Digital standards and green information technology

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Abstract:
Green information technology is a rather recent topic. Since it is in a formative stage, it comes as no surprise that the development of standards in this field is still lagging. Given the stakes however — the conservation of resources or the reduction of pollution and greenhouse gases — progress must continue being made. A presentation of the guidelines, regulations, standards and others forms of regulation that are tending in this direction…

The "standardization" of green information technology (IT) is a recent phenomenon that pervasively covers a range of aspects. The issues are similar to those having to do with corporate social responsibility.[1]

What is meant by "green IT"? Since information and communication technology (ICT) is to be "*designed or used to reduce the negative effects of human activities on the environment*",[2] the phrase refers to two spheres of reality: on the one hand, the ability to reduce ICT's impact on the environment and on humanity; and, on the other hand, IT's capacity for limiting the impact of other human activities (dematerialization, optimization, model-building, etc.). To interpret green IT standards, we have set them in the light of the issues in each of these spheres.

Not all the "standards" presented herein are specific to digital technology, but they are useful for developing green IT. As used herein, the word "standards" refers to rules of all sort that are to be followed: laws, regulations, codes of good conduict and guidelines as well as international standards. Rule-making differs depending on the country. In the United States, rules tend to take the form of standards or regulations whereas French prefers *norme*, a word that has a binding, official sense missing in the English word "norm".

The first part of this article will present standards for better managing the product life cycle. Attention will then be turned to the management of the ICT infrastructure, a major stake in matters of energy efficiency. Finally, the rules having to do with social responsibility in the digital realm will come under discussion.

[1] This article, including quotations from French sources, has been translated from French by Noal Mellott (Omaha Beach, France). All websites have been consulted in April 2019.

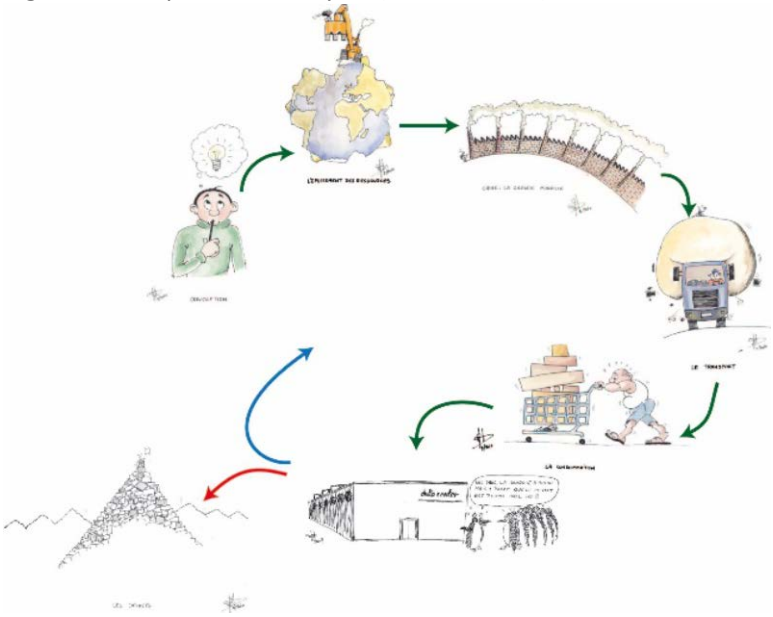
[2] Definition from the *Journal Officiel de la République Française*, 12 July 2009.

Better managing the product life cycle

Standards for environmental impact assessments

The environmental effects of human activities are varied. Despite the cogency of global warming, it is essential to measure all the effects of our products, lest some innovations turn out to be catastrophic for the planet.

Figure 1: The product life-cycle (©Eric Drezet)



Several environmental assessment methods exist. Life-cycle analyses (LCA) are part of a family of tools for analyzing the flows of materials at the level of an individual, a firm or a country, and for better understanding interactions between human societies and natural systems. Based on multiple criteria, LCA takes under consideration the full environmental impact (consumption, emissions, wastes, etc.) over a product's life cycle, in other words from the extraction of minerals or production of natural resources through the phases of production, distribution, use and consumption to the product's final elimination. LCA can be applied to products, processes and services in all types of industries.

