conservatively; into an industry that uses a complex system of building designs, building methods, and building materials increasingly relying on skilled labour and sophisticated plant. According to 11th five-year plan, construction industry is the second largest economic activity after agriculture. Based on an analysis of the forward and backward linkages of construction, the multiplier effect for construction on the economy is estimated to be significant (Srivastava and Chini, 2009). However, it has long been regarded as one of the major contributors of negative impact to the environment due to the high amount of waste generated from construction, demolition, renovation and activities associated with construction.

According to Macozoma (2006), construction and demolition (C&D) waste implies non-hazardous waste resulting from the construction, remodeling, repair and demolition of structures. Structures include both residential and non-residential buildings, public works projects such as roads, bridges, piers and dams. It also results from natural disasters such as earthquakes, hurricanes and tornadoes. C&D waste includes but is not limited to concrete, bricks, masonry, ceramics, metals, plastic, paper, cardboard, gypsum drywall, timber, insulation, asphalt, glass, carpeting, roofing, site clearance, excavation material and site sweepings. Some wastes are not included in the definition of C&D waste because of their nature e.g. paints and other liquid wastes, asbestos and other hazardous wastes, putrescible waste, tires, appliances and containers with residue. Also, C&D waste is the type of waste generated when there is an activity such as building and demolition of roads, bridges, and flyover, subway, remodeling or remover of construction and to name of few. It comprises of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics and so on (The Ministry of Urban Development Government of India).

In the past, C&D waste has not been given serious attention as a waste that has value rather than using it for landfill. However, in the recent years; more concentration has been placed on alternatives, and information were discovered that many materials in C&D waste are contaminated either as part of their original design or through their use and as well pose a big potential threaten to the air, water and soil of urban areas. Hither to, construction materials should gain much more attention from human being and therefore should be managed accordingly (Nkosi and Muzenda, 2013). The volume of C&D waste produced in a region depends on many factors including population growth, city or regional planning, state of the construction industry and landfill fees (Zhao etal, 2010). But responsible management of C&D waste is an essential aspect of sustainable building in construction industries. In this context, managing the waste means eliminating the waste where possible; reducing waste where feasible; and reusing materials which might otherwise become waste. Moreover, it has been noted that a large proportion of C&D waste about 90 % can be easily recycled and thus can conserve landfill capacity (Thomas and Lizzi, 2011). For instance, Waste concrete or abandoned bricks or stones can be used to produce coarse and fine aggregate, such as new concrete, mortar, floor tiles, etc. Muck can be used as materials in foundation earth layer. Waste wood, which has been seriously damaged can be used to make paper or recyclable slab, and those which has no obvious damages can be reused as construction materials. Waste steel and other metals can be melted down and reprocessed. Realistically, recycling which is the process of converting waste materials into new materials and objects is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions and also prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution from incineration, and water pollution from landfilling (Nkosi & Muzenda, 2013).

In South Africa, waste collection has been tackled to an extent by the creation of South Africa Waste Information System (SAWIS) to provide public with access to information on waste collected, recycled, treated, landfilled and waste exported out of South Africa but the conversion of waste to energy is still yet to be fully implemented. In 2011, 108 million tons of waste was generated in South Africa of which 98 million tons was disposed at landfill. 59 million tons was general waste, 48 million tons was unclassified and the remaining 1 million tons was hazardous waste. It was reported that only 10% of all the waste generated in 2011 was recycled. With the diminishing landfill space, it has become imperative to find other option to manage these wastes especially those that can be converted into a resource. In an era of increasing energy prices, C&D waste will be more widely recognized as a recoverable resource. Technology and attendant regulations may promote improvements in the diversion of wastes from the landfill and increasingly toward energy generation and recycling of materials. Reduction of C&D waste is capable of leading to sustainable growth, and can improve green building projects since it minimizes waste in construction environment and at the same time generates wealth.

