**(Attar, 2012)**	Sangli, Kolhapur, and Pune districts	-	Lack of material	-
6	**(Ameh and Osegbo, 2011)**	**Lagos, Nigeria**	32	Inadequate funds for the project & Use of wrong construction method	Descriptive & Inferential Statistics (Mean)
7	**(Khaleel and Nassar, 2018)**	**Iraq**	42	Availability of material	RII
8	**(VTam, 2018)**	**Vietnam**	43	Experiences of worker	RII
9	**(Alaghbari, 2017)**	**Yemen**	52	Labour's experience and skill	RII
10	**(Rao and Sreenivasan, 2015)**	**Bangalore, Karnataka (India)**	61	Poor work planning & scheduling	RII
11	**(Hickson and Ellis, 2014)**	**Trinidad & Tobago**	42	The lack of labour supervision	RII
12	**(Enshassi, 2007)**	**Gaza Strip**	45	Material shortage	RII
13	**(Gerges, 2016)**	**Egypt**	41	Tools & equipment shortage	RII
14	**(Ghate, 2016)**	**Mumbai, India**	24	Skilled labour	RII
15	**(Al-Rubaye and Mahjoob 2020)**	**Iraq**	110	Poor management of the site, and lack of communication and structure	Delphi Method
16	**(Hafez, 2014)**	**Egypt**	27	Payment delay	RII

17	**(El-Gohary, 2013)**	**Egypt**	30	Labour experience and skills	RII
18	**(Henry, et al., 2007)**	**Uganda**	36	Incompetent supervisors	RII
19	**(Makulsawatudom and Emsley, 2001)**	**Thailand**	23	Lack of Material	RII
20	**(Rahmman and Memon 2019)**	**Pakistan**	33	Misuse of time schedule	Weighted average (WA)
21	**(Dakhil, 2017)**	**Basra, Iraq**	59	Corruption	RII
22	**(Mohammed and Jasim 2017)**	**Iraq**	45	Lack of financial capacity of the contractor during the exexution	Internal consistency (Cronbach's alpha)
24	**(Stifi and Ponz-Tienda 2014)**	**Spain**	35	Shortage or late supply of materials	RII
25	**(Karukh Hassan, et. al., 2021)**	**Iraq**		Assesment of the cost and Time impact of variation orders on construction projects in Sulaimani governorate	descriptive statistics & one way ANOVA

2.2 Pilot Study

To ensure the validity of the questionnaire in the Kurdistan region and improve it, a pilot study has been conducted and checked by experts who had experience in the construction field in Kurdistan. At first 90 factors were chosen to be analyzed and later 76 were chosen to be tested in the Kurdistan region base on the pilot study. Although, the expert's opinion was taken to design the form of the questionnaire for the web survey in order to be in better form.

Table 2. Overall Factors

No.	Factors
G1	Management Factors
Q1	Site Complication
Q2	Lack of Construction managers Leadership
Q3	Communication between Site Management and Labor
Q4	Sequence of Work
Q5	Late Payment from Client to Contractor
Q6	Labor Interference
Q7	Provides all drawing details during works
Q8	Choose an adequate staff and site supervision efficiency
Q9	Services provided in site (water, electricity, WC, ...etc.)

Q10	Nature of work management (Individual or companies or government)
Q11	Contracting system to work (Daily wage, lump sum, unit price, …etc.)
Q12	Design changes
Q13	Working in confined spaces
Q14	management to organize site activities
Q15	Lack of Training Sessions
Q16	Project budget
G2	Technical & Technology Factors
Q17	Clarification in Technical Specification
Q18	Extents of Variation
Q19	Delay in Responding to Request for Information
Q20	Design Complexity Level
Q21	Project size(volume)
Q22	Project size(area)
Q23	Type of structure (concrete, steel, load bearing walls, ... etc.)
Q24	The accuracy and the level of project specifications
Q25	Building technique and technology (traditional, advanced, panelized, … etc.)
Q26	equipment required for work on the project (heavy, simple or hi-tech equipment)
G3	Human & Workforce
Q27	Number of Working Groups
Q28	Absence from work (Labors)
Q29	Disloyalty
Q30	Lack of Competition
Q31	Laborer's experience and skill
Q32	Physical fatigue
Q33	Communication problems between labor and supervisor
Q34	Late arrival
Q35	Early quit
Q36	Strength and physical structure of laborers
Q37	Laborer's age
Q38	Laborer's education level
Q39	Arguments between workers
Q40	Personal/family problems
G4	Leadership Factors
Q41	Lack of supervision leadership Incapability of contractor's site
Q42	Misunderstanding Among Workforce
Q43	Lack of Periodic Meeting with Workforce
Q44	Labor Supervision
Q45	Rework
Q46	Supervisors Absenteeism
Q47	Inspection delay
Q48	Personal/family problems
G5	Motivation Factors
Q49	Payment delay
Q50	Give laborers some incentives and rewards
Q51	Wages level for labors
G6	Safety Factors
Q52	Working at High Place
Q53	Accidents
Q54	Unemployment of Safety officer at Construction Site
Q55	Violation of Safety Precautions
G7	Time Factors
Q56	Misuse of Time Schedule
Q57	Working for 7 Days of The Week Without Holiday
Q58	Work overtime
Q59	Working hours
Q60	Daily hours of rest during work (1.30 hours)
Q61	unscheduled breaks
G8	Material & Equipment Factors