As compared with others methods, LCA's major positive point is that it covers the whole life cycle and thus helps us see whether an action for improving the environmental impact might not amount to shifting the negative effects somewhere else. For instance, might reducing CO_2 emissions in France not increase nitrate pollution in China?

LCA's methodological and ethical framework has been defined since 1997 through a series of ISO standards.[3] These international standards have harmonized the methods adopted, improved the reliability of their results and formalized the reporting of results.

[3] ISO 14040: Environmental Management — Life-cycle assessment. During the drafting of the series ISO 14040 to 14049 in 2006, 14041, 14042 and 14043 were combined into a single standard: ISO 14044.

Regulations for designing products

Ecodesign

Ecodesign seeks to reduce a product's or service's impact during its life cycle. Till now, EU directives have mainly addressed the question of energy consumption during the use of the product or service. In recent years however, proposals are on the table for a more global view.

Among the now regulated categories of high-tech products are:

- television sets, in particular the screens (EU regulations 642/2009 and 1062/2010 having to do with energy and labeling). A revision of the minimal thresholds for performance is expected soon.
- computers. Regulation 617/2013 is being modified, a process that will probably take several years.
- electric and electronic household appliances and office equipment under Regulation 1275/2008 on power consumption in standby and off modes. In 2013, this regulation was completed with a provision about the standby mode.
- external power supplies (Regulation 278/2009 on a no-load condition for electric power and the average active efficiency of an external power supply).
- servers and products for data storage. A regulation is being drafted to set the requirements for energy efficiency (including the minimal efficiency of internal power sources) and material efficiency (*e.g.*, the removability of certain components).

Figure 2: Design (©Eric Drezet)

In 2009, the European Commission signed, with telephone manufacturers, a first protocol on the harmonization of battery chargers. This voluntary protocol provides for chargers with a standard USB-A port and smartphones with a micro-USB port. In the meantime however, technological advances have come up with a new solution: the better performing USB-C. The Commission has launched a campaign in favor of a new charger for all mobile telephones. Seven smartphone manufacturers have pledged that, by 2021, their new smartphones will be capable of being recharged via a USB-C connection. Note, however, that this protocol fails to specify the type of connection at the other end of the cable.

Toxic chemicals

Given the growing concern for health and the environment, regulations have been proposed to limit the use of dangerous substances in products being designed and to set up a system for handling wastes so as to prevent the scattering of pollutants and protect the wage-earners who collect and recycle them.

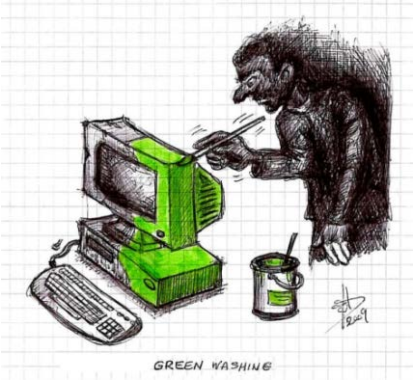
EU Directive 2002/95/CE of 27/01/2003 on the restriction of hazardous substances (RoHS 1) seeks to limit the use of dangerous chemicals in electric and electronic equipment (EEE).[4] Recent modifications (directives 2011/65/UE of 01/07/2011 and 2017/2102 of 15/11/2017: RoHS 2) have broadened the definition of EEE to nine categories; and raised from six to ten the number of outlawed substances (at a concentration of 0.1% or even less), thus aligning the aforementioned directives on the EU's REACH regulation.

