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DETERMINING THE CRITICAL SUCCESS FACTORS FOR WASTE MANAGEMENT IN CONSTRUCTION PROJECTS IN KHARTOUM CITY, SUDAN

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Abstract: The enormous amount of construction activity in Khartoum city associated with its rapid economic development has produced a large amount of construction and demolition waste over the past three decades. The majority of these wastes has not been well processed, which led to severe damage to the environment. The scenario in Khartoum city showed that there is a clearly need for better construction and demolition of waste management in their construction industry. Thus, this paper aims to determine the critical success factors (CSFs) amongst 18 factors which obtained from the previous studies. A questionnaire survey was conducted in Khartoum city; Sudan in order to conclusively these CSFs can serve as valuable references for stakeholders to develop effective construction and demolition wastes strategies. This also adds to the knowledge on how to reduce adverse environmental impacts caused by construction activities in rapidly developing economics.
Keywords: CSF, waste management, construction, projects, Khartoum city, Sudan

INTRODUCTION

The term construction and demolition waste (C&DW) is commonly used to describe a large number of waste materials generated from the construction and demolition of buildings and civil infrastructure. While many waste materials from construction and demolition projects are the same, the quantities produced will vary greatly with demolition projects often creating 20 to 30 times as much waste as construction projects (Recycling Council of Ontario, 2006). The construction sector has been thriving in Sudan lately. Although it accounted for only 4% of GDP in 2006, it continued to drive economic activity, growing by a healthy 10% (in real terms) last year. Furthermore, construction trends currently allow for too much space between buildings. If buildings are built closer to each other they could conserve cool air better. But they are not and that means we need more electricity to keep air-conditioning running to keep building cool that also creates more pollution (Ahmad, 2007). These views are echoed by Bannaga. A research by Bannaga (2007) stated that contractors have the freedom to do what they want. They are not thinking about how they are endangering the environment. The government runs everything. Once you have its approval nobody cares, and nobody's supervising the government. Agrees that government's control over construction needs to be improved, there's gap between legislation and the monitoring of projects. Bannaga (2007) pointed out that that disregard of the construction industry is part of a broader tendency to sideline the environment in a county that is grappling with widespread poverty as the shantytowns of Khartoum can attest. He said we have difficulty in treating water and waste water. Most households provide their own means of discharging waste water into sub-surface soil and water. There are no wastewater networks. We also do not have systems for refuse collection in many areas. Most of our solid waste is burnt on the ground. We are dependent on mechanical air-conditioning and there is no eco-building (Bannaga, 2007). About two decades ago, Hong Kong Polytechnic (1993) have defined construction waste as the by-products generated and removed from construction, renovation and demolition workplaces or sites of building and civil engineering structures°. In environmental terms the latter definition provides the better description as it identifies clearly materials that must be either recycled or re-used or disposed of. Although construction and demolition waste materials are often grouped together under the generic term "C&DW", the materials generated from these activities can be quite different. One reason for this is that construction activities make use of currently available manufacturing processes and materials while demolition activities often remove older structures. Older buildings can contain materials no longer used in the construction industry today, resulting in a different waste stream. An example of this is asbestos, which was a common insulation material forty years ago, but is now regarded as hazardous waste. Differences between construction and demolition waste are also due to the nature of each process. Demolition procedures typically remove the whole structure, resulting in (20-30) times more waste material than construction activities. Materials such as metal, which is rarely wasted during the construction process, can form a significant percentage of total demolition waste when a building is torn down. Wood, concrete, brick and other masonry typically constitute more than (60%) of residential and (80%) of non-residential demolition waste (Recycling Council of Ontario, 2006).

RESEARCH METHOD

A Quantitative method was used for collecting the data, whereby 65 questionnaires were sent to different companies in the city of Khartoum, targeted the project manager, contractor, consultant and The study was carried out in the city of Khartoum in Sudan as shown in Figure (1). Additionally, the geographical areas selected include the locations where construction activities are high. Questionnaires were distributed to a different construction firms, and a total of (45) were completed returned and analyzed. The distribution of the survey instrument commenced on 1st January 2013 in Khartoum city in Sudan and the survey was completed on 21st February 2013. Moreover, the data were collected by firstly using close ended self-administered questionnaires. And then, this study was employed survey method to obtain the perceptions of the respondents toward the critical success factors for waste management in construction projects in Khartoum city, Sudan. Out of the 65 administered, only 45 useable questionnaires were returned analysed, provided a response rate (69.2%) response rate. The data collected were analyzed with aid of statistical package for social science (SPSS) version 20.0. The data were analyzed in the following order. Cronbach's coefficient alpha was used to determine the reliability of the various items used in the study. The statistical procedures were conducted to find the alpha value of items. Cronbach's alpha was computed and the result for the critical success factors was (0.65). The Relative Importance Index (RII) is used for the followings sections to describe it in greater details.

