Severity of Causative Factors to Construction Waste Generation: Iraq Construction Industry

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Abstract

Objectives: Construction and Demolition (C and D) wastes affect negatively to environment and economic of Iraq. This paper presents the severity of 78 identified factors contributing to C and D waste generation in Iraqi construction industries.

Methods/Statistical Analysis: The structured questionnaire survey amongst contractors, consultants and clients was conducted and a total of 208 valid response data was collected for the analysis purpose. Descriptive analysis employing average score index was used for collected data.

Findings: The results indicate severity of each factor toward the C and D waste generation and also the severity ranking. It was found that poor site management, lack of experience, rework, design errors and lack of environmental awareness are ranked as five most sever factors to C and D waste generation in Iraqi construction industry.

Application/Improvements: Benefit from this study will be shared amongst researchers and also construction community to ensure the minimization of the (C and D) waste generation in Iraq.

Keywords: Construction and Demolition Waste, Construction Waste Causes, Factors Contributing C and D, Iraqi Construction Industries Causing C and D, Ranking and Severity of C and D Waste

1. Introduction

Construction industries play a significant part for improving socio-economic condition of any country. The impact on economic, the advantages of investment and assistances to employment are extremely tremendous in construction industries. The construction industries predict the overall direction of an economy and by this mean, it often designated as a prominent economic sector. Construction industry has a dynamic capacity in most developing countries and for this reason; it is among the most prosperous sectors in the globe and remains so with the continuation of the development of any country.

Undeniably, the advancement in the living standard, the congenital population growth and modifications in consumption behaviors cause to escalation of construction activities and led to progression to the Construction Waste (CW) and such witnessed considerably during last two decades. Currently, construction industry is confronting numerous hindrances and issues related with unbelievable generation of CW amount. The quantification of such CW generation through numerous construction activities is being the foremost need of most environmental organizations. However, still developed and developing countries generate tons of CW through
In developing countries, disposing off C and D wastes to landfills without recycling remains the commonplace treatment method. Because of the inadequate landfill spaces; harmful gas emissions and building demolition wastes, water pollution, energy consumption has grown into a major problem for sustainable urban development. All such evidences are alarming the urgency of reducing and or recycling C and D wastes so as to relief the landfills pressure and to provide better options for the waste diversion.

| Country          | Quantity            | Reference                                  |
|------------------|---------------------|--------------------------------------------|
| U.S.A            | 584 million ton/year| EPA, (2018)                                |
| European Union   | 2 billion ton/year  | Defra, (2007)                              |
| Honk Kong        | 1,152,670 ton/year  | EPA, (2008)                                |
| UAE (Dubai’s)    | 27.7 million tons/year| Al-Hajj, (2011)                           |
| Malaysia         | 9,344,000 ton/year  | Zulhabri et al. (2016)                     |
| India            | 14.7 million ton/year| Gupta, (2018)                             |
| Iraq             | 11,235,478 ton/year | Central organization statistics of Iraq,(2016) |
| Thailand         | 1.1 million ton/year| Kofoworola and Gheewala, (2009)           |
| Brazil           | 68.5 million ton/year| John et al., (2004)                       |
| U K              | 70 million ton/year | Tam et al., (2018)                        |
| China            | 2 Billion ton/year  | Wang, et al., (2019)                      |
| Bulgaria         | 44 million ton/year | Coelho et al., (2013)                     |
| Czech Republic   | 24 million ton/year | Husnain et al., (2017)                    |
| Denmark          | 14 million ton/year | Kozlovská et al., (2013)                  |
| Germany          | 364 million ton/year| Akhar et al., (2011a)                     |
| Estonia          | 19 million ton/year | Low et al., (2014)                        |
| Ireland          | 20 million ton/year | Coelho et al., (2013)                     |
| Greece           | 69 million ton/year | Kofoworola et al., (2016)                 |
| Spain            | 138 million ton/year| Kozlovská et al., (2013)                  |
| Austria          | 35 million ton/year | Kozlovská et al., (2013)                  |
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2. Construction Waste Causative Factors Group

The rapid growth in construction activities during the last few decades has brought huge amount of waste generation world widely. Most of such waste is not recycled nor reused but subsequently transferred to landfills, consequently exerts massive pressure on the landfill depletion and harms adversely our surroundings and the environment. Improper and illegal CW dumping depends on many factors during the construction activities. In categorized such factors into four groups: design; procurement; handling of materials; and operation. In stated that CW generation is not just a technical problem, but a behavioristic one also. In also supported this statement and there are many factors for contributing the Construction Waste.

