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Abstract

The advent of the ‘digital revolution’ in the 1970s was forecast to make paper all but redundant. Recent figures suggest though that paper consumption continues to increase unabatedly, with a correspondingly adverse environmental impact. This research uses a single exploratory case study in the School of Management, University of Southampton to explore the environmental impact of current A4 paper usage, followed by recommendations for reducing consumption. Whilst some changes have occurred to make more documents available electronically, the research finds that ‘the paperless office’ within the School remains a fictional concept.

Keywords

Paperless office, Corporate Environmental Responsibility, environmental impacts

*This is a discussion paper, please do not quote from or reference
without prior contact with the author*

Introduction

Just over thirty years ago, an article in *Business Week* suggested that the digital age would bring about the ‘paperless office’ (Anon., 1975). By contrast, actual paper usage between 1988 and 1998 in Britain alone rose by 65% per head (Anon., 1998). Figure 1 shows increasing consumption across the developed world.

Figure 1 about here.

Sellen and Harper (2001) also highlight that e-mail has actually *increased* paper usage by some 40% in offices. The environmental impact of the paper lifecycle (see Figure 2) is significant, ranging from land usage for forests (managed or otherwise), impacts to ecosystems on ‘harvesting’, energy consumption and chemical usage during processing (including recycled stock) and the printing process. Finally, the paper is used and potentially stored before eventual disposal via recycling, incineration or landfill. Robinson (2006, p.1) states that “[UK] businesses throw away about five million tonnes of printing and writing paper every year”. The paperless office appears then to remain a myth (Sellen and Harper, 2001).

Figure 2 about here.

The underlying assumption for this research is that A4 paper usage (especially from virgin pulp) has a negative environmental impact and that reducing consumption would be a responsible action for an organisation to take. On this basis, the project revisits the concept of the ‘paperless office’ (Anon., 1975) and investigates A4 paper usage within the School of Management (SoM) at the University of Southampton (<http://www.management.soton.ac.uk/>). Over recent years, a number of changes have been implemented in the SoM in order to move many resources over to electronic systems (most notably the ‘Blackboard’ Virtual Learning Environment but also an intranet and documents such as minutes of meetings being placed on a shared drive). However, paper still appears to feature in many of the School’s activities which has led to the following research questions:

- What is the annual consumption of A4 paper within the SoM?
- What is the environmental impact of this consumption?

- What would be the environmental impact of reducing the consumption of paper and changing the pulp content?
- How could this change be implemented within the SoM?

This research looks at the instrumental values placed on paper (over and above alternatives), the various sources (and contests) of power amongst different stakeholders that maintains the current inertia, and possible actions required to reduce the environmental impact.

Methodology

The above questions have been addressed through a single exploratory case study (Yin, 2003). Existing A4 usage data for the latest available full academic year (Oct 2004 to Sep 2005) have been calculated by combining historical copy ‘chits’ to the central printroom together with purchase orders for A4 paper reams within the SoM. The environmental impacts of this usage and a plausible change scenario are then estimated using a web-based calculator.

Insights into the existing demand for A4 paper were collected through participant observations and discussions with staff and students within the School. Through Force Field Analysis (Lewin, 1951), a combination of this primary data and extant literature is then used to identify some driving and restraining forces (values and power) that maintain the current demand for paper within the SoM, as well as identifying various ‘levers’ to bring about the change scenario.

Analysis

There are two major sources of paper use within the SoM. Firstly, the central printroom which provides bulk copies such as unit handbooks, some marketing literature and lecture handouts (hereafter referred to as ‘printroom’) and secondly, A4 paper reams used for personal printing, photocopying, fax, etc within the School (hereafter referred to as ‘personal’). Table 1 shows the monthly usage figures for the latest academic year from these two sources, which combine to an annual total of 2,417,290 sheets of A4 paper, costing £31,369.

Table 1 about here.

This usage equates to an average of 201,441 sheets per month, with 68% of the volume arising from personal usage and the remaining 32% from the printroom. Representing this data graphically (see Figure 3), we can see that the highest demand is in October which relates to the start of the new academic year and August being the lowest usage due to the holiday period.

Figure 3 about here.

Calculating the environmental impact of this consumption is not straightforward, not least because it has not been possible to ascertain factors such as the sources of energy used in the paper mill. However, an estimated environmental impact has been established based on a web-based calculator using peer-reviewed data of average paper usage in America (see <http://www.environmentaldefense.org/>).

