Applying Technology Management concepts in analyzing e Waste, sustainability and technology development in Mobile Industry: A conceptual perspective

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ABSTRACT

In the highly globalized, competitive and technocrat world, mobile industry is heavily focused on making itself sustainable. In order to achieve this focus should be on improving the e waste management in the industry. Currently the industry is advanced beyond market demand in delivery services to customers in terms of ICT and smart phones. This research paper is trying to conceptualize the aspect of technology management by comparing technology advancement of mobile phone technology and the lagging e WASTE management in the same industry. The paper further explores the importance of sustainability and its acceptance by the customers of the mobile technology. The reasons for this adoption lag among customers of mobile technology might be lack of awareness or just slow response. The paper reviews current literature and the author tries to conceptualize his thoughts in this paper.

Keywords
Adopters, reverse salient, ecosystem, e waste.

1. Introduction

Consumer electronics especially mobile phones have become increasingly popular and culturally important over the past several decades. The recent trends and pattern of updating hardware due to advancement of technology and customer demand thus creating large scale electronic waste is alarming. E-waste in mobile industry is a direct offshoot of neglect of both industry and consumer towards sustainability. E waste management is currently the largest growing waste stream that has been ignored for more than a decade as compared to rapid growth of technological evolution in the mobile phone technology. Neglect of e Waste management as contrary to huge advancement in smart phone technology are two contrasting aspects that have been explored in this paper.
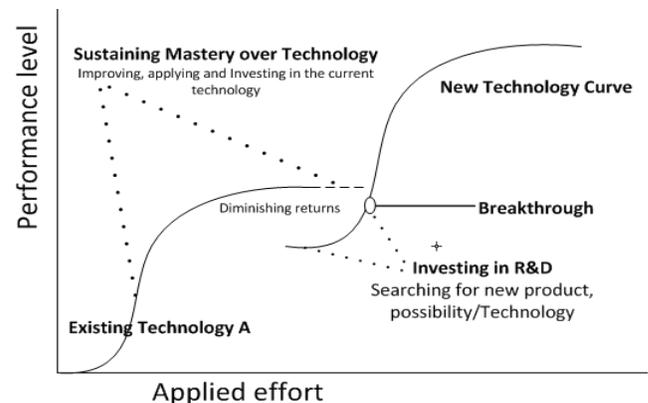

Figure.1. New technology evolution. [5].

2. E waste in Mobile Industry

The definition given in the Directive 2002/96/EC of the European Parliament and Council on waste electrical and electronic equipment (WEEE) [2] seems to be the most comprehensive and used. It states e-waste as "electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/EEC, including all components, subassemblies and consumables which are part of the product at the time of discarding.

Used and old mobile phones are the most rapidly growing problem in the waste stream due to their quantity and toxicity. Mobile Phones have fast become one of life's most important communications tools. With new technological advances encouraging regular upgrades, mobile phones are rapidly becoming a major waste problem. The average useful design life of a mobile handset is around seven years, yet users in developed countries typically replace their phones about every 18 months driven by both the evolution of technology and the tendency of consumers to want a device with more applications [1]. The life cycle of mobile electronics products includes following steps: (i) Raw materials acquisition (ii) Manufacturing, (iii) Purchase and use, (iv) storage, and (v) End-of-life management.

The subsequent management and processing of e Waste involves procedures that have been adopted by only few nations across the

globe. Some developed nation shows their concern to look into that segment up to some extent. According to [3], e-waste from developed countries that is sent for recycling, 80 per cent ends up being shipped (often illegally) to developing countries such as China, India, Ghana and Nigeria for recycling. The waste destined for recycling is either burned, dumped or recycled using processes which involves polluting operations without taking concern for environment and sustainability [4]. Most of the recycling is done informally by poor and small social groups who involved into waste picking for income generation and survival, impact of which till date was ignored by the mobile industry.

But the recent developments in the industry has shifted the focus to the topic of sustainability, thus highlighting e Waste as one the major issue to be tackled within the industry. Sustainability is balancing environmental, social, and economic outcomes in order to endure, is being recast as a way to unleash innovation [6]. Mobile industry in the last couple of years has been improving their sustainability practices by changing products and processes with the help of their stakeholders and concerning elements. The correlation of this has been explained further using accepted management theories.

3. Technology management and S curve

Innovation is driven by need for performance improvement and the customer's willingness to pay (WTP) for this extra performance [7]. The advent of mobile phones can be one such example; Motorola was the largest manufacturer of cordless phones in the 90's, but the customer demand for communication tools surpassed the maturity of Cordless phones, which enabled the communications industry to come out with mobile phone technology. On the contrary technologies are not always given the opportunity to reach their limits—they may be rendered obsolete by new technologies [8].

