Slender waste: reducing the girth of construction and demolition waste to landfill in Alice Springs

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Abstract: Construction and demolition (C&D) waste is a critical issue nationally where it forms more than one third of the total waste generated. Several town councils and other regulatory authorities have developed policies towards construction and demolition material recovery and resource efficiency. However the situation with C&D waste is very different in the Northern Territory, especially in remote regional centres such as Alice Springs. Whereas metropolitan centres are now able to recycle 40% of the C&D waste, Alice Springs only manages to salvage 2%. This paper argues that there is need for context specific approaches to construction and demolition waste management in remote regional centres because of barriers arising out of the physicality of the location. To this extent, this paper aims to identify the current building waste streams in Alice Springs as well as understand the stakeholders’ behaviour towards reducing building waste.

Keywords: Construction and demolition waste, remote regional centres, Alice Springs.

1. Introduction
The construction industry is the fourth largest contributor to the Australian economy, accounting for 6.8% of its GDP in 2008-2009 (ABS, 2010b). It is the fourth largest employer after retail, health care and manufacturing. This industry impacts the environment enormously, consuming more raw materials and energy than other sectors and producing more waste. Construction and demolition (C&D) waste is a significant issue nationally since it forms 38% of the total waste generated (ABS, 2010a).

Waste generation demonstrates poor use of resources, including a waste of energy and water used for the extraction, production and transportation of the product. Additionally, landfills are known sources for greenhouse gas production such as methane, and redirecting waste materials from landfills would lead to a reduction in greenhouse gas production (Campbell, 2008). Internationally, efforts are aimed at reducing waste from going to landfill, thereby conserving natural resources, reducing the production of waste and recycling and reusing waste that is produced.

In Australia, research on C&D waste focuses on generating statewide data, with a concentration on cities. What is evident from the various reports on C&D waste is that there is very little baseline data
regarding C&D waste for regional towns such as Alice Springs. The low landfill levies and lack of implementation of waste management plans, leads to an absence of initiatives towards waste reduction and recycling. It is more cost effective for builders to dump building waste on an empty site on the outskirt of town than attempt to separate it on-site and recover the materials.

Since the construction industry is a labour intensive industry, in order to bring about any change in waste reduction practices, it is fundamental that construction industry stakeholders are part of this discussion. Stakeholders in decision making roles such as clients, architects, builders, planners, engineers, project managers as well as trades people are all critical to the success or failure of any waste management plan. Especially significant is the fact that their behaviour is conditioned by their attitudes towards waste reduction, their resistance to change, their need to conform to new social norms and their perception of the problem. Therefore, it is essential to understand the attitudes of the stakeholders in order to recommend effective models of regulations and incentives.

This paper argues the need for context specific research on C&D waste in remote regional towns such as Alice Springs. It suggests mapping the waste streams generated, as well as using Ajzen's theory of planned behaviour as a framework for obtaining insights into stakeholder behaviour regarding reducing and recycling building waste.

2. The case of Alice Springs

Alice Springs, located in Central Australia, is the second largest population centre (28,000 approx) in the Northern Territory after Darwin. The largest industry sectors of this region are mining ($552 million), Construction ($313 million) and Health care and social assistance ($240 million) (NTG, 2013). The construction industry employs the fifth largest number of people after public administration, health, education and accommodation and food structures. In this context, it is critical to pay attention to the reduction of construction and demolition waste in Alice Springs. At the same time, the issues related to C&D waste in Alice Springs are very context specific.

The primary barrier to C&D waste management in Alice Springs, as well as the Northern Territory, is the lack of baseline waste data. The only available data is for waste in Darwin City Council. Moreover, there is no current policy for procurement of recycled materials. Although there is a strategic policy through which the Territory is aiming for a 50% reduction in waste to landfill by 2020, there is lack of clarity around what the current volume/tonnes reduction to landfill are. Thus making it difficult to actually measure the success of this policy (Hyder Consulting Pty Ltd, 2011).

