Possible solutions to the sustainability issues facing the ICT sector

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Introduction

This report aims to take the reports studied and create a summary of systems which could reduce the sustainability issues facing the company in the future. The report is divided into 4 sections.

- Systems which can be used
- Global issues facing the company
- The cloud and how it can reduce energy consumed
- How products can be designed in the future with solutions to the sustainability issues in mind

By using some of these solutions, the products can be more sustainable and combat the sustainability issues facing the ICT sector. If eco design, power management and longer lifetimes are taken into account during the design phase of products, they can last longer, be more energy efficient and therefore reduce waste and energy consumption.

Contents

Systems

One system for increasing the IPR (increased producer responsibility) is to add RFID tags to all the products so that when a product goes into a recycling plant, it can be scanned and therefore the company can be billed for their own products that come back, rather than just calculating it based on the market share. By doing this, the companies have incentives to reduce the amount of time it takes to dismantle the product as then they will be charged less for it.

By having a database on each product, its materials and other factors, when a product comes to be recycled, this information will ensure that as much as possible of the materials can be recovered. It will also help in sorting the products into batches for dismantle.

Studies have been done on this by the University of Limerick ECE department on the effectiveness and cost of such a scheme, it was found on products such as white goods (fridges, freezers etc.) this can be achieved successfully as they are more structured in the containers and all the RFID tags could be read successfully during the tests. However, on other items rates varied in different categories on the amount of successful tag reads from the reading device which points out the challenges of implementing such a scheme. The tags would have to be standardised to stop manufacturer putting weaker tags on the devices to avoid being detected and also the current tags range would have to be improved to ensure that all the tags would be detected. [1]

Whether to invest in a new, more energy efficient product or to keep the older, less efficient product is a big question, particularly with white goods where a user does not see any difference in the end result (unlike phones/laptops etc. where speed/features improve the users view on the product). If one plots the accumulated energy usage of a product showing the manufacturing spikes and the slope of the energy in the use phase. The graph would look something like:

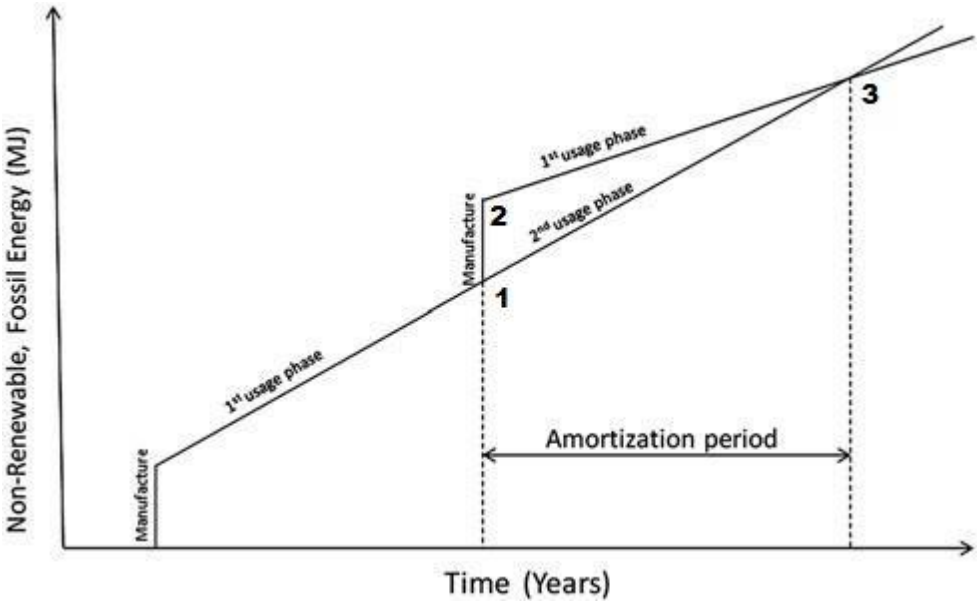

Figure 1 : Time vs. Energy for a product

The size of the amortization period (the length of time the effect of the energy saving in the use phase takes to equal the manufacturing energy) would show how long the new investment would take to pay off in terms of energy. The shorter this is, the effect of the energy saving will have a

much greater effect in the long run as after this period, the accumulative energy is less than the original products energy if it was kept.

