PAUL MOBBS

A practical guide to sustainable IT

Unit 10

APC

This unit is one of 12 sections to a "A practical guide to sustainable IT", a hands-on guide to working with everyday technology in an environmentally conscious way. The guide has been written by environmental activist and ICT expert Paul Mobbs, and was commissioned by the Association for Progressive Comunications (APC) with the support of the International Development Research Centre (IDRC). To download the full text of the guide, or any of the other units, please visit: greeningit.apc.org

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REUSE AND RECLAMATION

Computers and the internet have enabled a capacity for human interaction and creativity that has not previously existed in our history. However, while many enjoy the products of the digital electronics revolution, comparatively few understand the principles behind how these tools function, and fewer still have the skills required to reconfigure these systems to perform different functions. In order to ensure that these technologies support the needs of the broadest spectrum of civil society, more people need to engage with the technical mechanics of information systems – both to improve their everyday use and extend and adapt their function to meet new challenges.

One of the simplest ways to engage more people in the techniques and skills required to maintain and adapt information systems is to set up computer reuse and reclamation projects. Such projects offer a wide scope of opportunities for those who wish to take part:

- They can learn more about how these systems can be used to create more interactive media through the development of online content and audio/video media recording/editing;
- They can learn about the functioning of information systems through the installation and configuration of operating systems and software; and
- They can develop electrical and mechanical skills through the maintenance, disassembly, and construction of machine hardware.

In this unit we'll examine the last of these options – developing practical computer reuse and recycling projects. Such projects are the foundation on which the community use of information technology is based. Creating the independent capacity to reclaim and re-purpose IT hardware allows a whole range of other projects which rely on the use of these technologies to take place.

10.1. ICT "RE-CYCLING" AND "DOWNCYCLING"

The term "recycling" has been widely used since its promotion by the green movement in the 1970s. What is less familiar if the term "downcycling".[1] Recycling implies that goods or materials are reused for similar purposes; downcycling implies that the waste is processed to produce materials of a lower quality.

The quality of the material produced by reclamation is important. When raw materials are processed into finished goods a large quantity of energy is required, and this entails the production of pollution. The investment of energy and resources in manufactured goods is often described as embodied energy.[2] The benefit of recycling is that much of the energy and resources investment in the original production of the goods is retained, avoiding the need to expend resources again to produce those materials. Downcycling often involves breaking down or disassembling the goods to produce materials of a lower quality which, while they may be useful, require that the value of energy embodied within the goods is diminished. It is technically possible to re-manufacture goods from the downcycled materials, but doing so requires that we invest a greater quantity of energy and resources to achieve this.

When we look at the options for reusing digital electronics and information systems, the principles of downcycling and recycling can help us find the best options for the use of these goods. Many commercial electronic waste companies crush and fragment electrical goods,[3] even if they are serviceable, because that is the cheapest way to extract value from the collected waste. Community-based schemes, provided they have the skilled technicians available, can look instead at the options for recycling – finding new uses for serviceable goods, and only discarding those items which cannot be reused because they have reached the end of their serviceable life.

This is why the level of technical skill possessed by the community is so important to how we can maintain the value invested in the production of technology. Community-based organisations can find ways of reusing electrical goods which may not be open to commercial reclamation companies – for example repairing electrical goods to supply at low cost to low income families. Community organisations can also respond to the needs of a community by using these materials to develop low-cost community projects – such as community ICT access and training projects. Such projects help to retain the value of the energy and resources originally invested in the production of these goods, and can make them available at low cost to those who may otherwise not be able to access them if they had to pay the market value for newly manufactured goods.

10.1.1. Equipment triage

The first important step in the reclamation of electrical goods is "triage". Like medical triage, this involves separating the waste goods received by the project into different groups depending upon the serviceability of the items. This needs to be carried out by someone with experience of reclaiming electronic goods; so that they can diagnose any faults or problems which exist with them, and classify them according to the likelihood of repairing/reconditioning them.
As the electrical goods come into the project they must be sorted into three categories:

- *Serviceable* – the goods have no faults, and are in working order. In order to comply with electrical safety regulations in many states[4] this may require a qualified electrician to carry out earthing and electrical safety tests in order to certify them ready for reuse. Once certified these goods can immediately be reused by the local community without the need for further work or modification.
- *Unserviceable* – the goods may have minor faults which need rectifying. In contrast to

1. Wikipedia, 'Downcycling'. en.wikipedia.org/wiki/Downcycling
2. Wikipedia, 'Embodied energy'. en.wikipedia.org/wiki/Embodied_energy
3. BBC News (2008). Throw-away Britain: How to recycle a television. news.bbc.co.uk/1/hi/uk/7747975.stm
4. Wikipedia, 'Portable appliance testing'. en.wikipedia.org/wiki/Portable_appliance_testing

the financial restrictions which operate within commercial reclamation organisations, where the most practical economic option is to recover the scrap value of the materials, this is the type of repair and reclamation work which could be carried out at a low cost if a project could be developed to organise the required training and safety certification. Once repairs have been carried out the goods can be passed as "serviceable" and made available for use.