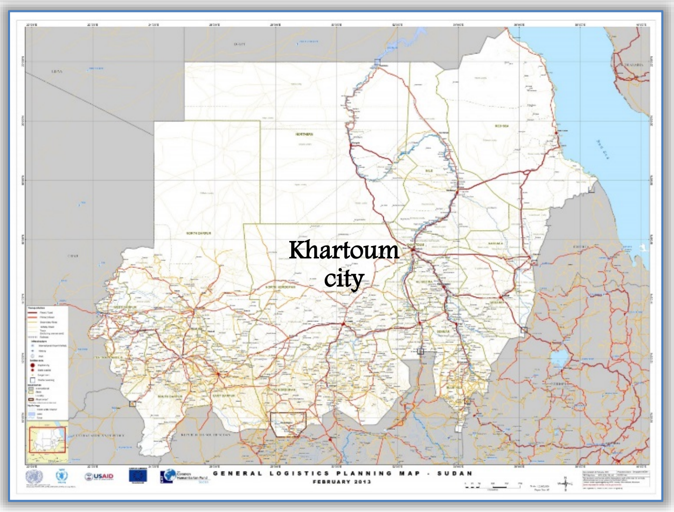

Figure 1. Shows the Study area

RESULTS ANALYSIS AND DISCUSSION

Respondents Background

The first part of the questionnaire was designed for the purpose of eliciting information of the respondents' background where out of 45 (13) of the questionnaires were solved by project managers (28.9%) which is indicating the highest percentage (28.9%) comparing to others, where eleven of the questionnaires were solved by contractors (See Figure 2).

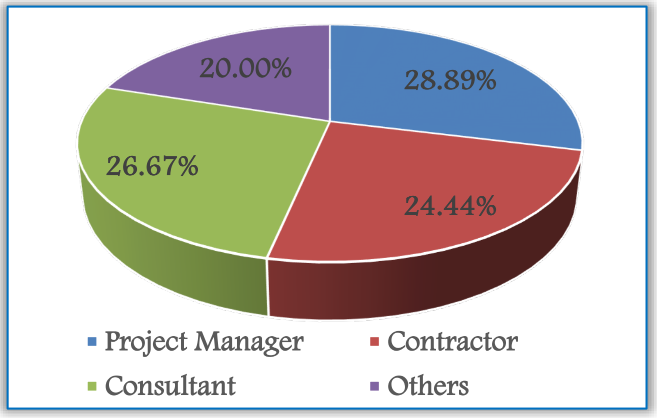

Figure 2. Position of the respondents

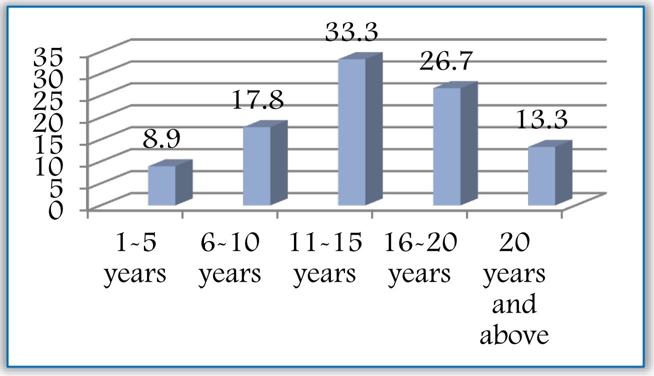

Figure 3. Shows the working experience of the respondents

The information for the respondent's working experience was also elicited. As shown in Figure (4) indicates that only fifteen respondents (33.3%) had worked for 11-15 and not more than twelve respondents (26.7 %) had worked more than 16 to 20 years. Other different participants had indicated difference working experiences is shown in Figure (3). The last part of the respondents' background was designed for the purpose of eliciting information regarding the respondents' involvement in the construction industry. As shown in Figure (4), less than twenty respondents 19 (42.2%) were involved in buildings project while 15 respondents (33.3%) were heavy engineering (infrastructure).