Therefore, the habit of recycling and other reduction practices in a proper and standard means have to be employed by all in order to attain a sustainable development in construction industries. Also, waste reduction practices are applicable to virtually any construction and demolition project scenario. The goal is to divert materials from landfill disposal to the greatest extent practical under the circumstances. There are two opinions about whether this is a realistic expectation under real world project conditions. One is that waste reduction costs money, and the other is that waste reduction saves money. As with any construction project, planning and project management will ultimately dictate whether waste reduction is accomplished within the established cost, schedule, and quality parameters. But is C&D waste economically efficient? It has traditionally been argued that recycling municipal solid waste-MSW which constitute largely C&D waste; is usually not economically viable and that only when externalities, long-term dynamic considerations, and/or the entire product life cycle are taken into account, recycling becomes worthwhile from a social point of view, hence there is need to access the efficiency and impact on sustainable construction and if checking the performance of recycling on sustainable waste management we could indicate so far how the construction industry had utilized the advantageous effect and identify the economic efficiency.

2. Literature Review

2.1 An Overview of C&D Waste Production and Management practices in South Africa

Most developing countries of the world are posed with the challenge of solid waste management and construction waste is becoming a serious environmental problem in many countries in the world. Construction and demolition (C&D) debris frequently makes up 10-30% of the waste receive at many landfill sites around the world (Fishbein, 1998). International studies have found the construction industry to be a generally wasteful sector (Ekanayake & Ofori, 2000). It is estimated that up to 15% of material delivered to a construction site ends up in landfills. At construction site level it is estimated that up to 15% of materials purchased end up as waste while at demolition sites up to 100% of the waste generated can end up as waste destined for landfill (after the usual stripping of basic high value products). Demolition sites usually generate the highest proportion of C&D waste, followed by renovations while construction sites generate the least. Waste which is recovered is utilized in high level application such as, road construction building and formed layer. Construction and demolition waste contributes in the range of 15-30 percent (%) of the total amount of waste that is disposed of in landfill sites in most countries (McDonald & Smithers, 1996). McDonald and Smithers (1996) also claim that this figure increases to approximately 40% when taking into consideration the amount of construction and demolition waste generated. This indicates that construction and demolition waste makes for a large part of the total waste stream of a country.

By 2020, more than 50% of the population in Sub-Sahara Africa will be living in urban cities which will likely raise the rate of production of waste by as much as 1kg per capital. Also, in other African countries for instance; in Zimbabwe, solid waste generation is on average of 0.7kg/day per capita, in Tanzania it is 1/day per capita and likewise 1.1k/day per capita of mixed Municipal Solid Waste-MSW in Mauritius. Majority of this waste contains larger proportion of organic matter. However, in these countries, government agencies and other parastals are making considerable effort in tackling waste related problems yet there are still major gaps to be filled especially in the area of solid waste sorting. The World Bank reported that in developing countries, it is common for municipalities to spend 20-50% of their available budget on solid waste management even though 30-60% of all the urban solid waste remain uncollected. Therefore, it's of optimistic significance to determine the impact of C&D waste reduction operation on green building projects for most especially developing countries in Africa to take a critical look at step taken towards diminishing of C&D waste. Meanwhile, the performance of sustainable or green building construction in most of these developing countries of Africa is a critical step towards diminishing the waste (DEA, 2011).

Considering that the construction industry contributes a significant amount to the GDP and development of any country. Notwithstanding, the waste levels highlight lost opportunities, particularly in terms of employment creation, economic growth, prolonged use of finite natural resources and preservation of habitable ecosystems that support a better life for all. According to the Council for Scientific and Industrial Research (CSIR, 2001) the South African construction industry has been found to generate approximately 5-8 "' million tons of construction and demolition waste per annum. This waste results from residential building, dense housing projects and high rise residential and non-residential dwellings. Over one million tons of construction and demolition waste is generated during activities such as new construction, renovation and demolition in South Africa per annum majority of which ends up in landfills (Macozoma 2006). This consists of concrete and masonry rubble and a small proportion is timber, steel, metal, glass and plastic. A large proportion of this construction and demolition waste is reused both on and off site. A smaller proportion is recycled into secondary materials. The bulk of the waste that is not recorded is dumped illegally in open areas.

