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The Sustainable Interventions for Mobile Phone's Hazards

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Abstract

Mobile phones are universally popular due to its convenience. Mobile phones solve problems and offer new channels of communication and just by using a device small enough to fit into one hand. On the other hand, mobile phones are harmful to the environment and the society which makes health problems, pollution problems via discharge of its radiations. Mobile phones have recently fallen into the examine on their sustainability and their potential effects on the environment. This study discusses the issues relating to the risks of the mobile phones and addresses the sustainable concerns rectify those issues.

Keywords: **People; Mobile phone; Hazards; Environment; Health and sustainability**

INTRODUCTION

Mobile phones have become an intrinsic part of most people's lives, connecting them around the world. Mobile phone has many advantages, enabling communication with family, friends, and business wherever a signal is available. In addition, the 3G telephone enables users to access data; listen to music; play games; send and receive simple text messages (SMS); access multimedia messaging services, voice, and video, as well as internet access through wireless application protocol (WAP). Even though mobile phone has several advantages, there are significant disadvantages associated with the use of mobiles. Components of mobile phones included, arsenic, lithium, cadmium, copper, lead, mercury and zinc. When mobiles are discarded, these toxic substances may leach from decomposing waste in landfills, seep into groundwater and contaminate the soil. Metals build-up in the soil, and in sufficient concentrations may cause health problems. Using mobile phones can harm the brain, and excessive use of mobile phones has been associated with dizziness, and radiations emitted from the phone are harmful to the eardrum. Furthermore, World Health Organization [1] stressed health risks associated with mobile phones, such as cancer, other health effects. Other risks included accidents and electromagnetic interference.

Mobile sustainability would help to mitigate or minimize the risks associated with the use of mobile phones. The World Commission on Environment and Development [2] defined sustainable development as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development promotes the idea that social, environmental, and economic progresses are all attainable within the limits of our earth's natural resources. Sustainable development approaches everything in the world as being connected through space, time and quality of life. This paper discusses the issues relating to problems arising from the use of mobile phones and also addresses aspects of sustainability in mobile phones to overcome those issues.

RESEARCH PROBLEM AND OBJECTIVES OF THE STUDY

Mobile phones are very widely used to simplify daily routine jobs by users. There are many ways that mobile phones could be harmful to users. The risks are associated both in environment and users' health effects of mobile phones. The connections between research problems are shown

• Lack of awareness about the health risks while using mobile phones.
• Lack of understanding the problems relating to the environment due to mobile

phones.
The objectives of this research are as follows,
• To identify the health risks while using mobile phones.
• To identify the environmental problems due to mobile phones.

To provide sustainable concerns in order to overcome environmental and health hazards of mobile phones.

LITERATURE REVIEW

Mobile phones have an increasingly significant role in daily life, and the associated environmental and human health hazards require detailed investigation. Mobile phone's poisonous substances can leach from decomposing waste in landfill and seep into groundwater, contaminate the soil and enter the food chain. The production of new mobile phones contributes to climate change by using up energy and virgin materials in recycling processes, which release greenhouse gases into the atmosphere. Snowden [3] stated that mobile phones had recently come under scrutiny regarding their sustainability and their potential effects on the environment. The energy consumption of mobile phone batteries contributes significantly to the device's environmental impact. The total CO2 emissions, which are closely linked to total energy consumption, from the life cycle of a 3G mobile phone are equivalent to the emissions from driving a car for only 65 to 95 km or to use 4–6 liters of petrol. Replacing the handset every year, as new models become available, creates an unnecessary carbon footprint and hazardous waste. Mobile recycled wastes led to environmental hazards, and contamination of soil, water, fish, and wildlife. For example, the leakage of cadmium in the battery from a single phone could contaminate 600,000 liters of water [4]. Huang et al. [5] examined people's actions surrounding mobile phone sustainability, how they attributed value to their phones, and how these perceptions affected the choices they made in acquiring and discarding phones. Mobile phones are composed of several electronic components, whose material compositions pose a threat to humans and the environment [5]. By considering mobile phones' situated sustainability, the study explored the complexity of the ecological problem posed by the device proliferation on a global scale. EITO [6] stated that damaging materials are used in mobile phones; the batteries contain toxic metals such as lithium or cadmium. The ores of such metals must quarry and then undergo lengthy and expensive refinement processes, causing significant environmental disruption. Mobile phones' cathode-ray tubes contain large amounts of lead, shown to have high levels of toxicity [6] . Many devices are coated with flame retardants that contain toxic compounds.