The first stage to estimating the environmental impact is to convert the annual usage from sheets of paper into weight. Firstly, the A4 paper in question is specified as 80 grams per square metre and with 16 sheets of A4 paper per square metre, each sheet of A4 weighs $80/16 = 5$ grams. Multiplying the weight per sheet by the annual usage of 2,417,290 sheets gives an annual weight of 12,086,450 grams, or 12.09 tonnes.

The current supply of paper (see http://www.image-paper.com/product_universal.html) does not appear to contain any recycled pulp, and is therefore 100% virgin pulp (which is not even sourced from a Forest Stewardship Council (FSC) organisation). Armed with these two pieces of data, the environmental impact can be estimated as shown in Table 2, with some ‘headline’ variables shown in bold.

Table 2 about here.

Perhaps surprisingly, and despite pockets of activism on campus, there appears to be a general lack of awareness or appreciation of the impact of using paper unquestionably; which is exemplified by the University only slowly beginning to introduce paper recycling facilities across campus (see <http://www.bulletin.soton.ac.uk/1207/front.htm>). With this background

and having established the environmental impact of the current annual usage of A4 paper within the SoM, the following section will explore a potential abatement strategy (Annand, 2003). There are many potential scenarios available, but the scope of this paper allows for only one as an example: i.e. change to a recycled pulp source using 100% recycled office paper (de-inked kraft) and reduce consumption to a plausible 75% of current usage in the first instance. The annual weight of paper would therefore be reduced to $12.09 \times 0.75 = 9.07$ tonnes, with the following estimated environmental impact (see Table 3).

Table 3 about here.

We can see from Table 3 that the proposed change would annually reduce the use of wood by 37 tonnes, energy by 2.7×10^8 BTUs, greenhouse gases by 16 tonnes, waste water by 5.1×10^5 litres and solid waste by 7.3 tonnes (together with the other reductions shown). Along with these environmental savings, a reduction in consumption may also result in some economic savings. One problem here though is that prices for A4 paper reams are constantly adjusted through promotions or volume discounts, making direct comparisons difficult. As an example, a ream of A4 80gsm 100% post consumer recycled paper costs £1.99 without a volume discount (<http://purelypaper.co.uk/>), compared with the current SoM supply at £1.42 per ream. It may be possible, through negotiations with the current supplier, that a switch to recycled stock paper could be achieved with little or no price differential. Based on this assumption, a 25% reduction in printroom activities and 'personal' A4 paper usage in the SoM (during 2004/5) could equate to £7,842 in potential savings.

These savings may not appear significant on a global scale, however it should be recognised that this is a reasonably modest change in a relatively small academic school. In contrast, the University of Southampton as a whole currently uses one million sheets of A4/A3 paper *per week* (Candy, 2006), and so significant environmental and economic savings could be achieved if the changes were expanded across the University. The next section discusses how the likely issues might be overcome when trying to introduce such a change within the SoM.

Discussion

The above analysis has shown how a relatively straightforward change could yield some improvements to the environmental and economic impact of paper use in the SoM. It is important though to assess the various values and sources of power (i.e. forces) that maintain the current demand for paper, thereby resisting any actions for change. Key insights gained from participant observations and discussions within the School have been divided into driving and restraining forces in order to conduct a force field analysis of the current ‘quasi-stationary equilibrium’ (Lewin, 1951).

Figure 4 about here.

In order to bring about the change to the desired state (i.e. 25% reduction in usage and use 100% recycled stock), the current situation has to be ‘unfrozen’ (Lewin, 1951) thereby shifting the balance of forces. To do this, Rosenfeld and Wilson (1999) suggest that the restraining forces have to be attended to first and selectively removed.

The change to 100% recycled stock paper appears to be a straightforward sourcing and procurement decision. However, this may be complicated by the University belonging to the Southern Universities Procurement Consortium (SUPC) who have the power resources (Hinchliffe and Belshaw, 2003) to make collective procurement decisions and contracts for universities in the south of England. In order to remove this restraining force and action such a change, the SUPC would first need to be lobbied with the facts and environmental benefits presented in this research. The University of Southampton is currently involved in a carbon management programme (CMP) in order to reduce its overall carbon footprint across all activities (see http://www.carbontrust.co.uk/about/presscentre/060503_universities.htm). The procurement group are represented on the CMP taskforce which should ease the lobbying activities.

