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Modern consumerism and the waste problem

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1 Introduction

With the advance of industrial mass production, modern micro-electronics and computers, the intervals between the release of new generations of consumer products have been dramatically reduced and so have their lifetime cycles.

While it was very natural in the post-war era, that sophisticated consumer products like television sets and stereo equipment would not be replaced with a new product until they break, and usually beyond that point since it was very common to have a broken television set serviced, the habits of consumers have changed during the last quarter of the 20th century. The variety of television sets, radios, stereos, phones and computers available on the market has surged and more and more vendors are competing against each other to win the favor of consumers.

A modern consumer product, like Apple's famous iPhone has a market life of approximately one year [1] until a successor is announced and subsequently pushed onto the market. Usually these new generations bring a bunch of new features, have a higher performance (CPU speed, battery life, radio data rates) while maintaining the price or becoming even cheaper, thus the consumer greatly benefits from the reduced lifetime cycle of these products.

On the other hand, electronic devices not only require a lot of of Earth's limited resources for their production (including rare metals like tantalum and indium), but their production processes are a major source for harmful climate gases like carbon dioxide and toxic waste like heavy metal alloys, acids and alkalis. And last but not least is every obsoleted iPhone a candidate for waste facilities unless consumers are going to sell them on the second hand market.

While we can not expect consumers and manufacturers to go back to the early days of consumer products where lifetime cycles reached up to 20 years, the world record being the famous "Centennial Lightbulb" in Livermore, California in the United States, which has been lit for over 100 years [2], it is certainly about time to rethink modern consumerism with regard to responsibility to future generations.

In this essay I would like to discuss the problem using the example of Apple Inc. and their famous iPhone and the manufacturers of inkjet printers. I will examine possible ways to improve the situation with the help of viable alternatives and ways to prolong lifetime cycles as well as if and how much governments should try to tackle the problems of planned obsolescence and waste production by passing of stricter laws to regulate the markets.

2 Proprietary standards and patents

When Apple introduced their first iPod, in 2001 and, 6 years later in 2007, the iPhone, they set to revolutionize the markets for portable music players as well as smart phones. Thanks to their unique design and ease of use, iPods quickly evolved as world's most popular portable players, nowadays account for over 70% of all players sold world-wide [3]. While not as dominant within its market as the iPod is in the market for portable music players (market share as of the first quarter of 2011: 16.8% [4]), the iPhone is still very popular and has had a strong impact on its market, setting a standard for most mobile phones to be released later on.

With the introduction of the iPod and the iPhone, Apple introduced a new, proprietary type of data and charge connector, the so-called "30-pin dock connector" [6] which can exclusively be found on Apple's handheld devices. While the design of the 30-pin dock connector allows combining many connectors into



Figure 1: Proprietary dock connector found in Apple’s iPod and iPhone products (left) compared to a standard mini USB plug (right) found in most handheld devices by other manufacturers [5]. Apple’s proprietary connector makes it impossible to use cheap standard cables and chargers supplied with non-Apple brand handhelds.

a single one and thus reducing the amount of connectors while still remaining universal connectivity¹, the proprietary connector takes away the possibility to charge and connect the iPod/iPhone with a standard USB cable as it can be done with most other handheld devices on the market (see Figure 1).

Besides the practical difficulties it introduces, the use of such a proprietary connector is also a potential source for avoidable electronic waste, since all accessories and cables for the iPod/iPhone cannot be used with non-Apple products if the consumer decides to buy a different brand after the Apple handheld has reached the end of its lifetime cycle.

Another very prominent example shown in the 2010 documentary movie “The Light Bulb Conspiracy” by Cosima Dannortizer [7] are consumer inkjet printers produced by companies like HP, Canon and Lexmark. All these manufacturers use proprietary types of ink cartridges which are protected by international patents against reproduction by third-party manufacturers [8, 9, 10], forcing the customer to buy the expensive original cartridges.

