SUSTAINABILITY IN GRAPHIC DESIGN AND PRODUCTION. EDITORIAL CASES

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Abstract
Global warming and other negative impacts of human activity are aspects that urge to mitigate. Much has been done to this regard in the graphic areas, but they continue to have a significant impact on the environment and in human health. This article aims to contribute to the growing awareness of professionals in these fields to this issue. Here are identified some of the areas of the graphic production chain with the greatest potential, pointing out the main problems, and possible solutions for application in the daily professional practice. The identification of problems is carried out through a review of studies on the life cycle assessment of some graphic products. These allow us to envision some solutions. Identification of other problems and improvement opportunities resulted also from the observation that the authors have been carrying out of the production and consumption realities of printed artefacts in their areas of expertise, especially in their home countries. Proposals are focused in design for reduction of materials and in its implications in production. Graphic professionals may directly implement them or sensitize their partners to do so.
Key words: *graphic design, graphic production, publishing, sustainability*

Introduction

Global warming and other issues related to sustainability are some of the biggest problems that humanity has to face today and must try to solve in the near future. The graphic industry and design, including its professionals, researchers and educators, have their share of responsibility in the environmental and social impact, but they are also the most qualified ones to seek solutions in order to mitigate these problems.

Nowadays we have some knowledge and tools that allow us to reduce the impact of our activities. However, in our daily lives, whether as producers of communication artefacts or as consumers, we are often focused on other issues, forgetting to think about our actions in order to achieve the primary

goals of our companies and institutions and, simultaneously, to reduce the impacts of our activities. Another aspect to keep in mind is the pedagogical role that professionals in these areas can play in raising the awareness of their customers and other actors in the production process with whom they work directly, seeking a continuous improvement towards sustainability.

This article summarizes the main results of life cycle assessment studies that allow us to identify more clearly which phases of graphic production and design have the greatest impact. With this in mind, professionals, researchers and educators in these areas can think of concrete and more efficient solutions for solving some of these problems. The examples that illustrate the article are from the publishing area, one of the most important areas for design and graphic industry, which also play an important role in our lives as citizens.

The publishing area has historically been central to the development of our society, as well as in the development of graphic arts, its technologies and industry. Currently, print editions are still responsible for an important and large part of information and news consumption and, as such, for much of graphic production. Paper production for newspapers and magazines remains as one of the major areas of paper production. According to CEPI [1], the union of paper producers' associations, in 2016 newsprint represented 5.3% of paper consumption in Europe, while papers currently used in magazines –of mechanical pulp, lightweight coated or uncoated– accounted for more than 9%. Book publishing also continues to play an important role in Westernized societies even though, like in periodical publishing, the reduction in print runs has been constant over the past few decades.

The main objective of this article is, therefore, to continue to raise awareness of the importance of, in the daily professional practice, professionals of these areas being aware of the impact that graphic production and design can have on the environment and for man. Finally, it aims to suggest concrete actions to be applied in these areas, which may contribute to a sustainable development.

Methodology

All analysed studies use the methodology of life cycle assessment (LCA), probably the most complete and rigorous method of analysing the production processes of an artefact or service. This consists of collecting data –inputs and outputs– throughout the entire life cycle of a product from production, distribution and consumption until its end of life, known as a cradle to grave assessment. The way in which the objectives of the analysis are defined, how the inventory of raw materials, energy, emissions and waste

are carried out, and how the impacts are assessed, in impact categories, is defined in ISO 14040 and 14044, which started to be discussed in 1997 and were published in 2006 [3].

Considering the differences between the studies –especially regarding to the included impact categories, the degree of detail of each one and the way of assessing the impacts and presenting the results– we chose to limit our analyses to the only category that is clearly shown in all studies: the impact on climate change of greenhouse gases emissions, measured in Kg of carbon dioxide equivalents (CO_2 eq.). Being only one category out of more than ten, the analysis is necessarily restricted. For a detailed analysis of the remaining impact categories, we also recognize technical limitations. In practical terms, thinking about the design and graphic production, we still believe these are sufficiently useful and valid results.