As categorized these factors under four categories like “design”, “procurement”, “handling of materials” and “operation”. While the fifth major factor “workers” added by. In supported the researchers’ findings on the sources of waste generation, and added “site condition” and “external factors” as two more categories. While others increase the sources of waste to 10 as shows in Table 3, proposed groups of factors by previous researchers.

Table 3 presents several groups effects of Construction Waste generation found by previous research which carried out in different countries.

| No. of groups | Reference | Name of classified groups |
|---------------|-----------|---------------------------|
| 4             | Lingard et al., (2010); Ekanayake and Ofori (2000); Polat and Ballard (2004); Mostafa et al., (2017) | Procurement, Culture, Handling and Operation |
| 5             | Teo, et al., (2001); Urio & Brent (2006); Adnan (2012) | Design, Procurement, Operation, Handling and Site Operation |
| 6             | Bossink and Brouwers (1996); Alwi et al. (2002a); Nazech et al. (2008); Guerrero et al. (2012); Husnain et al., (2017) | Management, Design, Procurement, Operation, Handling, Others |
| 7             | Nagapan et al., (2012); Akter et al. (2011a); Ismail et al., (2015); Polata et al., (2017) | Design, Management, Site Condition, Handling, Procurement, Workers and External Factor |
| 8             | Ilhaq (2010) | Design; Contractual; Transportation, Procurement; Material storage; Site Operation; Material Handling; Planning; Onsite management and Others |
| 10            | Osmani et al. (2008); Shant et al., (2014); Gupta et al., (2018) | Design, Contractual, Transportation, Procurement, On-Site, Storage Of Material, Management And Planning, Handling, Residual, Site Operation, Other Factors |
3. Construction Waste in Iraq

In Iraq, after (2003), the cost of wasting the construction materials have already crossed the allowable limits as standardized by the Iraqi Ministry of Construction and Housing (MOCH), and is increasing expeditiously. For that reason, it is mandatory to take steps for reducing such kind of cost and need to encourage the professionals to

Table 3. C and D waste generated for 2015, 2016 and 2017, in Iraq

| City          | No. of Municipal | 2015         | 2016         | 2017         |
|---------------|------------------|--------------|--------------|--------------|
|               |                  | C and D waste (ton / year) | Total waste (ton / year) | C and D waste (ton / day) | Total waste (ton / day) |
| Baghdad [centre] | 15               | 583,890.5    | 4,118,259    | 3,500.8      | 3,838,237.4      | 59,766.4      | 2,522,159.9 |
| Baghdad [outskirt] | 16               | 15,001.5     | 321,273      | 95,201       | 634,245         | 117,424       | 680,777      |
| Karbala       | 7                | 214,255      | 563,633      | 436,950.4    | 867,130.8       | 331,769.6     | 794,741.4    |
| Babil         | 16               | 73,182.5     | 347,298      | 356,308.2    | 785,437.2       | 186,884.8     | 575,874.8    |
| Salah al-din  | 18               | 22,520.5     | 269,480      | 462,321      | 825,806         | 823,911.5     | 1,556,554    |
| Maysan        | 15               | 126,472.5    | 645,284      | 93,568       | 430,123         | 46,364        | 401,919      |
| Muthanna      | 12               | 184,982      | 348,977      | 179,220.8    | 357,869.8       | 60,435.2      | 219,077.2    |
| Wasit         | 17               | 61,320       | 364,015      | 232,194      | 606,506         | 219,078       | 539,544      |
| Qadisiyah     | 15               | 134,247      | 452,345      | 167,080      | 579,244         | 236,712       | 554,659      |
| Diyala        | 22               | 26,243.5     | 354,306      | 85,128       | 409,928         | 74,223.2      | 440,158.2    |
| Anbar         | -NA-             | -NA-         | -NA-         | -NA-         | 2,073,483       | 2,954,364     |
| Kirkuk        | 7                | 7,482.5      | 377,155      | 99,297.6     | 385,298.67      | 86,412.8      | 384,420.8    |
| Dhi Qar       | 20               | 6,0663       | 226,997      | 80,924.8     | 620,201.8       | 95,707        | 701,822.5    |
| Najaf         | 9                | 285,101.5    | 902,098      | 341,587.7    | 895,451.2       | 490,947       | 1,168,301    |
| Ninewa        | -NA-             | -NA-         | -NA-         | -NA-         | 3,210,299.4     | 3,899,283.8   |
| Basrah        | 15               | 433,547      | 1,647,647    | 2,120,484    | 3,310,214       | 2,249,905.6   | 3,276,539.6  |
develop the significant CW management system at project sites on expeditious basis and moreover to analyze the influencing factors that contribute to cause the CW. Thus, to overcome this problem, proper steps must be taken and introducing the effective waste management practices. In conclusion, effective waste management implementation will guarantee the construction material flow in a closed loop so as to minimize the CW generation, decrease the need for landfills demanded and more than that will preserve natural resources but prior to those, the causes of waste generation are compulsory to find.