In the case of regional towns, such as Alice Springs, the cost of transport of even virgin materials is considerable and raises the overall cost of construction. All building materials have to be freighted by road or railway to Alice Springs. Additionally, higher fuel prices in Central Australia add to the cost of the building materials as well as to the cost of running construction machinery (Szava et al., 2007).

Due to limited or no C&D waste recovered, the reused materials have very little market and must compete with virgin extracted material market. Recycling of materials is very different in Alice Springs because of its remoteness and lack of access to recycling centers. Unless there is a local market or a facility to recover C&D waste materials in the vicinity, the C&D waste is likely to be landfilled. As stated in the report by Hyder Consultants,” Materials tended to be transported to the closest site, whether this was a landfill or reprocessor, due to the expense of materials cartage and the relatively low value per tonne of recovered product” (Hyder Consulting Pty Ltd, 2011). The other generic challenges towards recycling in regional towns are lower landfill levies than cities, non-availability of re processors,
availability of private land for illegal dumping, assuming waste is a by-product of construction and therefore lack of awareness of waste reducing approaches.

A feasibility study done by the Alice Springs tip operators in 2006 identified barriers regarding overall waste (not specifically C&D Waste) as low resale price of recovered materials, high transport cost of carrying recyclables to recycling centers and lack of financial incentives at the regional scale (Bowerbird Enterprises Pty Ltd, 2006). Although the Northern Territory Government, Alice Springs Town Council, and NGO's such as ALEC have initiated schemes to promote the reduction and recycling of domestic and commercial waste (Eloise, 2009), no initiatives have been taken to reduce the C&D waste. Since context specific research on C&D waste streams is lacking, it is difficult to suggest solutions towards reducing or recycling waste. This study aims to fill that gap. Therefore, not only is it fundamental to raise awareness about regarding C&D waste in Alice Springs it is even more important to address the apathy in the construction industry towards reducing waste.

3. Sources of waste generation

Waste streams from a building are generated throughout the life cycle of the building involving new construction, renovations and finally demolition.

![Figure 1: Waste generated during the lifecycle of a building. (source: Cochran and Townsend, 2010)](image)

For long, waste was regarded as something to be collected and disposed of. Now a fundamental shift is occurring where construction and demolition waste is seen as a resource that can be reused and recycled. Lehmann (2010) suggests that the material life-cycle loop need to be closed by transforming waste into a material resource. He urges to “move the focus to waste avoidance, behavioural change, and waste reduction”.

Construction waste has been defined by Ekanayake and Ofori (2004) as” any material apart from earth materials, which needed to be transported elsewhere from the construction site or used on the site itself other than the intended specific purpose of the project due to damage, excess or non-use or which cannot be used due to non-compliance with the specifications, or which is a by-product of the construction process.”

The waste produced ideally should be reduced, recycled or reused rather than thrown in the landfill. So how do we reduce this waste in the building sector? One of the best ways to reduce waste is to stop producing it (Ekanayake and Ofori, 2004; Osmani et al., 2006; Wang et al., 2014). The process of construction waste is a complex one involving several stakeholders, numerous materials and different construction technologies (Keys et al., 2000). In their research assessing building waste in Singapore, Ekanayake and Ofori (2004) sorted the source of waste production into four categories - design related,
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operational related, material handling and procurement related. Research by Osmani et al. (2006) concludes that although one third of waste generated can possibly be attributed to design decisions, architects do not perceive waste reduction as a high priority. In fact the common perception is that waste is largely generated through on site operations and not design and planning stage decisions. The operational wastes are attributed to errors by trades people and laborers on site, ‘damages to work done due to subsequent trades and required quantities unclear due to improper planning’ (Ekanayake Ofori 2004). Inappropriate site storage and damages while transporting materials lead to wastes generated from material handling. In addition, ordering too much or too little materials are also a source of waste related to procurement.

