



ENGINEERING in CONTEXT

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You are an engineer at a consulting firm retained to provide civil engineering design services for the electronic waste recycling facility in Giuyu, China, described in the scenario below.

Comment on any ethical considerations related to your employment in this case, with appropriate references to the Code of Ethics of the American Society of Civil Engineers provided on page 3.

This commentary of 400-800 words is required for successful completion of CVEN-4000. It will be graded on a pass/fail basis. This commentary will also be used to assess the following:

- Your understanding of professional and ethical responsibility (ABET Student Outcome F)
- Your ability to communicate effectively (ABET Student Outcome G)

Life Cycle for E-Waste *

Meet Xiao Zhang. This forty-year-old former farmer and current resident of Giuyu, in the Guangdong Province of China, has never used a computer, photocopier or iPhone. In spite of this, Xiao has quite possibly interacted with every single high-tech component known to man every day for the last six years. His job? Scavenging electronic parts and melting lead solder off circuit boards in what may be the largest E-waste dump on earth. In exchange, he makes less than three US dollars a day.

Twenty to fifty million metric tons of electronic waste are generated globally each year. Electronic waste, known as E-waste, is composed largely of computers, phones, tablets, laptops, MP3 players, televisions, monitors, printers, etc. Only 10-18% of E-waste is recycled whereas the remaining E-waste is taken directly to landfills. E-waste represents only 2% of trash in US landfills, but constitutes 70% of the overall toxic waste in landfills. The amount of E-waste is growing 5% annually.

There is substantial economic rationale to recover or refurbish E-waste products. When possible, some electronics can be refurbished and used by new users. When a reuse opportunity is not identified, E-waste can be processed to reclaim valuable materials within. E-waste typically has multiple types of valuable material including gold, silver, aluminum, and copper. When processed properly, valuable materials are recovered, hazardous waste is properly treated and expensive and potentially damaging mining operations to acquire additional raw materials can be avoided. Unfortunately, a substantial amount of E-waste is being exported to China, India, and Africa for recycling where labor costs are low and environmental regulations are not prevalent.

* McCormack, J.P.; Beyerlein, S.W.; Kranov, A.A.; Pedrow, P.D. (2014), Scenario and Scoring Sheet Development for Engineering Professional Skill Assessment, Paper ID #9942, 121st ASEE Annual Conference and Exposition, Indianapolis, Indiana, June 15-18, 2014.

In Guiyu, Xiao Zhang and about 100,000 other workers scavenge E-waste for recoverable materials, earning a wage five times more than they would earn as a farmer or laborer. Unfortunately, about 88% of the workers are afflicted with neurological, respiratory, or digestive abnormalities. The local river is poisonous. The local groundwater is also undrinkable. A recent reduction of some coal furnaces has returned the air to levels that are technically habitable. The children of that region have 50% more lead in their blood than typical values. The Guiyu scavenging operation is not legal by Chinese standards, but the venture is so profitable that it continues to thrive. E-waste is sold to government organizations like Guiyu because they are the lowest bidders. The exports from the United States alone are substantial. In 2011, Americans disposed of about 130,000 computers and 300,000 cell phones every day.

A number of companies have instituted high profile hardware buyback or recycling programs where consumers can send their products back to the manufacturer for processing and reclamation. This is clearly a positive environmental and marketing move. Many of these same companies have also increased the amount of E-waste produced from their products. Mandated changes to use lead free solder has reduced the amount of harmful materials in the electronics device but has caused design and reliability problems. These problems may be increasing the total amount of E-waste. Additionally, the past 5-10 years has seen a dramatic increase in the “disposable electronics” mentality. Product lifecycles for phones, laptops, televisions, etc. have been reduced and the culture of early adoption forgoes environmental responsibility for the latest, greatest technologies. Manufacturers have fed into this culture of continuous change by designing obsolescence into their products by, for example, changing their car charger plugs so that consumers will have to buy all new accessories.

References

- “China’s Electronic Waste Village”, Time, Walsh, B., Jan 2009,
- “Was Lead-Free Solder Worth the Effort?”, Electronic Component News, Titus, J., Dec. 2011
- “E-Waste: How the New iPad Adds to Electronic Garbage”, Time, Walsh, B., March 2012

Appendices

1. Code of Ethics of the American Society of Civil Engineers (page 3)
2. Rubric for ABET Student Outcome F (page 4)
3. Rubric for ABET Student Outcome G (page 5)