Technologies often exhibit S-curve in their performance over a period of time. The S-curve is seen when the performance parameters like speed, capacity, accuracy, cost and many others are plotted against effort or time. The shape typically shows initial growth followed by steep accelerated increase and then diminishing improvement [8]. Thus, it is very important to evaluate the Technology S-curve along with the demand curve so as to know if the customer is willing to pay for the added extra performance. There is also a need to know the demand Curve so to predict when the technology might mature in the minds of customer and be ready with a new technology or product to suit the growing demand needs.

When an existing technology gets disrupted by adopting a new technology, there arises a concept of diffusion of technology with its ambient and this will be discussed in this Section. As shown in Figure 1 disruptions occur when the new technology achieves the performance level greater than that of the existing technology; then there is a breakthrough. Now this breakthrough technology will either cause disruption in other technologies in its ambient or has to diffuse with the existing setup; in most cases it will have to diffuse in the existing set up or process [5].

This similar pattern is seen with mobile technology wherein the pace of technology evolution is rapid and so is the diffusion of technology. The diffusion can also be shown as an S-shaped; the shape shows few adopters or accepters of technology initially, but adoption level increases slowly and approaches maximum [9].

Furthermore diffusion is the gradual adoption of an innovation, concept or new technology in a market segment or society. The same concept will be used further to explore the correlation sustainability adoption, e waste and mobile technology evolution.

4. Evolution of Mobile Phone as technology

The cell phone is one of the most rapidly growing new technologies in the world. In 2001, cell phone subscriptions were less than a billion worldwide with the majority of the cell Phone user were from the developed countries. At the end of 2010, however, cell phone number had reached five billion worldwide with subscriptions from developing countries out numbering that of the developed countries [11]. Mobile devices have become the most ubiquitous consumer electronic devices ever invented. The rate of Technological growth surpassed any other growth in this decade. Every year hundreds of new models with new and advanced features are launched by different companies. Even in the poorest of the nations, mobile phones have evolved from being a luxury to an in dispensable necessity. Figure 2 shows the evolution of mobile phone with respect to time. The rapid growth shows the technological advancement in mobile phone sector.
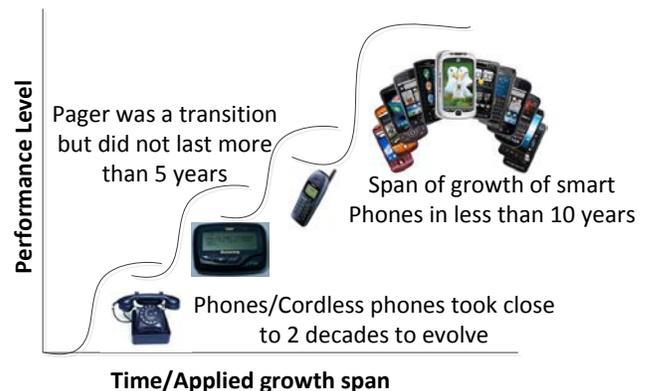

Figure.2. Evolution of Mobile phone with time.

Mobile phones, especially smartphones have become our inseparable companions today. New companies are bringing new set of technology to attract people around them. The recent trends show that the life cycle of mobile phones are decreasing at alarming rate and there arises the question of sustainability of this industry.

5. Process Sustainability in Mobile Industry

Using the theory explained in previous chapter and with help of other concepts of "reverse salient" and "era of dominant design", the concept of sustainability in mobile phone industry has been probed and conceptualized in the paper. According to [12] the mobile phone industry is facing a huge challenge with respect to achieving sustainability and e waste management. The main challenges are implementing e waste management as a company responsibility and educating the customer on sustainability. There is also a need for efficiently using existing ICT and smart phone technology to promote sustainability among users [12]. The report states that the EU has regulations in place to ensure take back and recycling of mobiles and companies are working on developing a sustainable supply chain to ensure collection of these mobiles.

Mobile industry has grown with respect to technology and features, but the waste management technology development

currently in place is lagging behind the requirement of the society. This has been illustrated in Figure 3, wherein core aspects of management and technical aspects with recycling has reached threshold limit and there is demand for new technology to replace the current scenario.
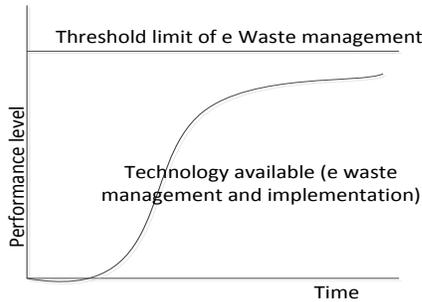

Figure 3. Technology limit with e waste management.