Iraq is a developing country and currently facing problem with the CW which has brought many illegal dumping sites but at the same time, many organizations are working to finding out the source causes of CW and the effective practices for relieving from such problems. Table 2 illustrates the volume of (C and D) waste and total waste for Iraqi governorates for the last three years.

Table 3 indicates that Iraq construction industry also producing huge amounts of (C and D) waste generation. Figure 1 shows the percentage of the resulting of (C and D) waste generation to total (C and D) waste generation for Iraqi cities except Anbar and Ninawa.

Figure 4 illustrates the percentage of C and D waste compared to total waste of each city in Iraq for 2015, 2016 and 2017, respectively.

4. Data Collection

This study was carried out in three phases: In the first phase, identified 78 important factors affecting Construction Waste generation through literature review and designed questionnaire survey. In the second phase, a pilot study was carried out to identify the factors effecting Construction Waste generation. The third phase, actual study was carried out to calculate the mean score and the ranking of factors by importance. Also analyses the current views of the participants in the construction
industry in Iraq on the generation of Construction Waste.

The structured questionnaire contains mainly two parts: The demographic data sample of the participated respondents and identifies the 61 factors that mainly contributed to the C and D waste generation. All such factors had been categorized into 7 groups. The study involved 38 experts selected from contractors, consultants and clients who are experienced in handling construction projects in Iraq. The participants were invited to give correct rating as per the Likert scale: 1–5 points (from the lowest to highest level) for each factor to check the relative importance for considering in CW generation.

4.1 Respondents Demography

Actual survey involved bigger samples to give better representation of construction practitioners in deciding the outcome of this survey. The actual survey was accomplishing to define the ranking based on mean score value of the causative and effective factors. In the meantime, the survey was conducted using the developed questionnaire based on the findings from pilot survey. Questionnaire sets were distributed among construction practitioner randomly selected in Iraq.

Two hundred twenty (220) sets of questionnaire were circulated for the collection of data, a total 208 completed questionnaire sets were received back within a time period of 3 months with respond rate of 95%. The respond rate is acceptable as it is around 20-30% response rate is considered as normal in construction research.\(^\text{41,42}\)

Table 4 shows the summary of statistics for collected samples.

In Table 5, it can be seen that most of the questionnaires were collected through in person/site visit. The percentage of questionnaires received from the respondents through in person/site visit is 140 out of the 140 questionnaires received with percentage 100%.

4.2 Organization

Respondents involved in the survey were engaged in different types of organization. The results of respondents based on the type of organization are presented in Figure 2.

From the Figure 2, it is obvious to see that the majority of respondents are working as a contractor: 133 experts with 63.94%, followed by consultants as 61 experts with 29.28% and clients/developer were 14 experts with 6.73%. Since majority of the respondents are from the contractor side, then the input from them are meaningful for this survey as they are the one that spend most of the time at the construction site.