While it should be the right of every of every creative mind to be able to protect their engineering works against plagiarism, securing a revenue for the ten to twenty years to come, helping to pay back the expenses and efforts necessary to develop a patented product, it is very obvious that in the case of ink cartridges, the patents are solely filed to secure the manufacturers monopoly in the market for printer supplies. This suspicion is further sustained by the fact, that companies like HP encourage their customers to send them back empty inkjet cartridges, claiming that their only intention is to protect the environment [12]. However, by taking care of the recycling of old cartridges, HP eliminates the viable possibility of refilling and reselling used cartridges by third-party manufacturers. Thus, HP has gained monopoly in the market of printer supplies for their products.

Due to their monopoly position, manufacturers like HP, Lexmark and Canon are able to dictate the prices in the supply market, leading to absurd prices for their printer ink. The Financial Times reported in 2004 [13], that a gallon² of HP’s ink for inkjet printers costs up to 8000 US Dollars, a price that well ranges between those of synthetic drugs like GHB or artificial insulin [14].

To make things even worse, the overpriced printer supplies have not only lead to consumer frustration, but also introduced another source of electronic waste. Since the manufacturers have discovered that they can much more on supplies than on the actual printers, they have started subsidizing the printers, allowing them to offer them at dumping prices as low as 30 Euros, sometimes even undercutting the price of a new set of cartridges³ such that many customers actually rather buy a new printer, which usually

¹Both the iPod and the iPhone have, in fact, only a headphone jack and the 30-pin dock connector.

²A US gallon corresponds to ≈ 3.78 liters.

³Color inkjet printers usually have to be supplied with at least two inkjet cartridges - color and black ink - or even four cartridges - 3 colors and black, each of them costing 10-20 Euros, depending on the type and brand.

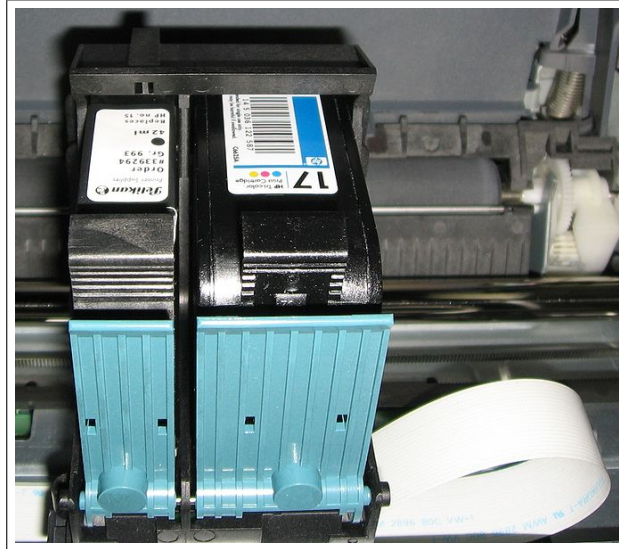


Figure 2: Typical inkjet cartridge as used in most consumer inkjet printers. The cartridges usually employ a (avoidably) sophisticated design, which often means they are protected by patents and therefore cannot be supplied by third-party manufacturer at reasonable prices. This makes the prolonged use of such printers very cost-ineffective as new printers are often sold at prices lower than a new set of cartridges would cost. (Image from: [11])

ships with a set of ink cartridges, instead of just buying supplies for the printers that they already own.

Both examples clearly show that proprietary standards can have impact on not only consumers choices but also have consequences on the environment, since they prevent the economic (re-)use of consumer products once they have entered the aftermarket status.

3 Planned obsolescence

Planned obsolescence is a term first coined in the title of Bernhard London's pamphlet "Ending the Depression Through Planned Obsolescence" in 1932. In his essay, London suggested a regulatory to be imposed by the government which would subject all consumer products to a pre-defined, limited lifespan after which the product would have to be replaced. Upon caught using beyond their expiration date, he suggested, consumers should even be penalized. His intentions were motivated by the idea, that a major cause for the *Great Depression* in the 1930's were consumers' habit of "using their old cars, their old tires, their old radios and their old clothing much longer than statisticians had expected" [15].

