



Campus Printing

**Releasing funds using
Print Fleet Management**



**making the possible
probable**

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Notes:

This paper has been produced for the purposes of discussion and to give a general overview of the potential within University printing fleets for substantial annual savings.

The specific environment within a particular University will require evaluation.

The author holds an honours degree in Printing Technology and specialises in digital print management consultancy.

1 Summary

This brief paper is intended to provide a stimulus for discussion about the future direction of reprographic resources (the “printer fleet”) in Universities.

We address the issue of ownership costs from desktop to departmental multifunction devices.

We recommend that an audit and analysis of the existing fleet, initially through a pilot study, is undertaken.

The purpose of an audit is to determine the opportunity for both quantitative and qualitative savings through changes in policy, procurement and resource management.

William Blake

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2 Context

A successful university sustains and increases its reputation for excellence in teaching, research and its graduate output to attract students and funding. This needs support to ensure an appropriate level of quality exists in its published output for its internal, external and regulatory audiences and eventually for the common good.

Across University Schools and Departments this support is likely to consist of a remarkable range of printers, on average, numbering well over a thousand devices. For the most part these become part of the fabric and are less evident than PCs. In my experience about 80% of these devices are desktop and single user machines.

Reprographics (scanning, copying printing and finishing) has become a commodity, especially with the rapid reduction in the original equipment costs, particularly at the personal/desktop level. These reprographics resources deserve close attention because of the cumulative cost of their ownership to the institution over their operational life.

These devices, sitting on desks throughout a University, probably bought within the last five years also contribute significantly to the institution's carbon footprint (CF) not least because they consume (and waste) paper.

2.1 Changes in University reprographics

Over the past few years Universities have experienced four major changes in the manner in which reprographic resources are provided.

1. Centralised copying and printing, where it exists, is now produced on digital reprographic systems by rather than traditional processes such as offset lithography. Where the latter is required, external contractors are generally engaged directly, usually without reference to central services.
2. The proportion of total print undertaken by central services has reduced while the number of networked desktop printers, multi-function devices (MFDs) and personal printers purchased by staff has increased.
3. More course materials are now being printed directly by students.
4. More printed documents contain colour (which is more expensive, and has greater environmental impacts, than monochrome print). Colour is now estimated at 10-20% of networked print output in universities¹.

2.2 Research survey

A recent analysis of these changes in higher education for the Standing Conference for Heads of Media Services has commented that:

¹ Wyse, 2007. Review of Technologies. Getting VFM from Printing and Copying project. June 2007.

“The university sector has been fortunate to have benefited from a highly economical framework vehicle for the procurement of traditional photocopier devices. As the responsibility for these devices has shifted from Print Unit to IT team, the benefit of the buying framework has been diluted. IT teams are happy buying HP printers. They are cheap to acquire. Once installed, the IT team then passes the responsibility for running the printer on to the department. Costs of running a fleet of printers have been virtually impossible to isolate. Copier costs have been very visible and focused on by management. The truth is that print volumes have grown, copy volumes have fallen, and document production costs are under less control than five years ago².”

This has energy, waste and other impacts related to the additional volume of equipment, paper and consumables. It inevitably results in some work being printed on the most environmentally damaging devices even though it could be produced on others which are less so, such as a workgroup device.

These changes are reflected in further recent research³, which found that “higher education has an estimated 148,000, and further education 98,000, printers, and that these account for at least 10-16% of ICT related electricity consumption. The SustelT survey also asked about individual’s access to, and use of, printers. It found that:

- Most respondents (68%) had access to a laser printer;
- Many people had access to multiple printing devices;
- Multi-functional devices (MFDs) are common, with 42% of respondents having access to one; and
- Respondents estimated that they printed an average 224 sheets of paper a week.”

2.3 Heaters, Perfume and the Environment

Imagine each desktop laser printer device as a small radiant heater, either already on or switching itself on as a result of the depression of a key on a computer keyboard somewhere. Excess heat is either tolerated as a nuisance or is removed by air-conditioning (another expensive resource and CF contributor).

How many of the resulting prints are thrown away? Who produced the waste? How many “proofs” are produced before a “final” version is deemed acceptable? Where does the paper go? Then, always at the most inconvenient moment, a message pops up to say that a toner cartridge needs replacing (after just a few thousand pages). Who pays for that? Where’s it kept? A set of colour toner cartridges for a desktop device can cost more than the device itself. Black toner is also relatively expensive: And what about recycling?