In South Africa (SA), the impacts of increasing waste generation are evident in various forms which affect the environment and human health in many ways (DEAT, 2000; Almorza and Brebbia, 2000). The negative impacts caused by the mismanagement of waste include: Aesthetically unattractive surroundings; loss of land where new land must be identified for the development of facilities to manage waste; furthermore, land that could be utilized for other land uses, such as housing or industry, will be lost; increase in the spread of diseases, community health suffers in the vicinity of waste accumulation; waste accumulation can promote the spread of disease vectors and result in specific adverse health effects associated with pollution, such as birth defects, cancer and respiratory illnesses; and air and water pollution; air pollution will occur in the form of dust and hazardous compounds if the landfills are not managed correctly. Water pollution, on ground and surface water, will occur where improper precautions have been taken to prevent leachate (DEAT,2000; Almorza and Brebbia, 2000; Boadi and Kuitunen, 2005; Vasanthi *et al.,*2008). In many cities such as Cape Town, Durban, Johannesburg and Tshwane, there are institutional frameworks in place to facilitate the management of waste from source to its disposal (DEAT, 2000). However, there is massive accumulation of waste, particularly in poor settlements located outside the urban edge and in townships, where there is a need for attention to support waste management (Frewin, 1997). In 2001, the amount of waste produced was noted as increasing due to population growth, urbanization and economic growth.

What these dynamics of waste production and management demonstrate is that there are disparities between higher-income and lower-income countries in the volume of waste generation and management strategies. Higher income countries generate more waste per capita (approximately 2,7 m3/capita per annum) than the lower-income countries (approximately 0,2 m3/ capita per annum). This is reflected to a greater extent among African countries. South Africa generates approximately 42 million cubic metres of solid waste annually and largest portion is generated in Gauteng province (DWAF, 1997; DEAT, 1999; Treasury, 2011; Simelane and Mohee, 2012; Nkosi and Muzenda, 2013). The majority of solid waste was produced in two urban hubs of South Africa which are Gauteng-45% and Western Cape-20% provinces in 2011 (DEA, 2012). Of the 108 million tons generated in 2011, about 43.2 million tons was municipal waste and about 97 million tons generated was disposed of at landfill facilities (Kalule and de Wet, 2009; DEA, 2012).

South Africa's current waste economy is estimated to be worth R15 billion and provides 29,833 people with employment. However, the GreenCape report (Waste Economy: market intelligence report 2017) suggests that R17 billion worth of resources could be unlocked if 100% of the identified 13 waste streams could be recycled. By 2019, South Africa is aiming to reach the target of 20% waste division by weight. But based on current waste management costs and limited resource capacity, the implementation of alternative waste management practices such as recycling is perceived to be costlier than landfill. This perception has been partially responsible for the slow uptake of alternative waste management measures, despite national laws. Although South Africa has constituted an integrated waste management plan which requires the implementation of a hierarchical approach to waste management, namely. a sequential application of waste prevention or minimization, recycling and re-use, treatment, and ultimately disposal (Formoso et al, 2002). Hence, recycling is an integral activity in the way waste management is implemented and practiced. If we consider South African recycling practice with respect to specific C&D waste materials, we find that: Building rubble recycling is limited to single operations in the Western Cape, Cape town, Gauteng, Johannesburg and KwaZulu-Natal, Durban. This is not surprising, as the quantities of C&D waste appear to be the highest in these metropoles. However, even in these areas rubble recycling has a small market share. Nonetheless, there has been an increase in interest in the subject since 1999. Waste glass, paper, plastic and metals have existing markets and technologies are well established. Wood and asphalt recycling are also established markets that have been around for a long time. It should not be difficult to find applications or start up new ventures in specific cases. This show significantly that many stakeholders in the construction industry and waste sectors are beginning to realize the environmental benefits as well as the social and economic opportunities that are presented by recycling and developing secondary construction materials markets (.