A study was done in the ECE department in UL which shows that for appliances rated A-C, keeping the product or reusing it is better from an environmental point of view and, with an economical point of view it would be better to reuse, A-C as well as D if used with medium to low intensity and even E if used on a low intensity. The 'reuse' in this case could be that the person keeps the product or sells it on to someone who will still use it for its functional purpose. [2]

Product service systems are another system that could combat the sustainability issues. The concept is that a rather than selling the product to the customer, the use of the product is sold to the customer for a fixed amount per functional output, and the provider looks after all the expenses from this including servicing, consumables, disposal etc. With traditional sales, the manufacturer wants to make the product consumable so that they can sell the latest version on a regular basis to make a profit. With a PSS (b) it is in their interest to make it last as long as possible as the longer it lasts, the more profit they can make per system and the lower their disposal/installation costs etc.

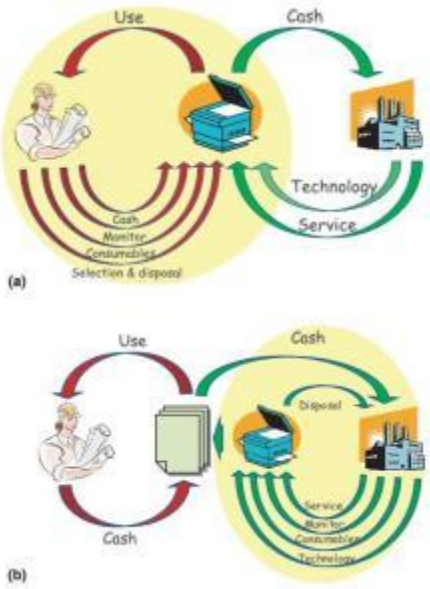

Figure 2 : PSS model

Another benefit of the system is that the manufacturer looks after servicing the equipment. This means for them to have fewer problems and call outs, it is up to them to keep the product in its best possible state and so this means the product should run better as a result and be more energy efficient. The provider can also collect data on how it is used and perhaps upgrade it and move the customer to a different product and use the existing one for another customer. At the end of the products life there is also an effective collection system where the manufacturer disposes of the old product and so would do so in the way that they would be able to reuse parts if they were useful and the know what the best way to recycle the rest would be. [3]

Remanufacturing is a system whereby sections from older products are used in such a way that they are taken out of the old products and put into new products, thus reducing the amount of raw materials required. This system takes products that cannot be reused and rather than stripping them down to the bare elements, uses modules that are still in working order to make new products which would be put through the same testing and checks as a new product and then would be sold as new. This cuts down on the recycling energy cost and also the manufacturing energy costs associated with the product.

Xerox did a case study with two of its photocopiers where they decided to remanufacture two of its models, one modular and the other non-modular. From the table below it is clear that the modular

photocopier had a lot greater saving due to the fact it was much easier to remove the working parts and also to integrate the working parts into the new product. [4]

	Xerox 5100 copiers (non-modular)		DC 265 copiers (modular)	
	% saving	Reduction by a factor of …	% saving	Reduction by a factor of …
Materials consumption (kg)	25	1.3	49	1.9
Energy consumption (MJ)	27	1.4	68	3.1
Water consumption (L)	19	1.2	38	1.6
Landfilled waste (kg)	35	1.5	47	1.9
CO_2 equivalents (kg)	23	1.3	65	2.9

Figure 3: Comparison of Xerox remanufactured models with their savings

Another place where remanufacturing is a success, is in India, where the majority of people cannot afford new mobile phones. The idea behind this is that rather than old phones being dumped/kept, vendors buy back old phones when the customer 'A' (the first customer that the phone gets used by) buys a new phone and then remanufacturers the phone and sells it on to customer 'B' as a remanufactured phone such as the model below. In general, the customer 'B' would be people from poorer areas of the country. [5]