Q62	Availability of materials in the market
Q63	Material Shortage
Q64	Unsuitability of Materials Storage Location
Q65	Tool and Equipment Shortage
Q66	Inefficiency of Equipment
G9	External Factors
Q67	Weather
Q68	Corruption
Q69	Religious Occasions
Q70	Security
Q71	Impact of Neighboring Buildings
Q72	Availability of the labor in the market
Q73	Political and security situation
Q74	Economic condition in the country
Q75	Ease of delivery to the site (labor and materials)
Q76	Public holidays

2.3 Survey Design

Survey research is defined as a collection of different data by asking people questions **(Cosenza & Fowler, 2009).** A total of 76 factors were designed under 9 groups and designed using Google Forms. The form was sent to targeted people in the Kurdistan region. The basic rule of the questionnaire design is that it should be clear, simple, and understandable to everyone. The form was designed in two different languages (Kurdish and English) in order to be completely understandable for respondents in the Kurdistan region, where, the language of speaking is Kurdish. The form had four sections;

- the General Information Section: Which contains information about the topic and the purpose of the study.
- Respondent's Information Section: This section contains information about the respondent's background and profile.
- Group Factors Section: In this section, nine groups of factors are designed under each group the factors were designed in the form of questions, and respondents were asked to rate the factors.
- Respondent's Opinion Section: This section is designed to get the respondent's idea and comment about the study.

The main advantage of a web survey is that it provides all information on a large group of respondents with little effort and less time. Although, surveys allow the researchers to mitigate information obtained from a sample of people rather than the entire population. However, the main criteria that the survey was designed upon are;

- Factors with similar meanings should be removed or rearranged.
- Some factors should be rearranged to be understandable
- Some factors should be revised with additional information.
- The questionnaire should start with general information on the topic and profile of the respondents.
- Respondent's profile should be taken to ensure the accuracy of the survey.

A 5-point Likert scale is used to rate the factors by the respondents.

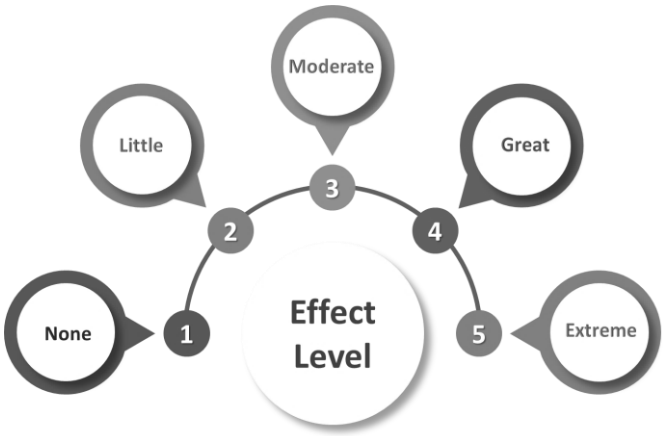

Figure 3. Likert Scale Range.

2.4 Method of Data Analysis

As the population of targeted people is unknown, so the sample size was calculated using Eq. (2) for a 95% of confidence level:

$$n = \frac{Z^2\, p(1-p)}{\varepsilon^2} \quad (2)$$

Where:

n= sample size
Z= critical value of the standard normal distribution for a 95% confidence interval around the true population which is 1.96.
p= expected proportion of the interest to be studied, which is 50%.
ε= sampling error or margin of error ME (10% were taken in this study).

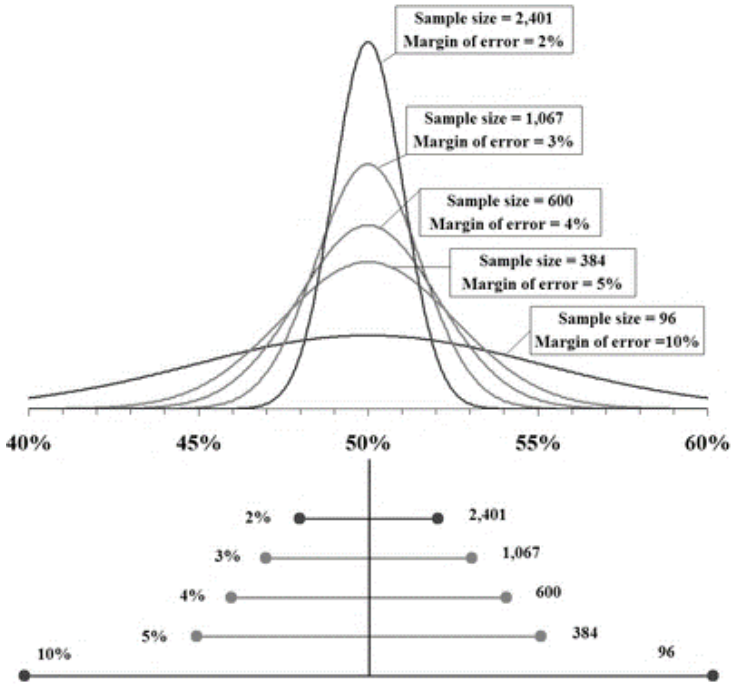

Figure 4. Margin of Error Graph.

To obtain a 95% confidence level with a 10% error from the real population, it was calculated to have 96 samples for each party (n=96).

2.5 Data Collection

In achieving the main objective of this study, accurate data collection is one of the most important phases. After the questionnaire was designed and distributed among experts, the next step was to collect the data. In addition, missing data happened since 214 people responded to the survey, but 202 were completed (**Table 3**).

Table 3: Statical Data of Questionnaire Survey.