Furthermore compared to e waste technology and management, the mobile technology has surpassed customer demand. The ICT application and mobile technology has successfully satisfied customer needs. As illustrated in Figure 4, the customer's willingness to pay is much smaller than the value provided by the smart phone technology itself. Hence sophisticated features of smart phone should be used to promote sustainability among users.
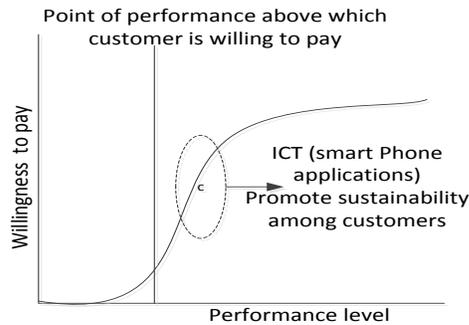

Figure 4. Willingness to pay for sustainable solution.

The above discussion reiterates the fact that "ICT and mobile phone technology has surpassed market demand, but the recycling and sustainability aspect among users and companies is lagging behind by a huge margin".

6. Impact of Society on sustainable approach

The last chapter discussed on comparison between mobile phone technology and recycling aspect in the industry. Continuing this discussion, we look into societies and cultural aspect in this chapter. In Figure 5, the left hand side illustrates customer/user of the mobile phones. The willingness of the customer to pay and the technology demand is different in Africa and in Europe. There are number of reasons of this difference, few being (i) money (ii) education (iii) mindset to sustainability and priorities in life. The cost incurred for a sustainable product and increased features on a smart phone/ICT will cost the customer more. The customer in different societies will react differently to these aspects. Furthermore the level of education about pollution caused and

acceptable norms would vary, hence creating a huge challenge for companies to satisfy the criteria.
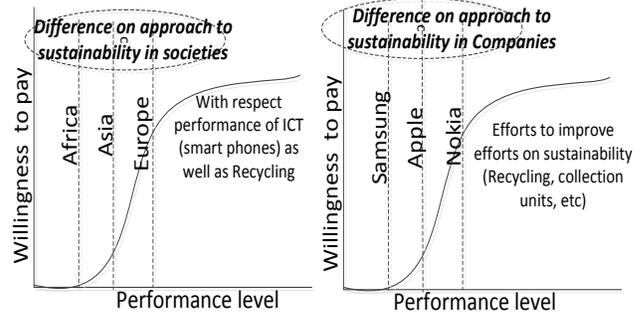

Figure 5. Adoption across companies, customers and societies.

The right side of Figure 5 illustrates approach of companies and their policy towards profit and sustainability. According to [11], Nokia leads the Telecom sector in sustainability approach, especially with respect to product design, green supply chain and efforts to recycle and re use. The approach varies between companies, if they adopt stockholder or stakeholder ethics in management. European companies are ahead in sustainability as compared to their American or Asian counterparts and the comparison has been clearly illustrated.

7. Ecosystem Analysis & reverse salience

According to Institute of Manufacturing at Cambride (2010) , disruption happens when a new product or innovation arrives in the market that offers better perofmance on know measured parameters or along a new dimension. Furthermore we try to analyze sustainability of mobile industry as shown in Figure 6. The mobile industry grew and smart phones are dominating over regular mobile and pager industry in today's world. The different eras of growth and development are shown in the figure. What would be the next technical marvel that would replace current smart phones and ICT would be a question to answer. The purpose of Figure 6 was to explain how mobile technology has grown and smart phone/ICT has dominated the current market as a technology.
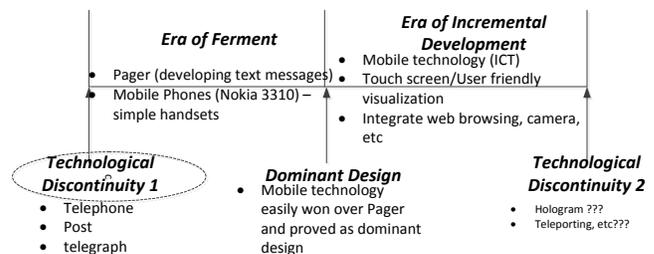

Figure 6. Mobile phone industry growth cycle.

Now using the similar approach we try to understand the sustainability in the mobile industry. As illustrated in Figure 7, the technology and management related to recycling are still in era ferment and being developed. The adopters among the companies are increasing and even societies are accepting sustainable approach to recycling. Web 2.0 and ICT touch screen has proved itself to be the dominant technology currently and should be used to promote sustainable lifestyle among users.

