Waste Management Issues Concerning Personal Computers

Introduction

The United Kingdom is well known for being a high-populated and urbanised society. Population levels are set to rise by 5 million by the year 2027. The UK is the second largest emitter of sulphur dioxide and nitrogen oxides per capita, and levels of recycling are among the lowest in Europe.

Unfortunately, techniques like "environmental impact assessments" tend to be used to facilitate further exploitation of the environment, assessing how far it can be stretched. The effort does not seem to focus on reducing human impact or about environmental protection, restoration and rehabilitation.

A whole cocktail of environmental problems is emerging from the above-mentioned situation. Computer recycling represents a significant challenge, and is therefore the object of this piece of work. A recent study by Carnegie Melon University (USA) predicted that by the year 2005, there will have been approximately 150 million personal computers (PCs) and workstations sent to landfills. There is not a single biodegradable item in a computer, and they do not belong in landfills.

Recycling personal computers

The environmental benefits of recycling (saving on raw materials, extraction, transport, energy) extend beyond the immediate area where the waste is dealt with. As regards personal computers, it is important to consider the materials related to its manufacture, the manufacturing processes and all the current policies to deal with their results. Moreover, the design process as a whole might have to be reconsidered, from concept to distribution. As new technology becomes less expensive the cost of removing the old technology becomes a major cost factor in an upgrade budget; thus the value of the older equipment may no longer cover the cost of removal. The "Design for Manufacturing" philosophy should be replaced with "Design for Disassembly" instead, in order to make recycling easier to achieve. Although still unknown, the best practicable environmental option for waste management should be much further back in the production / distribution chain.

A careful analysis of the issue and a careful look at the policies in others countries may highlight good practices that can be used by the engineers who are involved in the computer's design and manufacturing process.

There are approximately 6 pounds of ABS or polystyrene plastics found in a standard desktop computer system, which includes a CPU, monitor, keyboard and mouse. Each pound of plastic requires 2 cups of crude oil and 50 cubic feet of natural gas to manufacture. Thus each new computer system requires 1 1/2 gallons of crude oil and 300 cubic feet of natural gas to manufacture.

Here is a list of the most common materials found in a ton of random electronic boards:

Material	Lbs/ton	Material	Lbs/ton
Plastics	600	Cadmium	0.79
Copper	286	Tantalum	0.38
Iron	90	Molybidenium	0.31
Bromine	56	Palladium	0.25
Lead	54	Beryllium	0.18
Tin	44	Cobalt	0.17
Nickel	40	Cerium	0.10
Antimony	22	Platinum	0.07
Zinc	9	Lanthanum	0.06
Silver	1	Mercury	0.02
Gold	1	Source: Technical University of Denmark	

Opinions and practices on dealing with these materials vary according to companies and countries. After showing the substances commonly found in computer manufacturing it is also necessary to explore the ecological implications of each component:

- Monitor glass: The cathode ray tubes are heavily leaded and are considered hazardous waste. However, there is an economically viable recycling method that grinds the glass to a powder, which is resold to cathode ray tube manufacturers, creating a true circular life cycle. Another use for the ground leaded glass is flux used in smelting operations.

- Precious Metals: Electronic boards may be sent to precious metal refiners. Unfortunately, as computer manufacturers strive for lower costs, they are reducing the amount of precious metal in the manufacturing process, which makes the entire recycling process less economical.

- Batteries: One of the most environmentally dangerous items found in today's computers are the nickel cadmium (NICD) and nickel metal hydride (NIMH) batteries used in laptop computers, and lithium batteries used in all computers to save times and dates when computers are powered down. This still remains an unresolved problem. There are some specialised recycling facilities located in places, such as Pennsylvania, USA, where all nickel based and lithium batteries disposed in the USA are sent to.

- Metals and Plastics: This is where the true challenge of recycling computers lies. 80% of the volume is miscellaneous metals and plastics, which are all intermixed in a small container connected by screws, bolts, rivets, and/or glue. Further disassembly is a manual process and extremely uneconomical. The cost of the labour far exceeds the cost of the separated recyclable materials.

For a long time, incineration with energy recovery had been believed to be a good approach to waste management. Unfortunately, some recent studies at Teesside, UK, have shown that incineration should be seriously challenged as it can lead to 'waste maximisation'! It seems to be a poor quality, low-job high-capital, heavily subsidised, potentially hazardous, very expensive way of dealing with waste, and moreover it militates against any progress to construct a sustainable waste strategy. It demands more waste, not less! PCBs are among the major sources of dioxins (particularly released in incineration) and which damage the ozone layer. The researchers at Teesside believe that incineration is so environmentally damaging by demanding so much waste for so many years to come that the proper environmental standards and legislation (such as the UK Wildlife and Countryside Act of 1981, the UK Environmental Legislation & Land Use Planning and the Environment Protection Act

of 1990, for instance) are made subservient to commercial priorities. Today's environmental laws do not deal with the horrendous consequences of millions of tons of desktop computers being disposed every year.