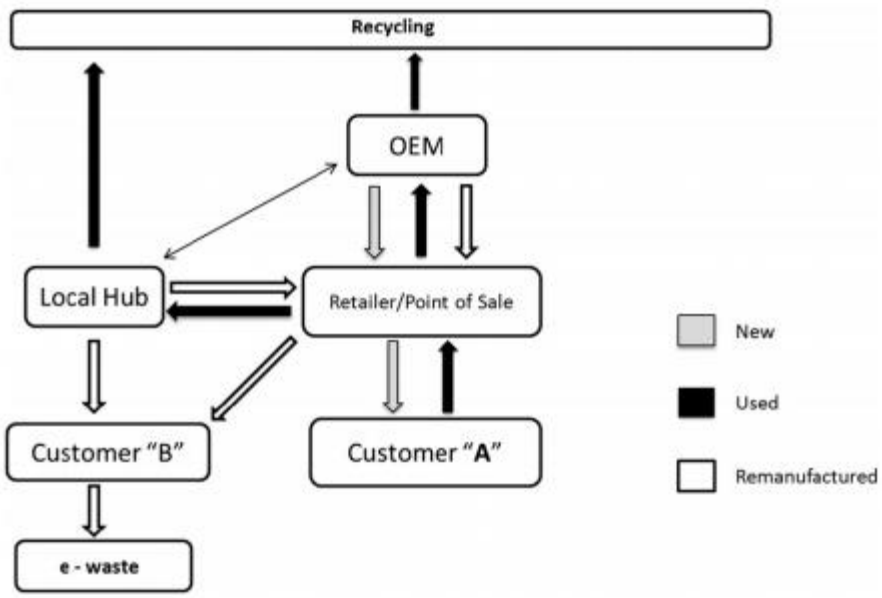

Figure 4 : Mobile phone retail flow in India

Global Issues

The concept of BO2W is where the recycling is a two-step process, manual processing and automated processing. Manual processing is done in order to remove the metal in a much more efficient way than the automatic processing and the automated processing is used to remove toxic or hazardous materials. By using both, a much greater percentage of the material is recovered than either one individually. By doing the manual processing in developing countries, this can be done cost effectively and also by having a structure in place that the people in these countries can have a save workplace rather than rummaging through the landfills for electronic waste that they may be able to get some value out of. By doing the end processing then in an economy where the procedures are in place for the toxic and hazardous materials to be removed, it will recover even more of the useful materials while still ensuring that the other materials do not end up in the wrong place. [6]

Obviously by using manual processing of the materials, large areas will need to be used and also large amounts of people will need to be involved which leads to the economic feasibility of this concept. In many emerging countries, it can be seen that the cost of both area and labour is relatively cheap. By doing it in these countries, you also provide stable jobs and safe working conditions for the people in the area. When calculating the feasibility of doing such a system in an area, for each product to be processed there will be a period at the start where you will be making a loss then something of value will come out of it then it will start to decrease again until something else of value comes out. This continues until the product is completely sorted or until what's left of the product is not worth recycling as the time required would be more than the value you would get off it. An example of a good place to set up a recycling centre would be in Tanzania where the minimum wage is 90USD/month but the average is 167USD/month, even at the average which is much higher than the minimum wage, it is still much cheaper than many countries. The average rental cost is approximately 0.82USD/square meter/month also the transport costs is relatively small. [7]

It is important to ensure that the business does not get a reputation for 'using' people or getting associated with violence or crimes in other countries. For example, due to the crime in Congo, the companies who buy in the minerals from countries do not want to deal with the countries suppliers as they want to make sure that they are not seen to be 'funding' the violence. By doing this violence is increasing due to publicity. It is also an issue that the media and governments are not focusing on the major issues when sending peace keeping missions. For example, the main publicity from the media about Congo and the focus of the police force is on sexual assault where as this, although it is a serious offence, accounts for a very small proportion of the violence and crime in the country. Since all the media focuses on this, businesses are more inclined to stay away from the country so that they or their products do not be seen to be causing or funding the assaults. The paper 'Dangerous Tales: Dominant Narratives on the Congo and Their Unintended Consequences' suggests that the country should be reconstructed so that the trading with the country might improve and the more widespread issues can be addressed to help make the country a better place. [8]

