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Digital Black Hole and Electronic Waste: Twin Fears of Digital Age

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Abstract:

This discusses the concept of digital black hole, citing the similarity between a digitization project and life cycle of the star. Electronic waste is an alarming ingredient of environmental pollution. The present study is an effort to discuss the elements and sources of electronic waste. Some measures are also enlisted to overcome this alarming situation.

Keywords: Electronic Waste; E-hazards; Digital Black Hole.

Introduction

Growth of information and Communication Technology sector has enhanced the usage of electronic equipment exponentially. To avoid Digital Black Hole, where all the digital information is lost forever, we need to upgrade technology. Again, faster obsolescence and subsequent upgradation of electronic products are forcing consumers to discard old products, which in turn accumulate huge e-waste to the solid waste stream. The situation demands a long-term planning; otherwise on one hand, Digital Black Holes will eat all necessary digital information and on the other hand, our earth will be the garbage of harmful E-waste.

Digital Black Hole

The inherent attribute of the digital information is to use technology rather than naked eyes to access and retrieve information. Some factors are always associated with digitization and archival project to keep information accessible. These are: upgradation of hardware in accordance with the upgraded and new software; preservation of digital information to be accessed; recurring cost and the shifting of objective and respective priority areas. If any factor starts to fade, the information may still be retrieved, but after a while it will no longer be accessible due to improper storage media, corrupted files, or obsolete file formats or technology. Then, the digital information is lost forever in the black hole.

Life Cycle of the Digitization Project Compared to the Life Cycle of a Star

Life cycle of the digitization project is very much similar to the life cycle of a star. In the beginning, digital projects may seem easy to plan and fun to conceive. But long-term costs for keeping the digital files alive are really beyond our imagination and hard to calculate at initial stage. Without any long-term planning, digitization projects can come to behave like black holes in the sky. Scanned and or hard copy of digital information, which in the analog world could be accessed using our naked eyes, is suddenly stored in an electronic environment where it is only retrievable through the use of ICT, which constitutes a constant cost factor. More the digital information is created and / or converted, the more the cost for accessing it. In addition, in due time the project may be discarded and the information may be finished in a digital black hole forever.

The life cycle of digital information or digitization project is akin to the life cycle of a star. The life cycle of a star is shown in the Fig

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Fig 1: The Life Cycle of Massive Stars (Adapted from Ref. 6).

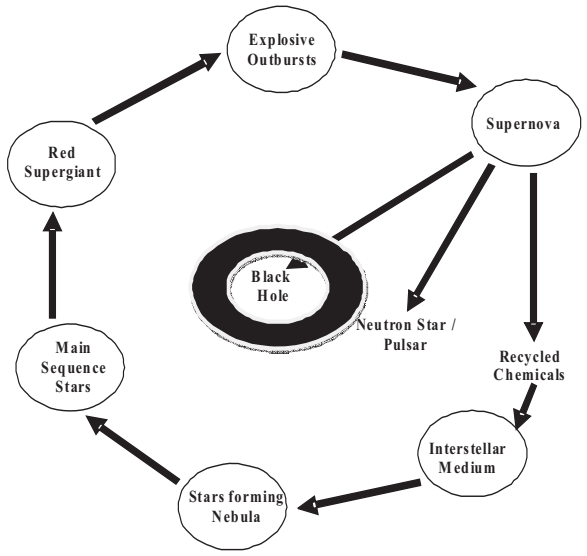
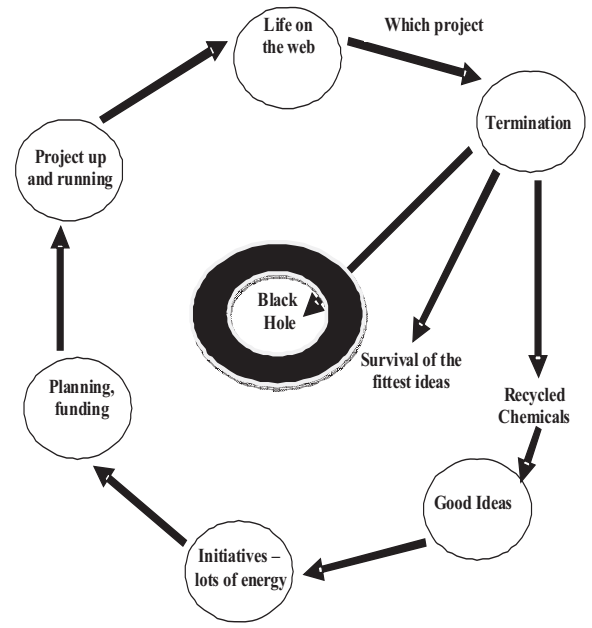