The analysed studies are the ones we have known and had access to, all related to graphic production processes, most of them including newspapers. In some cases, also magazines were analysed, leaflets and, in only one of them, a hardcover book and a photographic album, or photobook. Most of the studies are not very recent, but we believe that they are the most important ones being conducted on graphic artefacts so far. Tables 1 to 4 summarize the cases covered in each of these works, showing the characteristics of the printed matter described by the authors. Blank cells refer to unspecified information. Data in square brackets is deduced by us, with a high degree of probability, depending on what is implicit in the studies or the knowledge we have on the realities of these countries and cases. Data separated by two bars (//) represent different scenarios analysed by the authors. LCA results are shown in Figures 1 to 4 in percentage values. Here the impact of the paper production, printing and distribution phases is discriminated. Waste management is always considered, with the exception of books. In the case of newspapers, the impact of content production is also included. The results are separated by type of media, respectively: newspapers, magazines, books and advertising leaflets. Figure 5 shows the carbon footprint in absolute values of Kg of CO_2 eq., whenever the authors provided this value per ton of each of the media under analysis. These data provide us with just an indication of the impacts of different media, as in practice each of them has different objectives and, therefore, are not directly comparable in terms of environmental impact.

Table 1. Analyzed studies and main characteristics of newspapers

Study	Infras et al (1998**)**	Carbon Trust (2006)	Nors et al (2009)	Moberg et al (2009)	Pihkola et al (2010)	Hohental et al (2013)
Newspaper	*Bild + Die Welt + Berliner Morgenpost + BZ*	*Daily Mirror + Celebs*	Typical Finish regional newspaper	*Sundsvalls Tidning*	Typical Finish regional newspaper	*Aamulehti // Iltalehti // Kauppalehti*
Edition	daily	daily + weekly magazine	[daily]	daily, 6 days/ week, 32 000/day in SWE // EUR	daily	morning daily, 365/ year, 132 000/day // evening daily 301/ year, 107 000/day // economic daily 249/ year, 70 000/ day
Format	[broadsheets + tabloid]	tabloid	[broadsheet]	tabloid (40x28 cm)	broadsheet	broadsheet
No. Pag.				40	48	48
Paper	newsprint, 42,5 g/ m^2 (26% recycled + 74% virgin fibre) prod. in GER	newsprint (100% recycled + coated), prod. in GBR // in SWE	newsprint, 40 g/m2 (40% recycled + 60% virgin prod. in FIN	newsprint, 45 g/m^2 (recycled and virgin), prod. in SWE // EUR	newsprint, 40 g/m^2 (60% recycled + 35% virgin fibre, 5% fillers, prod. in FIN	newsprint, 45 g/m^2 (75,5%) + newsprint, 48,8 g/m^2 (4,3%) + improved newsprint, 48,8 g/m^2 (20,2%) prod. in FIN
Print	coldset web offset printed in GER	coldset web offset: [mostly B&W] + web heatset offset: CMYK in GBR	coldset web offset in FIN	[coldset web offset] in SWE // EUR	coldset web offset in FIN	coldset web offset printed in FIN
Distribution	[urban] in GER	[urban] in GBR	home delivery, [urban and rural] in FIN	rural SWE // urban EUR	home delivered, at night	mostly home delivered in FIN

End of Life	70% recycled, 30% incinerated or landfilled in GER		83% recycled, 16% landf. (Less// more methane), 1% inciner. in FIN	80% recycled, 20% inciner. in SWE // 60% recyc., 30% landf., 10% incin-er. in EUR	79% recycled, 16% land-filled, 5% in-cinerated in FIN	79% recycled, 16% landfill., 5% incinerated in FIN

Table 2. Analyzed studies and main characteristics of magazines

Study	Infras et al (1998)	Nors et al (2009)	Pihkola et al (2010)
Magazine	Bildwoche, Horzu, Sport Bild, Bild der Frau, Com-puterbild, Allegra, TV neu, Auto Bild, etc.	Typical Finish magazine	Typical Finish magazine
Edition	weekly and monthly	[weekly]	weekly, 70 000 to 80 000/ week