- *Unusable* – for a variety of reasons goods can be unusable if it is not practical or economic to refurbish/repair them. That does not mean the whole unit has no use and must be scrapped. Parts of the mechanism could be stripped down and components reused in order to provide the parts to repair unserviceable goods. Stripping down old equipment can also act as a valuable teaching aid for those learning the skills of electrical repair, and being able to separate waste materials into separate metals, plastics and waste electronics allows a high price to made from the sale of these materials to commercial reclamation companies.

Repairing computers and information devices is a very much simpler task than trying to repair the previous generation of analogue electronics. That's because digital electronics have a more standard format – although the electronics are broadly similar it's the software which makes them function in different ways. Desktop PCs are a good example of this. As outlined in unit 3, the circuit boards, cards, hard drives and other components are manufactured according to a standard design which makes individual parts interchangeable. An unserviceable PC, or a PC with an outdated motherboard, could have its case, hard drives and other components reclaimed and rebuilt with a more powerful motherboard – only the old motherboard need be scrapped.

How the reclamation process is carried out is often determined by the structure and objectives of the project. There are many examples of computer reclamation projects in operation around the world: International organisations, such as Compteraid,[5] specifically work with aid organisations to provide computers to developing countries for education and community projects; some groups are more focussed on recycling, such as Free Geek[6] (an urban project in the US), who work on a semi-commercial basis providing a community service, training and volunteering opportunities related to the reuse of ICTs; others, such as The Container Project[7] (based in rural Jamaica), are wholly community based, using IT reclamation as part of wider cultural and educational projects within the local community.

10.1.2. Finding a purpose for the equipment

Projects can run into trouble if their objectives are poorly designed, or because they lack the capacity to provide the service they desire. In the worst case they can rapidly become a dumping ground for waste electronics. Especially in those states where the disposal of electrical goods is regulated, donating equipment to community groups can be seen as the easy option for disposing of old equipment. As a result the groups can become quickly submerged in old equipment with no immediate outlet for its reuse, and no funds to pay for the disposal of it.

An important element within community-based recycling projects is having a community or body of people who are ready and able to put the reconditioned equipment to good use. Irrespective of how many technicians the group has available to carry out work, without a group of people ready and able to use/take-away the equipment the project will again become a storage area – albeit a store of repaired rather than scrap electrical equipment.

Setting up a recycling project depends upon finding people with the skills and motivation to "seed" their skills into the project. Even if the project has sufficient people to undertake the work, it is important that those administering the project take a cold, hard attitude to the acceptance of any and all waste electronics. There has to be a balance between the demand for the service by the wider community the project supports and the acceptance of excessive volumes of waste, or unusable types of equipment. Although having too little waste to recondition can be a problem for projects, having too much is equally problematic because it gives rise to storage problems and potential

5. Computeraid UK. www.computeraid.org

6. Free Geek. www.freegeek.org

7. The Container Project. www.container-project.net

regulatory liabilities for storing e-waste – all of which increase the costs and legal liabilities of the project.

Ideally any community-based recycling scheme should have its purpose defined by the users of the goods to be recycled. In that way the supply of waste goods doesn't drive the project: it's the needs of the users. By having a clear purpose the triage of equipment can proceed in a more efficient way. If those involved know the standard or purpose of equipment they require, waste can be refused before delivery; and when waste goods are accepted the triage process can focus more clearly on accepting only that equipment which meets their specifications. As a result of a more focussed approach, the project is less likely to become a dumping ground for unusable/superfluous types of waste electronics.

10.2. RECLAMATION PROJECTS

If we look at the examples of successful computer/IT recycling projects around the world we can find that there are certain characteristics which are common to all. Those wishing to develop ICT education and computer recycling projects should consider these factors, and look at the information available to guide their own thoughts and planning.

10.2.1. Types of project

As outlined earlier, projects which recycle computer and other electrical equipment can have a varied purpose:

- For some groups the recycling of equipment is the only reason they exist, and those joining the project would not look at social or educational applications of their work. An example would be local Linux user groups[8] who undertake recycling work as part of their promotion of free and open source software. This is not always the case, and for some technology centred groups reclaimed and re-purposed technology is a critical part of how they promote their social and political agenda – for example, the Institute for Applied Autonomy.[9]
- Others may use the equipment they recycle to support community-based education and training initiatives. Some charities and education agencies give financial support to IT recycling projects as a means of providing skills training in economically disadvantaged areas, such as supporting practical training for the long-term unemployed. Such funding can form an important part of the project's budgets, as well as providing connections to the local business community in order to source discarded equipment. There are a number of examples of this around the globe, such as Hole-in-the-Wall education in India.[10]
- For some reclamation work is incidental to the purposes of the project, but the work carried out can provide a means to provide cheap IT equipment to support the educational or cultural activities of the group. Some groups have developed operating system support in native languages, usually ignored by mainstream systems developers, as part of their work to support the local indigenous culture – for example the NepaLinux[11] system in Nepal; others use recycled technology to offer new opportunities to express local culture, such as the iStreetLab project[12] or the Sheffield Access Space.[13]