Fig 2: The Life Cycle of Digitization Projects (Adapted from Ref. 6).



1, where every step is very much similar to the life cycle of digitization project shown in Fig 2.

Good ideas in the information world carry similar to the interstellar medium in physical world. In case of digitization project there is a lot of energy in the initial stages. Therefore, the next phase of planning and securing project funding carries on as usual. Digitization is started. Gradually, all the information is digitized and organized. Then it requires long-term preservation and storage for further use. In addition, side-by-side new projects begin to develop, other interests get in the way, and the project begins to be neglected, starts to collapse, and ultimately ends in the black hole. All efforts and money is wasted in this way. Some strong ideas may survive and give rise to a new project. It is really a fear of the digital age.

Electronic Waste

Electronic Waste (E-Waste) comprises of waste electronic goods, which are not fit for their originally intended use and have been discarded by their original users. It consists of household appliances such as refrigerator, air conditioner, cellular phone, personal stereos and consumer electronics to computers. While there is no generally accepted definition of electronic waste, in most cases electronic waste consists of electronic products initially used for data processing, telecommunications, or entertainment in private households and businesses that are later considered obsolete, broken, or unrepairable. E-waste is growing in India at the rate of 10%. (Author please mention year?)

Sources and Chemical Elements of Electronic Waste

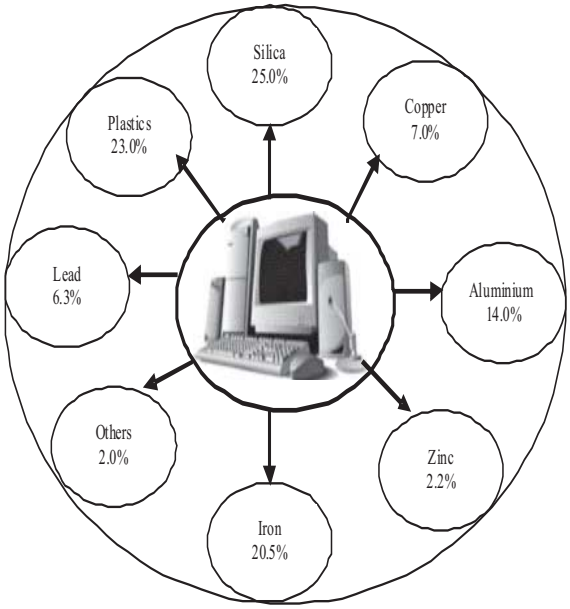
Electronic waste is the most rapidly growing waste problem in the world. Modern civilization is full of electrical, electronic and digital gadgets. These modern gadgets produce e-waste directly or indirectly. The main sources of e-waste are listed below:

- Import

Chemical elements in electronic waste are varied in nature. The chemical elements in the computer are shown with the help of pie diagram (Fig 3).

