

## **MSUS Culminating Experience Report Requirements**

### **Culminating Experience Final Report**

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Construction and demolition waste impact, policy and diversion

Stardust Building Supplies

#### **Abstract**

Humans, throughout the world, build houses to live in and raise their families. The construction of houses and other buildings produces a large quantity of waste during this process. This waste is not necessarily biodegradable or derived from environmentally friendly materials. They often damage the environment causing pollution and contributing to greenhouse gas emissions (Tam, V. W., & Tam, C. M, 2012). This type of waste is categorized as Construction and Demolition(C&D) waste.

My culminating experience focuses on C&D waste and this summary is divided into three parts. In the first part, the report covers the impact of the C&D waste in sustainability. Considering the three pillars of sustainability the effect of C&D waste on these three pillars are analyzed. The second part is the policy analysis surrounding current C&D waste in cities within the states of Arizona, Oregon and California. This section also covers the current practices and impact that the policies have had in diverting C&D waste from landfill. The report features application of conceptual mapping to explore the issues surrounding C&D waste in the circular economy, and intervention points for waste diversion. The third part of this project focuses on a selected intervention point: Community engagement, and education. The report also discusses the processes and strategies applied to organize an event to create art from salvaged building supplies. Stardust celebrated their 20<sup>th</sup> year anniversary in April 2017. In collaboration with them, the “Salvage This” event was organized to engage with artists, to exhibit arts created from salvaged building supplies, and promote reuse concept in the community.

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### 1. Introduction

Waste is an unnecessary drain on otherwise useful resources. Despite the increase in recycling and composting activities in many states and cities, C&D waste is largely ignored. The fundamental issue with this waste management is the logistical complexity of classifying, sorting, diverting and recycling. Furthermore, in today’s world, we synthetically produce many materials which are inexpensive, but difficult to economically recycle. To better understand the current situation, this report assesses C&D waste policies in several states and cities. The intent is to establish a baseline for current practices in this area. The next focus is on the conceptual mapping of the material flow by discussing closed loop management of construction and demolition (C&D) waste. Finally, the report describes a collaborative outreach project, with Stardust Building Supplies, to understand their business and impact in the community by salvaging building supplies.

Core goals and outcomes of my project:

1. Assessment of policies around C&D waste in certain Oregon, California and Arizona cities. As an outcome, the report covers the opportunities for the state of Arizona to implement C&D waste policy changes.
2. Conceptual mapping of the flow of C&D waste and an identification of intervention points.
3. “Salvage This” event: Collaborative outreach project with Stardust. An event was organized to create art from salvaged building materials to promote reuse in the community.

## 2. Background and Context

What is Construction and Demolition waste?

According to EPA, C&D materials are generated “when new building and civil-engineering structures are built and when existing buildings and civil-engineering structures are renovated or demolished”. It includes materials such as concrete, wood, asphalt, metals, bricks, glass, plastics, paint, salvage building components (doors, windows, cabinets, etc.). Table 1 is derived from the data in the Environmental Protection Agency (EPA) Sustainable Material Management fact sheet for 2014. This shows that C&D waste is clearly the largest waste sources, and therefore requires more focus and solutions. About 90% of this waste is produced from demolition whereas only 10% comes from construction (EPA 2014).