4.3 Knowledge and Experience

Respondents involved in the survey have immense practice in managing several kinds of projects in Iraq. The details of projects handled by the respondents are summarizing in Figure 3.

According to Figure 3, 208 of respondents have experience more than 10 years in managing infrastructure projects. Most of the respondents have experience more
than 15 years’ practice in construction industry projects and only 4 of respondents are involved in construction industry have more than 35 years.

4.4 Qualification

For expert's academic background, most of them have the qualification of university degree; some even have master and PHD degree as presented in Figure 4.
Respondents’ knowledge was measured based on their academic qualification and working experience in the construction industry. Academic qualification and working experience are an essential point and plays important role in understanding any problems at sites. The respondents’ knowledge is considered in this questionnaire as to ensure that they have the ability to understand and answer the questionnaire swiftly.

5. Ranking of Causative Factors

The overall data gathered from 208 respondents for significance level of 61 factors causing Construction Waste Generation are summarized and ranked in Table 5.

Table 5. Results of reliability test

| No. | Groups             | Gronbach alpha | No. of items |
|-----|--------------------|----------------|--------------|
| 1   | Design (DESG)      | 0.980          | 11           |
| 2   | Handling (HAND)    | 0.993          | 7            |
| 3   | Workers (WORK)     | 0.993          | 10           |
| 4   | Management (MANA)  | 0.894          | 15           |
| 5   | Site Condition (SITE) | 0.919      | 4            |
| 6   | Procurement (PROC) | 0.991          | 8            |
| 7   | External (EXTE)    | 0.972          | 6            |
| 8   | Overall            | 0.985          | 61           |
Waste were analyzed statistically using frequency analysis and average index obtained through SPSS V 24 software package. Reliability analysis was used to check the consistency of the collected data. The indicator used for checking the consistency is Cronbach's alpha value. The Cronbach's alpha value consistency degree is varying from 0 and 1 and on the basis that the higher values represent a higher degree of internal consistency of the data\textsuperscript{23}. As per\textsuperscript{24}, the reliability is considered low if Cronbach alpha value is less than 0.3 and the data cannot be accepted, whereas, consistency of data will be high if the Cronbach alpha value is more than 0.7 and such will be acceptable. A total of 208 valid collected data from the actual survey were analyzed for its consistency using SPSS software to get the Cronbach's alpha values for each group of factor and the overall factors. All the generated value of Cronbach alpha is reorganized as in Table 5.

Table 5, shows the value of Cronbach alpha for each group of the factors. The values of Cronbach alpha are in the range of 0.894 to 0.993 for all groups while alpha value is 0.974 for overall data which is ≥ 0.70 as a cut-off

| Code      | Item names                          | Severity 5-points Likert Scale | AI | STD  | SI Rank |
|-----------|------------------------------------|--------------------------------|----|------|---------|
| GS1-1     | Design errors                      | 0 36 68 57 47                  | 3.55 | 1.02 | R1      |
| GS1-2     | Lack of design information         | 0 39 68 64 37                  | 3.48 | 1.00 | R2      |
| GS1-3     | Frequent design changes            | 0 36 80 50 42                  | 3.47 | 1.00 | R3      |
| GS1-4     | Inexperience designer              | 0 39 74 54 41                  | 3.47 | 1.01 | R4      |
| GS1-5     | Poor design quality                | 0 47 67 49 45                  | 3.44 | 1.07 | R5      |
| GS1-6     | Incomplete contract document       | 0 37 84 49 38                  | 3.42 | 0.98 | R6      |
| GS1-7     | Complicated design                 | 0 37 87 45 39                  | 3.41 | 1.00 | R7      |
| GS1-8     | Slow drawing distribution          | 0 39 89 40 40                  | 3.39 | 1.00 | R8      |
| GS1-9     | Last minute client requirements    | 0 36 90 47 35                  | 3.39 | 0.96 | R9      |
| GS1-10    | Error in contract documentation    | 0 37 92 43 36                  | 3.38 | 0.97 | R10     |
| GS1-11    | Interaction between various        | 0 41 96 41 30                  | 3.29 | 0.94 | R11     |

*Note: NS-Not Strong, LS- Less Strong, N- Neutral, S- Strong, VS-Very Strong.*
value\(^5\). Thus, the collected data is considered reliable to carry out further analysis.