The regulation "Registration, Evaluation, Authorization and Restriction of Chemicals" (n°1907/2006 of 18/12/2006) seeks to identify, assess and control the manufacturing, importing and marketing of chemicals in Europe.[5] "*Since 31 May 2018, it is no longer possible to manufacture or import chemicals of more than one tonne per year if they have not been registered […] under the principle established by REACH: 'No data, no market'.*"[6] Manufacturers and importers must see to it that the chemicals in products have been correctly registered on the European Chemicals Agency's (ECHA) website, which, to date, lists 20,000 chemicals with potential, identified risks.[7]

Ecolabeling

Better managing the product life cycle has implications for consumption. "*The ecolabeling of products of mass consumption is a procedure decided by the 'Grenelle of the Environment' [a meeting in 2007 of French officials and organizations for a wide-ranging discussion of environmental issues] in order to make consumers aware of the environmental impact of products.*"[8] The wide variety of ICT products, along with the complexity and transformation of production chains, has made ecolabeling even more complicated. At present, there are only three categories of products of the type "*material/equipment (consumer of energy)*" for which ADEME (the French Agency for the Environment and Energy Management) has validated the specifications: television sets, reused laser cartridges and telephones. Ecolabels are intended to improve communication and information about products in relation to the environment.

Figure 3: Eco-labeling (©Eric Drezet)



[4] Transposed into French law by Decree n° 2005-829 of 20 July 2005 (articles R.543-172 to R.543-206 in the Environmental Code), this directive is paired with the Framework Directive on wastes to be discussed later in this article.

[5] https://reach-info.ineris.fr/?content=accueil

[6] https://www.ecologique-solidaire.gouv.fr/reglementation-reach

[7] https://echa.europa.eu/home

[8] http://www.affichage-environnemental.fr

Ecolabels of the so-called "official" type, since public authorities issue them, are designed in line with ISO 14024. They abide by several requirements: performance thresholds, the process for drafting them ("consultations"), certification (by an independent organization) and their scope (cradle-to-grave LCA). The best known are: the European Ecolabel, NF Environnement, Blue Angel (the oldest environmental certification in the world, introduced in 1978 in Germany), Energy Star[9] for the energy efficiency of products (created by the US Environmental Protection Agency) or TCO[10] for certifying IT products (to minimize their impact on the environment and on health).

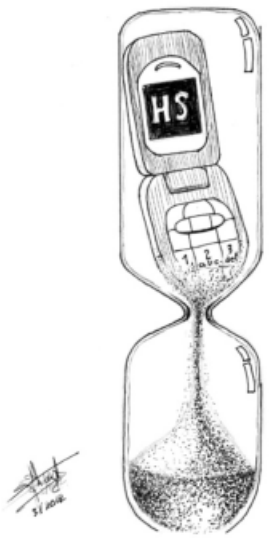
Ecolabels of a second type correspond to self-declarations in line with ISO 14021. The criteria used depend on the interest groups (NGOs, industrial or business trade groups) who have designed them. Let us take as example the Electronic Product Environmental Assessment Tool (EPEAT)[11] proposed by Green Electronics Council. It focuses on a cradle-to-grave life-cycle analysis of ICT products. Though of American origin, it is now worldwide. We might also mention ECMA-370,[12] a standard specifying environmental attributes and methods of measurement for helping ICT manufacturers to make their own self-declarations.

A third type are "ecoprofiles", as defined by ISO 14025. Resulting from an LCA, they are intended to help compare products. However their highly technical specifications do not make it easy to form an idea about a product's environmental qualities.

Planned obsolescence

Since the production of electronic equipment can account for up to 90% of a product's environmental impact, the most effective approach is to reduce purchases of new devices.

Figure 4: Obsolescence (©Eric Drezet)



Article L.213-4-1-I of the French Consumer Code defines planned obsolescence as "*the set of techniques whereby a marketer seeks to deliberately reduce the life of a product in order to increase its replacement rate*". This is now an offence under Act N° 2015-992 of 17 August 2015, the TECV Act "*on the energy transition for green growth*".[13]

[9] https://www.energystar.gov

[10] http://tcocertified.com/tco-certified/

[11] https://greenelectronicscouncil.org/epeat/epeat-overview/

[12] https://www.ecma-international.org/publications/standards/Ecma-370.htm

[13] Available at https://www.legifrance.gouv.fr/.