Table 3. Analyzed studies and main characteristics of books

Study	Pihkola et al (2010)	Pihkola et al (2010)
Book	Novel, hardcover, with jacket	Photobook, hardcover + package
For-mat	205 x 135 mm	A4
No. pag.	300	64 // 128
Paper	COVER: coated paper, 150 g/m^2 (100% virgin) + board, 1300 g/m^2 (100% recycled) + INNER PAGES: uncoated paper, 90 g/m^2 (100% vir-gin) + END PAPER: uncoated paper, 150 g/m^2 (100% vir-gin) prod. in FIN	COVER: coated paper, 150 g/m^2 (100% virgin) + board, 1300 g/m^2 (100% recycled) + INNER PAGES: coated paper, 150 g/m^2 (100% virgin) + END PAPER: uncoated pa-per, 150 g/m^2 (100% virgin) + PACKAGE: corrugated board box, 120 g/m^2, plastic wrapping, prod. in FIN

Study	Infras et al (1998)	Nors et al (2009)	Pihkola et al (2010)
Format	[close to A4]	[close to A4]	22x30 cm
No. pag.			56 and 86
Paper	SC and LWC (40% recycled + 40% mechanical + 20% chemical pulp) prod. in GER	COVER: coated fine paper, 150 g/m2 + INSIDE: LWC, 80 g/m^2 prod. in FIN	COVER: coated fine paper, 150 g/m^2 + INSIDE: LWC, 80 g/m^2, prod. in FIN
Print	web rotogravure, [CMYK] in GER	heatset web offset, [CMYK]	heatset web offset, CMYK, printed in FIN
Dist.	[urban] in GER	home delivery, [urban and rural]	home delivery in FIN
End of Life	70% recycled, 30% incinerat. or landfill in GER	83% recycled, 16% landfilled (Less // more methane), 1% incinerated in FIN	83% recycled, 16% landfill., 1% incinerated in FIN

Study	Pihkola et al (2010)	Pihkola et al (2010)
Print	sheetfed offset, printed in FIN	electrophotography, CMYK, printed in FIN
Finishing	sewn, water varnish, hot melt glue	laminated cover, glue bound
Dist.	[urban and rural] in FIN	home delivery by mail in FIN
End of Life	Not included	Not included

Table 4. Analyzed studies and main characteristics of advertising matters

Study	Leaflet / Flyer	Format	No. pag.	Paper	Print	Finishing	Distrib.	End of Life
Pihkola et al, 2010	advertising leaflet	A4	4	SC, 52 g/m² (100% virgin) prod. in FIN	Gravure, CMYK in FIN	folding	home delivery by mail in FIN	83% recycl., 16% landfill., 1% inciner. in FIN
Holmen, [2019]	advertising flyer	[A5-A6]	2	100% virgin prod. in SWE // 100% recycl. prod. in GER	[offset] in GER	none	[urban]	85% recycl., 15% inciner. in GER

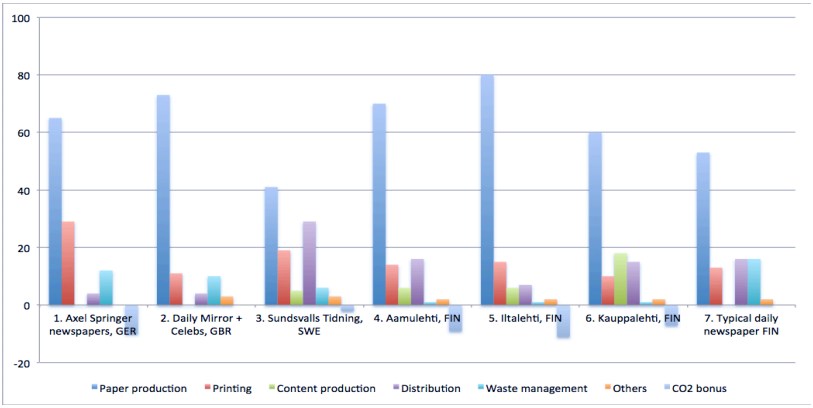

Fig 1. Climate Change impact of newspaper production main phases in %

Results

It is clear that paper production, even with significant variations, is almost always the element with the greatest impact, which is especially the case in newspapers and magazines. The amount of paper used in these cases is quite large, which explains the results, even on papers that use a large quantity or the totality of recycled fibre.