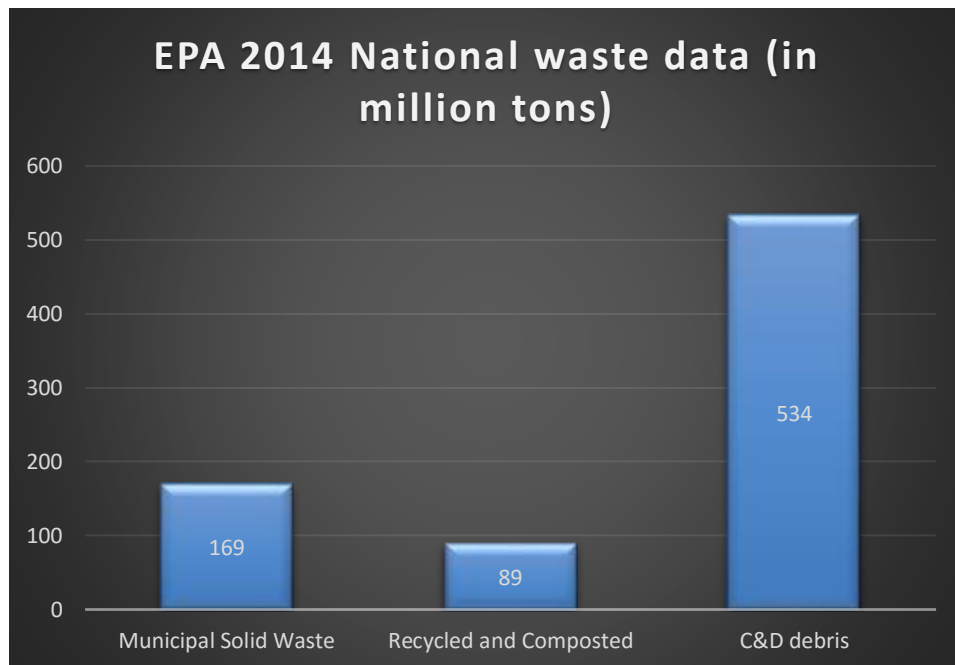


Table 1: EPA 2014 National waste data

Even though the EPA has national data on C&D materials generated for 2014, there is no data regarding C&D waste generation in the state of Arizona. Currently Arizona Department of Environmental Quality (ADEQ) does not capture any information regarding C&D waste. Capturing information is important to measure the amount of materials that are ending up in the landfills. This will also help to understand the amount of materials which can be saved and divert from the landfill.

The second challenge is that the amount of C&D waste generated is dynamic. This is because at any given time, the quantity of waste being generated is directly dependent on the level of construction and demolition work that is happening in any place. Missouri reported that about 5% of their solid waste is construction waste, while about 13% of their solid waste is demolition waste. California reports that about 12% of their

total waste consists of C&D waste. However, it can increase up to 30% during construction booms.

The third challenge of C&D waste is differences in the sub-classification of these materials. It is important to consistently classify different types of C&D wastes to increase diversion. Providing clear information to relevant parties about material types will help improve diversion rates over time. As an example, Missouri has produced clear documentation on the relevant differences between construction waste and demolition waste.

This report discusses one of the main intervention points – community engagement. This may help to find solutions in recognizing and managing C&D waste. The strategies discussed can help to recover materials, provide jobs, prevent pollution, reduce greenhouse gas emissions and contribute to the circular economy. The report also explores C&D waste policy, discussing contractors C&D material practices, promoting to reduce, reuse, recycle, upcycle of building supplies and coalitions for green building.

#### About Stardust Building Supplies:

Stardust Building Supplies is a non-profit organization. They sell salvaged building supplies such as doors, wood, bricks, windows, appliances, marble, furniture, paint among many other materials. Stardust's business model is based on the donors donating gently used building supplies, these are then bought by Stardust's customers. Stardust's clients purchase materials from them due to following reasons: materials are less expensive, to create art, and for supporting reuse market. This information was gathered by talking to the customers visiting Stardust.

These items otherwise would end up in the landfill. Stardust's retail model uses salvage materials to sell to their customers at a discounted price. After discounting the operational cost, the revenue generated is invested in supporting their business, deconstruction of materials, transportation of salvaged items, provide employment at Stardust, train new employees, support their "Gifts in Kind" program.

About 65% of the items that Stardust acquires is from drop off from clients. These clients include independent home owners, small business owners or corporates such as Walmart, Home Depot, etc. About 25% of the items are acquired by pick-ups. Pick-ups include curbside pick-up which are organized by Stardust once a month at Mesa, Tempe and Phoenix locations. The other 10% of the items comes from deconstruction. Stardust offers free deconstruction/pick-up if the value of the items is worth more than \$100. This value is decided when the front desk representative speaks to the client over the phone. Clients explain the type of material that they have, if it needs to be deconstructed or just picked up. For deconstruction, Stardust sends in a crew who are well trained to dismantle items without causing any impact on the quality of the product. Deconstruction can include process such as removing kitchen cabinets, bathroom cabinets, sink, doors, windows, etc.

### 3. Project Approach

The approach is to use the Life Cycle Assessment (LCA) model of cradle-to-grave material flow. This linear flow of materials shows the current management of C&D waste.



Figure 1: Linear model of material flow

Three main questions were asked from the linear model:

1. What is the impact of the linear flow model?
2. What are the intervention points?
3. What are the strategies taken to make this into a circular model as shown below?