Zadok and Riikka [7] introduced an early-stage design concept called the Green Mode App, as an example of a mobile product which adheres to the green switch methodology, which must be satisfied in order to achieve the positive

environmental impact. They reported that with regard to human health hazards, mobile phones consisted of several high-risk electronic components such as lead, brominated flame retardants and beryllium. Lead used to solder components may cause damage to the immune, endocrine and central nervous systems, and to children's brains. Brominated flame retardants, used in wiring boards and plastic cases, might be associated with cancer, liver damage and problems with neurological systems. Beryllium, used in contacts and springs can cause serious lung damage, if the phones are incinerated in waste plants. Szmigielski and Sobiczewska [8] reviewed briefly possible health effects that include headaches, difficulties in concentration, apathy, weakness and a variety of neurasthenic symptoms, which tended to be linked, at least partially, with the frequent use of mobile phones by the patients. Several researchers [9-11] identified the following health risks: certain head and neck neoplasms, brain tumours, salivary gland cancer, acoustic neurinoma, as well as lymphatic and haematopoietic malignancies; risk ocular pathologies; microwave hypersensitivity; influence on hearing ability; cancer incidence and adverse pregnancy outcome.

Acharya et al. [12] focused on the health effects of mobile phone usage among students and observed that many students felt frequent headaches, neck pains, limb pains, back aches and had redness in their eyes and tinnitus in their ears due to continuous mobile usage, on some days. Certain neurological symptoms occur due to frequent use of mobile phones, such as depression, sadness, irritability and headaches, anxiety, loss of memory and lack of sleep. Mobile phone's electromagnetic radiations; listening to loud music and keeping the higher volume will cause auditory effects. World Health Organization [1] confirmed that cell-phone use indeed represents a health nuisance, and classified mobile phone radiation as a carcinogenic hazard, possibly carcinogenic to humans. 'Cell phones' [13] stressed that unfavorable health effects have increased dramatically due to the frequent use of cell phones. Khan et al. [14] explored the several major deleterious effects of cell phone usage at various stages of life. 'Mobilewise' [15] identified possible health risks, including not only brain tumours, but also damage to fertility, genes, the blood-brain barrier and melatonin production as well as other biological effects thought to have a role in cancer development. Karger [16] identified that mobile phone radiation may affect medical equipment or implanted pacemakers. Kapdi et al. [17] explained the health hazards of mobile phone's electromagnetic radiation exposure in terms of thermal and non-thermal effects.

Apart from the health risks on mobile phone's radiation, this paper also focuses on mobile phones affect road accidents. The use of mobile phones by vehicle drivers and pedestrians can cause road accidents due to their loss of concentration. Acharya et al. [12] emphasized that accident due to cellphone use while driving is commonly seen on the roads today. Khan et al. [14] confirmed that 36% of road accidents happen due to use of mobile phones while driving a

vehicle. Karger [16] also verified using a mobile phone while driving a car is significantly associated with a higher risk of vehicle collisions. Hence, mobiles are the greatest handheld device, but they still have harmful issues. Therefore, it is necessary to conduct research on sustainable interventions for defeating those issues.