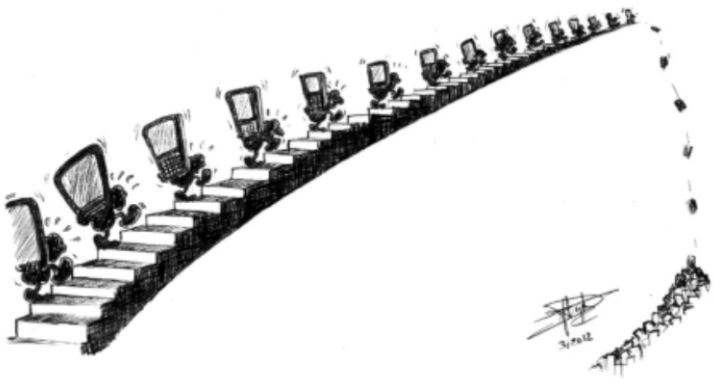
Removable batteries have been the subject of an EU directive (2006/66/EC, Article 11), which a decree of 10 July 2015 transposed into French law. Samsung, Apple and Huawei frequently install unremovable batteries. However this violation is never officially reported and does not seem to bother consumers even though a smartphone is used for two years on the average — longer than the battery's life.

The obligation to provide information about the availability of spare parts (Article L.111-4 of the Consumer Code) is, unfortunately, too seldom and partially enforced to have any effect on the durability of electronic devices.

Regulations for managing wastes from electronic and electrical equipment

According to a UN report, Europe accounted, in 2016, for 12.6 million tonnes of wastes from electronic and electrical equipment (WEEE) out of the 44.7 million metric tonnes produced worldwide.[14] These wastes — an enormous potential as urban mines (for metals) — are a source of serious pollution when not appropriately processed. Regulations about the end of the product life cycle and the transportation of wastes seek to lessen the environmental impact and reduce waste.

Figure 5: Electronic wastes (©Eric Drezet)



EU Directive 2002/96/CE of 27 January 2003 on WEEE[15] completes the Framework Directive on Wastes (2008/98/EC).[16] A "polluter pays" principle has been adopted; and a regulated WEEE management chain, set up. Four organizations have been certified: Éco-Systèmes, Recyclum, Ecologic, and PV Cycle. Funding comes from an "ecotax", which consumers pay when purchasing new equipment. Manufacturers have to declare to ADEME the products they place on the market; and they are liable for processing them at the end of their life cycle. For consumers, this means that distributors must accept to take the equipment back in line with the principle "one device recycled for one bought". Delivery slips for tracking these wastes are made to ensure the transparency of the operations of collecting, recycling and reclaiming wastes. To further the harmonization of regulations in Europe, the WEEE Forum, which groups the certified environmental organizations, has defined a set of standards about the phases in this process (collection, depollution, recycling). This set is called WEEE Labex (WEEE Label of Excellence).[17]

[14] BALDÉ C.P., FORTI V., GRAY V., KUEHR R. & STEGMANN P. (2017) *The Global E-waste Monitor 2017: Antonyms, Flows and Resources* (Bonn/Geneva: United Nations University & International Telecommunication Union), 116p. available via https://www.itu.int/en/ITU-D/Climate-Change/Documents/Global%20E-waste%20Statistics%20Flyer.pdf.

[15] Modified by Directive 2012/19/EU and transposed into French law by Decree n° 2005-829 of 20 July 2005 as articles R.543-172 to R.543-206 of the Environmental Code.