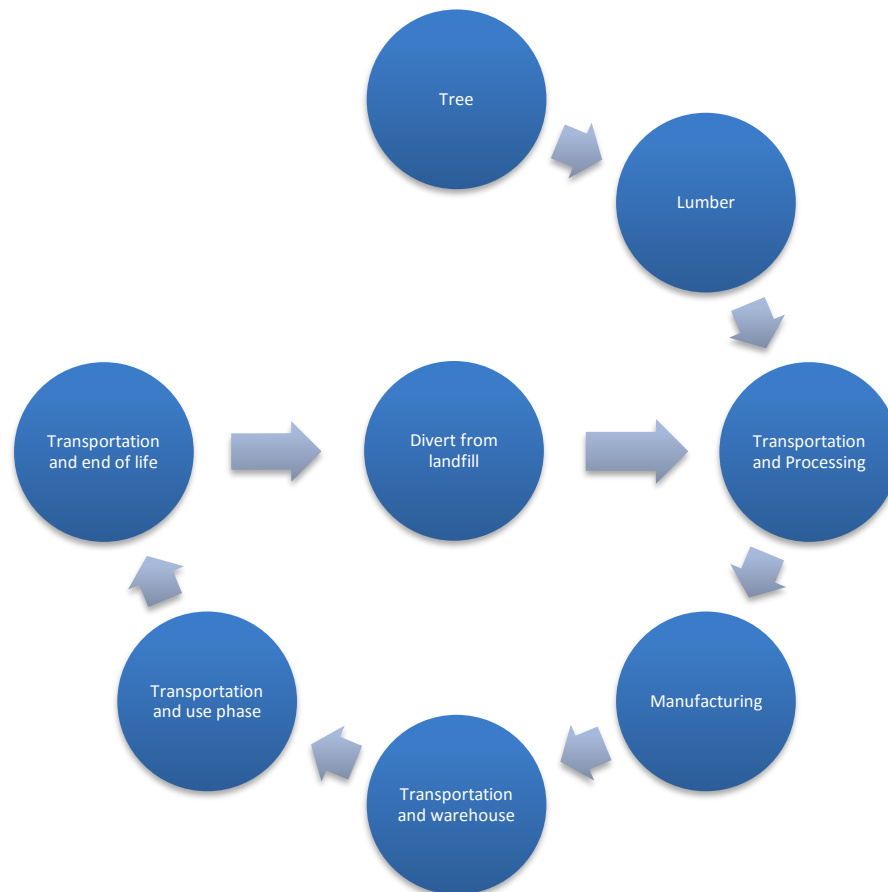


Figure 2: Circular model of the material flow

### Impact:

To understand impact of the linear model on the material flow, the report considers three main aspects of sustainability (Hall, T. J., 2011): Social, economic and environmental. C&D waste which ends up in the landfill directly affects the quality of life that underprivileged live in. The materials could be utilized to improve living conditions of the poor through implementing social housing projects (McGrath C, 2001). However, current regulations allow these wastes to be disposed at an inexpensive price (Tempe). C&D waste has a significant impact on the environment leading to increase in greenhouse gas emissions contributing to the climate change (Marzouk, M., & Azab, S., 2014). The economic incentive of recycling outweighs the cost of landfill in many folds (Gui-min, N. I. U. 2005). NRDC 2008 report shows that for every 1000 tons of waste generated, recycling can create 6-13 jobs.

### Policy analysis:

To understand why the model is currently linear, the report examines the policy surrounding C&D waste in Oregon, California, Missouri and Arizona. Oregon and California were chosen because of their progressive environmental policies and proximity to Arizona, and Missouri was chosen because they have detailed and specific policies in this area. Therefore, analyzing policies surrounding these states will help in benchmarking and creating a vision for Arizona's C&D waste diversion and policy.

### Diversion strategies:

The diversion strategy is created to address limitations in the current policy. Primarily this involves improvements in community engagement as a bottom-up approach to address C&D waste diversion.

## 4. Methodology:

This section of the report is divided into three sub-sections: Research, intervention points and solutions.

To understand C&D debris impact in the linear model (Figure 1), several LCA studies of C&D debris were examined. Therefore, the main intervention point that is focused in this report is between use phase and end of life. For this intervention point, it is important to understand the current policies and waste regulations. Focusing on the city waste regulations in Arizona, the report considers cities closer to Stardust's Mesa location: Tempe, Phoenix and Mesa were selected for the analysis. The findings are presented under findings section of this report.

We next focus on community engagement to address C&D waste issues. This intervention point consists of educating the public about C&D waste, organizing events and recycling programs to influence residents to divert C&D waste from the landfill. Community

engagement involved local artists taking part in creating art using salvage building materials and a collaboration with Stardust to organize their 20<sup>th</sup> anniversary and involve “Salvage This” event (appendix 1).