MATERIAL AND METHODS

All the information and data presented in this paper were gathered from various sources of secondary data. The sources came from online databases like ProQuest, Emerald, Ebsco and ScienceDirect. The online search database provided secondary data such as journals and extracts from newspapers, books and magazines. Some of the information and data were obtained from the internet search engines like Google. The research framework was developed as shown in Figure 1.

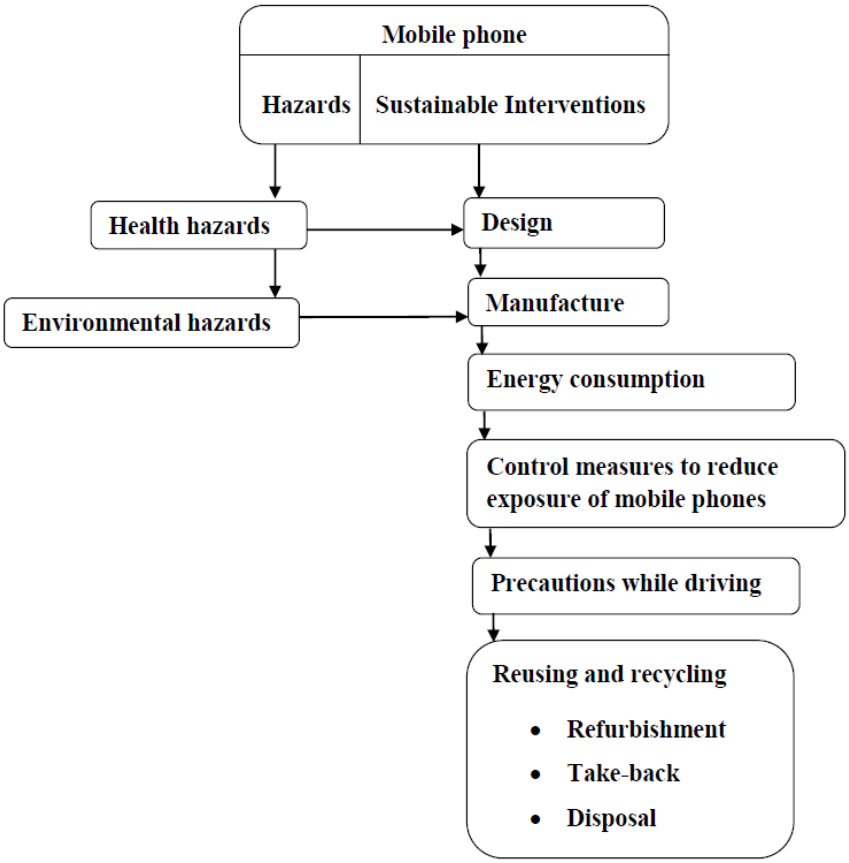

Figure1: Research framework.

RESULT AND DISCUSSION

To reduce environmental and health risks of mobile phones, this study identified that sustainable interventions were fallen into design, manufacture, energy consumption, recycling, reusing and take back to mitigate and minimize the negative impacts of mobile phones. EITO [6] also confirmed that the design, manufacture, operation and disposal of information communication technology (ICT) does, however, have an overall negative impact on the environment, although some action can be taken to mitigate these impacts. The control remedies are discussed below.

Designing and manufacturing of mobile phone

Mobile phones are becoming more energy-efficient and are eliminating the use of hazardous materials. Nokia [18] suggested the integration of the concept of 'Design for the Environment' into product and technology development, and sound end-of-life practices. During product creation, they focus on energy efficiency, sustainable use of materials, smart packaging, and creating environmental services, which engage people to adopt more sustainable lifestyles. Development of new products includes a dedicated role for the environment specialist, who supports the product development project. They verify the implementation of the legal, environmental requirements and voluntary substance and material's requirements, promote the implementation of more sustainable alternatives for material choices and energy efficiency, and provide sustainability reporting like 'Eco Profiles.' GSM Association [19] suggested that the ideal, from an environmental perspective, is to design a mobile phone with reuse, recycling and minimal disposal in mind. This starts with reducing energy input to the manufacture of components, substituting fewer hazardous substances (for example, the use of lead-free solder), and minimizing mixing of materials, such as metals embedded in plastics, which could be difficult to separate during recycling. Designing a phone for easy dismantling is also an important factor, as this would reduce the cost of refurbishment and recycling.