² Wyse 2007

³ SustelT - James and Hopkinson 2009c

Of course there is the option of using an inkjet device. That will save on the power for printing small quantities. But the cartridges often cost as much as expensive perfume. Walking through an area with small stacks of Channel No: 5 packages next to each machine might raise a few questions, especially when each is likely to require replacement after just a few hundred prints. The relative costs are shown in APPENDIX II.

Laser printers draw more than 7 times the power of an inkjet, and more than 4 times the power of a PC, in active mode, and 2 and 3 times the power respectively when in sleep mode. Inkjets have higher levels of power draw than PCs when in sleep mode. Laser MFDs have higher power consumption than pure laser printers.

Laser printers use more energy when active and on standby than inkjets. This means that they are less energy efficient for smaller print runs. Their higher speed and relatively low incremental energy consumption per page printed as volumes increase means that they are more energy efficient when intensively utilised. Where many small print runs are directed to a departmental MFD significant efficiencies can be achieved in running costs and wastage particularly when combined with a security release capability such as a personal card reader.

The environmental impacts of these technologies vary. While it is important to assess specific printing circumstances to judge specific suitability, the presence of individually allocated desktop devices can prove highly inefficient.

An EUP study⁴ concluded that the main environmental impacts of inkjets are concentrated in their manufacture and disposal because they generally print small volumes. The higher volume associated with Electro photographic devices means that their impact is more evenly spread between manufacture, use and disposal.

However, we have concluded that individual desktop printing is becoming less and less appropriate for large organisations seeking to reduce costs (as well as their carbon footprint). This is primarily because the means are now available to increase significantly the utilisation of laser multifunction devices through appropriate systems management practices. Two reviews⁵ have estimated that print capacity is well below 50% utilised in many institutions.

2.4 Paper

The production of the paper used in printers has an important environmental impact. For example, almost 17 Watt-hour (Wh) is consumed in making a sheet of paper from virgin pulp and 12 Wh when it is made from recycled material⁶. Paper recycling technology is generally a cleaner manufacturing process than making paper from trees, provided that local sources are used. This compares to the typically 2-4 Wh used by a laser (EP) printer when it prints the sheet, and the

⁴ Fraunhofer IZM and PE Europe 2007

⁵ AIMS 2007, MTP 2007

⁶ EU Energy Star website

typically 5-17 Wh used by an inkjet printer⁷. So printing one sheet of paper generally uses less energy than it takes to produce that sheet of paper.

Our conclusion is that reducing paper consumption is probably the most important feature of a sustainable printing strategy. Studies by Lexmark have estimated that the average UK worker prints around 38 pages a day. The SustelT survey suggests that the figure is closer to 50 pages a day. There is general agreement however that the level of wastage approaches three pages for every ten printed.

2.5 Culture

The apparent loss of a personal print resource can be hard to accept, not least from those more senior in the organisation and with the power to insist on their own device for priority and security.

Both these factors can be relatively simply addressed in a workgroup environment combined through secure release (usually via a personalised swipe card). The latter can also have the effect of rationing unnecessary proofs.

The change from desktop to workgroup access requires a cultural change in the use of printing systems and a policy to underpin the culture. It will not happen without a strong lead at the most senior level of the organisation.

The suppliers of “personal” machines make their profits from consumables supplies. The devices are the means to this end. The goals are to sell toner, drums, fusing units, ink cartridges, components, maintenance and support. An appropriate culture and policy can address such external commercial pressures.

2.6 Numbers

Any project to increase printing efficiency within an enterprise requires an audit of the existing conditions (the baseline), a strategy with realistic goals, tactical planning and management.

Of particular interest are the number of readily accessible, networked floor-standing copier/print machines installed across a University. Typical installations (e.g. a campus university with around 2,000 academic staff) will have around 300-500 devices. Desktop printers usually number in excess of 1,000 devices. An audit would resolve any uncertainty.

2.7 Expenditure

A picture of current spend on these systems may not always be straightforward to generate. The larger the enterprise, the more dispersed the accounting for digital reprographics services tends to be.

⁷ Fraunhofer IZM and PE Europe 2007

In the author's experience, the typical annual average spend for a campus University with around 2,000 academic staff and an equivalent number comprised of technical, support and administrative staff is likely to lie in the range £1-1.5 million. This figure would include paper and all the non "click-use"⁸ devices such as laserjets and inkjets together with their cartridges and spare parts (such as drums, developer and fuser units). It does not include any provision for support from central IT services. It also doesn't include the cost of power. A typical A4 desktop laserjet can draw as much as 0.5kw while "awake". Many draw considerably more. A typical A3/A4 workgroup machine may draw up to 1.5kw awake. A close study of the energy drawn by the printer fleet is likely to show significant annual costs⁹.