2.2 South Africa Waste Management policy and control

The South Africa government is committed to its vision and waste management strategies of reducing waste generation and disposal by 50% by 2012 and develop a plan for zero waste by 2022 (Nkosi and Muzenda 2013). The South Africa waste management policy and framework is presented with attention drawn towards national legislation and how it has affected the decisions of waste management mandatory functions within the spheres of government, particularly in the last decade. Also, consideration is further given to the shift in policy and legislative direction since the promulgation of National Environmental Management: Waste Act adopted for National Waste Management Strategy and various waste management policies and regulations (NWMS, 2011). The roles and responsibility of government institutions and the legislative mandates of key spheres of government are presented in the Act, including a presentation of the government performance management system. With good legislation in place, clarity in functional roles and responsibilities, lessons and commitments, the South African approach demonstrates the country's commitment towards an efficient system for waste management. Although South Africa does not have sufficient technical capacity and human capacity in waste management field. A number of opportunities for continuous improvement exist within the enabling legal framework and institutional arrangements on waste management (DEAT, 2000). Emphasis for future improvements is place on key system elements that can trigger higher efficiency in the waste service sector. These include; service level agreements and contracting of services amongst key role players in government. For instances, where spheres of government (e.g. district and local municipalities) share responsibilities, a clear contracting framework is required. This contractual arrangement must ensure that a single authority remains publically and administratively accountable for the service (DEAT, 2001).

Also, a new emphasis on regionalization means better efficiency and transparency of service. This will ensure that resource mobilization is maximized. An obstacle to regionalization is funding of services; according to the municipal Systems Act, when two local municipalities perform the same function, that same function becomes elevated to the district and Municipal infrastructure Grant funds are no longer allocated to the districts. As a result, funding of such functions by the districts poses a challenge; and, a system where all revenue collected from waste management service provision is ring-fenced towards improving the same service is desirable within government institutions. Such a system for South Africa will result in improving the same service is desirable within government institutions. Such a system for South Africa will result in improved financial management, re-investment into waste facilities and infrastructure, improved financial accountability and fair waste management service delivery (DEA, 2011). According to Godfrey *et al*., (2017), the South Africa's legal framework on waste management is one of the most progressive on the continent of Africa. There is a clear division of roles, responsibilities, and mandatory obligations framework environmental legislation established by the NEMA. The National Environmental Management; Waste Act places considerable emphasis on the development of an integrated waste planning system, through the development of integrated waste management plans-IWMPs by all spheres of government, and identified industries must develop industry waste management. All spheres of government are legally responsible for waste management in the country. The specific roles of all the spheres of government are clearly outlined in the Municipal Waste Sector Plan 2011 (DEAT, 2011).

2.3 Waste reduction practices in alliances with green building projects delivery

Globally, there is a concern about the vast volume of water, energy or electricity and materials consumed by buildings, therefore the building sector is saddled with the responsibility to deliver significant cuts in emissions at little or no cost. On record today, about 18% of the global emissions are incurred in buildings or the equivalent of about 9 tonnes of carbon (iv) oxides annually (Faniran and Caban, 1998). Green building which is regarded as both the organization and application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from the design planning, construction, operation, maintenance, renovation, and demolition requires a close cooperation of the contractors, the architects, the engineers, and the client at all stages. Although, green building is now becoming a corporate construction strategy and there are huge correlations between green building and waste reduction. Also sustainably, waste reduction practices aid the achievement of green building delivery. But the major issue is the cost implications of the various waste reduction techniques which are commonly practiced especially recycling. Furthermore, a new waste management hierarchy called the Zero-waste hierarchy is now being embraced and applied in order to achieve a green economy. The concepts introduce a way to conserve all resources by means of responsible production, reuse, recycle and recovery of materials without burning or disposal to land, water or air that poses a threaten to the environment or human health (Zero Waste International Alliance, 2018).

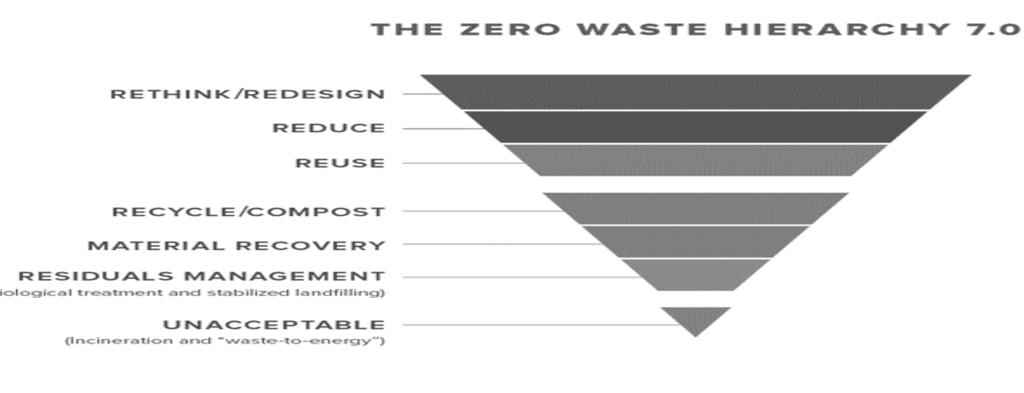

Figure 1. Zero-waste Hierarchy (Source: Zero Waste International Alliance, 2018)