Irrespective of the purposes, reclamation projects are usually based around the vision and drive of a handful of people. Most computer reclamation groups are motivated by people who have in-depth practical ICT skills – although they may not necessarily be employed by the in-

8. Wikipedia, 'Linux user group'. en.wikipedia.org/wiki/Linux_user_group
9. Vimeo (accessed June 2012). Institute for Applied Autonomy. vimeo.com/channels/iaa/6075432
10. Hole-in-the-Wall. www.hole-in-the-wall.com
11. NepaLinux. www.nepalinux.org
12. iStreetLab. istreetbhae.ning.com/video/mervin-s-bin
13. Sheffield Access Space. access-space.org

dustry. Others within the group may represent specific community or educational stakeholders who work alongside the more IT-literate members, bringing their community organising and networking skills to the project.

While groups may come and go, what marks out the most successful projects is that they are able to transfer the skills held by the founders to successive members who have joined at a later date. Although organisational and logistical problems often dominate the activities of the organisers, particular in more commercial projects, the longest-running projects are often the most successful in transferring skills to a large number of people within their community of users. Without such skills transfer the whole project might be jeopardised by one or two members leaving, taking with them the essential skills required to undertake practical recycling work.

As it is the sharing of skills which identify some of the most successful and longest-running projects, the groups which have had the greatest success have been those which are allied to the free and open source software movement.[14] It may be that because the free and open source philosophy puts a great emphasis on skills sharing and collaborative development, they are more likely to create an environment which is more supportive and inclusive when training new members of the group.

10.2.2. Space

Most successful recycling projects, in addition to having the motivated people with the right mix of skills, usually possess another important commodity – *space*. It takes very little space to recycle a computer; a small desktop or workbench and a few hand tools is all that is required. Even so, to be successful a project needs sufficient space:

- To provide for the storage of computers, both waste computers which have been through the triage process, and also for the secure storage of the tools and test equipment used in the reclamation process;
- To provide sufficient space for education and training to take place, with sufficient seating to accommodate the groups who take part; and
- To provide, if possible, a space for a wider community of users to use the reclaimed equipment informally, perhaps with internet access – note that public participation is an important part of promoting the work of the project, and a means to gain new active members.
- For the most successful projects, an exhibition space, or small theatre space for showing training/educational films or multimedia presentations created by the project.

Many projects fold when the space they originally used is lost. Some get around this by using vans or buses, converted into travelling workshops, to act as a base for the project. Others use low-cost or reclaimed buildings, such as shipping containers.[15] Projects which do not have a secure base will often founder because of the problems of continually relocating, and because not having a fixed base prevents them from building up a critical mass of membership in the area. Often the most successful projects have an association with educational establishments, particularly universities, as this provides a secure base and a regular turnover of enthusiastic members.

10.2.3. Tools

The simplest recycling projects can be based around nothing more than a workbench and some hand tools. For more ambitious projects, particularly tied to education and training, a larger and more secure space is required in order to store the test equipment required for servicing IT equipment.

As outlined earlier in unit 3 computers are assembled and serviced on a workbench. A bench, with sufficient lighting to allow for the inspection and repair of equipment, is also an essential part of carrying out the initial triage on the waste goods taken in by the project. To ensure safe working, a bench is required for each person undertaking recycling work.

In addition to the basic hand tools required for servicing, projects can also benefit from having access to:

14. Wikipedia, 'History of free and open source software'. en.wikipedia.org/wiki/History_of_free_and_open_source_software

15. Paul Mobbs (accessed June 2012). The Container Project. www.fraw.org.uk/mei/container_project

- Sufficient storage space, both racks/shelving and drawers, to safely store IT equipment, computer components and tools;
- A properly installed "signal earth" to connect anti-static mats and wrist straps to for servicing computer circuit boards (connecting to the mains earth can be highly dangerous);
- A voltmeter/electronic multimeter for circuit testing;
- A bench space for soldering/de-soldering and electrical assembly work, with good ventilation to extract the fumes created by this process (this is an important part of electronics/multimedia based projects as they often involve the assembly and repair of many different types of audio/hifi equipment and cables);
- Test units for identifying/testing memory modules and other components;
- Network cable test unit for checking/manufacturing ethernet cables;
- A bench power supply;
- Speakers, audio amplifiers, data projectors and other peripherals to aid in the practical use of the equipment refurbished by the project.

