The Sustainability Issues Facing the ICT Sector

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Introduction

In the past number the advancements in technology have led to many sustainability issues for the ICT sector. The industry must take a serious look at the sustainability issues and ensure that the effect of these issues are minimised so that the sector will not be affected in future years.

The first thing one should look at is the causes behind these new sustainability issues for example:

- Population growth
- Increase in the number of devices per person
- Quicker improvements in technology causing a decreased lifetime in products
- Speciality materials being used in products

These are not necessarily bad causes but they, and their projections must be taken into account to ensure that any solutions to the issues take into account the future requirements or are scalable in line with the projections of the above.

These issues fall under the headings:

- Resources
- E-Waste
- Energy/Climate Change

Each of these has social, environmental and economic issues, all of which affect the future and the sustainability of the ICT sector.

Resources

Materials in products come from either mining or from recycling of used products. In order for the products to be manufactured in the future, adequate supplies of the materials used will need to be available or appropriate substitutes will need to be found (which in turn are subject to the same pressures). The main issues going forward for Mining/non-recycled materials are:

- Resources are finite
- Cost of mining
- Current supplies are not known
- Substitutes are more expensive or not as effective

There is a limited amount of metals available for mining. This means a lot planning must put into products when being designed to ensure that for their estimated manufacturing life that the materials used will be available and that it will be cost-effective not only now but in the future to produce the product based on estimated supply and demand figures. “Scarcity could potentially arise from developing and emerging economies such as China, Brazil and Russia who will be demanding more of these materials in the future.”[1]

Other materials are by products of mining a primary material. This means that the supply of the metal is not dependant on the demand/mining rate of the material but of the primary mining material. “These metals can often come as a by-product of another market such as the production of indium from zinc production.”[2]

When it is said that resources are finite, it is not so much that once it reaches its limit that there is no more of that material possible to extract from the earth’s crust. More often than not, it means that it’s the point where it is not feasible or cost effective to mine that material because of its location/depth/research involved etc. “The mineral deposits and reserves at present are located close to the surface with the deepest open pit mine less than a kilometre deep and the deepest underground mine is roughly 4 kilometres deep. The continental crust is approximately 35 kilometres” [1], so it is pretty obvious that there is a vast amount of buried deposits still lying underground. If the cost of mining a material increases, this cost will be passed onto the manufacturer, and in turn the wholesaler and customer. If the price of the product is beyond the value that the customer reckons they will get out of the product, they won’t pay. So if mining in much deeper mines causes the prices to go up dramatically, manufacturers won’t buy it if it will cause their products to increase significantly. So going back to the mining company, if the manufacturer won’t buy the materials at the higher prices, they won’t invest in the infrastructure to mine it so effectively, only the mined materials will be available for use.

Due to political and other reasons, countries are not fully disclosing their supplies of metals, in particular speciality metals which mining of the metals is not as wide spread as other metals. This means that projections for these materials are actually based on estimates of the countries materials reserves and so any forecasts in relation to these materials should have this in mind. For example, the Bayan Obo deposit accounts for the majority of China’s 31 % share of the world’s rare earths reserves. [1]

Since some materials are now being ‘overused’, and newer materials (which could take their place) are coming on the scene, some ask the question ‘Why not substitute the material for another?’ The two main reasons are that the newer materials are not as cost effective or that the substitute’s properties are not as good and could reduce the reliability/quality of the final product. By using other metals, the physical/chemical/electrical properties are different and so since the product was designed using one it may not be economically feasible to move to a new product e.g. using a different conductor on a circuit board could affect the bandwidth of the signals and could cause issues or if the replacement was a better conductor (e.g. gold), chances are that the cost will be higher.

Coming away from mining, recycling is the other possible source of the materials for use in products. Currently the main metals (copper, zinc etc.) in use have many effective sources of recycling especially in the developed countries where plants exist that can separate them efficiently to get most of the non-speciality materials out of the products. However in non-developed countries, when products are sent there to be ‘used’ when the products are finished with their recycling procedures are not safe or effective and consist of melting down the products in massive bonfires which has very bad impact on social and environmental aspects

of the industry. This method along with being a high source of pollution, being ran by the army and the employees are on extremely low wages, are an extremely inefficient way of recycling the metals and most of the metals remain buried in the rubble and may not be recyclable.[3]

E-Waste

Throughout the manufacturing process materials become by-products (waste), in the use process, servicing of machines causes the broken/older devices to be replaces making the older devices waste, and when the product reaches the end of its life, all its parts becomes waste. During these stages, the waste can either become scrap or can be recycled and put back somewhere into the life cycle of the product.

The aim of recycling is to decrease the amount of E-waste that goes into scrap and increase the amount that will go back into the life cycle of another product. As the years go on, the amount of resources used is increases due to the amount of products per person and also the amount of people who are 'up to date' with technology. "Results (of projections) show that the volume of obsolete PCs generated in developing regions will exceed that of developed regions by 2016-2018. By 2030, the obsolete PCs from developing regions will reach 400-700 million units, far more than from developed regions at 200-300 million units."[4] This shows that the level of obsolete PCs will be accelerating dramatically as the developing countries become more up to date with the latest technology.