However, according to the hierarchy, it is essential to rethink or redesign strategies in order to avoid unnecessary and or wasteful consumption of materials, make use of less or reuse materials on construction sites. Recycling activities should simultaneous with material recovery and waste management policy must be imposed to reinforce government effort in providing green building. Not only this, the environment impacts of waste on human health and the ecological sphere would be drastically eliminated. If the waste management system is not sustainable then there would obvious need for an optimization of the system to cope with existing demand on waste reduction or avoidance.

3. Methodology

This study was carried out in order to determine the impact of sustainable C&D waste reduction practices on green building projects in Gauteng province. Primarily, a well-structured 100 numbers of questionnaires were constructed and distributed, while a reasonable 78 numbers of data were collected i.e. 78% which is deem sufficient for this study. The contributors were building engineers, quantity surveyors, project managers and architecture that engages in construction activities with more than 5 years' experience. And because of the Gauteng province goal of delivering green building projects, the province was considered a worthy rationale for the study. Meanwhile, the vast activities of construction going on in Gauteng metropolis, and the huge amount of waste its generating; assuredly makes it the major contributor of construction and demolition waste in South Africa, and thereby provides an enably atmosphere for this research. The data that was gotten through the questionnaires was analysed using statistical Package Social Science-SPSS 21. This study made use of Mean item score-MIS to symbolize 5-point Likert scale. Finally, to determine the consistency and validity of the study, the *Cronbach's alpha* was applied.

4. Findings and Discussions

4.1 Background Information of respondents

The respondents were professional in the construction industry, building construction engineers has the highest percentage with 35.9 per cent, followed by quantity surveyor 27.2 per cent, projects managers have 25.2 per cent, and architect has 10.8 per cent. While under the age group, 50-45 years has 36.2 per cent, 45-40 years has 30.8%, 40-35 years has 20.6 per cent, 35-30 years has 12.4 per cent. In years of experience, 1-5 years has 31.0 per cent, 11- 15 years has 22.4 per cent, 6-10 years has 17.2 per cent, 16-20 years has 17.2 per cent, 20 years above has 10.3 per cent. Finally, under educational qualification of the respondents. Master's degree has 43.1 per cent, bachelor degree has 36.2 per cent, HND has 13.8 per cent, OND has 3.4 per cent while doctorate has 1.7 per cent. Table (1) below shows the tabulated illustration of the respondents.

Table 1. Demographical illustration of background information of respondents

Demographic	Percentage (%)
Respondents Profession	
Building Construction Engineer	35.9
Quantity Surveyor	27.2
Project Manager	25.2
Architect	10.8
Age group	
50-45	36.2
45-40	30.8
40-35	20.6
35-30	12.4
Years of experience	
20 years above	10.3
16-20	17.2
11-15	22.4

6-10	31.0
1-5	17.2
Education Qualification	
Master Degree	43.1
Bachelor Degree	36.2
Higher National Diploma (HND)	13.8
Ordinary National Diploma (ND)	3.4

4.2 Impact Analysis using indicators

For the impact analysis, selected indicators where used as variables to determine how the waste reduction practices could impact green building projects in Gauteng, South Africa. According to Zero Waste International Alliance, (2018), there are seven-7 categories of indicators of waste reduction or management called the Zero Waste Hierarchy 7.0 which is used for the impact analysis consequently showing the level of impact in hierarchical order. The results are tabulated in table-2 below.