Ordinarily projects would have a mains electricity supply. However, projects which work in less developed states with a poor quality power grid, or which work in a mobile environment such as a bus, may incorporate renewable energy supplies. They may also teach the skills to create and maintain off-grid power supplies as part of the work they do. Diversifying from an IT-centric project to a more broad-based approach to education and technology is commonly found in successful recycling projects, in part because it reflects the "do it yourself" culture[16] which motivates many of those taking part.

In unit 3 (box 3.3) and unit 4 (box 4.2) we looked at the range of applications it is possible to create with reclaimed equipment. Many of these are related to the networking of computers to perform more complex functions – such as running websites or file servers. While this can be difficult for the average person to organise at home, IT recycling projects offer the ideal space to experiment with wired and wireless networks and the configuration of services to run over networks. Having such a capability can be extremely valuable for training as fully functional networks are usually only found in universities and corporate IT training centres. For projects which include arts or multimedia components, this also allows the testing and simulation of more complex multimedia content before publishing it online. If the site doesn't have a live internet connection, it's also possible to simulate online services over a local network[17] to provide experience and training in the use of email, the web and other internet services.

10.3. WASTE DISPOSAL

As noted above, space is also required for storing the waste generated by the project. In some states this may be required to meet a certain standard in order to comply with environmental and safety laws. For projects which accept large volumes of e-waste, the sorting and separation of different types of waste for recycling can represent a valuable source of income. How much space is required, and how it is organised, is usually determined by the contacts/opportunities the group has for disposing of its sorted waste to merchant recyclers.

Ideally, no electronics recycling project should operate without first identifying a viable disposal route for the waste it generates. In those states which regulate electronic waste disposal, the waste produced by community groups, even not-for-profit groups, may be classed as commercial waste and disposal will cost. That need not be a barrier if the groups

16. Wikipedia, 'DIY ethic'. en.wikipedia.org/wiki/DIY_ethic

17. For an example of "offline" Internet services training see Free Range Network (accessed June 2012). The history of the Community-Linux Training Centre Project. www.fraw.org.uk/projects/community_linux/cltc_history.shtml

charges a gate fee[18] for the waste they accept, and the fees collected are sufficient to fund the disposal costs of the project. Before setting up any project it is important to identify any regulatory hurdles that need to be resolved before the project opens. Often such restrictions only involve a one-off fee for registration, although there may be a burden of paperwork to complete afterwards in order to demonstrate compliance with the law.

Another important factor is the availability of disposal contractors. These might be e-waste reclamation companies, but if the project can sort different waste streams to the required standard then they could sell the materials to merchant recyclers. This creates a positive environmental benefit because separated waste materials can be more easily and cheaply recycled than bulk disposed waste – reducing both the pollution created and the resources wasted. Bulk electrical waste is usually crushed, fragmented and then incinerated to recover only the metal components; waste separation allows more metals to be recovered from the e-waste, and the plastics can be recycled rather than incinerated. Separation may also create a stream of usable components which can be sold to others engaging in similar work – for example people who have trained with the project and who are renovating/maintaining their own equipment.

18. Wikipedia, 'Gate fee'. en.wikipedia.org/wiki/Gate_fee

A practical guide to sustainable IT

This practical guide to sustainable IT offers a detailed, hands-on introduction to thinking about sustainable computing holistically; starting with the choices you make when buying technology, the software and peripherals you use, through to how you store and work with information, manage your security, save power, and maintain and dispose of your old hardware. Suggestions and advice for policy makers are also included, along with some practical tips for internet service providers.

Written by IT expert and environmentalist Paul Mobbs, the purpose of the guide is to encourage ICT-for-development (ICTD) practitioners to begin using technology in an environmentally sound way. But its usefulness extends beyond this to everyday consumers of technology, whether in the home or office environment. We can all play our part, and the practice of sustainable computing will go a long way in helping to tackle the environmental crisis facing our planet.

This is also more than just a "how to" guide. Mobbs brings his specific perspective to the topic of sustainable IT, and the practical lessons learned here suggest a bigger picture of how we, as humans, need to live and interact in order to secure our future.

The guide is divided into 12 sections (or "units"), with each unit building thematically on the ones that have come before. They can be read consecutively, or separately. The "unit" approach allows the sections to be updated over time, extracted for use as resource guides in workshops, or shared easily with colleagues and friends.

The guide has been developed on behalf of the Association for Progressive Communications (APC), with funding support from the International Development Research Centre (www.idrc.ca). It is part of a APC's GreeningIT initiative, which looks to promote an environmental consciousness amongst civil society groups using ICTs, and amongst the public generally. Other publications and research reports completed as part of the GreeningIT initiative can be downloaded at: greeningit.apc.org

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