However, while the list of handset functions grows, the actual product size decreases. This produces environmental benefits through reductions in natural resources used during manufacture, and the substitution of one device for many. Motorola is currently evaluating the use of biodegradable plastics in mobile phone covers, with a view to using composting in their disposal. In order to further reduce environmental impacts, NTTDoCoMo has announced the use of recycled plastics in its new phone accessories, and Fujitsu is developing a plastic derived from corn starch. The mobile industry's pioneering switch to the batteries with a higher-energy density has also produced environmental benefits. For example, power cells currently in use require fewer resources during manufacture, and avoid the use of toxic metals in mobile phones. This makes the batteries much safer during the recycling and disposal processes. Mobile devices

should be equipped with multiple functionalities, for instance; many include a digital camera, music player, navigation, web browser and several other features (all in one product) to help consumers reduce their own environmental footprint and avoid buying, using and charging several separate devices, when one device can be used for many different purposes.

An Integrated Product Policy project has been established to identify the improvement options that Nokia, and the stakeholders could take to enhance the environmental performance of the phones. Nokia introduced the Green Channel store, which has information about applications and services related to the environment, to raise public awareness about sustainable lifestyles, health and well-being and social responsibility. Mobile telecoms network operators should investigate often the possibility of using renewable or low-impact energy sources to power base stations. Zadok and Riikka [7] have provided the Green Switch methodology that can be adapted to achieving positive environmental impacts; for instance, battery life increase through the usage of Green Mode to reduce energy consumption during recharge of the mobile device. Pranshu [20] proposed these options for improvements in mobile phones: optimization of lifespan; reduction in energy consumption and environmentally friendly chemicals used during component manufacture; influencing the buying, usage and disposal patterns of consumers; end-of-life, management of disposed mobile phones; reduction of energy consumption of network infrastructure; development of suitable environmental assessment methods; and development of a conducive policy environment.

Vodafone [21] aimed to reduce the environmental impacts of mobile phone products and services through the following measures designed to empower customers to make more sustainable choices, such as Vodafone launched Eco-rating scheme, which assesses handsets on a scale between 1 and 5, with 5 being the most ethical and environmentally responsible. Manufacturers are asked to respond to more than 200 questions covering the environmental and social impacts of each phone across its lifecycle, from the mining of raw materials used to make components to consumer use and disposal, and the level of commitment of the manufacturer to managing its own impacts. This assessment is carried out annually. Vodafone concentrates on working with operators, manufacturers, suppliers, the GSMA (Groupe Spéciale Mobile Association) and the ITU (International Telecommunication Union) to develop an industry standard for measuring the environmental and social impact of mobile phones and other devices. Vodafone works with both their suppliers and customers to reduce the impacts of their products across their lifecycle and the focus with suppliers is on improving their sustainability performance in sourcing raw materials and manufacturing products, hence empowering customers to make more sustainable choices and also helping customers achieve their sustainability goals through low carbon solutions.

Energy consumption

In order to satisfy consumer expectations about talk and standby time, there have been significant improvements in the energy efficiency of mobile phones. Over the last 20 years, the standby operating time on a mobile phone after charging has increased from about 4 hours to 10 days or more. There has also been an industry focus on reducing the phone's power consumption during the charging period. However, consumers can also make an important environmental difference, by simply switching off the phone and charger when it is not needed [19]. Vodafone is a signatory to the GSMA's industry-wide commitment to introduce a universal charger. This initiative aims to reduce electronic waste by eliminating the need for consumers to replace their charger when they buy a new phone. Vodafone also offers solar-powered charging solutions that can reduce environmental impacts from charging phones and extend access to reliable, renewableenergy supplies in remote areas of emerging markets. Vodafone helps consumers to make an informed choice about which mobile phone they buy, to reduce impacts from charging their phone and to recycle it when they no longer need it. For instance, Nokia estimates that if just 10% of the world's mobile phone users turned off their chargers after use, the energy saved in one year could be powering 60,000 European homes.