Table 2. Indicators of waste reduction techniques in alliance with green building

Indicators	Mean	Std. Deviation	Rank
Rethink or Redesign			
• Avoidance of complex design and detailing	3.98	0.790	1
• Contractual agreement on waste reduction	3.95	0.854	2
• Design and purchase materials reusable, recycled or sustainably renewable	3.91	0.912	3
Reuse			
• Select materials that maximize the usable lifespan and opportunies for continuous use	3.91	0.906	1
• Minimize quantity and maximize quality of materials	3.89	0.904	2
• Implement sustainable procurement of materials	3.88	0.827	3
Recycle			
• Develop resilient secondary materials markets	3.94	0.856	1
• Recycle and use materials as maximum as possible	3.89	0.994	2
• Provide incentives for transaction on secondary materials	3.79	0.861	3
Material Recovery			
• Maximize material recovery	3.79	0.861	1
• Recover resources and energy if possible	3.78	0.994	2
Residual Management			
• Minimize negative impact on the environment	3.77	0.964	1

• Encourage preservation of resources	3.75	1.023	2
• Conserve landfill sites	3.73	1.048	3
Policy Implementation			
• Optimization of waste management system	3.74	1.009	1
• Impose of landfill tax by government	3.72	1.048	2
• Instituting laws against incineration	3.72	1.048	3
On-site Waste Management plan			
• Awareness among clients and contractors	3.67	1.058	1
• Waste expertise involvement on site	3.56	1.102	2

Table 3. Check for Consistency

Cronbach's alpha	Number Items	Consistency
$0.90 \leq \alpha < 0.9$	20	Excellent

4.3 Interpretation of results

In the findings, the categories of waste reduction indicators show the various reduction techniques practiced and how its impact various green building projects in Gauteng, South Africa. The respondents indicate that avoidance complex design and detailing with 0.790 standard deviation has the greatest impact on green building project in category-1. In category-2, selection of materials that maximize the usable lifespan and opportunies for continuous use with 0.906 standard deviation has the greatest impact. In category-3, developing resilient secondary materials markets with 0.856 standard deviation has the greatest impact. In categogy-4, maximizing material recovery with 0.861 standard deviation has the greatest impact. In category-5, minimizing negative impact on the environment with 0.964 standard deviation is the greatest indicator of the impact of waste reduction on green building. In category-6, optimization of waste management system with 1.009 standard deviation and in category-7, awareness among clients and contractors with 1.058 is indicated as the greatest impact of waste reduction practices on green project in Gauteng, South Africa. The indicators rank-1 is considered the indicator having the greatest impact. Therefore, such waste reduction practices are considered the best to be utilized in order to effective achieve a green building project delivery.

5. Conclusion and Recommendations

In South Africa, green building is considered the highest eco-friendly practices which can eliminate waste and the government encouraged every stakeholder in the construction industry embraces the culture. The waste reduction techniques indicators used can as well be a performance evaluation tool for determine how optimal the waste management system is and as well be able to identify possible future area where an improvement might be considered. Also, with the knowledge of waste reduction techniques practiced, the optimality of these waste reduction techniques with potentially huge environmental benefits that could be obtained in using them is identified in this study. From the results, every indication point to the facts that the waste reduction techniques practiced is an optimal option and as such can impact green building projects delivery for achieving a balance in the economic, social and environmental impacts of development in South Africa. Moreover, there is a need for other Africa developing country to shift from the usual culture of landfilling to more sustainable waste reduction techniques some which is identified in this study. In conclusion, the other waste reduction techniques should not be ignored as its highly dynamic and as well has a great impact on green building projects. Therefore, further studies should consider optimizing waste reduction techniques on construction sites to assist decision and policy makers on the best way to manage waste on sites.

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References

Abioye A.O., Rao B.: Sustainable Approach to Managing Construction and Demolition Waste: An Opportunity or a New Challenge. Journal of Innovative Research in Science, Engineering and Tech., Vol.4, Issue 11, pp 10368-77, 2015.

Almorza D, Brebbia C.A.: Waste Management and Environment. WIT Press Boston Participation in Domestic Waste, 2000.

Boadi, K.O, and Kuitunen, M. Environmental and health impact of household of solid waste handling and disposal practices in third world cities: The case of the Accra metropolitan area, Ghana. Journal of environmental health, 68(4): page 32-6, 2005.

BREEnvironment Assessment Method "Good Practice Guidance: Sustainable Design and Construction", 2012, [Online] www.breeam.com/filelibrary/BREEAM.