Toner costs are notoriously complicated to estimate¹⁰. This is usually because cartridges are not associated with specific devices. Actual page costs are best calculated adding all elements of consumables and parts cost associated with the desktop (non "click use") fleet and dividing by the total page count for a selected period. This assumes that the figures are readily extractable from the University's accounting systems.

2.8 Management and services

Few University printer fleets have formal management systems or standards applied to ensure their most economical and effective use. However, the application of user "smartcards" are beginning to be established. This assists with security and access to multifunction devices as well as tending to reduce waste.

A central information technology department usually exists to provide an installation and network service for printers. The resolution of faults is for the most part managed by each group or individual. Hardware purchase and supplies requests are often similarly managed with reference to purchasing for advice and guidance for acquisitions. Various purchasing routines exist for establishing user requirements (forms, visits etc.).

"In the absence of a corporate overview, there can typically be:

A lack of corporate knowledge of what printing equipment exists across an institution;

⁸ "Click use" refers to the charge made by suppliers for prints. A click is a printed sheet of paper. It may be A4, A3 or double sided. The definition is important. The charge covers the consumables such as toner, developer, drums, fusers and so on. Again, definition of what is included in the click charge is important.

⁹ As an example, 1000 500 watt desktop devices, predominantly A4, "awake" for (say) 30 minutes will consume 250kWh energy. Assuming 10p per kWh this amounts to £25 in a day. Assuming 200 operational days the annual energy cost would be £5,000. In fact these are very conservative figures as many older devices are less efficient in terms of "wake" time and fuser technology and a typical two year old A4 colour laser will draw at least 6 amps awake. The figures quickly rise, the longer the wake time – e.g. 2 hours average "awake" equates to £20,000 p.a. energy use.

¹⁰ Typical lower cost for toners will be at least £70 for black and around £110 for colour for a mid range desktop machine. This will cover approximately 5,000 colour pages at 5% coverage – an average of 8p per colour page. In practice the black toner will be replaced three times for every pack of three colour toners. So a busy desktop can consume in £500 toner in a year.

A lack of accountability for the purchase - initial or replacement - of equipment which can result in less efficient and ecologically sound investments being made;

No clear picture of how much output is produced across the institution, by whom and for what purpose;

A lack of understanding by management of the costing structure to be used;

No clear guidance as to what should and should not be printed locally or centrally;

No clear guidance as to what type of work should be outsourced to external suppliers; and

No recommendations as to which external suppliers should be used.”¹¹

2.9 Independence

Many universities have a significant number of desktop devices which are not directly networked but attached to a user's PC or workstation. These devices are generally not available to other users. The use of these bypasses the need to use any smartcard system for releasing jobs for print on networked workgroup machines and contributes to inefficiencies.

Most University IT departments are not resourced to manage the printer fleet.

2.10 Policy and standards

Some Universities have a comprehensive reprographic policy with regard to document creation and archiving standards especially in the use and positioning of the University's logo and some sample document templates. However there are many that do not.

Moving towards the use of recycled paper requires a clear understanding of those instances where its use may be inappropriate (e.g. for archive purposes) or where its use might lead to excessive maintenance and downtime. (Manufacturers should be asked to advise on the suitability of recycled paper for specific machines).

In our view it is likely that a detailed audit and analysis of the economy of a University's printer fleet would offer the opportunity to reduce the numbers of devices and to make significant financial savings allowing valuable resources to be directed towards teaching and research.

This requires the development of a comprehensive campus policy and standards for reprographics, together with a programme of integrated management and device rationalisation.

¹¹ AIMS 2007

3 Strategy (outline)

3.1 Positioning

The Printer Fleet strategy is how to position a management and process approach to the reprographic requirements across the university, for the best service to staff and students.

3.2 Purpose (example)

1. Reduce the volume of printed and photocopied material without detriment to teaching, learning and administrative functions.
2. Reduce spending on printing and photocopying through providing local management with improved information, devolved control on the costs of print and provision of access to the most efficient equipment.
3. Encourage the use of recycled paper and environmentally friendly printing processes where appropriate (i.e. for non-archival outputs).
4. Promote best practice for the strategic management of print operations through the management of devices across the network.
5. Generate policy and standards (house styles and templates) for reprographics publishing output from the University.
6. Seek efficiencies of operation through liaison with other Higher Education Institutions with compatible requirements.