There would appear to be far more restraining forces to be overcome in order to reduce the usage of paper. Firstly, the term ‘paper’ is enshrined in academic culture and discourse, with discussants referring to some form of ‘comfort’ (and instrumental value) in having articles in hard copy. Many also opined that printed materials were easier and more convenient to read and annotate, especially when working in multiple locations; as well as citing a general lack

of trust in computer systems being able to reliably store documentation. Students also have a ‘use value’ (Burgess, 2003, p.261) in having hardcopy lecture handouts distributed at the start of a lecture. The end of unit student assessment questionnaire also asks students to rate the ‘quality of handouts’, thereby reinforcing the instrumental value in providing paper copies for staff and students alike.

To reduce these restraining forces, an education and awareness campaign is required amongst both staff and students. For instance, research that finds that reading from a computer screen can be equivalent in speed and comprehension to reading from a book (e.g. Muter and Maurutto, 1991) should be disseminated (by electronic means). Currently, many copies are scrapped or inefficiently printed due to a lack of awareness of printing options in software packages (such as setting duplex to the default setting or printing more than one page on each side) which could be improved through training. The creative process of research and writing academic articles appears to create numerous printouts of draft copies which is potentially a behavioural activity that could be addressed through an awareness campaign. At the very least, the environmental impact of paper usage should be (electronically) published within the School and any documents available online should not be duplicated in hardcopy (except in perhaps exceptional circumstances).

There are currently few disincentives for printing or copying within the SoM, nor are there many monitoring or controls of paper usage. It is also perhaps too easy to print from software packages without a second thought, especially as every computer in the School is linked to a printer. This may be overcome by disabling the print function from some packages (such as e-mail) or disconnecting some computers from printers. Whilst draconian in nature, if the above education and awareness campaign fails to produce the desired reduction in usage, then a system of individual quotas could be installed with volume data being openly published.

Once these restraining forces have been reduced and the current situation ‘unfrozen’ in order for the change to be implemented, it is important to ‘refreeze’ (Lewin, 1951) the new working practices by periodic reinforcement in order to prevent a regression to previous ways of working.

Summary and conclusions

This paper has explored aspects of A4 paper use within a single exploratory case study (Yin, 2003) in the School of Management, University of Southampton. Using data from the 2004/5 academic year, 68% of the consumption (1,643,634 sheets) arose from personal usage and the remaining 32% (773,656 sheets) from the printroom. This combines to give an annual total of 2,417,290 sheets, or 12.09 tonnes of virgin pulp (non-FSC sourced) paper. In terms of 'headline' environmental impact, this usage consumes 3.7×10^4 Kg of wood and 4.6×10^8 BTUs of energy whilst producing 3.2×10^4 Kg of greenhouse gases, 8.6×10^5 litres of wastewater and 1.2×10^4 Kg of solid waste.

The research has considered one plausible change scenario to reduce consumption to 75% of current demand in the first instance and switch to a 100% recycled stock paper. By doing so, the proposed change would indicatively reduce the annual use of wood by 37 tonnes, energy by 2.7×10^8 BTUs, greenhouse gases by 16 tonnes, waste water by 5.1×10^5 litres and solid waste by 7.3 tonnes. Annual cost savings of £7,842 may also be possible.

Force field analysis (Lewin, 1951) has been used to identify some driving and restraining forces (i.e. values and power) behind the proposed changes (i.e. actions), which are discussed in detail above. The main thrust of changing values and power sources comes from an education and awareness campaign within the School, supplemented by the subsequent potential for monitoring and controlling paper usage.

Whilst there are numerous examples of electronic documentation within the SoM, the totally 'paperless office' appears to remain elusive. This paper does though identify various actions for change in order to at least make a move in the right direction.