Intelligent and alternative practices

Future trends show a decrease in the number of recycled computers, against an increase in computer manufacturing of more than 15% a year, according to the 1998 National Safety Council Report of the USA. Being able to reuse some of the obsolete equipment would appear to be a good solution. The use of a single refurbished computer and the repair or upgrade of an older computer using refurbished parts means one less new computer manufactured. Repair schemes can also create jobs.

Although it seems that adopting this kind of policy can lead to a non-profitable business, it is fact that many electronics manufacturers are reaping great savings from pollution prevention efforts. Examples are abundant: 3M has saved over $ 1 billion since the establishment of its environmental program in 1975; one division of Hewlett-Packard has saved $ 17 million a year by recycling and reusing parts and metals; Canon has cut laser printer maintenance costs by recycling 95% of collected laser cartridges; Fuji Xerox recycles 33% (by weight) of their copiers, fax machines, and workstations, saving $ 3.3 million annually in parts' costs. Environmentally conscious technologies and design practices will allow manufacturers to mitigate disposal problems by cost-effectively manufacturing long-life recyclable and reusable products that will no longer need to go to landfills.

European Policy

The German electronics industry participated in the drafting of the "Ordinance on Prevention, Reduction and Recycling of Waste from Used Electrical and Electronic Equipment ", which requires mandatory collection and maximum possible recycling of computers and consumer electronics by their manufacturers and local suppliers.

In the United Kingdom, an electronics industry-working group has been established by the Centre for the Exploitation of Science and Technology (CEST). Created in 1987, CEST helps companies to identify new areas of business opportunity. Because the European Community could potentially pass mandatory electronics take-back legislation, the CEST working group has been commissioned to study recycling options for used electronic equipment.

Another important initiative in the UK came from a group of 32 microelectronics manufacturers who have joined forces to draft an "Environmental Code of Practice for the Microelectronics Industry." The code of practice will outline the current best techniques and standards for preventing or minimising emissions from microelectronics facilities. The code will serve to highlight opportunities for increasing knowledge and developing new pollution prevention technologies.

There is huge potential for using economic and other regulatory instruments to improve efficiency and encourage more sustainable options, such as subsidies for environmentally sounder alternatives (reused or recycled products). However, whatever interventions in the domestic production process are made in the UK, there is a risk that it will leave UK enterprise commercially less competitive in a global market in which trade barriers are constantly being challenged and brought down.

Looking to the future

Companies are being increasingly required to find the best way to deal with their own waste. However, the system in which we live does not allow different countries to join forces to research this world worry: companies are tuckling environmental problems individually rather than in a cooperative manner, because they are not willing to share proprietary information.

Nevertheless, there are general measures that encourage a sustainable local economy, which must be implemented to achieve an environmentally conscious infrastructure for the computer industry.

The product can either be refurbished for resale as a complete unit or disassembled for spare parts. Then, it can return to the public in a low-cost scheme: direct selling via the Internet was found to be the most effective tool to present refurbished computer equipment to the public.

Besides, there are practices that must be introduced at the design stage, in order to allow recycling without many disassembly efforts:

- Many components could be brought together to form one module;
- Additional components should be mounted in the final stages of assembly, using specially designed two-way fixings, in order to avoid breaking the recycling loop;
- Breakout systems could be used instead of bolts, in order to increase disassembly speed;
- Snap combinations and fasteners could be used, as well as non-return clip fasteners, providing ease in disassembly for recycling or reuse of the components;
- When the use of metal fasteners is unavoidable they should be removed by reversed assembly motion or design breakout areas.

These directions will certainly help to lead to an effective waste strategy, using easily disassembled product configurations and materials which readily break down in the environment.

Unfortunately, the commitment made at the design stage for easier "demanufacturing" and the utilisation of more easily recycled components flies in direct opposition to the "low cost" mentality of computer manufacturing policies. However, given the increasing cost of managing pollution, environmentally benign production is now both a business and a technological issue. Less waste produced means less money spent on disposal costs and pollution control.

The will to leave behind a better world - less polluted and contaminated - must result in design policies, which bear in mind sustainable development although this option may be more expensive.

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The information provided from the Internet makes reference to the following conferences and studies, but unfortunately none of them is available in Frewen Library:

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- Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry - International Analysis, Conclusions and Recommendations : March 1993

- An industry-led study on environmentally conscious technology in the electronics and computer industry : "A Life Cycle Environmental Assessment of a Computer Workstation"