Era of Ferment	Era of Incremental Development
• Recycling included in sustainability regulation	• Development in materials (mobile becoming lighter)
• Introduction of Producer responsibility	• Improved life of components
• Cost effective urban mining	• Recycling and dumping processes

Technological Discontinuity 1
• Dump e Waste in Africa
• Recycling responsibility to customer and Government

Dominant Design
• Use of Smart phone (improve life)
• Improved supply chain to promote recycling and rebuy
• Use of web 2.0 and ICT to promote sustainable living

Technological Discontinuity 2
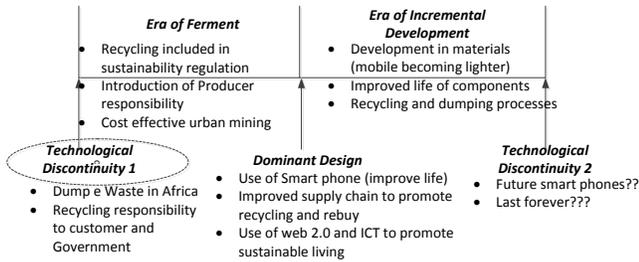• Future smart phones??
• Last forever???

Figure 7. Sustainability and mobile phone growth cycle.

The smart phone applications and ICT combined with crowdsourcing is dominating the effort of promoting sustainability among users. The development of lighter phones, less toxic materials and dumping processes are in the era of incremental development. The next technological discontinuity would be cell phones that last forever and superior management methods of collecting e Waste and disposal mechanisms.

From the discussions in the paper there is a consensus that mobile industry has a goal of sustainability for themselves and the users. To achieve this goal, the concept has been visualized a system in itself and an effort is made to identify the reverse salient features as illustrated in Figure 8. The combination of existing ICT, mobile technology, materials, management, supply chain, policy and customer knowledge is necessary to achieve the system goal of a sustainable mobile industry.
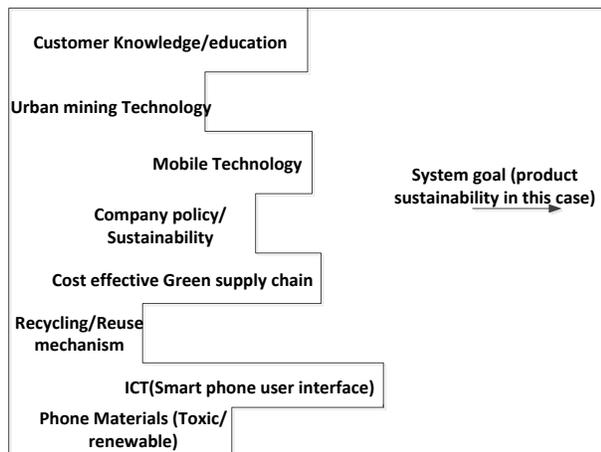

Figure 8. Reverse salient analysis to achieve sustainability.

As shown in the figure, ICT (smart phone interface) and mobile technology is leading the system. The supply chain and distribution has been optimized to a higher degree as compared to recycling and reuse/take back mechanism. The education of users to be sustainable has been improved steadily using the smart phone interface and mobile technology. To achieve complete sustainability a lot of work has been done to push producer responsibility in policy making and investments in urban mining and toxic material disposal. This combines the discussion of sustainability, mobile technology and concepts of technology management.

8. CONCLUSIONS

In the recent years of globalization high end technology evolved rapidly which gave end user lots of choices and selection options in terms of mobile phones and electronics devices. In mobile sector there is huge transformation from low end phones to high end advanced phones, these rapid transformations created a serious and unnoticed threat, which is expanding at same rate as technology.

Furthermore, from all the above discussion on sustainability promotion and adoption, it can be deduced that the customer has adopted the technology of mobile phone and ICT very well. There is a large base of adopters for smart phones and its applications. But the adoption of sustainability is still in its initial phase among customers and this idea has been illustrated in Figure 9 below. The adoption of the concept of sustainability and efforts for promotion among customers is gaining momentum among companies and this phase has crossed the chasm phase, thus ensuring that this would be the trend going forward. Figure 9 gives a clear illustration of the idea presented in this paper.
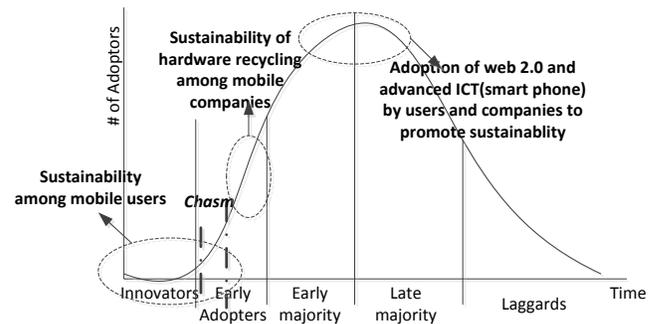

Figure 9. Adoption of sustainability- customers, companies and technology.

Therefore in order to achieve the ultimate goal of sustainability and achieve high adoption rate, a lot of improvement needs to be done with respect to green supply chain and urban mining/recycling technology. The management and ethics of sustainability needs to be also worked upon and strong efforts are to be made to improve promotion of sustainable living among the customers as well.

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