The factors ranked based on average index value. The results of frequency for level of significance, average index and rank of severity for each causative factor of design categories are shown in Table 6a.

Table 6a, shows there are 11 factors in design group arranged based on the average index score of severity of each factor contribute to Construction Waste generation. Result from this table indicates that three severest factors are design errors, lack of design information and frequent design changes. This finding concur with the study conducted by\(^5\) where the most sever factors are design errors, lack of design information and frequent design changes.

**Table 6b. Rank of the of management group factors**

| Code   | Item names                        | Severity 5-points Likert Scale | AI  | STD | SI Rank |
|--------|-----------------------------------|--------------------------------|-----|-----|---------|
|        |                                   | 1    | 2   | 3    | 4    | 5    |       |
| GS2-5  | A poor site management            | 0    | 20  | 40   | 64   | 84   | 4.02  | 0.97 | R1    |
| GS2-2  | Rework                            | 0    | 20  | 61   | 60   | 67   | 3.84  | 0.99 | R2    |
| GS2-1  | Poor supervision                  | 0    | 20  | 67   | 61   | 60   | 3.77  | 1.03 | R3    |
| GS2-9  | Poor planning                     | 1    | 28  | 68   | 45   | 66   | 3.71  | 0.94 | R4    |
| GS2-3  | Lack of environmental awareness   | 0    | 31  | 71   | 51   | 55   | 3.63  | 0.99 | R5    |
| GS2-6  | Long project duration             | 0    | 26  | 98   | 47   | 37   | 3.46  | 0.93 | R6    |
| GS2-8  | Waiting periods                   | 0    | 31  | 86   | 62   | 29   | 3.43  | 0.92 | R7    |
| GS2-7  | Lack of knowledge about construction | 0   | 31  | 105  | 40   | 32   | 3.35  | 0.91 | R8    |
| GS2-11 | Poor information quality          | 5    | 33  | 91   | 45   | 34   | 3.34  | 1.07 | R9    |
| GS2-12 | Non availability of equipment     | 4    | 38  | 88   | 40   | 38   | 3.34  | 0.97 | R10   |
| GS2-4  | Poor controlling                  | 0    | 37  | 98   | 41   | 32   | 3.33  | 1.01 | R11   |
| GS2-10 | Inappropriate construction methods | 2   | 38  | 89   | 49   | 30   | 3.32  | 1.04 | R12   |
| GS2-14 | Resources problem                 | 1    | 43  | 93   | 42   | 29   | 3.26  | 0.98 | R13   |
| GS2-13 | Lack of waste management plans    | 4    | 39  | 96   | 38   | 31   | 3.25  | 0.96 | R14   |
| GS2-15 | Lack of influence of contractors  | 3    | 36  | 109  | 31   | 29   | 3.23  | 0.94 | R15   |
Management group involves the largest numbers of factors (15 factors), that contribute to C and D waste generation and the result of ranking is as shown in table 6b.

From Table 6b, it is found that the most significant factor is “Poor site management”, thence “Rework”. This finding is concurrent with the findings from other countries such as in Ghana, a similar study conducted

Table 6c. Rank of the of handling group factors

| Code   | Item names                        | Severity 5-points Likert Scale | AI    | STD | SI Rank |
|--------|-----------------------------------|--------------------------------|-------|-----|---------|
|        |                                   | 1  | 2  | 3  | 4  | 5  |             |           |       |
| Si3-5  | Wrong material storage            | 3  | 41 | 84 | 41 | 39 | 3.35 | 0.96 | R1    |
| Si3-6  | Poor material handling            | 6  | 35 | 82 | 53 | 32 | 3.34 | 0.95 | R2    |
| Si3-3  | Poor quality of materials         | 1  | 45 | 92 | 34 | 36 | 3.28 | 1.01 | R3    |
| Si3-1  | Damage during transportation       | 5  | 33 | 105| 37 | 28 | 3.24 | 1.02 | R4    |
| Si3-7  | Tools not suitable used           | 11 | 31 | 98 | 37 | 31 | 3.22 | 1.04 | R5    |
| Si3-4  | Delay during delivery             | 4  | 47 | 89 | 37 | 31 | 3.21 | 1.02 | R6    |
| Si3-2  | Equipment failure                 | 4  | 41 | 94 | 46 | 23 | 3.21 | 1.04 | R7    |

