Optimizing Consumer Electronics for the Environment and Power Consumption

Mitigating the Constant Reliance on Electronics in Society

A Thesis Prospectus
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By
Fayzan Rauf

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Technical Team Members:
Zachary Hogan
Yusuf Cetin
Will Sivolella

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Name of STS 4500 advisor, Department of Engineering and Society

Name of technical advisor, Department

Introduction

Every day, over four million mobile phones are sold (Consumer Electronics - worldwide: Statista market forecast, 2021). Yearly, roughly 375 million smartphones are sold (Mexicanist, 2021). In 2020, over seven billion people owned a smartphone, which makes up 89.84% of the global population (Turner, 2021). This only includes smartphones, it does not include mobile phones in general. Also, it does not include other consumer electronics such as televisions, tablets, laptops, computers, and the like. If one assumed that almost every person on the globe who had a smartphone also had at least one television or laptop or tablet, the sheer number of consumer electronics owned globally will be better understood and put into perspective. The numbers are immense. Furthermore, nearly every single one product of consumer electronics is made of rare earth metals or elements, which themselves are mined by processes that use a great deal of fossil fuels (Wagner, 2021). Also, data centers that run on fossil fuels are used to store all digital information transmitted between devices (Siddik, A. B., Shehabi, A., & Marston, L., 2021). Translate the astronomical aforementioned numbers to the widespread production of consumer electronics and the stripping of the earth's resources and mass operation of data centers and there is an active serious issue of harm to the environment.

Despite this harm, people interact with consumer electronics every day. It is nearly impossible for many to go a day without using one. They act as tools to help make lives easier in many ways, whether it be for the sake of any type of productivity, or for the sake of entertainment. Take the most popular example: the cell phone. Companies give out work cell

phones to communicate directly with employees or for constructive purposes. Regular everyday people use them for the same reasons and for watching videos or movies. No matter the piece of consumer electronics one is using, there is no denying that these items play a crucial role in lives. So much so that if they were absent, society will likely take drastic negative consequences. Although the importance of consumer electronics is so pronounced in modern society, it must also be acknowledged that a side effect of mass production of these items actually leads to a negative impact on the environment and power consumption (Oakley S. & Nalwa S., 2018). With all the information laid out in terms of the environmental and power consumption issues that phones pose, policy changes surely need to take effect in order to mitigate threats to the already struggling environment. Perhaps there is a ceiling on the positive effect humans can do for the environment and power consumption as it relates to electronics. Humans rely on these items on a daily basis, and it is difficult to come up with a solution to mitigate use of electronics, as they are so vital to modern society. If the impact of consumer electronics on the environment and power consumption was to be mitigated, then society will have to relinquish intense reliance on these products, and it will have to be okay with using lower quality products than what it is used to, mainly in the form of products made of renewable or recyclable materials as opposed to nonrenewable or non recyclable materials.

Technical Topic

In regards to the example of a smartphone, its environmental impact is seen by analyzing its makeup. A smartphone is after all composed of a wide variety of elements taken from the

Earth's crust (Lotzof, 2020). In order to extract these elements, mines are often required, which take a toll on the environment on their own. Many of these elements that are being extracted are irreplaceable. For example, gold, cobalt, and lithium are all elements used in smartphones. They are depleted every year because of the creation of smartphones, tablets, laptops, televisions, etc. (Bratcher, 2020). Keeping this information in mind, and also keeping in mind the short life cycle of phones, it stands to reason that the current model of creating consumer electronics is unsustainable. Technology evolves to meet the wants and needs of consumers (Cscheafer, 2018). This is why new phones that come out every year always have some sort of new advancement, a better camera, processor, higher screen resolution, etc. When new products are being made constantly, it in turn creates a demand for more resources to be used. This process repeats every year with all major electronics manufacturers, and it has taken a toll on the environment. As a result of this dilemma, a priority of electronics manufacturers is to produce smaller products that last longer and consume less power. As an example of policy change, the following information can be considered: data centers are absolutely key when it comes to smartphones (Mytton, 2021). Without them, many fundamental functions of smartphones are nullified. When a text message is sent, when a phone call is made, when a FaceTime call is made, when a video is uploaded or downloaded, all these things are facilitated through data centers. Since they are facilitating an unfathomable amount of data, they tend to consume an enormous amount of energy (Marashi, 2020). After all, they are serving the digital needs and tasks done every day on smartphones. The massive amount of electricity that is generated in these data centers mainly come from fossil