If the obsolete products are not managed, they will all end up in scrap but papers in this area lead to the question…Who should pay for all of this extra cost of recycling and processing the obsolete PCs so that they do not become scrap and their materials wasted? The arguments point to the people/companies who get value out of the product rather than the tax payers of the country where the product ends up.

The concept of EPR (Extended Producer Responsibility) is one solution. It started in Sweden and Germany in the 1990's. "Its main aim is to create incentives for manufacturers to create eco- designs of packages and products, leverage private sector expertise to achieve public goals and to internalize the costs of waste management into product prices." [5] By putting the cost on the manufacturer and the customer and using this finance to fund the disposal and recycling of the waste from the products, at least it is not the tax payer that has to pay for the waste generated. However "the data and accounting challenges in calculating and allocating costs and benefits in EPR programs is a major undertaking. Governments and producers are often disinclined to expend the resources to collect the relevant data or they object to disclosure of what they view as proprietary information."[5] So accurately calculating the EPR price associated with each product is the major obstacle with this idea even though it is a step forward to encouraging the manufacturers to make their products eco-friendly as the EPR associated with it will be less.

To ensure collection rates of materials is high (and increasing) directives such as the WEEE directive from the EU ensure that products are put into relevant categories and each of these categories should (by the end of set periods) have certain increasing recycling rates.

Manufacturers are being directed to take back old products as they have the best knowledge of the materials included and so the chances are that this will increase recycling rates by increasing the collection rates. "Memberships fee that producer pays all depends on the amount of tonnes of EEE they produce and place on the market per year."[6] This means that the current pricing structure encourages manufacturers to reduce the weight of their products so that they will have to pay less for their market share.

This is fine for countries in Europe and America but in Africa, there is no WEEE organisation and as mentioned previously, once a product goes to Africa and becomes no longer useful except for its materials, there is no requirement for the manufacturer's to take the products back as there is nobody enforcing this in Africa. Some people say that the electronic equipment should not be allowed to be exported to Africa as a result but the problem with this is by putting a blanket ban on the movement of electronic materials into developing countries one is just increasing the digital divide between the developed and developing countries. "There is a fault within this as e-waste is listed as both hazardous and non-hazardous within two different Annexes of the convention. There are clear challenges here as there needs to be a clear distinction between used EEE and e-waste and whether it is hazardous and non-hazardous."[5]

Over the past number of years the number of materials used has dramatically increased. This means not only is there the problems of the materials being recycled effectively in developing countries but in developed countries there are many new materials where recycling facilities are not up to scratch so this is a new challenge for recycling facilities. The main issue and reason that the recycling plants are not putting the facilities into place is that the collection rates are so low. Due to the fact that there is so little of the materials in the products a large percentage of products must be collected in order to bring up the amount of the material available for recycling in order to make it cost effective. Even if large percentages are collected, this may still mean that the amount is small – especially with speciality metals where tiny amounts are used per product. [7]

Energy/Climate Change

The third major area of concern is the amount of energy that products consume during their life cycle; many think of this being just the amount of energy used when on or active but when one dives in, this is more often than not, the stage that is not the most energy consuming. This means regardless of the power saving modes the products may have, the energy used in its production is a lot more than people may think. The manufacturing process also uses a lot of other materials in the production of the microchips or products e.g. water/other cooling materials. It is reported that "a typical 6-inch wafer fabrication plant processing 40 000 wafers per month reportedly consumes 2-3 millions of gallons per day, which corresponds to 18-27 L per square centimetre of silicon."[8] The life cycle assessment is a method where all the energy and resources of a product type throughout a products life cycle are taken into account to come up with an analysis of how much energy it uses overall and how much energy is used at each stage of its life cycle.

The issues with determining the LCA is that the specifications of the scenarios taken into account are not defined so for example "by not restricting a specific type of computer to be analysed it is nearly impossible to accurately measure the environmental impact consistently." [9] "Another source of variation occurs during the manufacturing and production phase that includes material extraction, processing and assembly, which particularly difficult to analyse because of the highly complex processes involved…. This is caused by a lack of sufficient data during the manufacturing phase." [9] So although the LCA could be a useful tool, when using the data from them, one must be aware that the data may not have underestimated or overestimated some of the components in the LCA.

Another hidden energy consumption with products are the support services that it uses, data centres for example have massive energy consumption in order to keep the servers alive but also to keep them cool. "Overall datacentre electricity usage for 2010 accounted for between 1.1% and 1.5% of global electricity consumption and 1.7% to 2.2% of U.S consumption."[10] The effectiveness of the data centres is measured using PUE (Power Usage Effectiveness) which is the total power going in divided by the power used by the IT devices, not by the infrastructure. Obviously 1 is the ideal number for this but is often unrealistic when cooling, backup power supplies and power distribution is taken into account.