Table 6d. Rank of the site condition group factors

| Code   | Item names                        | Severity 5-points Likert Scale | AI    | STD | SI Rank |
|--------|-----------------------------------|--------------------------------|-------|-----|---------|
|        |                                   | 1  | 2  | 3  | 4  | 5  |             |           |       |
| Si4-3  | Waste resulting from packaging    | 23 | 112| 41 | 31 | 78 | 4.83 | 0.90 | R1    |
| Si4-2  | Leftover materials on site        | 29 | 86 | 51 | 42 | 167| 4.71 | 0.97 | R2    |
| Si4-1  | Lack of experience                | 17 | 101| 48 | 42 | 173| 4.27 | 0.45 | R3    |
| Si4-4  | Poor site condition               | 46 | 74 | 46 | 32 | 113| 4.29 | 1.10 | R4    |
by\textsuperscript{48} found that majority of respondents participating in survey agreed that poor site management is the major factor of Construction Waste generation. In a study related to Construction Waste generation in India highlighted that poor site management factor is major reason of waste generated\textsuperscript{55}. Result of the handling group factors are shown in Table 6c.

Based on the ranking results, 2 factors have importance level for C and D waste generation. These factors are “Wrong material storage and Poor material handling”. This finding is concurrent with the findings from other study by\textsuperscript{28}, found that majority of participating agreed that wrong material storage is the main factor of Construction Waste generation. The result of site condition for each factor is as presented in table 6d.

From Table 6d, it was found that “waste resulting from packaging” is the main contribute factor\textsuperscript{56}. In another study\textsuperscript{57} pointed out the waste resulting from packaging significant factor that contribute C and D waste generation.

Table 6e shows the highest severity score in this phase is “mistakes on quantity surveys”, subsequently “Ordering errors” this result similar study conducted by\textsuperscript{28}, found that majority of the respondents participating that agreed that mistakes on quantity surveys is the major factor of C and D waste generation. According to\textsuperscript{34}, in their study related

### Table 6e. Rank of the procurement group factors

| Code | Item names                              | Severity 5-points Likert Scale | AI   | STD | SI Rank |
|------|----------------------------------------|--------------------------------|------|-----|---------|
|      |                                        | 1 | 2 | 3 | 4 | 5 |
| Si5-2| Mistakes on quantity surveys            | 2 | 47 | 34 | 76 | 49 | 3.59 | 1.11 | R1 |
| Si5-1| Ordering errors                         | 6 | 53 | 28 | 90 | 31 | 3.42 | 1.11 | R2 |
| Si5-3| Frequent variation orders               | 3 | 60 | 48 | 56 | 41 | 3.35 | 1.16 | R3 |
| Si5-4| Items not in compliance with specification | 4 | 62 | 57 | 41 | 44 | 3.28 | 1.21 | R4 |
| Si5-5| Different methods used for estimation   | 3 | 78 | 48 | 41 | 38 | 3.16 | 1.09 | R5 |
| Si5-6| Wrong material delivery procedures      | 1 | 77 | 56 | 42 | 32 | 3.13 | 1.16 | R6 |
| Si5-7| Error in shipping                       | 6 | 68 | 59 | 45 | 30 | 3.12 | 1.14 | R7 |
| Si5-8| Supplier errors                         | 8 | 87 | 43 | 32 | 38 | 3.02 | 1.11 | R8 |
### Table 6f. Rank of the workers group factors