fuels. To fix this, it will be beneficial if these data centers operate under renewable energy. In fact, Google and Facebook have been set to operate under such conditions (Jones, 2018). Although that is a great start, other data centers must follow suit in the same way if smartphones are to decrease their energy consumption. It is also worth noting that although smartphones are the biggest cause of environmental problems as far as consumer electronics are concerned, it must also be remembered that other items cause a great deal of stress on power consumption and the environment as well. Beforehand, it was mentioned that laptops, televisions, and tablets all cause problems as well (Martin, 2020). For example, a laptop's chip and motherboard require a great deal of energy to produce, as they are also composed of precious metals. These same precious metals are mined at a very large cost. As it relates to televisions, it has been reported that "missing greenhouse gas" called nitrogen trifluoride, which is used in the production of flat-screen televisions, chips, and synthetic diamonds could accelerate the issue of global warming. Keep in mind that most American households have at least one flat screen television that is likely at least thirty-two inches in screen size. However, most households have more than one television, and likely ones that are bigger than thirty-two inches. Translate that into missing greenhouse gas, and the quantity is enormous as it relates to the issue of global warming according to what has been reported. Lastly, tablets have many of the same issues that cell phones have. They are larger, so they require the mining of more precious metals, and they also are capable of communication, so the argument of data centers also stays true.

STS Topic

It can be concluded that if the impact on power consumption and the environment from

consumer electronics was to decrease, then there will have to be less resource extraction and less use of electronics (Pasternack, 2020). Less resource extraction will allow more natural Earth minerals to be preserved instead of mined, and less electronics use will lead to less reliance on data centers, which use up a great deal of fossil fuels (Data Center Power Consumption, 2021). That being said, less resource extraction means lower quality products, and less use means that society will have to undo years' worth of social conditioning (Roose, 2019). The general public may not be so receptive to this, or at least it will be slow to adopt this change. There may be many who want to support helping the environment, but may not be willing to do it at the cost of an important piece of property, like a cell phone. If firms/companies are slow to show their support for the environment, the general public may catch onto this, and may refuse to support a given firm/company. In order to combat that, a firm/company may have no choice but to take a financial hit in the name of helping the environment and seeming better to the general public.

There are two relevant frameworks that have been discussed that are applicable to this topic: process over outcome and anticipatory governance. Process over outcome, which is defined as "Do not focus on an outcome, focus on building strong processes that can be adapted for new situations in the future. Do not focus on where you are going, but how you get there." This concept brings forth the idea: what if society never achieves the outcome of no environmental impact from electronics? Maybe it is more realistic to focus on the process of getting there. Maybe focusing on the process of getting to that point will help society achieve greater milestones along the way. The second framework that applies to this topic is anticipatory governance, which is defined as "How can we use what we know today to mitigate negative consequences in the future?" The way one can apply this to the topic is with the following

analyzation: what can be taken with what is known already about consumer electronics and the environment to mitigate the impact between the two? In other words, what adjustments can be made/have made that will be beneficial for the future? Many of the solutions that are presented in the gathered evidence almost exclusively assert that in order to mitigate the impact of consumer electronics on the environment and power consumption, people will have to give up the intense reliance on these products, and they will have to be okay with using lower quality products than what they are used to (Zetlin, 2019).