Control measures to reduce exposure of mobile phones

Better Health Channel [22] suggested that several measures to reduce exposure of mobile phones:

• Choosing a mobile phone model that has a low specific absorption rate (SAR), that refers to the amount of radio frequency (RF) radiations absorbed by body tissues.
• Using a landline phone if one is available.
• Keeping your mobile phone calls short.
• Using a hands-free kit.
• Not carrying your mobile phone close to your body when it is switched on.
• Being wary of claims that protective devices or 'shields' can reduce your exposure to radio frequency (RF) radiation.

Precautions while driving

CARRS-Q [23] recommended some safety measures for avoiding road accidents, the study identified some safety precautions for avoiding vehicle collisions. They are,

• Any emergency call, stop the vehicle and then attend the call.
• Slowed it down.

• Choose a time when there was little traffic.
• Choose a time when the traffic was still or moved slowly.
• Pull over safely and park your car, and then make your mobile calls.
• Use voicemail and return all calls when you reach your destination.
• Plan breaks in your trip to contact family and friends and advise them not to call when you know you'll be driving.
• Never read or send text messages while driving.
• Whilst it is legal to make and receive mobile phone calls using a hands-free.
• Keep conversations short and avoid complex or emotional topics.
• Tell callers you are driving and may have to end the call. End the call if you are finding it distracting.
• Use a hands-free device only in light traffic, and avoid all calls in heavy traffic and poor weather conditions.

Reusing and recycling

According to the Basel Convention and the Mobile Phone Partnership Initiative (MPPI) guidance document published in November 2006, "Re-use, directly or via repair or refurbishment is usually the preferable option over recycling and disposal from an environmental perspective. Re- use can extend product life and means less environmentally damaging extraction, less energy consumption and less waste. Reuse of second-hand equipment can also often mean a lower price for products, thus increasing accessibility for more people who might not otherwise be able to afford the product." The energy and raw materials used to produce millions of new mobile phones contributes to CO2 emissions and global warming. Mobile phones can be separated into their different components and recycled. For example, the copper, gold, lead, cadmium, silver and nickel; the gold and silver recovered can be made into jewelry. Often the batteries are first separated from the mobile phone and sorted into their various types before reprocessing by specialist recyclers. Nickel cadmium, nickel-metal hydride and lithium ion/polymer batteries have their metals recovered and reused in products such as power tools, saucepans and new batteries. The metals extracted during this process – including gold, platinum, palladium and silver – are put back into productive use. Phones deemed to be beyond repair – or simply too old – still have a residual value, and their parts may be reused. Therefore, practical and environmentally responsible methods for the recycling of end-oflife phones have to be developed in conjunction with those for other electronic equipment. GSM Association [19] suggested that phones may be further dismantled and some parts shredded, or processed intact for material and energy recovery. Chargers, accessories and even packaging should be recycled. It is generally not economical to reuse the plastic components due to mixed grades, and the presence of dyes and other contaminants, so energy is recovered through the incineration process. In one case, energy produced from the incineration of waste materials is used to heat a village local to the recycling plant. In another, plastics are shredded and used locally in the manufacture of fence posts and

pallets. The handsets, batteries, plastics and accessories may be separated according to their chemical and material composition; plastics can be recycled to make items such as traffic cones and metals are used again as good-quality raw materials. If a mobile phone is returned by a consumer and sent to a company where it may be refurbished, then it may be sold for reuse. This may not be the case if the mobile phone is not properly recycled when it reaches end-of-life.