The principle of planned obsolescence was first put into practice on a large scale with the formation of the Phoebus cartel in 1924 [16]. It was a joint-venture of the light bulb manufacturers Osram, Philips, Tungsram and General Electric, among others. In the cartel, manufacturers did not only agree on fixing prices such that no manufacturer had to fear the competition of the others. But they also secretly signed a commitment, pledging each other that light bulbs would be designed and constructed such that their expected life time would not exceed 1000 hours. The Phoebus cartel demised in 1939 when the war broke out and manufacturers in Scandinavia decided to start an independent collaboration producing cheaper light bulbs.

After its demise, the Phoebus cartel fell into oblivion for a long time until the controversy it set off became newsworthy with the advent of modern consumerism: Due to huge advances in design and manufacturing processes, many consumer products can nowadays be produced with such high quality standards that they last a life time and beyond, while still being very cost-effective in production. The probably most-notable industry worth mentioning in this context is the semiconductor field. Semiconductors can be produced very cheap and with very high yield rates, i.e. there are very little amounts which have to

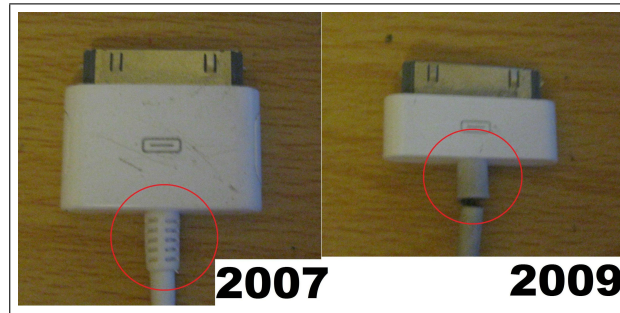


Figure 3: Consequences of cost reduction in the design of electronic consumer products. The image shows the standard connection cable of an iPod which has received a more cost-effective design over the years, making it more prone to failure [17]. However, nowadays many consumer products do not obsolete on the hardware level but it's rather its software which becomes outdated and thus obsoletes the whole product.

be scrapped. And since a lot of electronic and even mechanic⁴ functionality can be integrated into a semiconductor, modern consumer products like cell phones contain nearly only semiconductors along very few other parts, making them very durable and cheap. Obsolescence due to technical failure has therefore become rather uncommon and usually only occur with design flaws (Fig. 3), which many manufacturers often recognize leading to free repairs or replacement.

Naturally, the durability of modern consumer products is a problem for an industry that fuels itself from the sales figures it generates and companies have to find new ways to constantly motivate consumers to buy their products. If the consumer products do not become obsolete by technical failure, they have to obsolete on a different level. And, in fact, manufacturers have found a viable method to achieve that and their effective means is to limit the time the consumer can obtain product support.

While this doesn't really affect conventional consumer products like household equipment or classical electronic appliances like television sets and radios, the discontinuation of product support has dramatic impact for digital products like computers, cell phones (especially cell phones) and MP3 players. Major parts of the functionality of such digital products stems from the software they are running. And with the increase in functionality, the software of digital products has become more and more complex which makes them more prone to errors in implementation (often referred to as "software bugs") and therefore subject to frequent software updates [18]. Besides fixing bugs, software updates will very often also bring new functionality and overall improvements to a digital product.

A very common and prominent example for obsolescence through the lack of software updates are computers running the popular Microsoft operating system Windows [19]. Most desktop and laptop computers ship with the Microsoft operating system already installed. Since the software has been installed by the hardware vendor, it is assured that hard- and software work well together and hardware-specific software, so-called drivers [20], which are required for the hardware to operate, are working properly. At the time Microsoft releases a new version of Windows, the current version will be deprecated and - after a certain grace time - fall out of software support by Microsoft because the old version will have reached the end of its life time [21]. So, besides the new features which is users luring into buying the new version of Windows, it is also the planned obsolescence of the software it which will eventually force people into the upgrade.

At first sight, one might probably think that planned obsolescence of software does not eventually lead to large amounts of electronic waste except for the CDs and DVDs it is stored on, which are made from polycarbonate, a plastic which can be easily recycled. However, the opposite is true not in all but many cases. The problem with an upgrade to a new version of the Windows operating system is that users will also need to obtain updated drivers compatible with the new version of Windows. While updated drivers are usually provided by the hardware vendors for free, it is not guaranteed that these drivers are provided for older hardware which is no longer available on the market. The consequence is that the affected hardware won't work with the new version of Windows and will have to be replaced with new hardware for which the hardware vendor provides drivers for the new Windows version. And on the other

⁴Many electro-mechanic devices like microphones, switches and relays and much more can nowadays be produced as semiconductors as well, reducing their cost dramatically.