## 5. Findings

Oregon (ODEQ and Portland Gov.)	Missouri (Missouri Gov.)	California (CalRecycle)
A recovery program for construction and demolition debris that requires construction and demolition debris to be source separated at the generation site or sent to a material recovery facility for processing and recovery	Detailed description about C&D waste. Difference between construction waste and demolition waste.	Extensive research on C&D waste management implemented statewide.
Have a dedicated webpage about C&D waste - includes basic description of C&D waste	The website is very recently updated on Feb-2017	Informs about the amount of C&D waste generated, types of C&D waste
Portland Bureau of Planning and Sustainability provides resources to manage C&D waste	Detailed information about demolition or re-innovation waste for public.	Onsite sorting of C&D waste which other places do not implement
Resources related to C&D waste includes alternate ways of handling C&D waste	Asbestos handling and contact information for proper disposal.	Different materials and amounts of each material that is recovered.
Covers history of C&D waste policies structure and how it all started.	Burning of C&D waste debris with regulations and contact information on the website.	Resources informs about Green building practices for contractors but also available for public to be informed and educated.
Tools to understand C&D waste	Tool kit consisting of discussion on C&D waste helps public to understand the city is serious about it.	
At least 13 recycling programs offered by Oregon Department of Environmental Quality for local government to choose from.		

City of Tempe (Tempe Gov.)	City of Phoenix (Phx Gov.)	City of Mesa (Mesa Gov.)
Pilot program to divert C&D waste launched in 2012. Capturing concrete, asphalt and metal	Do not have information about C&D waste	Describes about C&D waste but is not obvious in their website
Not clear about the metrics used and analysis done	Separate program for recycling appliances	Separate recycling programs for textiles, appliances and paint
No clear description of C&D waste	Webpage mentions appliances could be recycled in Household hazardous waste program but fails to mention about it in the webpage.	Environmental requirements for construction activities but no demolition activities
No follow-up information about whether the program still exists or not.	Pick up fee for each appliance which is \$20 may discourage people from participating in the recycling program	
	Phoenix has 40 percent landfill diversion goals as a part of zero waste initiative by 2020. But fails to cover C&D waste category.	

Table 2: C&D waste policies (Please refer to references section for more city/state policy data)

Based on the policy analysis, to transform the linear model of material flow (Figure 1) to the circular model of material flow (Figure 2), presented below are the key proposed changes based on the intervention points.

Policy

- The process of capturing data should be improved to mandate minimum diversion percentages and more closely define prohibited materials in landfill.
- ADEQ need to clearly define C&D waste and apply more regulations for handling the waste. This also requires providing specific examples which can make it easier to understand for the contractors or individual home owners.
- City of Tempe currently allows residents to use landfill up to 2000 pounds for free, they can implement policies tied to their zero waste events and diversion rate goals.
- City of Phoenix also should improve C&D waste policy in addition to their 40 percent trash reduction by 2020 goals.



- Stardust can be an intervention point where they can improve data collection and help understand the diversion process and types of materials that are being diverted.

#### Education

- Donors receive tax breaks for donating items to Stardust, so there is an economic incentive. They are also helping the environment by saving resources which otherwise contribute to greenhouse gas emissions.
- Engaging with contractors to help them understand the environmental and societal impact along with the economic incentive they are receiving

#### Community engagement

- Through Stardust's "Gifts in kind" program, they are helping underprivileged people in the valley to receive resources which otherwise they would not have access to.
- Provides employment to large numbers of unskilled workers locally.

## 6. Conclusions and Future Directions

To conclude, C&D waste is one of the major challenges in waste management. There has been recent progress particularly in food waste, plastic and paper recycling. However, more progress needs to be made in C&D waste management. The nature of C&D waste being more resource intensive (Begum R et al., 2006) improves the economic viability of sustainability. The biggest problem is the lack of data and information.

#### Recommended steps:

1. Clearly define components of C&D waste and standardize it.
2. Capture specific data to quantify the amounts of waste generated in Arizona. This will aid in the creation of any new policy in this area.
3. Train contractors to handle C&D waste in specific ways.
4. Build a C&D coalition within Arizona. This will help to share best practices and a community to support recycling of C&D waste.
5. More carefully quantify incoming and outgoing materials from C&D waste salvage operations such as Stardust. Capturing of incoming and outgoing items helps to identify the diversion rates.


## 7. Appendices and Acknowledgements

### Appendix A

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Reduce Reuse Up-cycle

# Celebrating 20 years of reuse




Support a local green organization with your art


**CALL FOR ALL  
ARTISTS, MAKERS,  
UPCYCLERS**

Do you love creating unique art, furniture or décor out of salvaged or second-hand materials? Donate your creations to Stardust's Salvage This! Silent Auction to help raise funds to support their reuse mission.

Artwork credit: Christopher Gerlings



Artwork credit: Rob Freithoffer



Email: Soumya at [spartha8@asu.edu](mailto:spartha8@asu.edu) for registration process.  
Event is at: 1720 W  
Broadway Rd, Mesa, AZ  
85202

**Last date to register:  
March 10th**

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VISIT [WWW.STARDUSTBUILDING.ORG](http://WWW.STARDUSTBUILDING.ORG) FOR MORE DETAILS

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