The Cloud

The cloud has a lot of potential in many areas; energy efficiency is one of them. There are many ways in which a cloud based system can improve the energy efficiency of different sectors. Since one server can handle many users, it is much more efficient than standalone PCs and now with the introduction and improvements of virtualisation, each box can act as multiple servers, cutting down on the number of servers required and thus making the operation more efficient.

Other ways in which the cloud can reduce the CO2 emissions of the different industries is digital, downloadable music (40-80% less emissions), digital news (online newspapers, news feeds etc.) can reduce CO2 emissions by 1-2 magnitudes relative to their paper counterparts. There are methods and software tools such as the CLEER (Cloud Energy and Emissions Research) which can take in parameters and compare different solutions to see how efficient your cloud setup is and by changing the parameters you can see how you can make it more efficient. [9]

A case study of the environmental benefits of moving to Microsoft cloud was done which shows the estimated power decrease for small (100 users), medium (1000 users) and large (10000 users) businesses. The results are shown in Figure 5 below.

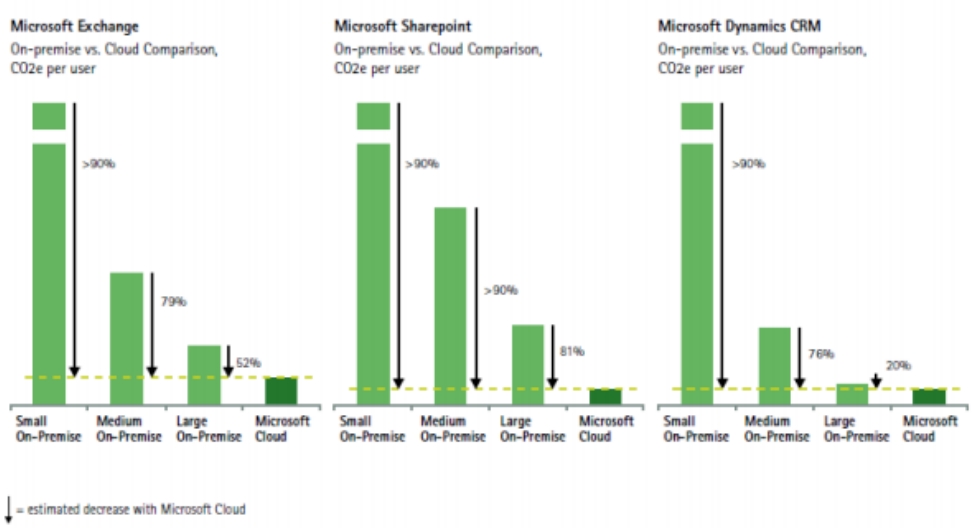

Figure 5 : Comparison of on premises solution vs. Microsoft cloud solution

This is mainly due to the fact that for large server plants, not all users are accessing them at the same time and so this means that less computational power is required for the same amount of users and the fact that the efficiency of the servers are better for example, Figure 6 shows that for a small increase in power, a 4x the computational power is achieved. [10]