Research Question and Methods

This begs the STS questions: can society collectively mitigate use of electronics, or is it too far into its reliability on these products that it would reject that idea? It is indeed much too dependent on consumer electronics. Society as a whole will not be receptive to giving up these products. They have become too much of an anchor in people's lives. However, there are still many who believe that sometimes, it is important to temporarily quit electronics (Luke, 2020). For example, people feel overwhelmed from all the constant notifications, tasks to complete, etc. and have left their phones alone for a period of time, just to detox from all the information they are constantly exposed to (Crudo, 2019). As engineers, there is in fact a ceiling on the positive effect humans can do for the environment and power consumption as it relates to electronics. Humans rely on these items on a daily basis, and it is difficult to come up with a solution to mitigate use of electronics, as they are so vital to modern society. Society will not allow the "perfect world" solution to take place where everyone collectively gives up consumer electronics

or tolerates low quality ones. The middle ground is somewhere else. Specifically, the middle ground is to make the most energy efficient data centers and mining practices possible, and to rely on people detoxing from their products, as media becomes more and more invasive (Damian, 2020). This is the only way people can continue to use electronics that incrementally get better, while mitigating the impact on the environment and power consumption. Research questions will be investigated in the following way: take multiple different experimental groups - one group with no use of consumer electronics, one group with use of relatively lower quality electronics, and one group with use of regular new electronic devices. Quality of life/efficiency will be assessed through these groups. Whichever group exhibits a balance between efficiency from a product of consumer electronics and the side effects to the environment will be noted. This method will allow the "perfect world" scenario (giving up all products) to be tested along with the middle ground scenario (lower quality), and the current scenario. There will be another experimental group as well that takes a complete break from consumer electronics for a period of time, then comes back to normal current behavior. This is the group that reflects the hypothesized most realistic middle ground. All these groups will be assessed to see quality of life/efficiency. Which ever one strikes the best balance will reflect the most favorable course of action.

Conclusion

Keeping in mind the fact that society will not accept lower quality products every year, it stands to reason that the mining of precious metals will definitely continue, however it will be

beneficial to the environment if these processes were made as “green” as possible, like for example, less reliance on fossil fuels. Also, less reliance on fossil fuels will greatly benefit data centers and their impact on the environment, as using renewable energy to facilitate data usage is a very practical alternative as seen by Google and Facebook. Lastly, there are many people who take breaks from electronics from time to time. This is far more common than most people realize. The collective impact of those who do this will help both the issue of the environment and lower power consumption since devices will not be in use. Coupled with renewable energy in data centers, and that is even more beneficial to the environment. All these listed solutions will allow that middle ground to be achieved: the harm to the environment will be mitigated, but at the same time, society will still be able to carry on using consumer electronics. The most efficient and realistic way to mitigate the impact of consumer electronics on the environment is to relinquish intense reliance on these products, or take periodic “fasts” from consumer electronics. Society must be content with using lower quality products than the norm. In other words, products made from more earth-friendly materials.