Heavy metals: lead, zinc, chromium, cadmium, mercury, copper

Fig 3: Chemical elements in the computer



Trace elements: germanium, gallium, barium, nickel, tantalum, indium, vanadium, terbium, beryllium, gold, europium, titanium, ruthenium, cobalt, palladium, manganese, silver, antimony, bismuth, selenium, niobium, yttrium, rhodium, platinum, arsenic, lithium, boron

Other: silicon, carbon, iron, aluminium, tin, copper

Problems Associated with E-Waste

E-waste contains several different substances and chemicals, many of which are toxic and are likely to create adverse impact on environment and health, if not handled properly. However, classification of E-waste as hazardous or otherwise shall depend upon the extent of presence of hazardous constituents in it.

- Computer or television displays (CRTs) contain an average of 6 pounds of lead each.
- When these components are illegally disposed and crushed in landfills, the lead is released into the environment.
- Lead can cause damage to the central and peripheral nervous systems, blood system and kidneys in humans.
- Improper collection system.
- Imports regularly coming to the recycling markets.
- Inhuman working conditions for recycling the products.
- Lead accumulates in the environment and has highly acute and chronic toxic effects on plants, animals and microorganisms.
- Other hazardous materials used in computers and other electronic devices include cadmium, mercury, hexavalent chromium, PVC plastic and brominated flame retardant.
- The presence of these chemicals also makes waste collection particularly hazardous to workers.
- E-waste is the most rapidly growing waste problem in the world.
- It is a crisis of not quantity but also a crisis born from toxics ingredients, posing a threat to the occupational health as well as the environment.
- Rapid technology change, low initial cost, high obsolescence rate of both hardware and software have resulted in a fast growing problem around the globe.
- Unavailability of rigid legal framework.

Environment and health hazards

Cathode Ray Tubes (CRTs)

i) Process: Breaking and removal of copper yoke and dumping

ii) Potential Occupational Hazards:

- Silicosis
- Cuts from CRT glass in case of implosion
- Inhalation or contact with phosphor-containing cadmium or other metals

iii) Potential Environmental Hazards: Lead, barium and other heavy metals leaching into ground water, release of toxic phosphor

Printed Circuit Boards (PCB)

i) Process: Desoldering and removing computer chips

ii) Potential Occupational Hazards:

- Tin and lead inhalation
- Possible brominated dioxin, beryllium, cadmium, and mercury inhalation

iii) Potential Environmental Hazards: Air emission of same substances

Dismantled Printed Circuit Board Processing

i) Process: Open burning of waste boards that have had chips removed to remove final metals

ii) Potential Occupational Hazards:

- Toxicity to workers and nearby residents from tin, lead, brominated dioxin, beryllium, cadmium and mercury inhalation
- Respiratory irritation

iii) Potential Environmental Hazards: Tin and lead contamination of immediate environment including surface and ground waters. Brominated dioxin, beryllium, cadmium and mercury emissions

Chips and Other Gold Plated Components

i) Process: Chemical stripping using nitric and hydrochloric acid along riverbanks

ii) Potential Occupational Hazards:

- Acid contact with eyes, skin may result in permanent injury.
- Inhalation of mists and fumes of acids, chlorine and sulphur dioxide gases can cause respiratory irritation to severe effects including pulmonary edema, circulatory failure and death

iii) Potential Environmental Hazards:

- Hydrocarbons, heavy metals, brominated substances, etc., discharged directly into river and banks.
- Acidifies river destroying fish and flora.

Plastics From Computer And Peripherals (E.G. Printers Keyboards, Etc.)

i) Process: Shredding and low temperature melting to be reutilized in poor grade plastics

ii) Potential Occupational Hazards: Probable hydrocarbon, brominated dioxin and heavy metal exposure.

iii) Potential Environmental Hazards: Emissions of brominated dioxins and heavy metals and hydrocarbons

Computer Wires

i) Process: Open burning to recover copper

ii) Potential Occupational Hazards: Brominated and chlorinated dioxin, polycycline aromatic hydrocarbons (PAH) (carcinogenic) exposure to workers living in the burning works area.

iii) Potential Environmental Hazards: Hydrocarbon ashes including PAHs discharged into air, water and soil.