3.3 Tactical elements (outline)

In order for any coherent strategy to succeed it will be necessary to:

- Gain board (Vice-Chancellor) agreement that the current position is financially and ecologically untenable. Provide reference evidence of (and/or visits to) equivalent installations where significant and proven savings have been generated through implementing printer fleet management.
- Gather, audit and analyse detailed evidence to generate cost benefit case(s).

We recommend a pilot study to establish baselines in two contrasting sections or departments ("sub-fleets") over a period of six months.

- This will require the acquisition of software to enable the management of the networked printers, the appropriate application environment software (server etc.), resource provision, training and management.
- An audit of each sub-fleet to monitor machine, type, users, smartcard capability, uses (A4, A3, duplexing, colour, wide format), throughput (clicks/page-count), substrate types (% recycled and requirement for archive permanence), downtime, waste count, network presence, power usage and consumable costs.

To roll out a printer fleet management project requires a dedicated resources and backup.

If positive results are achieved from pilots,

Prepare and cost a campus wide plan to:

- a) Generate Policy and establish Standards for print, publication and user procedures;
- b) Implement a programme of culture change for those sections concerned with internal and external publishing;
- c) Prepare printer rationalisation programme;
- d) Implement programme section by section (including training);
- e) Monitor and report results.

4 Conclusion

Implementing a programme of network printer fleet management across a University's existing fleet of digital reprographic devices has the potential to make significant savings through the reduction of device numbers by redirecting print output to workgroup (click charged) devices.

On completion of an audit it would be possible to evaluate a number of scenarios for device reduction and replacement to generate a picture of the potential release of funds due to:

- Lower capital/leasing costs
- Reduction in power consumption
- Reduction in consumable purchase
- Reduction in consumable wastage
- Reduction in maintenance costs

Qualitative benefits are also likely to arise from the application of the standards and processes that such a programme can generate.

We would be please to quote for undertaking a project of this nature.

APPENDIX I Key Environmental Differences between Electro photographic (EP) and Inkjet Technologies¹²

| | Electro photographic (EP) (including Laser) | Inkjet |
|-----------------------------|---|--|
| Technology | EP devices use a light source (a diode in copiers, a laser in printers) to create an image on a negatively charged photoreceptor. Areas exposed to light lose their electrical charge, and attract (dry) toner to them. The toner is then transferred to paper, and fused to it with heat and pressure. | Inkjet devices transfer (liquid) ink directly to paper through microscopic nozzles. The pressure required to force the ink through the nozzles at high speed is generated either by piezoelectric materials, or thermal expansion. |
| Energy | EP devices have a high energy 'overhead' because their fusers are maintained at around 180°C (which accounts for 60-70% of their power consumption during active mode). However, they print more quickly than inkjets so that energy consumption per page falls considerably with volume. It is generally much lower than inkjets at high volumes (see Appendix), but much higher at low volumes. | Inkjets do not require a permanently heated fuser, and so have a low energy 'overhead'. However, inkjet printing is a mechanical process, which has relatively high energy consumption every time a page is printed. Energy per page printed therefore remains relatively constant, whatever the volume. |
| Health and Pollution | The EP process creates small amounts of ozone and other substances which are potentially harmful in confined spaces. | Inks combine pigments and a solvent. The latter generally contains volatile organic compounds (VOCs), which are a significant air pollutant. |
| Recycling | Toner is relatively straightforward to separate from paper, and so EP printed pages can be recycled relatively easily. | The inks used in inkjets are often difficult to remove from paper, and so hamper recycling. |

¹² (Based on Fraunhofer IZM and PE Europe 2007; Lepisto 2008; Society for Imaging Science and Technology 2008)

APPENDIX II Relative costs¹³

Table 1: Black and White (Monochrome) Printing Costs (Wyse 2007) - includes paper costs

| Prices of Print by Area/Device Type | Minimum Price | Maximum Price |
|--|----------------------|----------------------|
| Print Unit | 1.2p | 4.0p |
| Floor Copiers/ MFDs | 1.5p | 4.0p |
| Network Laser Printer | 2.0p | 6.5p |
| Local Desktop Laser Printer | 5.0p | 12.0p |
| Inkjet Printer | 12.0p | 65.0p |

Table 2: Colour Printing Costs (Wyse 2007)

| Prices of Print by Area/Device Type | Minimum Price | Maximum Price |
|--|----------------------|----------------------|
| Print Unit | 12p | 50p |
| Floor Copiers/ MFDs | 18p | 75p |
| Network Laser Printer | 18p | 75p |
| Local Desktop Laser Printer | 20p | 100p |
| Inkjet Printer | 28p | 150p |

¹³ James and Hopkinson – Energy Efficient Printing and Imaging in Further and Higher Education, 2009-05-27