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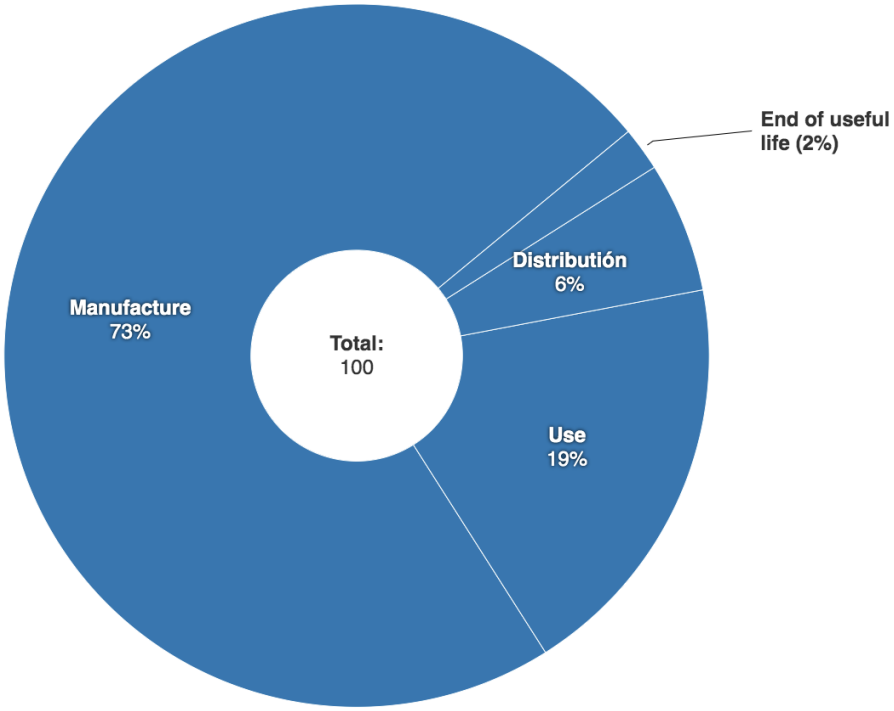
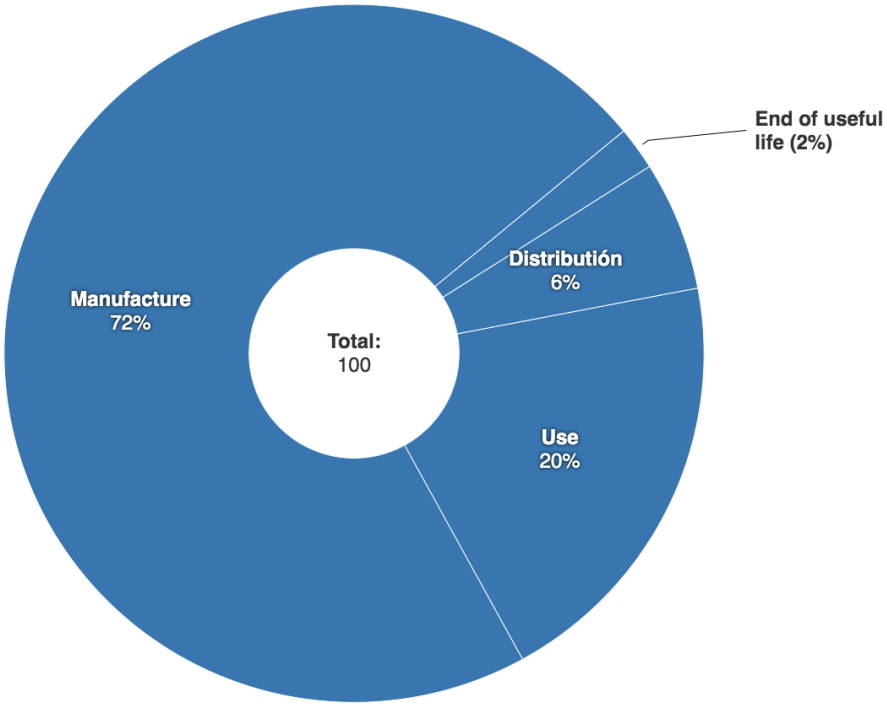
Appendix A

Tables and Figures

The Life Cycle of Electronic Devices (source: https://www.tecnologialibredeconflicto.org/en/environment/)



CO2 Emission by Life Phase of a Smartphone (source: https://www.tecnologialibredeconflicto.org/en/environment/)