Printing is usually the phase with the second largest impact, although usually to a much lesser extent than paper production. One of the cases where the impact of printing stands out is that of the hardcover book. This is largely due to the fact that this artefact has a much greater number of finishing processes, implying a much longer production time as well as a greater number of means. The study by Holmen [8], on flyers, is the only

one in which the impact of printing is bigger than that of paper production. This may be due to differences in the studies themselves, used methods, data and dates of execution, but also due to the fact that the amount of paper is considerably less in the flyers case.

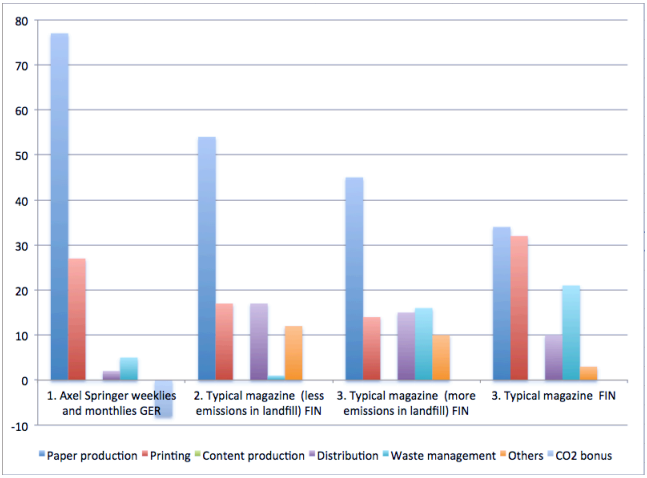

Fig 2. Climate Change impact of magazine production main phases in %

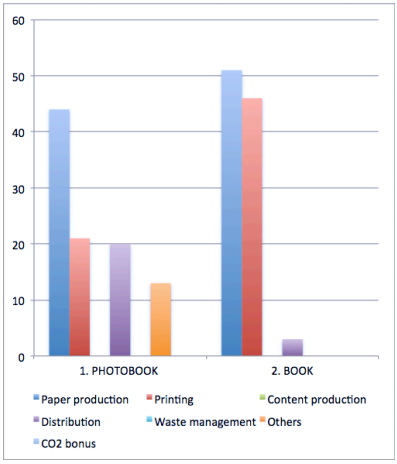

Fig 3. Climate Change impact of book production main phases in %

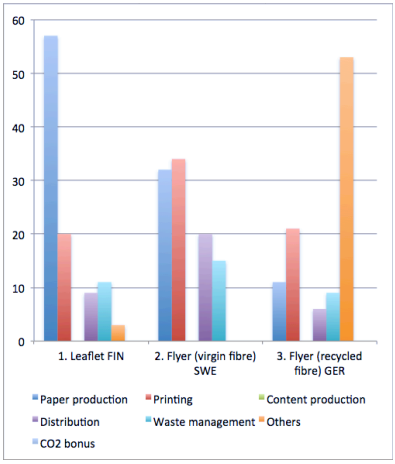

Fig 4. Climate Change impact of ads production main phases in %

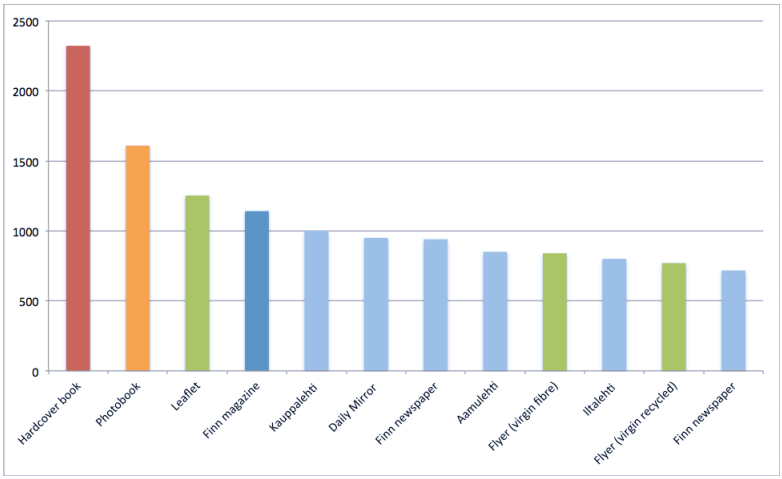

Fig 5. Climate change impact in Kg of CO_2 eq. per tonne of printed matter

Distribution can have a significant impact, especially in the newspapers' case, and in situations where distribution outside cities has a greater weight, as in Scandinavian cases. Subscription sales contribute a lot to this impact, as the periodicals are delivered to the subscribers' homes by an exclusive transport for this service, not being carried with regular mail.

In a much smaller number, waste management can represent a considerable impact, essentially when some authors have considered a greater emission of gases in the landfill.

Content production may also have some impact, as in the case of the Finnish newspaper *Kauppalehti*, according to the authors, due to the shorter circulation of the newspaper. However, in most studies this factor was not considered.

Discussion

Reducing the amount, weight or type/quality of paper used in any of those artefacts is fundamental, and may have a greater reach in the periodicals case, especially newspapers. We may also understand that a paper decrease has positive implications at all later production stages. For example, a newspaper that reduces the amount of paper by about 20% can save prepress time and materials by around 15%; reduce by 50% the time and materials needed to set up the machines; and decrease printing time by around 30% [9]. By reducing the weight of the final product, distribution is yet another area where there are environmental and financial gains.

Newspapers have been reducing their sizes in many countries, especially in Europe. This change was intense at the beginning of this century, with the size decreasing of many broadsheets to tabloid format, but after that phase, size reductions have been quite moderate. Micro formats (close to A4) are mainly used by free newspapers in some central European countries, but their use among quality newspapers is practically non-existent.