	No.	Percentage of Total (%)
Total Questionnaire Sent	Unknown	-
Expected Questionnaire to be filled Total	288	100
Total Questionnaire Received	214	74
Invalid Data	12	4.16
Valid Data	202	70
Site or Project Engineer	77	80.2
Contractors	76	79.16
Consultants (Designers)	49	51

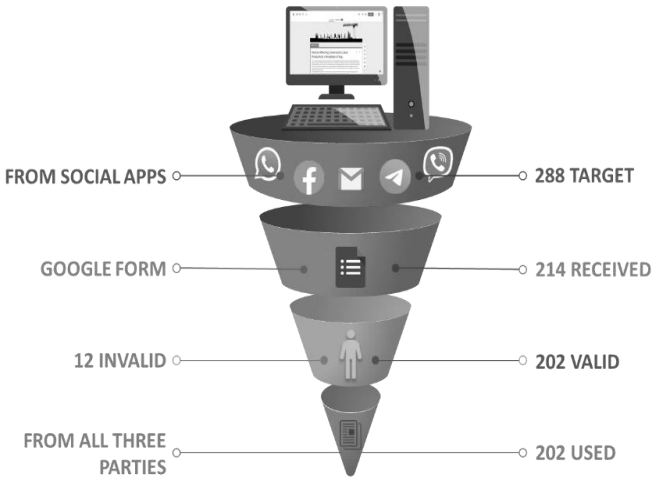

Figure 5. Form Distribution and Collection process.

2.6 Reliability Test

To test the result and be sure that the score actually represents the characteristic, this test was done after a period of time for a sample of the respondents. This test is extremely important to make sure that data works instead of assumptions. Although reliability refers to the consistency of the measure, it means that the measure would be re-applied to the same sample over a period of time and it will give the same result (Khaleel & Nassar, 2018). The value of consistency is between Zero and One, where the closer the value of Zero indicates the low reliability of the data and the opposite. In this study, Cronbach's alpha (α) coefficient was used Eq. (3):

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right) \quad (3)$$

Where:

k= Number of items or equations in a group.
V_i= The variance of score associated with each question (I).
V_t= Total variance of overall score (not %'s) on the entire test.

This test has been conducted twice; First, at the beginning of the data collection for 30 respondents by using MS *Excel*, the value was found to be (0.94907) which means that we are almost 95% sure that if we do this study over a period of time over and over again, we will get the same result.

2.7 Experience Level

Regarding the participant's experience level, one of the most influenced factors in achieving the main objectives is experience of participants. The average range of participants' experience was between 1 to 5 years which can be considered a weak point because it can be argued that they don't have enough experience to rank the factors and conclude the effect level. However, 5 to 10 years of experience is included in a good range of participants, which make this research a good combination

for different opinion based on experience level. Furthermore, 79.7% of participants replied by "*YES*" to a question which they were asked whether they participated in any project that had been delayed because of labor or not.

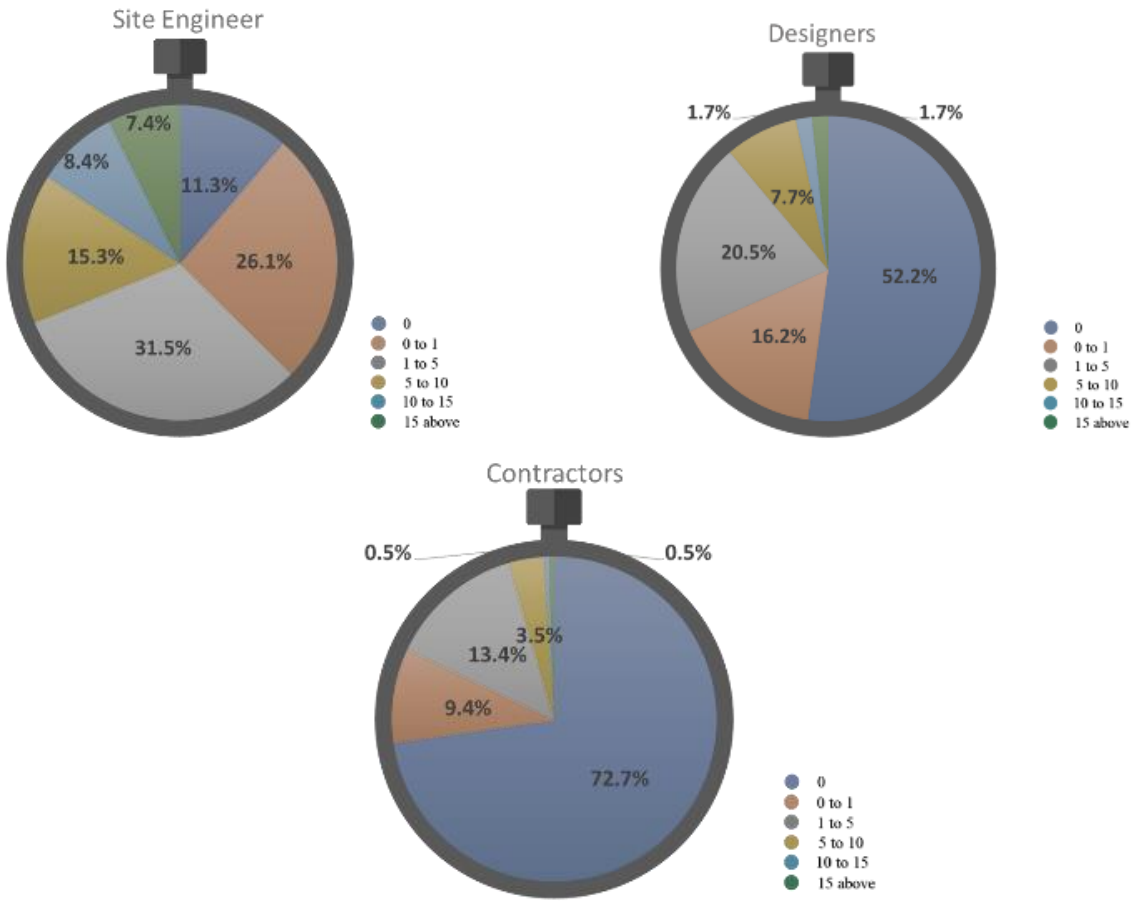

Figure 6. respondent's Experience level.