Miscellaneous Computer Parts Encased In Rubber Or Plastic E.G. Steel Rollers

i) Process: Open burning to recover steel and other metals

ii) Potential Occupational Hazards: Hydrocarbon including PAHs and potential dioxin exposure

iii) Potential Environmental Hazards: Hydrocarbon ashes including PAHs discharged to air, water and soil.

Toner Cartridges

i) Process: Use of paintbrushes to recover toner without any protection

ii) Potential Occupational Hazards:

- Respiratory tract irritation
- Carbon black, possible human carcinogen
- Cyan, yellow and magenta toners, unknown toxicity

iii) Potential Environmental Hazards: Cyan, yellow and magenta toners, unknown toxicity

Secondary Steel Or Copper And Precious Metal Smelting

i) Process: Furnace recovers steel or copper from waste including organics

ii) Potential Occupational Hazards: Exposure to dioxins and heavy metals

iii) Potential Environmental Hazards: Emission of dioxins and heavy metals.

How to Overcome the Situation

Source reduction

It is expected that manufacturers of electronic goods, who have benefited from sales of their products, should take responsibility from production through to the end of their lives. To prevent an e-waste crisis, manufacturers must design clean electronics with longer lifespan that are safe and easy to recycle and will not expose workers and the environment to hazardous chemicals. Side by side, consumers must have adequate knowledge about use, reuse, donation and recycling of the products. In both the cases reduction of sources is the vital issue. Source reduction is the least expensive and most effective way to manage e-waste.

Reuse: Schools, non-profit organizations, and lower income families can benefit from your equipment if it is in good working order.

Donation: Many charitable organizations and training programs repair equipment for reuse

Recycling: A growing number of electronics manufacturers offer fee-based recycling services. Also, some municipalities offer electronic collection as part of household hazardous waste collections or special events.

Buying Green Products: Many products are being made with fewer toxins and more recycled content, are more energy efficient, are designed for easy upgrade or disassembly and use less packaging. Some companies offer lease and take-back options to help you properly dispose of your electronics.

i) Clean up: Electronics manufacturers must stop using hazardous materials. In many cases, safer alternatives currently exist.

ii) Take back: The taxpayer should not bear the cost of recycling old electrical goods. Manufacturers should take full life cycle responsibility for their products and once they reach the end of their useful life, take their goods back for re-use, safe recycling or disposal.

iii) What we can do:

- Support companies that make clean products. If you are buying a product check the Guide to Green Electronics.
- Think twice before buying whether you really need a new device.
- Return your equipment to the manufacturer when you have finished with it.

Collection Events

E-waste collection events are very similar to HHW collection events, in that they can be sponsored by private corporations, communities, or by local government. They are beneficial because they reduce the amount of hazardous materials going to the landfill, which in turn reduces the threat to humans and the environment. Collection events create jobs and allow refurbished electronics to be available at reduced prices to the general public.

Items Usually Accepted in Collection Events

- Working / useable equipment;
- Repairable or upgradeable equipment;
- Non-usable equipment with salvageable components; and
- Equipment and components, some hazardous, that must be either recycled or disposed of according to applicable regulations.

Conclusion

Proper planning is needed before going through a digitization project, because, most of the project, due to the shortage of money and shifting of objective, may be terminated and finally be finished into the digital black hole. Again, proper planning and sufficient

fund may help the project to survive, but it requires regular updating of hardware, which indirectly increases the electronic waste. We are not referring to the right to vote or right to free speech, but rather the right to avoid environmental harm regardless of race, age, economic status or geographical location. In addition, while "environmental harm" is rarely a description attached to a television set or a computer monitor, it is fast becoming a known fact that violations run rampant in the world of electronic waste recycling. Currently, up to 80% of the electronic waste meant for recycling is quietly exported to countries where products such as computers, radios, and television sets are dismantled in a crude fashion that causes severe environmental and public health risks.

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