These energy issues could lead to sustainability issues in the future because as the developing countries catch up, these figures will increase and the energy for these often come from fossil fuel based generation which is finite so a focus on renewables and making each country self-sufficient is a necessary in the coming years.

"More than 80% of the environmental impact of a product is determined at the design stage. Because of this fact, a working plan was brought forward to optimize the environmental and energy performance of products while maintaining the products function."[11] This working plan aims to take products and divide into categories and implement changes that could make the categories more efficient in their design stages to reduce the amount of energy and resources used in the production. The first stage of this had 8 groups and as the information was gathered this increased to 18 for the second and a new 12 for the third and current stage. "These product groups are split up into priority list and conditional list due to possible overlap with on-going preparatory studies and regulations due for review. It was estimated that the combined energy of the priority group in this plan can save 3,000PJ per year by 2030."[11]

Another report on possible policy that aims to reduce the amount of energy used from fossil fuels is the IMF Report on Fiscal Policy to Mitigate Climate Change. "The IMF report recommends that carbon prices are applied in proportion to the carbon content of fuels as they enter the economy. It also suggests refunds on prices available for carbon capture technologies installed at industrial facilities."[12] This means that the companies who use the most amount of carbon based fuels (directly or indirectly) will be charged for the effect this has on the environment and so will encourage to make more eco-friendly designs so that their prices will not be incremented by the charge as much as the competitors.

Conclusion

In conclusion, there are many sustainability issues facing the ICT sector in the future, these include where resources will be sourced in the future, it is clear that eventually mining materials will not be feasible due to higher costs of mining further into the earth's crust etc. so in order to ensure that a stable supply of materials and energy is there in the future, these issues must be dealt with by the ICT industry or else prices will go up.

Along with ensuring that recycling facilities are improved, and that when designing products they are made in a way that they can be taken apart easily for recycling, businesses should also ensure that their sources are regulated so that the business doesn't get a bad name from where they source their materials.

From a manufacturing point of view, which is often the highest consumption of water and energy, new regulations are putting pressure on trying to reduce the amount of resources used or trying to make the manufacturing plants more efficient as in the future, demands for power and other resources will rise so the manufacturers and suppliers must ensure that between increasing renewable energy production and reduction in the amount of energy used in manufacturing if possible.

From an end of life perspective, the sector needs to ensure that the collection of these materials are possible, if the collection rates of the metals used are not able to increase, the finite nature of the materials will be cause the prices of the raw materials to go up. Companies must also be careful to ensure that the products do not end up in the big bonfires in the developing countries through exporting them.

Overall there are many issues affecting the sustainability issues affecting the ICT sector, some of which are mentioned above, some of which are being addressed but there are still many which will cause problems in the future if they are not addressed by the industry. In order to ensure that the sector remains viable and profitable along with being eco-friendly and accept their social responsibilities companies along with governments and customers must work together to address the issues facing the industry.

References

1. Review of '"Critical Raw Materials for the EU" Report of the Ad-hoc Working Group on defining critical raw materials' on http://niallgriffin.wordpress.com/
2. Review of 'Graedel, Harper, "A Tale of Three Metals" in E-Waste Management; From Waste to Resource' on http://eoinobrien.wordpress.com/
3. Review of 'Where are WEEE in Africa? Findings From The Basel Convention E-Waste Africa Programme Report from the Basel Convention' on http://ulkieranflannery.wordpress.com/
4. Review of '4. Yu J., Williams E., Ju M, Yan Yang A., "Forecasting Global Generation of Obsolete Personal Computers", Environmental Science & Technology 44, 2010' on http://chicktah.wordpress.com/
5. Review of 'Lifset R., Atasu A., Tojo N., "Extended Producer Responsibility, National, International and Practical Perspectives" Journal of Industrial Ecology, Vol 17, Issue 2, 2013.' on http://kieranhoulihan.wordpress.com/
6. Review of 'EU WEEE Directive' on http://dmitrijzarinovs.wordpress.com/
7. Review of '18.Williams E., Ayres R., Heller M., "The 1.7 Kilogram Microchip: Energy and Material Use in the Production of Semiconductor Devices" EST 36(24) 5504-5510.' on http://drewmcleanet4407.wordpress.com/
8. 'Reck B., Graedel T.E., "**Challenges in Metal Recycling**" Science 337, 690 (2012)'
9. Review of 'Teehan P., Kandlikar M., "Sources of Variation in Life Cycle Assessment of Desktop Computers", Journal of Industrial Ecology, Vol 16, S1, 2012' on http://cgall91.wordpress.com/
10. Review of 'Koomey J., "Growth in Data Centre Electricity Use 2005 to 2010" A report by Analytics Press' on http://10002050paulaherne.wordpress.com/
11. Review of 'EU Ecodesign Directive for Energy Related Products Work Plan 2012-14' on http://mcnamaradavid.wordpress.com/
12. Review of 'Fiscal Policy to Mitigate Climate Change A Guide for Policymakers, IMF Report' on http://gearoidryan.wordpress.com/