3. RESULT AND DISCUSSION

3.1 Respondents' Profile

In successfully achieving the main objective of this study, the respondent's profile is crucial and one of the most important factors in collecting accurate data. Data collection is a procedure of collecting important data records for a certain sample or population of observation (Bohmstedt & Knoke, 1994). Overall, 202 respondents successfully participated, and 80.1% were male while 19.9% were female. The age ranged from 20 to 65, and participants from all over Kurdistan participated in this study, **Fig. 7**.

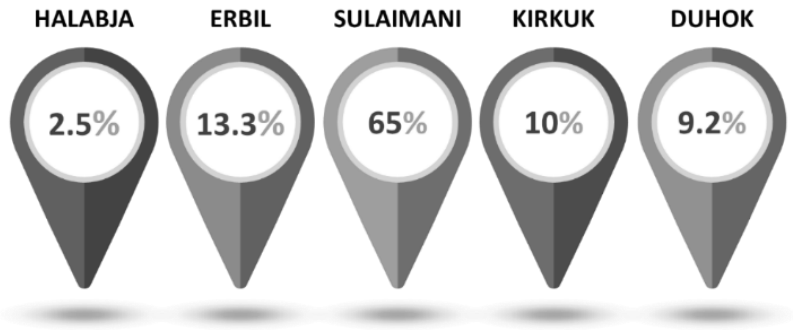

Figure 7. Respondent's Participation Percentage by Cities.

3.2 Research Findings and Results

The result for each group is mentioned below, and all the data with tables were concluded using MS *Excel 2015*.

Note:

Sum= summation of respondents.

Weighted Total= Summation of respondent's rank for each group.

3.2.1 Management Factors (G1)

Table 4. Management Factor Ranking.

Factors	SUM	Weighted Total	RII	Mean	rank
Q5	202	812	0.804	4.020	1
Q2	202	786	0.778	3.891	2
Q14	202	778	0.770	3.851	3
Q16	202	778	0.770	3.851	3
Q12	202	774	0.766	3.832	5
Q8	202	771	0.763	3.817	6
Q15	202	713	0.706	3.530	7
Q3	202	694	0.687	3.436	8
Q10	202	679	0.672	3.361	9
Q11	202	673	0.666	3.332	10
Q4	202	646	0.640	3.198	11
Q7	202	632	0.626	3.129	12
Q13	202	622	0.616	3.079	13
Q9	202	615	0.609	3.045	14
Q6	202	565	0.559	2.797	15
Q1	202	491	0.486	2.431	16

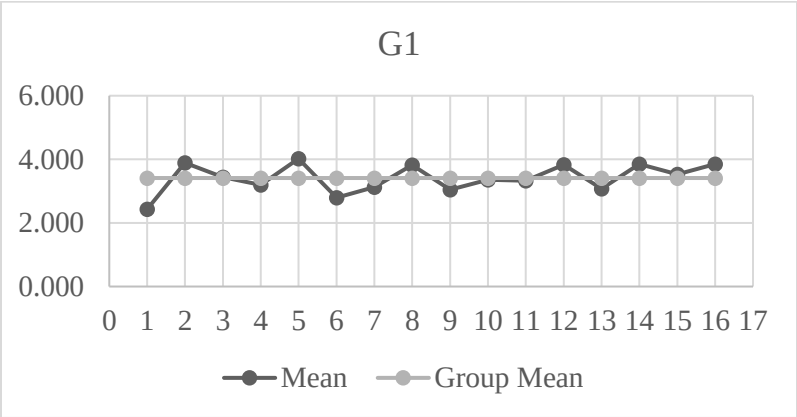

Figure 8. Scatter Chart for Factor's Mean with Average G1 Mean.

3.2.2 Technical and Technological Factors (G2)

Table 5. Technical and Technological Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q19	202	763	0.755	3.777	1
Q20	202	669	0.662	3.312	2
Q17	202	658	0.651	3.257	3
Q18	202	641	0.635	3.173	4
Q21	202	641	0.635	3.173	4
Q25	202	632	0.626	3.129	6
Q26	202	620	0.614	3.069	7
Q23	202	619	0.613	3.064	8
Q24	202	588	0.582	2.911	9
Q22	202	586	0.580	2.901	10

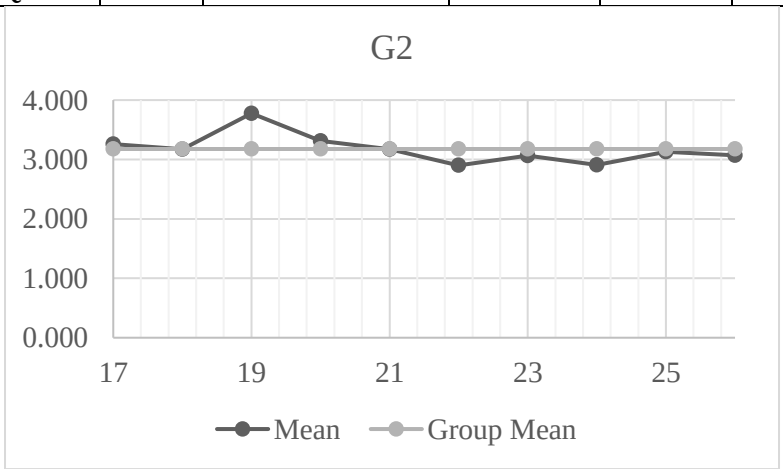

Figure 9. Scatter Chart for Factor's Mean with Average G2 Mean.