Mobile Phones have a greater chance of being reused if they are donated quickly rather than being stored. Importantly, when questioned, very few people reported that they would just throw the old phone away. Vodafone [21] encouraged customers to return their unwanted handsets and accessories to Vodafone for reuse (where possible) and recycling due to raising awareness about their recycling programs through posters, leaflets, in-store collection points and prepaid envelopes with new handsets. Vodafone offers a buyback proactive procedure, which aims to increase the number of handsets collected for recycling, but this also has a significant commercial benefit for Vodafone. Vodafone also offers incentives for customers to keep their handsets for longer, for instance, by offering SIM-only price plans with a lower monthly subscription rate for customers who continue using their existing phone rather than upgrading.

Nokia [18] proposed that recycling programs target the removal of valuable materials that can be used for new products. Nokia build recycling programs by identifying safe and reliable recyclers, developing the infrastructure for reverse logistics, offering a variety of their own take-back options, and partnering with others to increase capacity to take back old mobile devices that might otherwise be headed for landfill. The research also found that used mobile phones were particularly important to people who were new to mobile telephony, those on low incomes, those under the age of 18, manual workers and non-workers. These users used mobile phones were generally as happy with their device as users of the new phones.

Refurbishment: Mobile Phones are wiped of data, physically repaired, repackaged with new instructions and sent to suppliers. Refurbished phones can be of varying quality. According to GSM Association [19], some refurbishing companies have sought environmental accreditation to demonstrate that the entire process is properly managed. For a mobile network operator choosing a recycling partner, assurances that a partner operates best practices and with transparency in the way they work are important. For responsible partnering companies, environmental management systems are often used to provide assurance about the proper treatment of collecting phones. Collected phones must first be evaluated to determine those most likely to be suitable for reuse. These phones will then be subjected to a series of tests to determine suitability for reuse with or without further repair. The testing equipment and procedures are similar to those in manufacturer repair centers. Faulty parts will be replaced; batteries evaluated or exchanged, and the phone’s appearance reconditioned.

Particular care is needed to ensure that replacement batteries have proper internal safety circuits. All original customer information is securely erased, and the refurbished phone must meet all regulatory requirements. These steps are labor-intensive and in some cases the work is done in lower cost economies using internationally accepted health and environmental controls. Finally, the refurbished phone will be packaged for resale along with a battery, charger, and instructions. Any residual materials arising during the refurbishment process are disposed of in an environmentally sound manner. The price of a refurbished phone will vary significantly, depending upon the model type, its age and appearance. The extent of any guarantee offered by the refurbished is another key factor. Indicative prices for one scheme are in the range of US$30-40. Mobile manufacturers incorporate measures such as material identification and easy disassembly, to make recycling easier. Many people are looking for simple phones, so when upgrading, the user may be able to find a potential user for their old phone. The user can also be a smart consumer and think twice before upgrading their mobile phone; old phone still does the job, and the cost of a new one can be saved. Nokia has actively participated in the recast of the Waste Electrical and Electronic Equipment (WEEE), that has been made to establish and develop the existing national collection networks in every country, and these networks collect and treat all electronic waste from households. This represents a big step forward to making e-waste recycling the rule, not the exception.

In addition, Nokia has participated in the development of legislation concerning e-waste in countries around the world, including India, China, Kenya, Mexico and Thailand during 2011 just to name a few. Nokia takes part in collective recycling schemes with other equipment manufacturers in Europe, Canada and Australia. Nokia also engages in programs, raising local recycling awareness with retailers, operators, other manufacturers and authorities around the world. Nokia take-back and recycling programs continue to expand into new markets, ensuring that mobile devices end up in environmentally safe recycling processes.