Among magazines, there are rare cases of prestigious publications, with large circulation, with a smaller dimension. *National Geographic*, with an intermediate size for a magazine, is a unique case at an international level. Some European women's magazines have been editing for a few years the same issue in two sizes, one "normal", close to A4, and other in a pocket size, roughly half of the larger size. However, they do not make a definitive transition to the smaller size.

The area of books is quite vast and diversified. However, with the exception of pocket size paperback books or similar, there are also no significant changes in terms of saving paper. Especially in the case of novels, also the use of special finishes has increased significantly. Even though this is an artefact with a much longer life span than that of periodicals, in several areas, such as schoolbooks, e.g., there is still a significant consumption of resources regarding the their shorter life.

In all cases of periodicals and in various areas of book publishing, the quality of paper and printing has increased significantly over the past 4–5 decades. The use of super calendered papers (SC), in newspapers, lightweight coated (LWC), in magazines, or coated papers in certain books; full CMYK printing; an increasing use of white space; or an increase in the number and size of images, are other examples of a growing use of resources in these areas.

Conclusions

Decreasing the use of paper is a logical and obvious step towards reducing the environmental and financial impact of printed matter, which in some cases has been used, both in design and in production. However, its application has been subject to several restrictions in most communication and advertising printed media. There are several examples in the history of design and graphic arts that demonstrate that it is possible to maintain the same amount of information and, at the same time, a certain visual impact and a seduction of graphic communication. It is within the reach of graphic professionals to use space-saving features, such as a certain way of using typefaces, composing text or layout graphic elements. In certain cases, graphic professionals do not decide the size of the artefacts they design or print, but ultimately they can influence their partners to resource reduction.

In the cases where graphic professionals can decide about sizes, the role of designers and printers is central in order to optimize the quantity and quality of the forms of information and communication.

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