3.2.3 Human and Workforce Factors (G3)

Table 6. Human and Workforce Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q31	202	790	0.782	3.911	1
Q28	202	769	0.761	3.807	2
Q27	202	766	0.758	3.792	3
Q33	202	738	0.731	3.653	4
Q29	202	735	0.728	3.639	5
Q35	202	717	0.710	3.550	6
Q34	202	716	0.709	3.545	7
Q36	202	660	0.653	3.267	8
Q30	202	657	0.650	3.252	9
Q39	202	610	0.604	3.020	10
Q38	202	600	0.594	2.970	11
Q37	202	594	0.588	2.941	12
Q32	202	546	0.541	2.703	13
Q40	202	513	0.508	2.540	14

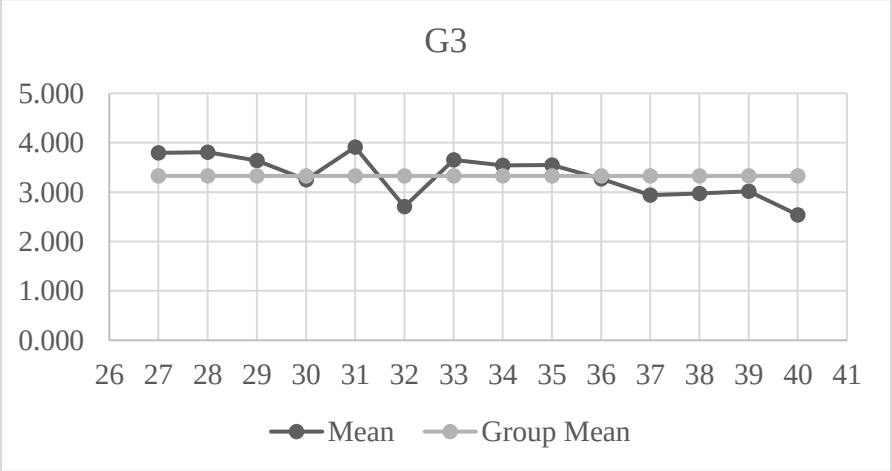

Figure 10. Scatter Chart for Factor's Mean with Average G3 Mean.

3.2.4 Leadership Factors (G4)

Table 7. Leadership Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q41	202	818	0.810	4.050	1
Q45	202	810	0.802	4.010	2
Q46	202	770	0.762	3.812	3
Q47	202	760	0.752	3.762	4
Q42	202	716	0.709	3.545	5
Q43	202	714	0.707	3.535	6
Q44	202	699	0.692	3.460	7
Q48	202	573	0.567	2.837	8

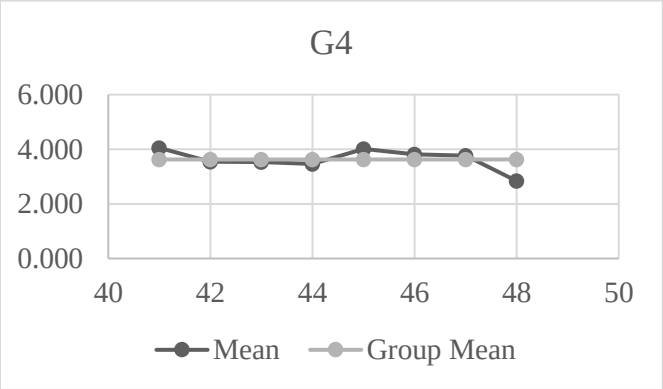

Figure 11. Scatter Chart for Factor's Mean with Average G4 Mean.

3.2.5 Motivation Factors (G5)

Table 8. Motivation Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q49	202	791	0.783	3.916	1
Q51	202	743	0.736	3.678	2
Q50	202	665	0.658	3.292	3

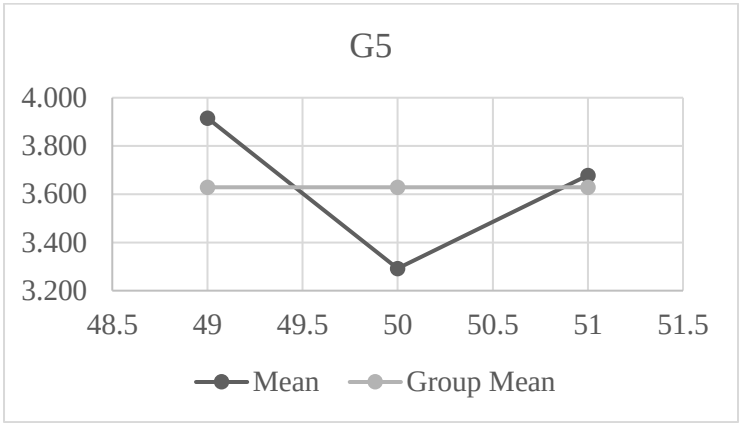

Figure 12. Scatter Chart for Factor's Mean with Average G5 Mean.