Figure 4: Electronic waste recycling in the Third World: A woman is decomposing electronic waste into its raw materials, trying to retrieve valuable component materials like gold and copper which they sell to local scrap dealers. Due to the recent increase in prices for raw metals, more and more people in these countries discover the recycling of electronic waste as an additional source of income. Picture from [22].

hand, for very new hardware drivers aren't usually provided for older, deprecated versions of Microsoft Windows. So there is obviously a mutual stimulation between Microsoft and the hardware drivers which will constantly fuel consumerism which again leads to the problem of electronic waste.

4 Consequences: The waste problem

As modern electronics industry encourages end users to replace their old consumer products with shiny new things from the shelf, the natural question arises where consumers dispose of their old stuff.

Luckily, there are some options available which allows to give used electronics a second life by selling it used or donating it for charity. A very viable option for the first scenario are online market places like eBay or Craigslist among many others. If someone prefers donating their used electronics for charity, schools and similar public facilities are always happy to receive such support. However, since users of second hardware often run into the same problem of the lack of software support, many old computers and consumer electronics end up on waste dumps or incinerators since their recycling is complex and expensive: It involves a lot of manual work and many steps to properly disassemble the old equipment such that the component materials can be recycled or disposed of properly.

Used electronics contains hazardous materials like mercury, lead, silver and flame retardants. On the other hand, many parts and components contain valuable raw materials like gold, copper, titanium and even platinum, albeit mostly in very small amounts. It can take up to one ton of electronic waste to recycle just 200 grams of gold [23]. It is therefore often not viable for recycling companies in the industrial countries to do the actual recycling but they found another, much cheaper method for getting rid of the electronic waste: they export the waste into Third World countries [24].

Officially declared as used, working consumer electronics to be sold on second markets in the Third World, most used electronics turn out to be non-functioning and useless and therefore end up as electronic waste. While it is not just immoral to take advantage of these countries and use them as cheap waste dumps, it also bears hazards for humans and the environment in the affected countries.

As mentioned before, electronic waste contains many toxic substances which need to be properly disposed of. This means that decomposing of the waste has to be performed in appropriately equipped recycling facilities where the individual component materials of the waste can be separated from each other in a safe manner such that workers are never exposed to toxic fumes or liquids. Special waste containments and protection suits for the workers are essential to guarantee safety for workers and the environment. Naturally, these requirements are usually never met and recycling in the Third World usually occurs

in the open, with no protection suits and no respiratory protection, simply because workers in these countries cannot afford those and are thus forced to perform the decomposing with their bare hands, often not knowing about how much these jobs put their health on risk.

5 Solutions: Stricter laws and consumer awareness

The question now is, what can be done to tackle the waste problem. Most readers would now demand government action in the form of stricter laws. Manufacturers should be forced to improve the recyclability of their electronic consumer products, avoiding the use of toxic materials like lead, arsenic and mercury. Furthermore should manufacturers be more subject to use standardized connectors and interfaces, such that, for example, consumers can continue to use the accessories of their old cell phone once they replace it with a new one, which avoids rendering the old accessories useless and eventually electronic waste.

There are, in fact, already certain laws and regulations pending which enforce such measures. For example, in the European Union, the RoHS (Restriction of Hazardous Substances) directive [25] has become effective as of July, 1 2006. Often known as the “lead-free” directive, it bans the use of lead, mercury, cadmium, certain types of chromium and some brominated flame retardants. While lead was primarily used as an ingredient for solder (lead reduces the brittleness of the tin solder), cadmium has been an essential ingredient of NiCd rechargeable batteries, which have been superseded by better and greener battery technologies like NiMH [26] and Li-Ion [27]. The hazardous brominated flame retardants have been replaced with non-halogenated flame retardant, organophosphorous or inorganic flame retardants like $\text{Al}(\text{OH})_3$ or $\text{Mg}(\text{OH})_2$.