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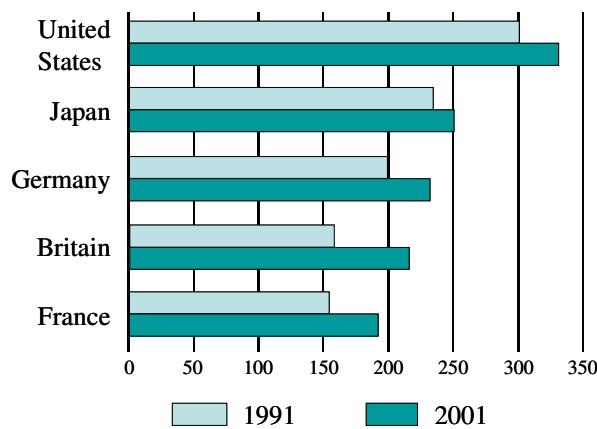
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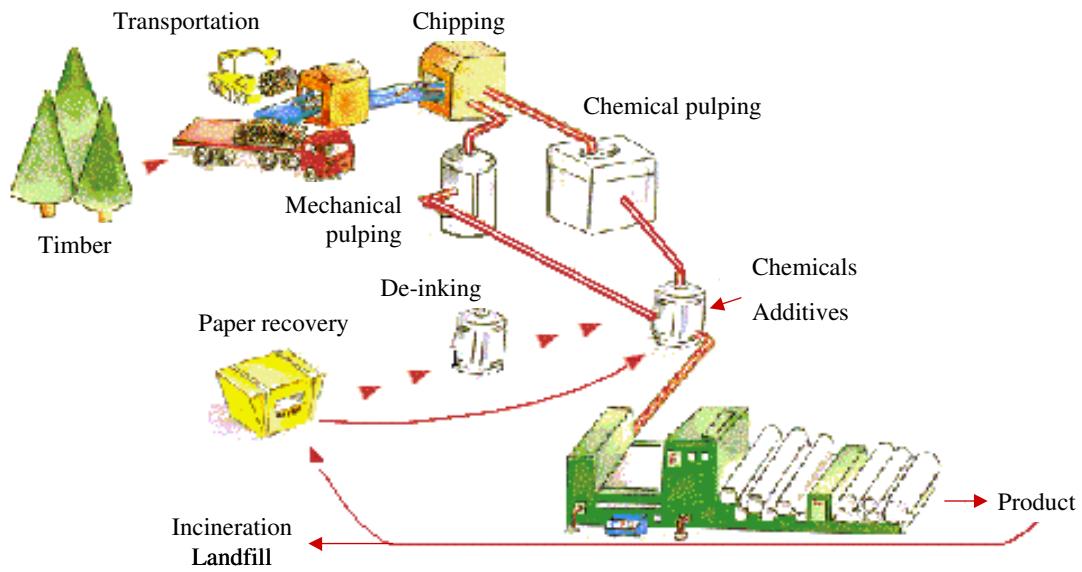
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Figure 1: Paper consumption per head, Kg year⁻¹



Source: Paper Federation of Great Britain via Anon. (2002)

Figure 2: The paper lifecycle



Source: adapted from http://www.paperonline.org/cycle/paperboard/paperboard_frame.html

Table 1: Volume data for A4 paper usage (sheets) in the SoM for the 2004/5 academic year.

Month/Year	Printroom	Personal	Total
Oct-04	156,283	294,577	450,861
Nov-04	93,449	61,648	155,097
Dec-04	55,360	52,173	107,533
Jan-05	104,872	75,320	180,193
Feb-05	128,886	115,264	244,150
Mar-05	2,635	192,060	194,695
Apr-05	133,584	184,944	318,528
May-05	50,197	183,289	233,485
Jun-05	29,164	120,606	149,769
Jul-05	13,816	185,849	199,664
Aug-05	5,392	59,577	64,969
Sep-05	18	118,327	118,345
Σ	773,656	1,643,634	2,417,290

Figure 3: Frequency distribution of A4 paper usage in the SoM (2004/5)