[16] EU waste management law at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Aev0010

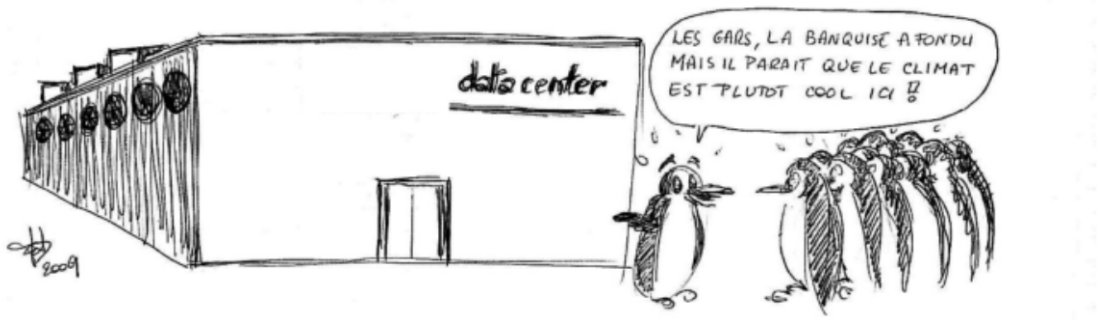
[17] http://www.weee-forum.org/weeelabexproject & https://www.weeelabex.org

Regulation 660/2014 of 15 May 2014 on transfers of wastes is but the transposition of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.[18]

Standards, guidelines and codes of conduct for data centers

Despite recent progress, most data centers are lagging; their design and technology falls far behind the state of the art. Rules and standards have been proposed to improve the design and operation of these centers, primarily so that they waste less energy.

Figure 6: Data centers (©Eric Drezet)



At the international level, a technical committee (TC 9.9) of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has drawn up environmental standards (temperature and hygrometry) for buildings that accommodate electronic equipment. The third edition of *Thermal Guidelines* (2012) lists four classes of data centers and broadened the acceptable ranges of temperature and of relative humidity[19] so as to reduce the load on cooling systems and increase the possibility of free-cooling (using air from the outside). Building companies and manufacturers sometimes try to have their products certified under conditions that are stricter than ASHRAE's.

In 2008, the European Commission's Joint Research Center (JRC) released a Code of Conduct (CoC). This code, which has been regularly updated. informs the operators and builders of data centers about how to reduce a center's energy consumption. It urges them to do this but without affecting the center's critical functions or the reliability of its installations. In addition to these general principles, the JRC sets objectives and defines best practices. The technical committee CLC/TC 215 is now updating the CoC's "best practices guidelines" (Document 50600-99-1).

CENELEC (European Committee for Electrotechnical Standardization) has drafted EN 50600 ("Information technology: Data center facilities and infrastructures"), which covers a data center's whole life cycle from design to installation and maintenance. Intended for all players in this sector, this new European standard moves beyond existing standards to address the issues of energy and environmental controls. It has instructions for technical implementation. Focused on energy efficiency in data centers, the most recent modules (2017) have proposed an approach to design as compared with costs.

[18] The regulation modified CE 1013/2006 of 14 June 2006 and is now being reviewed. See https://www.actu-environnement.com/ae/news/consultation-europe-revision-reglement-transfert-dechet-30584.php4. It can be downloaded from https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=OJ:L:2014:189:FULL&from=FR. About the Basel Convention: *cf.* https://www.ecologique-solidaire.gouv.fr/transferts-transfrontaliers-dechets.

[19] The first edition in 2004 recommended temperatures between 20° and 25°C (a range broadened to 18°-27°C in the second edition in 2008) and a relative humidity between 40% and 55%.

The key indicators for data centers

Measuring and improving a data center's efficiency calls for a global vision and requires indicators for assessing the impact of actions. The consortium Green Grid has developed several indicators:

- POWER USAGE EFFECTIVENESS. To measure energy efficiency, PUE calculates the ratio of the total energy consumed by a data center to the energy delivered to its computing equipment over a period of twelve consecutive months. This indicator was incorporated in an ISO/IEC standard in 2016 (30134-2 JTC1/SC39). A PUE close to one seems ideal, since only the computing equipment would then be consuming energy.
- WATER USAGE EFFECTIVENESS. This indicator is in the process of becoming an ISO/IEC standard. WUE equals the quantity of water used by a data center divided by the energy consumed by its IT equipment.
- CARBON USAGE EFFECTIVENESS. CUE is the total quantity of greenhouse gases (kg of CO_2) emitted by a data center divided by the quantity of energy (in kWh) used by its computing equipment.