Take-back: GSM Association [19] noted that since the 1990s, the mobile communications industry had been working in cross-sector partnerships to deliver sustainable initiatives, including used mobile phone take-back schemes that often predate national and international legislation. The industry supports handset, battery and accessory takeback in more than 40 countries. In addition, several mobile phone manufacturers have processes in place to deal with phones returned through the repair or retail outlets. In most cases, take-back schemes were established as voluntary initiatives, with self-sustaining financial structures. With some, a proportion of the revenues earned by takeback schemes are reinvested in environmental and charitable initiatives, depending on the customer culture in the individual countries. The typical price range for unsorted, used phones is in the range US$1- 10. Collection and recycling programs are operated and financed by the equipment producers, while municipal collections, specified Waste Management sites and shops selling

equipment are the main collection sites.

Experience from network operators shows that one of the most important steps in establishing a successful take-back scheme is the incentive provided to customers. These vary depending on customers and cultural preferences, but generally involve donations to charity, extra call minutes for the customer or a discount on a different phone. Nokia works to make sure consumers are aware of the channels open to them for take-back and recycling and support all safe and effective methods of mobile phone recycling. Success on take-back and recycling can be measured in three ways: the number of countries covered, the number of people reached with the recycling message in dedicated campaigns, and the weight of mobile devices, and accessories, recycled.

Disposal: If a mobile phone cannot be refurbished or if the components cannot be reused or recycled, the remaining materials are sent for environmentally sound disposal. GSM Association [19] reported that the remaining materials can be made insoluble in hightemperature processing so that they will not leach toxic substances into the environment, and may be safely used as a construction aggregate. In an efficient take-back program, only a tiny proportion of the materials that make up mobile phones should go for disposal (less than 10%). Consumers should be encouraged not to throw away their mobile phones with household rubbish, as the phones may end up in a landfill site. Instead, they should be deposited in a take-back scheme for refurbishment or recycling. Murphy [23] suggested that proper disposal of old cell phones by users should involve taking it to a place that recycles cell phones or to one that will ship it off for reuse. Some companies have a take-back program and will accept the old phone when a new one is purchased from them. Better still, by keeping the old phone for a few more years you can keep it out of the cycle of waste.

RECOMMENDATIONS

From the above discussions, the concepts and theories of sustainable interventions on mobile phone hazards can guide the mobile phone companies to develop their own unique customer retention strategies. Sustainable strategies are needed in guiding and developing proactive customer intentions to use mobile phones with minimum health risks and the environment. While developing awareness among customers in using mobile phones so as to minimize hazards, manufacturers should develop safe measures with greenery quotes that would influence customer buying behavior and customer retention of mobiles. The benefits of applying sustainable strategies in order to build up riskfree use of mobile phones is clear. Researchers have caused company executives to question and examine the needs and want of their customers. Companies have to find and refine best sustainable solutions in improving service quality and developing the trust of users with respect to mobile phones' hazards.

LIMITATIONS AND FUTURE STUDIES

Knowledge of mobile phone hazards is still being accumulated, and the literature on this subject is quite limited. This research has been conducted conceptually, with secondary data. However, it would be interesting to conduct this research with analysis of primary data from the consumer perspective on mobile phone hazards. Future research could identify how mobile phone hazards will influence both the environment and individuals. A research model to evaluate consumers' perspectives with respect to hazards of mobile phones should be formulated. This model could assist in the development of appropriate sustainable strategies to overcome these hazards.

CONCLUSIONS

Mobile phone technologies are universally accepted as handy and habitually, proficient. However, mobile phones have inherent characteristics that can cause hazards for both the environment and people. Until now, there has been little information on mobile phone risks affecting both the environment and people. Research should be carried out continuously to observe if there are any significant short and long-term risks associated with mobile phone use that will be harmful to the environment and to the society. This would provide sustainable theoretical concepts to minimize those deleterious effects. Therefore, governments and the mobile telecommunication industry need to work together to improve consumer confidence in all aspects of the design, manufacture, energy consumption, recycling and reusing mobile phones, while making environmentally friendly devices and accessories. Additionally, governments need to re-examine existing regulations on mobile phones to assist people to live more sustainably.

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