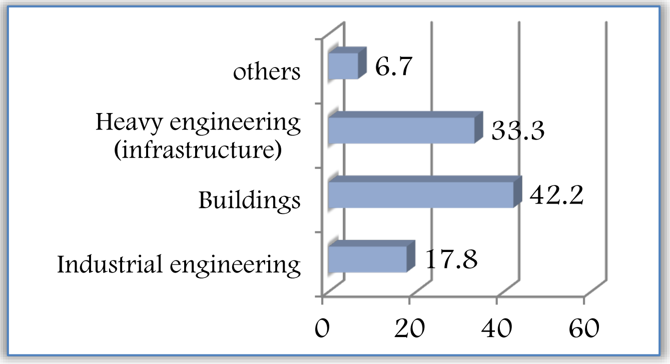

Figure 4. Shows the type of projects

Factors

The results showed that ten factors were found to be as a critical success factors after the analysis had been conducted by using SPSS and Relative Important Index formula (RII). As shown in the Table 1.

Table 1. Presents the Critical Success Factors

Factors	RII	Ranking
Material usage and storage system	0.733	1
Improving communication amongst project participants	0.711	2
On –site waste supervision system	0.688	3
Research and development in WM	0.683	4
Vocational training in WM	0.677	5
Improving conventional construction process	0.672	6
Waste management system (WMS)	0.638	7
Awareness of Construction &Demolition WM	0.638	8
Waste Management regulations	0.622	9
Taking WM into consideration in bidding and tendering	0.622	10

DISCUSSION OF THE FINDINGS

Waste Management Regulations

It is not surprising to see that a good policy system formulated by waste management regulations is ranked among the most significant success factor for conducting C&D WM in Khartoum. This is in line with Jaillon and Poon (2008) and Karavezyris (2007) who suggested that government generally plays a crucial role in promoting C&D WM practice by enforcing policies for the whole industry. As the result from the survey reflected that current policies for C&D WM are generally effective, although the promulgation of various C&D WM laws and regulation since decades ago has improved the situation. The biggest qualm is that most current policies are not detailed enough for guiding and enforcing C&D WM.

Waste Management System (WMS)

The establishment of WMS is also among the most significant success factors for C&D WM in Khartoum. As a clear definition of the term WMS appears to be absent in the literature, the working definition for this research was taken from the following definition of a Environment Management System (EMS) as stated in ISO 14000: an overall management system which includes organization structure, plan responsibilities , practices, procedures, processes and resources for managing C&D waste. It formulates an internal system for contractor to conducting C&D WM. Given that C&D waste is one of the major pollutants of the environment, a WMS for construction can be considered as sub-system of an EMS. Some of the respondents have commented by emphasizing the importance of a waste management plan, which has already been implemented in some countries UAE, and Hong Kong. According to Poon et al. (2001), effective on –site WM usually involves scheduling the waste clearance, arranging collection and scheming removal to appropriate disposal sites. All this can be developed in pre- arranged WMP by project managers. The plan should clarify the possible WM issues and actions in advance, for waste streams being encountered, necessary resources and suitable scheme for dealing with possible waste problem, and selected waste disposal sites, the most important step for developing a WMS is to encourage the development of a C&D WMP for construction projects.

Awareness of C&D Waste Management

This factor also considered among the most significant CSF. This resonates with the studies which have pointed out that the practitioners' awareness of resource saving and environment protection is a vital driver for C&D waste minimization (Osmani et al., 2008; Yuan, 2008). Nevertheless, what was observed from the respondents that both managers and contractor have little awareness of saving resources and protecting the environment through waste management. The development of C&D WM awareness is a lengthy process that requires vocational training and education practitioners. The research shows that C&D WM is incorporated in many training course provided by universities, research institutions, and government departments. The respondents suggested that a change of the current C&D WM mindset can be enhanced by the enforcement of government policies, the development of C&D WM systems within companies, and recognition of the importance of WM by clients and general public. While conducting this research, it is suggested that raising C&D WM awareness will be more effective if economic concerns can be recognized in developing regions. The economic is often high on the agenda of these local governments and they believe that environmental protection will slow down economic development. Conversely, research in other regions shows that good WM through reducing, reusing, and recycling does not necessarily add to project costs (Tam, 2008 a,b). In developing economies, it might be more effective to provide companies with solid evidences of the benefits and cost savings of C&D WM.