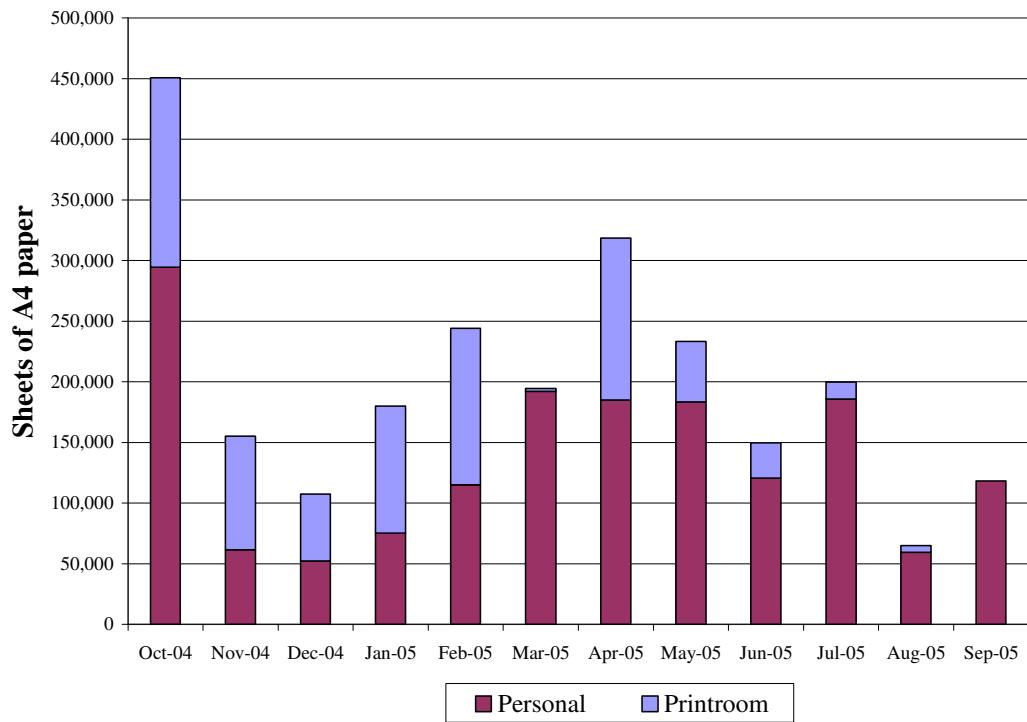


Table 2: Estimated environmental impact of 12.09 tonnes of 0% recycled content paper

	Existing usage	Units
Wood Use	3.7×10^4	Kg
Total Energy	4.6×10^8	BTUs
Purchased Energy	2.3×10^8	BTUs
Sulphur dioxide (SO ₂)	140.2	Kg
Greenhouse Gases	3.2×10^4	Kg
Nitrogen oxides (NO _x)	98.9	Kg
Particulates	66.7	Kg
Hazardous Air Pollutants (HAP)	11.3	Kg
Volatile Organic Compounds (VOCs)	29.9	Kg
Total Reduced Sulphur (TRS)	1.8	Kg
Wastewater	8.6×10^5	litres
Biochemical Oxygen Demand (BOD)	34.0	Kg
Total Suspended Solids (TSS)	54.4	Kg
Chemical Oxygen Demand (COD)	493.1	Kg
Absorbable organic halogens (AOX)	5.0	Kg
Solid Waste	1.2×10^4	Kg

Source: data from <http://www.environmentaldefense.org/papercalculator/>, then restated in SI units.

Table 3: Estimate of the annual impact of using 100% recycled stock paper and changing to 75% of current usage (i.e. 9.07 tonnes).

	Environ. impact of existing usage	Environ. impact of change scenario	Annual reductions	Units
Wood Use	3.7×10^4	0.0	-3.7×10^4	Kg
Total Energy	4.6×10^8	1.9×10^8	-2.7×10^8	BTUs
Purchased Energy	2.3×10^8	1.9×10^8	-4.0×10^7	BTUs
Sulphur dioxide (SO ₂)	140.2	103.0	-37.2	Kg
Greenhouse Gases	3.2×10^4	1.4×10^4	-1.6×10^4	Kg
Nitrogen oxides (NO _x)	98.9	58.1	-40.8	Kg
Particulates	66.7	29.5	-37.2	Kg
Hazardous Air Pollutants (HAP)	11.3	0.5	-10.8	Kg
Volatile Organic Compounds (VOCs)	29.9	7.3	-22.6	Kg
Total Reduced Sulphur (TRS)	1.8	0.0	-1.8	Kg
Wastewater	8.6×10^5	3.5×10^5	-5.1×10^5	litres
Biochemical Oxygen Demand (BOD)	34.0	24.5	-9.5	Kg
Total Suspended Solids (TSS)	54.4	27.7	-26.7	Kg
Chemical Oxygen Demand (COD)	493.1	111.1	-382.0	Kg
Absorbable organic halogens (AOX)	5.0	0.0	-5.0	Kg
Solid Waste	1.2×10^4	4.7×10^3	-7.3×10^3	Kg

Source: data from <http://www.environmentaldefense.org/papercalculator/>, then restated in SI units.

Figure 4: Force Field Analysis of paper usage in the SoM