Literature on building waste generation is mostly from countries such as Hong Kong, Singapore and UK and very little from Australia. Additionally very few researches have been carried out on understanding the stakeholders’ attitude and its impact on their approach to waste minimization. Examining waste reduction in Australia, Crowther (2014) argues for focusing on designing for disassembly where materials and components are separated from each other easily. Study by Teo and Loosemore (2001) investigates the attitudinal forces that shape behaviour of the site operators. The research, however, concludes that it is more critical to assess the attitude of the decision makers that are at managerial levels in the construction process. Lack of information on sources of waste in Alice Springs as well as attitude of professionals involved in the construction industry identifies the need for future investigations in this area.

The above mentioned sources of waste production are generic for cities and remote towns, but the difference between cities and remote towns lies in solutions targeted towards reuse and recycling of building waste.

4. Reusing and recycling building waste

Other ways of avoiding waste going to landfill is by reusing or recycling it. The primary considerations when reusing construction and demolition materials would be acceptance and demand in the market as well as their compliance of specifications. Reusing and recycling waste from construction and demolition can be very context specific. The issues of C&D waste in smaller regional or remote towns can be quite different from those in cities. In order for any waste management plan to be implemented, it is critical to map the waste streams generated. Sorting of waste into categories such as demolition materials, wood, concrete, asphalt, plastic, metal, packaging materials, glass and others allows the adoption of specific techniques in dealing with each type of waste effectively (Shen et al., 2004)

A study conducted into the C&D waste markets in Perth Metropolitan areas revealed that the C&D recovered markets have to compete with the virgin extracted material industry (Edge Environment Pty Ltd, 2012). The construction market requires basic raw materials for construction activities. If the recycled materials are comparable in cost and quality then they can be readily used. Construction companies cite “materials cost, transport costs, specifications and usability” as the key parameters in the use of any construction material (Cardno, 2008). The virgin extraction of materials is successful because there is economy of scale there which implies that the industry generates large volumes of materials with efficient machinery thereby reducing the cost of the product. It is observed that massive materials such as concrete, asphalt and bricks have higher recycling rates in cities since these materials are heavy and cost more to dispose at landfill. Additionally, the technology to reuse concrete, bricks and asphalt is uncomplicated and well established. Crushed concrete and bricks are in sub bases for roads and pavement, replacing virgin crushed rock (Edge Environment Pty Ltd, 2012). The high landfill costs in
cities such as Melbourne and Sydney, act as deterrents when disposing heavy materials. Adelaide not only has high landfill levies but also prohibits dumping of unsorted materials in landfills which further encourages recovery of materials (Hyder Consulting Pty Ltd, 2011). Although Perth increased the landfill rates, the site operators in some cases have absorbed the difference and it does not reflect as an increase in levy.

In absence of cost being competitive, the markets for recovered or recycled materials can be expanded if the governments pushes uptake of the diverted materials through appropriate legislation and polices.

5. The role of government in reducing of C&D waste to landfill

While the government’s intention is to encourage C&D waste reduction to landfill, there has been little organised effort in Australia to facilitate this. In contrast, several European countries demonstrate best practice examples by achieving very high rates of C&D waste recycling. Although the EU has no specific legislation for the disposal of C&D waste, certain directives have helped to reduce the waste going to landfill. Firstly they have suggestions on using excavated soil which constitutes a large percentage of the C&D waste. Secondly the directives provide goals for C&D waste which led to initiatives on C&D waste recycling (Malia et al., 2013). Regulations such as pre-separation and high landfill levies are the other policy mechanisms that have had a significant impact on waste management and in some extent to increase recycling of CDW (Poon et al., 2003; Rocha and Sattler, 2009; Michael Hiete, 2011; Poon et al., 2013).