3.2.6 Safety Factors (G6)

Table 9. Safety Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q55	202	690	0.683	3.416	1
Q54	202	676	0.669	3.347	2
Q52	202	648	0.642	3.208	3
Q53	202	642	0.636	3.178	4

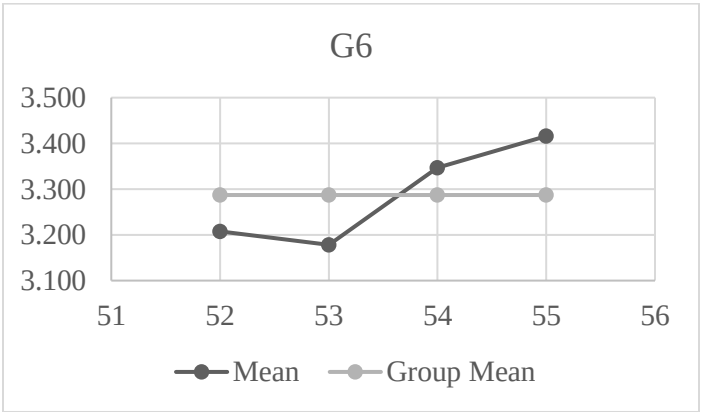

Figure 13. Scatter Chart for Factor's Mean with Average G6 Mean.

3.2.7 Time Factors (G7)

Table 10. Time Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q56	202	740	0.733	3.663	1
Q61	202	722	0.715	3.574	2
Q57	202	637	0.631	3.153	3
Q58	202	614	0.608	3.040	4
Q59	202	584	0.578	2.891	5
Q60	202	581	0.575	2.876	6

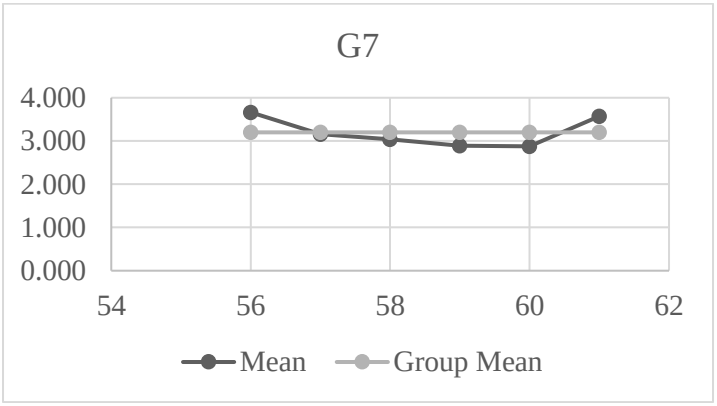

Figure 14. Scatter Chart for Factor's Mean with Average G7 Mean.

3.2.8 Material and Equipment Factors (G8)

Table 11. Material and Equipment Factors Ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q65	202	743	0.736	3.678	1
Q66	202	739	0.732	3.658	2
Q63	202	707	0.700	3.500	3
Q62	202	701	0.694	3.470	4
Q64	202	659	0.652	3.262	5

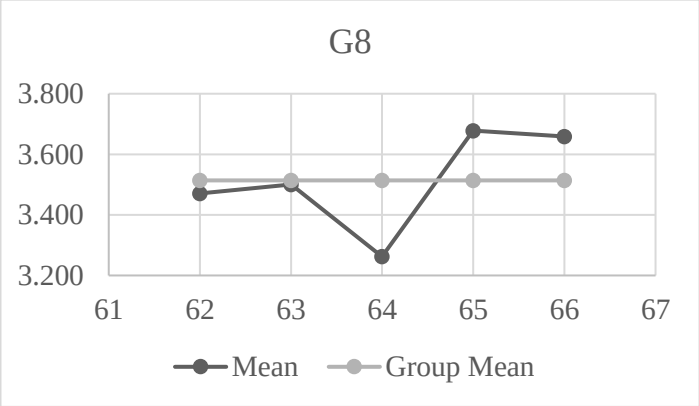

Figure 15. Scatter Chart for Factor's Mean with Average G8 Mean.

3.2.9 External Factors (G9)

Table 12. External factors ranking.

Factors	Sum	Weighted Total	RII	Mean	rank
Q74	202	879	0.870	4.351	1
Q68	202	846	0.838	4.188	2
Q73	202	803	0.795	3.975	3
Q67	202	782	0.774	3.871	4
Q70	202	696	0.689	3.446	5
Q75	202	689	0.682	3.411	6
Q72	202	656	0.650	3.248	7
Q71	202	655	0.649	3.243	8
Q69	202	590	0.584	2.921	9
Q76	202	552	0.547	2.733	10

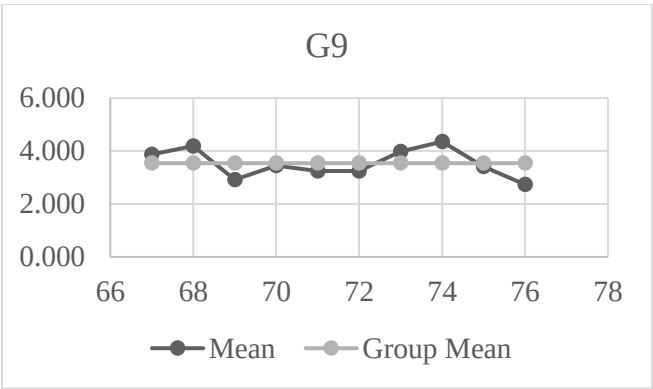

Figure 16. Scatter Chart for Factor's. Mean with Average G9 Mean.