When the energy from machine rooms can be reused, two other ratios are relevant:

- ENERGY REUSE EFFECTIVENESS is the ratio between the difference of the quantity of energy consumed by the data center less the energy reused divided by the energy consumed by its computing equipment. ERE can be used to take account of retrieving the heat in the rooms with servers in order to heat the building.
- The ENERGY REUSE FACTOR is the ratio between the energy reused and the total energy consumed by the data center. The standardization of ERF is an ISO/IEC project.

Other indicators complete Green Grid's:

- RENEWABLE ENERGY FACTOR. REF, which became an ISO/IEC standard in 2016 (30134-3 JTC1/SC39), measures the share of renewables in a data center's total energy consumption. It takes account of all renewables, regardless of their source, whether produced on location or purchased.
- DATA CENTER ENERGY MANAGEMENT. The DCEM, a global indicator of a data center's energy performance, became an ETSI standard in 2013 (GS OEU 001 V1.2.3). It combines four indicators of objectives: energy consumption, renewables, energy reuse, task efficiency. Though intended for comparisons between data centers, it is complicated to apply.

Corporate social responsibility

Mining whets appetites and has spawned abuses in several countries, notably in Africa and South America. As a result, conflicts, often armed, have broken out about, in particular, the use of water. To limit these risks, more or less binding measures have been taken at the national and international levels.

Figure 7: Mining (©Eric Drezet)

The Dodd-Frank Wall Street Reform and Consumer Protection Act was adopted in 2010 under the Obama administration. Though primarily intended to reform the financial sector by making it more accountable and transparent, this law also contains provisions (Title XV) about "*disclosures on conflict materials in or near the Democratic Republic of the Congo*". Corporations have to exercise "due diligence" in controlling their logistics and submit a public report to the Security and Exchange Commission (SEC) if their products are likely to contain blood-stained minerals. The objective is to see whether their purchases abet armed groups and to take the appropriate measures.

Between 2009 and 2012, the Organization of Economic Cooperation and Development drafted a set of guidelines for helping firms exercise due diligence for a responsible supply chain of minerals.[20] These guidelines came out of a multiparty process, and recommendations are reviewed annually.

On 17 May 2017, the EU, with reference to the aforementioned OECD guidelines, adopted Regulation 2017/821 "*laying down supply chain due diligence obligations for Union importers of tin, tantalum and tungsten, their ores, and gold originating from conflict-affected and high-risk areas*".[21] This attempt to regulate the commerce in "conflict minerals" occurred seven years after the United States. However it will be slowly enforced since it does not actually become binding till 2021.

In France, Act n° 2017-399 of 27 March 2017 on the "*due diligence of parent companies and contracting firms*"[22] calls on the latter to "*identify the risks and forestall serious violations of human rights, of fundamental freedoms, of the health and security of persons and of the environment*". These measures hold for all activities of a firm and its subsidiaries, subcontractors and suppliers with which it has business relations.

[20] OECD (2016) *Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas*, third edition (Paris: OECD), 122p. Available via http://www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf.

[21] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0821&from=ES

[22] https://www.legifrance.gouv.fr/eli/loi/2017/3/27/2017-399/jo/texte

A few remarks in conclusion

To conclude this article on green IT standards, we want to point out that there are very few strong, binding rules or standards in matters of ecodesign, apart from the aspects related to energy consumption during the use phase of electronic equipment or in data centers. The guidelines or standards proposed by interest groups or the European Commission go somewhat farther but are not compulsory; they often target the machines and devices used by businesses. For all that, a regulatory framework is being erected with regulations about ecodesign (of electronic components), corporate social responsibility (the conditions for mining the ores used to make these components), the use of electronic devices (for the sake of energy efficiency) and the analysis of ICT product life cycles.