In the UK, the Landfill Tax is the main legislative tool used to support an increase in recycling and to even promote reduction of waste production through design (Sassi, 2004). Denmark is cited as the success story for achieving a 92% recycling rate for construction and demolition waste (Danish Environmental Protection Agency, 1999). The two instruments for achieving this high ratio in Denmark are: state tax on non-recycled waste and ‘agreement with Danish Contractors’ Association on selective demolition of building materials which aided pre-separation of materials (Montecinos and Holda, 2006). Similarly, the Netherlands achieved its goal of recycling 90% its C&D waste by 1990 in 1999 and since then has aimed to achieve 95% recycling of waste produced (European Topic Center on Sustainable Cosumption and Production, 2008). Germany produces the most C&D waste in Europe but also recycles or reuses 85% of this waste (Weisleder and Nasseri, 2006). The Construction and Waste Disposal Charging scheme (CWDCS) in Hong Kong has also had a large impact in terms of reducing the construction waste both on site and in landfill sites (Lu and Tam, 2013).

However the situation is more ambiguous in Australia with states and local councils responsible for regulation of waste. The National Waste Policy, (DEWHA, 2009) which sets the direction for Australia for the next ten years aims to support development of best practice across all states and territories. With regard to C&D waste, Strategy 11 in the National Waste policy states, “All governments continue to encourage best practice waste management and resource recovery for construction and demolition projects.” With the current rate of recovery of C&D waste at 55% (2008-2009) (Hyder Consulting Pty Ltd, 2011), Australia has a long way to go before it catches up with the C&D reduction targets of other developed countries. Although Western Australia, South Australia, Victoria, New South Wales and Canberra have put in successful measures to recover C&D waste materials, Tasmania and Northern Territory are far behind, with even baseline data regarding C&D waste being unavailable.
6. Using theory of planned behaviour as a framework for understanding behaviour of stakeholders

Maloney and Ward (1973) argue environmental problems cannot be solved by technology but need change of behaviour. Environmental issues such as waste reduction and recycling issues, therefore, need to be addressed by first understanding human attitudes towards waste and then attempting solutions through regulations, incentives and education. Maycox (2003) in his seminal paper demonstrates that understanding behaviour is the key to the success of any solid waste management program. The outcomes from Maycox’s three year study demonstrates research design based on well-researched cognitive psychology can lead to significant waste reductions. Often projects encouraging waste reduction are not successful due to lack of any theoretical underpinning of the research design (Barr et al., 2001; Tonglet et al., 2004).

Ajzen’s Theory of Planned Behaviour (Ajzen, 1993) can provide a cognitive framework to understand and explain behaviour and to get insights into factors that underpin stakeholders’ behaviour towards waste reduction. The Theory of Planned Behaviour (TPB) has been widely tested, providing new insights into range of factor’s influencing people’s behaviour in an environmental context such as recycling behaviour and green marketing (Taylor and Todd, 1995; Chan, 1998; Harland et al., 1999; Teo and Loosemore, 2001).

The theory which developed from the earlier Theory of Reasoned Action (Ajzen and Fishbein, 1980), assumes that people have a rational basis for their behaviour, in that they consider the implications of their actions. It considers three aspects of influencing behavioural intentions - attitude, subjective norms and perceived control. The attitudinal behaviour is predicated on a person’s evaluation of a certain type of behaviour and is based on personal beliefs or knowledge of the outcomes of it. It could be based on, for example, a positive experience of working on a project that had successfully implemented a waste reduction plan. The second aspect is the social norms which are an individual’s perception of the social pressure to perform or not to perform certain behaviour. The third is perceived control, which refers to an individual’s perception of his/her ability to perform or not perform that behaviour. This reflects past experiences as well as anticipated obstacles in doing so.

This project builds upon the work done by Teo and Loosemore (2001) investigating attitudinal forces that shape behaviour at the operations level in the construction industry using the framework of TPB. Their study only took into account the attitude of the operational staff and identified the importance of examining attitudes of other groups for achieving higher rates of waste reduction and recycling. Therefore, this study concentrates on understanding the attitude of a range of stakeholders from the building industry towards decreasing volumes of C&D waste going to landfill.
The aim in this research is not to test Ajzen’s theory of planned behaviour but using it as a framework for revealing operative’s beliefs and perceptions of difficulty or ease towards building waste recycling. This would provide a rigorous set of evaluation criteria to determine the individual’s knowledge base and awareness of their role in the waste generation process and what they consider impediments to effective adoption of waste management strategies.