As for the proprietary connectors, the EU commission has, for example, requested manufacturers in 2009 to agree on a unified connector for cell phone chargers [28]. This unified connector is a standard USB connector which can be found on a huge variety of digital devices. The use of this connector not just allows to use any cell phone charger independent of the brands of charger and cell phone, but also give the opportunity to hook up the phone to a normal PC using a standardized and cheap USB cable which will allow to charge the phone. The unified connector reduces the amount of chargers users have to carry around for their various mobile devices and also allows to continue using a charger even when the cell phone has been replaced with a new model.

The continued efforts of the European parliament and EU commission to improve environmental aspects of electronics will certainly bring more of such directives, agreements and laws, so that, at least for the European Union, one can say that governments have recognized that there is a problem with the electronic waste that needs to be taken care of. Future efforts should certainly concentrate on stricter export laws for used electronics and encourage manufacturers to be responsible for the recycling of their used consumer electronics such that customers can return their devices to the manufacturers once they have reached the end of their life time.

Since decisions coming from governments side to tackle a problem like the one with the electronic waste can always take quite a long time before they become effective after the problem has become imminent (reasons are usually manufacturers and certain political parties or countries who block such decisions), it also the responsibility of consumers to help improving the situation. Consumers can have a very strong influence on manufacturers environmental guidelines if they decide to reflect environmental aspects in their decisions of purchase. In order to help consumers, Greenpeace regularly releases studies which rank the big manufacturers in electronics industry according to their environmental efforts [29]. With the help of this ranking and the included guide, consumers can easily assess manufacturers environmental efforts and with the decision for greener companies help making a choice to reduce the amount of toxic electronic waste being produced. The ranking includes many environmental aspects like the use of hazardous raw materials, production of climate gases throughout the manufacturing process as well the recycling efforts shown by the manufacturers. Clearly, a good starting point for consumers to help.

Also, consumers can prolong the useful life time of their computers with the help of free and open source software [30]. For example, Linux - a free clone of the Unix operating system - supports a wide range of hardware and especially a lot of old hardware. So chances are always that an old printer or scanner, for which no device drivers are available for a current version of Windows, will still work fine even with the most-recent version of Linux. Popular distributions of Linux are *Ubuntu* and *Fedora* which are becoming more and more adopted in private as well as corporate environments. Together with free desktop software

like *Libre Office* (office suite alternative to Microsoft Office), *Mozilla Firefox* (a free web browser), *Mozilla Thunderbird*, *GIMP* (free alternative to Adobe Photoshop) among many others, consumers not only get a complete set of desktop applications for free but are also able to use their old computers with modern software, avoiding the need to replace the hardware once the operating system is updated.

6 Conclusion

Over the last three decades, manufacturers have dramatically improved the reliability and life time of consumer electronics. However, the problem of electronic waste is still present since nowadays, very often (planned) obsolescence does not occur on the hardware level but on the software level. Software companies and hardware vendors very often silently stop providing software updates necessary to make old hardware run with recent software. This is very often the reason why consumers replace their old electronics with new models, even though the old electronics is still perfectly functional, just not with modern software. This problem can be avoided by replacing proprietary software with free and open source alternatives which very often provide continued support even for very old hardware. Consumers can also have a strong voice when coupling their purchase decisions with environmental aspects. Environment organisations like Greenpeace provide useful information and guides which will help consumers choose their consumer electronics while still being able to have a “green conscience”.

Governments in Europe have already passed a variety of directives like the *RoHS* directive and laws which permit the use of hazardous raw materials, making the recycling of used electronics less harmful for the environment. Additional agreement with electronics industry have also been achieved which obligate electronics manufacturers to use more standardized connectors and parts which help avoid electronic waste since consumers do not have to throw away all the accessories when they replace their cell phone, for example. Future efforts of the governments will have to include a stricter enforcement of export regulations of used electronics into Third World countries, such that recycling companies cannot take advantage of these countries as a cheap source of labor for recycling to harvest valuable raw materials like gold, copper and other (noble) metals while local workers risk their health when working without proper protection suits and respiration masks.

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