Bruce Mcdonald and Mark Smithers. Implementing a waste management plan during the construction phase of a project: a case study, Construction Management and Economics, 16:1, 71-78, DOI: 10.1080/014461998372600, 1998.

CSIR, "the situation of waste management and pollution control in South Africa", prepared for the Department of Environment Affairs, Pretoria, 2004.

DEA (Department of Environmental Affairs). National Waste Information Baseline Report; DEA: Pretoria, South Africa,2012.

DEAT (Department of Environmental Affairs and Tourism): White Paper on Integrated Pollution and Waste Management for South Africa. A Policy on Pollution Prevention, Waste Minimization, Impact Management and Remediation. Government Gazette No. 20978, Notice No. 227, 2000.

Ekanayake L.L & Ofori G. Construction material waste source evaluation, proceedings of the 2nd Southern Africa conference on sustainable Development in the Built Environment Pretoria, 23-25 August, pp1-6, 2000.

Faniran, O.O., & Caban, G. (1998). "Minimizing Waste on Construction Project Sites," Engineering Construction and Architectural Management Journal, vol. 5, pp. 182–188, 1998.

Frewin. Construction and Demolition Waste Guide-Recycling and Re-use across the supply chain, 2007.

Formoso C.T., Soibelman, C.L., de Cesare, and Isatto, E.L. "Material waste in building industry: main causes and prevention," Journal of Construction Engineering and Management, vol. 128, no. 4, pp. 316–325, 2002.

Ginindza B, Muzenda E.: Community Perception on Waste Management and Minimization: A Case Study for Mogale City and Westonaria Municipalities. Paper presented at the International Conference on Integrated Waste Management and Green Energy Engineering (ICIWMGEE'2013) April 15-16, Johannesburg, South Africa, 2013.

Macozoma D.S.: Developing a Self-Sustaining Secondary construction materials market in South Africa, a dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, 2006.

Mosidi M.: Key Areas in Waste Management: A South African Perspective, Integrated Waste Management - Volume II, Sunil Kumar, IntechOpen, DOI: 10.5772/18023. Available: from:https://www.intechopen.com/books/integrated-waste-management-volume-ii/key-areas-in-waste-management-a-south-african-perspective, 2010.

Nahman A., Godfrey, L.: Economic Instrument for Solid Waste Management in South Africa: Opportunities and Constraints. Journal of Resource Conservation and Recycling 54(8):521-531, 2010.

Nkosi, N., Muzenda, E.: Waste Management Participants: A South African Perspective, 3rd International Conference on Medical Sciences and Chemical Engineering (ICMSCE'2013) Dec. 25-26, 2013 Bangkok, Thailand, 2013.

Omotayo O.O, Akingbonmire, S.L, Ikumapayi S.M. Sustainable Application of Construction and Demolition waste: A review. Federal University of Tech; Akure, Nigeria annual conference Journal, 2017.

Simelane, T. Interpreting the transformation of the city centres of South Africa through system dynamics: How different are they from other African cities? Africa Insight, 40(4), pp.168–186, 2011.

Simelane, T, Mohee, R. Future Directions of municipal solid waste management in Africa. *Africa Institute of South Africa Policy briefing* No 81, 2012.

Srivastava, S., Chini, A.: "Construction Materials and C&D waste in India". CIB W11 Construction Material Stewardship (pp,72-76). Netherland: International Council of Building Research Studies and Documentation, 2009.

Sustainable Waste Management Fact Sheet: Sunshine Coast Council.www.sunshinecoastqld.gov.au 2013.

Waste Resources Action Plan (WRAP): Achieving good practice Waste Minimization and Management: Guidance for construction clients, design teams and contractors. Retrieved from www.wrap.org.uk/construction, 2007.

Thomas H. C, and Lizzi A. Construction and Demolition waste. *Blackwell publishing ltd,* DOI:10.1002/9780470666883, page 104-109, 2011.

Vasanthi P, Kaliappan, S and Srinivasaraghavan, R. Impact of Poor Solid Waste Management on Ground Water. Environmental Monitoring and Assessment, 143(3): 227- 238, 2008.

Waste Economy: market intelligence report 2017.

Zhao W, Ren H, Rotter V. A system dynamics model for evaluating the alternative of type in construction and demolition waste recycling center—the case of Chongqing, China.55:933–94, 2011.

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