As Stern (2000) explains that there needs to be a combination of interventions for any behaviour change. There is a need for combination of incentives and information for achieving successful outcomes. He gives the example of investment in home insulation. “To promote investments in home insulation, for example, it is necessary to reduce the financial barriers, provide accurate information on which actions would be effective, and reduce the difficulty of getting the information and finding a reliable contractor. Programs that did all these things were vastly more successful than programs that only did one or two.” (Stern, 2000)

7. Research design

The aim of my project was to identify context specific approaches towards recycling and reducing waste in Alice Springs. These approaches are examined under two categories—how the remote location of Alice Springs is impacting efficient recycling of various streams of building waste and the other is the attitude of the stakeholders within the building industry towards building waste recycling.

A two fold qualitative research approach was adopted for this study. First, a thorough literature review was adopted to obtain insight into the waste minimization and recycling debate in construction as well as assessing the role of stakeholders in improving waste reduction. Secondly, 22 semi structured interviews were scheduled to be conducted with professionals related to the building industry as well as those involved in recycling building waste. The stakeholders selected were from the following categories; Builders (10), plumbers (2), electrical contractors (2), civil work contractors (2), recyclers and landfill operators (6). The building related participants were randomly selected from the yellow pages. It was decided to use interviews rather than postal survey since the participants were more likely to spend 20 minutes answering questions than filling in a survey and posting it back. Also since Alice

![Diagram of Theory of Planned Behaviour]

Figure 2: Theory of Planned Behaviour adapted from Ajzen (1991)
Springs is a small town (25,186 population), it is easy to get introductions and to organise meeting times for interviews.

The interview questions are designed to map waste streams generated, examine reasons for low level of building waste recycling and get insights into attitude of stakeholders towards waste. The interview questions were tested in a pilot study to ensure ease of understanding and clarity.

The first set of questions related to identifying the waste streams generated and their disposal methods during the construction of buildings in Alice Springs. The next set of questions contained questions on recycling attitudes, perception of social pressure to recycle waste and factors which may facilitate or inhibit recycling behaviour. Most attitudinal surveys are usually conducted through a Likert-type scale for questions. However in this case, since the target population is small, open ended questions gauging stakeholders attitude were included within the interview questions. The focus was on getting insights into behaviour rather than making generalizations.

The analysis will consist of using the collected data to map the existing flow of waste building materials from the construction site. This would identify different waste management practices prevalent and types of waste. This information is essential before any recommendations leading to increased recycling are made. The second set of analysis will use the data collected relating to stakeholders attitudes towards building waste. This data will be categorised into themes that emerge from the interviews.

The interviews will be carried out in October and November 2015 and the preliminary results will be presented at the time of conference in December, 2015.

7. Conclusions

In this paper, the primary argument is that solutions regarding C&D waste cannot be generalised to cities and regional centres alike. Cities have the critical mass of recycled materials along with a demand for recovered products. Regional centres suffer a disadvantage because of small population and distances from major recycling centres. The cost of transporting virgin materials to remote regional centres adds to the cost of construction considerably and can be resolved to an extent if the C&D waste is managed efficiently and recovered in sufficient quantities to supply to the local market. The other major deterrent to recycling and reducing C&D waste are the low tip fees and available land on the periphery of towns. If the tip fees are increased marginally, there is an increase in illegal dumping in the bush or on vacant lands rather than more efficient on-site waste sorting or increase in recycling.

Often stakeholders do not realize that waste management can be a cost saving measure. There is a lack of awareness of waste generated at the design stage or how a life cycle waste can be minimized by designing for disassembly. The town councils are unaware that not providing specifications for reused materials can be a deterrent for recycling as well as not setting specific targets for waste reduction. Until perceived obstacles are not identified, it is difficult to suggest specific solutions. It is this situation that the theory of planned behaviour can help get insights into. Results from a research using theory of planned behaviour can then help formulating effective policies and incentives for waste reduction which are context specific.
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References