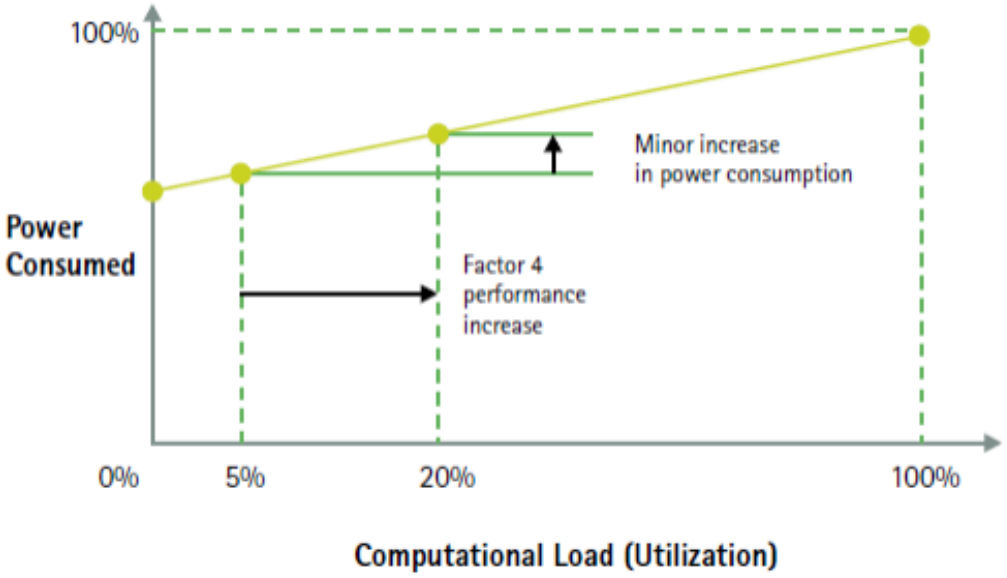

Figure 6 : Power consumed vs. Computational power of a server

Of course another way of reducing the impact of the cloud on the environment is by the effect of the power used on the environment (rather than the power used). Giants such as Amazon, Microsoft and Apple, focus more on setting up their cloud data centres where it cheap (power/location/climate) with little or no consideration to the source of their power. Other companies such as Yahoo and Google are focused on setting up where the power mainly comes from renewable sources. Facebook are the leader with its commitment to locating data centres solely in countries where they can be solely powered from renewable energy.

The geographic location of the cloud can also be used to reduce both the environmental impact and the cost of the cloud. By locating in cooler environments, where the air temperature is sufficiently low to cool the servers, massive cooling systems are not required and these are massive users of energy from a datacentre point of view. Microsoft and Google have data centres in Ireland for this free cooling reason. [11]

Another way central processing can be using thin clients and servers rather than standard desktops. While a tower (standard desktop) can be used as a standalone processing unit, a thin client is only used as an interface to a central processing unit and must be connected to the network. A study was done which showed that 30% of people do not turn off their PC at night and 30% are never switched off. If the thin client system is used, the use a lot less power and so the effect of this is less. It is estimated that the thin client solution saves up to 317kg CO2e per PC (including the energy used by the central servers and their cooling systems. Since they are smaller and contain fewer parts, they also save on the resources and manufacturing stages of the life cycle and in the use phase, it is estimated that they would last up to 4 times as long as since the software and processing is external, they will not go out of date or become slow as fast. [12]

Products

The sale and reuse of second-hand PCs is a very small market. This is mainly due to the fact the there are no obvious indicators of how the PC has been used and what state each component is in. A method of improving this would be to add sensors, which measure how the components in the PC were used throughout its life so that when buying second hand PCs, there are concrete methods of seeing the state of the PC, such as the odometer in a second hand car.

In a survey in Ireland 24% said that they would buy second had Pcs except for the reliability issues and not having knowledge on how they had been used. In the same survey 78% said they stored old PC's. This is another issues as if there are not reliable PCs in the market, people will not buy them. The second hand PC market is hindered by people not being willing to sell the old PCs as they do not know how much they are worth, despite the fact that they will probably be never used by them again making them effectively worthless to the seller. A system of where the sellers and buyers know how the PC has been used and therefore a better idea of the value would encourage people to sell their second hand PCs when they actually have a value rather than waiting until they are completely out of date. [13]