3.3 Top 10 Ranked Factors

Based on 202 participants from all over Kurdistan, "Q74" which is "Economic condition in the country" ranked as the first effective factor which affects Kurdish labor productivity on construction with an RII of (0.870). In the last 10 years, in the Middle East generally and in Iraq specifically, the civil war was a major reason behind the fall of economics in the whole country. Although the Iraqi economy depends on Oil which was decreased in the last years. Therefore, the construction industry was as well affected by this condition. However, after defeating ISIS, corruption is now the main threat to Kurdistan's stability. Since Iraq is the 162 least corrupted nation out of 180 countries with an index of 20 points out of 100, according to the 2019 Corruption Perceptions Index by Transparency International (Corruption, 2019). Although, Kurdistan was part of Iraq, "Corruption" came in second place among effective factors with an RII of 0.838. Nevertheless, lack of supervision is the third factor that affects Kurdish construction.

Table 13. Top 10 Ranked Factors.

Code	Rank	Mean	RII	Group No.
Q74	1	4.351	0.870	G9
Q68	2	4.188	0.838	G9
Q41	3	4.050	0.810	G4
Q5	4	4.020	0.804	G1
Q45	5	4.010	0.802	G4
Q73	6	3.975	0.795	G9
Q49	7	3.916	0.783	G5
Q31	8	3.911	0.782	G3
Q2	9	3.891	0.778	G1
Q67	10	3.871	0.774	G9

4. GROUP RANKING

Figure.17 shows the group ranking base on their RII value, and shows that "G5" which is the "Motivation Factor" that comes at the first-place base on respondents ranking. On the other hand, "Technical & Technology Factors" comes at the last place, which is "G2" with an RII of "0.635" based on experts.

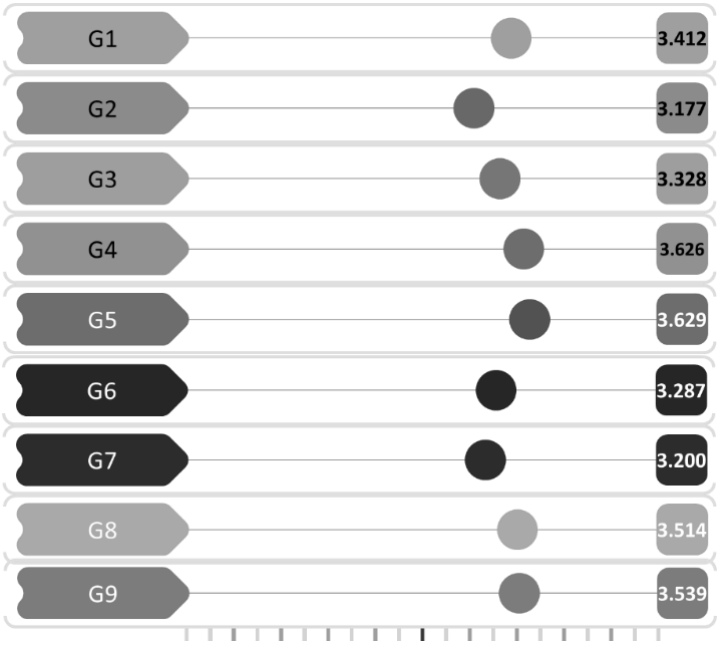

Figure 17. Group Ranking with RII Value.

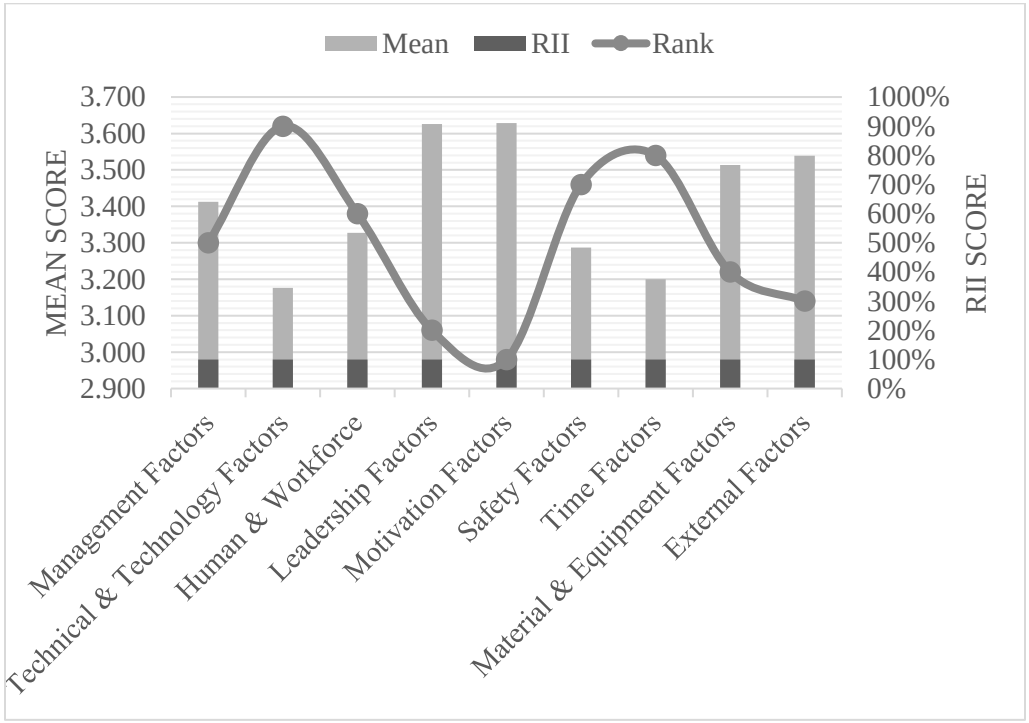

Figure 18. Graphical Illustration of all Group's Result.