| Code | Item names                              | Severity 5-points Likert Scale | AI  | STD  | SI Rank |
|------|-----------------------------------------|--------------------------------|-----|------|---------|
|      |                                         | 1    | 2    | 3    | 4    | 5    |       |       |
| Si6-2| Lack of awareness among the workers     | 1    | 93   | 31   | 51   | 32   | 4.59 | 1.02  | R1    |
| Si6-3| Too much overtime for workers           | 1    | 82   | 31   | 66   | 28   | 4.50 | 1.15  | R2    |
| Si6-6| Incompetent worker                      | 1    | 71   | 45   | 51   | 40   | 4.49 | 1.11  | R3    |
| Si6-4| Shortage of skilled workers             | 11   | 65   | 10   | 79   | 43   | 4.44 | 1.26  | R4    |
| Si6-8| Damage caused by workers                | 9    | 72   | 33   | 53   | 41   | 4.28 | 1.18  | R5    |
| Si6-7| Poor workmanship                        | 5    | 77   | 38   | 43   | 45   | 4.26 | 1.14  | R6    |
| Si6-1| Lack of experience of workers           | 0    | 58   | 67   | 53   | 30   | 4.24 | 1.22  | R7    |
| Si6-5| Workers’ mistakes during construction   | 1    | 75   | 18   | 73   | 41   | 4.16 | 1.24  | R8    |
| Si6-9| Inventory of materials not well document| 2    | 87   | 36   | 42   | 41   | 4.09 | 1.20  | R9    |
| Si6-10| Insufficient training for workers       | 4    | 94   | 31   | 47   | 32   | 4.00 | 1.17  | R10   |

### Table 6g. Rank of the external group factors

| Code | Item names         | Severity 5-points Likert Scale | AI  | STD  | SI Rank |
|------|--------------------|--------------------------------|-----|------|---------|
|      |                    | 1    | 2    | 3    | 4    | 5    |       |       |
| Si7-3| Lack of legislative enforcement | 0    | 58   | 60   | 53   | 37   | 3.33 | 1.01  | R1    |
| Si7-1| Effect of weather  | 6    | 57   | 50   | 54   | 41   | 3.32 | 1.19  | R2    |
| Si7-2| Pilferage          | 5    | 77   | 44   | 38   | 44   | 3.19 | 1.33  | R3    |
| Si7-4| Wars               | 18   | 48   | 67   | 44   | 31   | 3.11 | 1.22  | R4    |
| Si7-5| Accidents          | 6    | 82   | 31   | 65   | 24   | 3.09 | 1.42  | R5    |
| Si7-6| Vandalism          | 16   | 67   | 46   | 51   | 28   | 3.04 | 1.33  | R6    |
to C and D waste generation, highlight that mistakes on quantity surveys is the major reasons of C and D waste generation. The results for worker's group are shown in Table 6f.

Table 6f illustrates the highest mean score in the workers group is “lack of awareness among the workers”, thence, “Too much overtime for workers”, this finding similar to study that conducted by 33. The result of ranking for external group is shown in Table 6g.

In the external group, most of these factors are difficult control. From Table 6g, it was found that “Lack of legislative enforcement” then “Effect of weather” as the main contributes factors for C and D waste generation and found that majority reason of the huge waste generation was lack of legislative enforcement and effect of weather. In 56 claimed that lack of legislative enforcement, as one of the causative factors to C and D waste generation.

6. Conclusions

From this investigation, a superior comprehension of the sources and reasons for CWs and the existing waste control practices on construction sites in Iraq was accomplished. The quantity of CW and the generation of waste material at construction projects rely upon different factors. “A poor site management”, “Rework”, “Poor supervision”, “Poor planning” and “Lack of environmental awareness” are the major factors for contributing waste generation as witnessed through the value of degree of importance severity waste index. However, “lack of regulations, enforcement and guidelines” observed in some Iraq construction industry are also aspects that contributed to the generation of CW and could be considered as influencing factors. It is concluded on the basis of results achieved in this research would provide attentiveness to all Iraq construction industries to adopt and follow sustainable CW standards in line with standards originated by numerous international agencies. However, in continuation to this research work, further investigations will be conducted for documentation of the better practices for controlling and minimizing the CW waste and along with minimizing the barriers for that on construction sites in Iraq.

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