The life cycle of a desktop can be extended from an SME point of view by adding features, from the design stage, which can make the product more efficient and easier to re-use / have a longer use phase. By making the product easy to disassemble and upgrade, the SME's can upgrade a small part of the PC and therefore increase the lifespan of the product. When it is decided to get rid of the product, if it can be dismantled, the product may be able to be remanufactured. After this, what's left should be recyclable to ensure that most if not all of the PC goes back into the loop to be as efficient as possible. There is also the possibility that the PC could be used in developing countries for education and/or business. [14]

To help with the ECO design of notebook computers, there are 14 criteria which the laptop must pass in order to get the Eco Label on the device. These include criteria such as:

- Power management to reduce the amount of power used in the use phase,
- The lack of hazardous/banned materials, to make it easier and more efficient to dismantle,
- A certain amount of recycled materials, to show that the manufacturer has eco design in mind
- It must also be repairable
- Contain user instructions to show how to use efficiently
- Have recyclable packaging
- Have information on the Eco Label
- Have a lifetime extension

By SMEs choosing notebooks with the ECO label, they are doing their best to reduce the impact on the environment as they have no control over the notebooks other than off the shelf products. [15]

A system where the product dismantles its self when put under certain conditions, can aid with the recycling process as after the product comes out of the conditions, it is easier and takes less time, making it more effective to recycle. There are some issues with these materials as the operating temperature of the product will probably be affected since many of the smart materials used in

disassembly have low temperatures where they revert back to their original shape. They also cost a lot more than their counterparts, and so unless the business sees an obvious gain, they will not be designed into the products. [16]

Another method of reducing the waste generated from PCBs and devices is to use PLDs such as FPGAs. By adding an FPGA, the board can be reprogrammed and depending on the other devices on the board, it could be used for a completely different purpose. This would increase the life span of PCBs and so reduce the environmental impact of the environment. The fact that the device can be reprogrammed, the devices themselves are also high on the priority list for recovery as they can be reused for other applications. [17]

Demand side management is where appliances such as dishwashers, washing machines and dryers are 'smart' and can, through a smart grid, decrease their use at peak electricity times and increase their usage during the off peak times or times that there are not a lot of energy from renewable sources on the grid. This will reduce the demand on the fossil fuel plants and also increase the amount of energy used from renewable sources. By using data, they can be optimised for different things and, as shown in Figure 7, it can be seen that tests on a domestic dishwasher show that it can reduce the amount of peak-time demand and therefore reduce the cost of running the appliance. This, with a smart grid, can be used to reduce the reliance on fossil fuels in the future. [18]

Summary of optimisation results for each optimisation objective tested.

	Result			
	Cost (€)	Wind demand (kWh)	Carbon (kg)	Peak-time demand (kWh)
Optimisation objective				
Pre-optimisation	€11.63	18.51 kWh	84.466 kg	12.47 kWh
EA price	€9.60	21.64 kWh	86.037 kg	4.57 kWh
EP price	€9.18	22.86 kWh	84.871 kg	3.75 kWh
EA wind	€10.22	23.29 kWh	84.540 kg	8.97 kWh
EP wind	€10.57	24.79 kWh	83.399 kg	12.73 kWh
EP carbon	€11.86	22.63 kWh	80.907 kg	21.23 kWh

Figure 7 : Optimisation of DSM

Conclusions

In conclusion, there are many different solutions for reducing the impact of the products on the environment. We, the manufacturers, can help by:

- Reducing the energy used in the used stage
- Making the products last longer
- Making the products modular to make it possible to remanufacture
- Making the products easy and feasible to recycle
- Design products to get eco-labels or similar standards on them
- When considering cloud based systems, take environmental impacts as well as cost into account when deciding on locations for data centres.

Customers can do their bit by only buying from eco conscious manufacturers whose products have eco-labels, who locate in areas with renewable sources of energy and other eco-friendly design features. It is also important that global social issues are taken into account but it is important that the response to countries are not media driven and that the issues in the countries are address rather than the ones that the media highlights the most.

By using certain types of systems, increased IPR can be achieved and by using RFID tags and by using systems such as PSS or remanufacturing, the life time of products can be extended while not massively impacting on the company's profits and could in fact be a more profitable business model.

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