CO2 Emission by Life Phase of a Laptop
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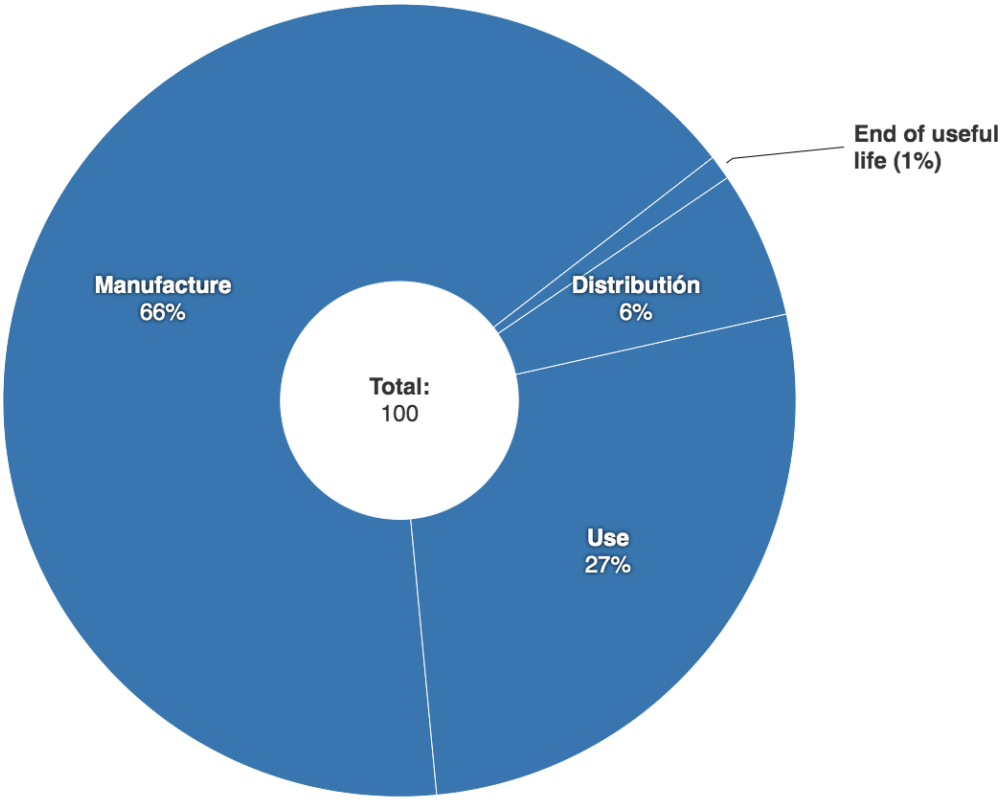

CO2 Emission by Life Phase of a Computer
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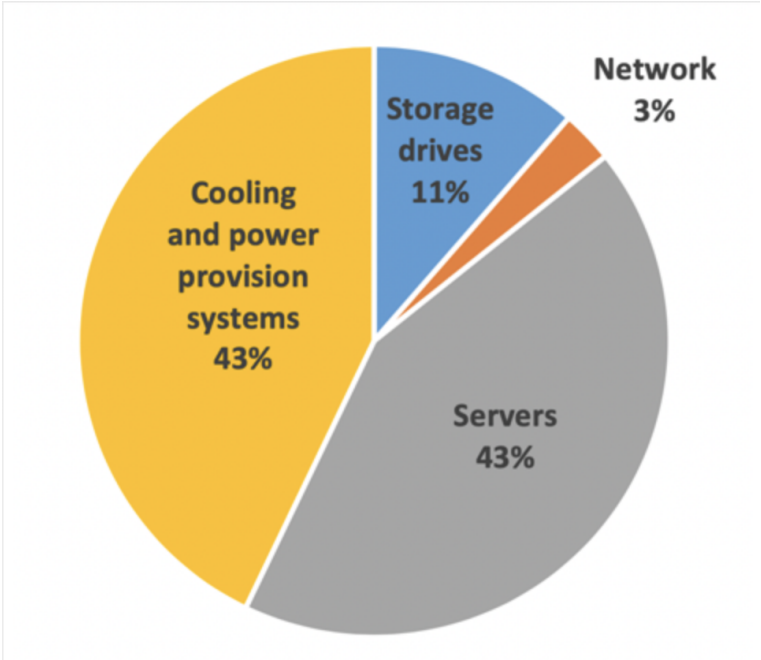

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