Research & Development in Waste Management

Identification of research and development (R&D) as a CSF for conducting C&D WM resonates with research by Weng and Liu (2008) and Yuan (2008) suggested that that R&D can provide guidelines and technical support for waste reduction reuse, recycling and disposal. The result from the survey by some comment of the respondents indicated that R&D should focus on the following: (1) government policies; (2) effective WMS within companies; and (3) waste management technologies.

Vocational training in WM

In support of this CSF, other studies have also revealed that the skill-level of construction workers has a major influence on C&D waste generation (Tam and Tam 2008; Yuan 2008). Activities such as construction formwork, plastering, and handling deliveries will cause large amounts of waste if the workers involved are unskilled (Wang et al., 2008). Most workers in the construction industry in Khartoum are from rural areas. They have limited skills that have not been trained sufficiently before starting work on construction projects. Findings from the research indicate that the training time for most construction workers is less than what is really meant to be.

CONCLUSION & RECOMMENDATIONS

The aim of this paper was to determine the most CSFs among the 18 factors that are most important for waste management in construction projects in Khartoum, Sudan. This paper determines ten critical success factors that are important and will impact positively on the waste management in construction projects in Khartoum city, Sudan if they focus on the ten determined CSFs by all the stakeholders. The score of the ten factors ranges from (0.733) being the heights and the least (0.622). Since this is the first research to determine the critical success factors for waste management in construction projects in Khartoum, Sudan, there are some results are the same of past researches with which to compare the results of this research such as It should be noted that reduction and reuse of waste is given as a national average and that considerable variation occurs between states. For instance, building rubble alone has contributed as much as (27.4%) of the total waste stream in Perth (Department of Commerce and Trade (Western Australia) and WA Municipal Association 1993). It should be remembered that the CFSs in this study were identified within the context of Khartoum's construction industry and that is Sudan is large country with many different cities and levels of economic development. The CFSs cannot be therefore simply applied to other parts of Sudan without considering the regional variations. However, further research could be conducted to investigate C&D waste management problems in other different parts by using CFSs as a reference. The CSFs could also be used as a reference to conduct research in other fast developing countries such as India and China, with aiming of helping those countries reduce the negative impact of C&D activities on their environment.

References

[1.] Ahmed, M. E. Ahmed's website [Online], (Accessed 31 December, 2012) available from World Wide Web: www.sudantribune.com.

[2.] Bannaga, S. Bannaga's website [Online]. (Accessed 31 December, 2012) available from World Wide Web: www.sudantribune.com

[3.] Jaillon, L., & Poon, C.S. Sustainable construction aspects of using prefabrication in dense urban environment: a Hong Kong. Engineering. Construction and Architecture Management; 7(1):103-13, 2008.

[4.] Karavezyris, V. Report: Treatment of commercial, construction and demolition waste in North Rthine-Westphalia: policy-making and operation options. Waste Management, 24 (2): 183-9, 2007

[5.] Osmani, M., & Glass, J. Price ADF. Architects' perspectives on construction waste reduction by design. Waste Management, 28 (7): 1147-58, 2008.

[6.] Poon, C.S., Yu, A.T.W., Ng, L.H. On-site sorting of construction and demolition waste in Hong Kong. Resources, Conservation and Recycling, 32(2):157-72, 2001.

[7.] Recycling Council of Ontario. Let's climb another molehill, an examination of construction, demolition and renovation (CRD) waste diversion in Canada and associated greenhouse gas emission impacts. Retrieved February 3, 2013 from http://www.nrcan.gc.ca/smm-mms.

[8.] Tam, V.W.Y. Economic comparison of concrete recycling: a case study approach. Resources. Conservation and Recycling, 52(6)1072-8, 2008a.

[9.] Tam, V.W.Y. On the effectiveness in implementing a waste-management-plan method in construction. Waste management, 28 (12)1649-60, 2008b.

[10.] Weng, W.S., & Liu, Z.Y. Source-oriented reuse of construction waste in cities. China construction Material, 7:91-3, 2008.

[11.] World Food Programme (WFP). United Nation, Map Centre retrieved September 5, 2013 http://www.wfp.org/maps/sudan-general-logistics-planning-map-february-2013