5. CONCLUSIONS

In brief, in today's world, the construction industry is rated as one of the key industries for the economic sector in each country. Kurdistan region in the north of Iraq a developing region is not far from this key industry. Study and Knowledge of Construction productivity help in achieving the goals of society and the economy. Apart from these goals, knowledge of labor productivity in construction can save budget and time. However, this study was intended to identify factors affecting labor productivity in construction projects in Kurdistan of Iraq.

As it is mentioned, based on site engineers, contractors, and designers the study came to a conclusion. All over the region, seventy-six (76) factors were identified and grouped into nine (9) groups. Moreover, by using the relative importance index the factors were ranked according to 202 participants, and they were asked to give weight to each factor by using a Likert scale from 1 "No Impact" to 5 "Extreme Impact". MS *Excel 2015* was used to analyze the factors and rank them based on respondents' opinions.

In addition, "Economic condition in the country" was chosen to be the first ranking factor by the respondents with an RII of 0.80, which is one of the "External Group" factors and has a vital effect on the construction productivity in the Kurdistan region, due to ISIS war and as Kurdistan economics depends on oil and in the last years, oil price dropped to the lowest price so the economic condition of this region was at the lowest. Unlike the "Site complication" which was the least effective factor according to site engineers, contractors, and designers that affects labor productivity on construction with RII of 0.486. Furthermore, as people are used to site complications and do not consider the surrounding on-site, so this factor holds the last position rank. The second-ranked factor which affects productivity is "Corruption". After the defeat of ISIS, corruption is now the main threat to Kurdish construction stability. Since Iraq is placed 162 out of 180 on the list of corrupted countries with an index of 20 points out of 100. according to the 2019 Corruption Perception Index reported by Transparency International) (A., 2019). Although, Kurdistan is north of Iraq and is a region of this country and as a part of this corruption had a major impact on all sectors, especially the construction sector. The factors that follow the economic condition and corruption are as follows; lack of supervision leadership incapability of contractors, late payment from the client to contractors, rework, political and security situations, payment delay, labor experience and skill, lack of construction managers' leadership, and weather.

Despite the factors, each group holds some factor and each group has been ranked based on the total mean in each group. Therefore, "Motivation Group" was the first ranked group based on respondent's opinions with an RII of 0.726", while "Technical & Technology Group" factors were the last ranked group with an RII of 0.635. Apart from factors, respondents chose "Site or project Engineers" to be the most effective party on construction projects in Kurdistan region.

Since this research is based on: site engineers, contractors, and designers, so the opinion of each group has been considered and analyzed as well. however, all three groups believe that "Site or project engineers" have the most significant effect on productivity in construction and they can make difference in productivity level.

Finally, in the past few years because of the situation in the Middle East and Iraq especially the productivity level is low and not at a good level base on this survey which contains the expert's opinions on who works on construction projects. Kurdistan as a part of Iraq is not away from the conflicts and wars which faced Iraq, therefore Kurdish construction industry is facing vital difficulties toward productivity and needs action to increase productivity. This research can be used to upgrade the productivity level in Kurdistan (north of Iraq) and to upgrade the labor performance on the construction site. Below is the Ishikawa diagram for labor productivity in Kurdistan.

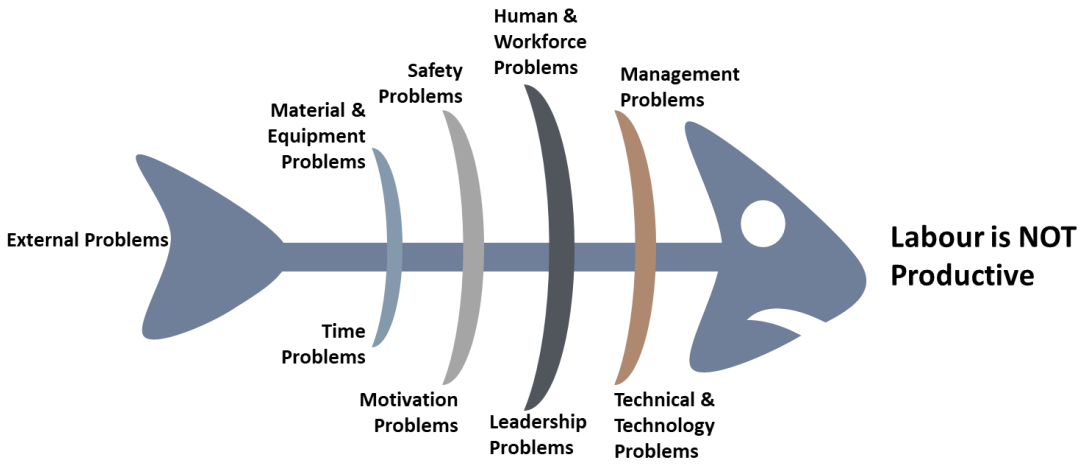

Figure 19. Ishikawa Diagram for labor productivity effect.

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