

WHAT DO I DO WITH MY USED PHONE? THE SUSTAINABILITY IN ICT IN CZECH REPUBLIC

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Abstract: Smartphones have become part of our everyday life. But what to do with our old device when we want a new one? Everyone will deal with this question differently and this paper aims to present the most used approaches and the reasoning behind them as well as pros and cons of each approach. The study is done by using an analysis of research conducted by the Czech Statistical Office on the topic of sustainability in ICT on respondents over the age of 16 in 4.5 million households. The results can help smartphone companies understand how their products are disposed of once replaced by another model and help us understand the effects and potential risks this might have on our environment. The targeted research area is the Czech Republic. By comparing age categories, we get the results that the most common option is to keep the old phone at home if the new one breaks, this option was chosen by 46,9 % of respondents. Other favorite options are sending it for recycling which chose 17,5 % or selling it with the results being 14,9 %.

Keywords: Smartphones, sustainability, recycling, ICT, electronic waste

1 Introduction

In the current era of the digital economy, the role of information communication and technology (ICT) and economic complexity is crucial for controlling environmental unsustainability and formulating policies to deal with ecological concerns (Khan & Ximei, 2022). This can be followed by the research done by Panzio & Gallardo (2023). The increasing integration of systems into people's daily routines, especially smartphones, requires ensuring the correctness of their functionality and even some performance requirements (Panzio & Gallardo, 2023). The number of end-of-life mobile phones is increasing every year, which includes parts with high reuse values and various dangerous and toxic compounds (Li et al., 2022). ICT products and especially smartphones are one of the most used products we use daily. Although smartphones are small mini computers, their impact on the environment is no longer small (Chun et al., 2022). Since mobile phones are one of the most popular electronic devices but have a short service life, they are one of the vital contributors to the fastest-growing waste streams worldwide, and the problems of recycling waste smartphones urgently need to be fully resolved (Liu et al., 2022). The issue of what to do with our old smartphones is becoming more and more problematic. Most people will store smartphone waste or give it to others (Sari et al., 2021). Some people buy new smartphones every year, or every other year - this depends on what they use the smartphone for. Some people can be addicted to their phones and just can't lay them down. It has been claimed that smartphone usage constitutes a behavioral addiction characterized by compulsive, excessive use of one's phone and psychological withdrawal or distress when the phone is absent. However, there is uncertainty about key phenomenological and conceptual details of smartphone addiction. One of the central problems has been understanding the processes that link smartphone usage and addiction (James et al., 2023). One of the most problematic behaviors is becoming the disposal of electronic waste and recycling of smartphones. Mobile phones represent an ever-increasing waste stream due to the increasing ownership and short lifetime. In particular, smartphones are among the most valuable e-waste because of their extremely high content of numerous key metals, specifically in the printed circuit board and magnets (Kastanaki & Giannis, 2022). Digitalization has considerable potential to help achieve the sustainability of the planetary and human systems, including organizations. As digitalization is one of the most promising factors for transformation, there is no doubt that ICT and big data can help promote sustainability (Alnasrallah & Saleem, 2022). As the use of information technology increases, the number of discarded devices increases, they are no longer functional or obsolete, and so the question arises of how to deal with such devices. From the perspective of sustainability, these devices can be recycled, and their parts reused or disposed of in

an ecological way. But how do Czechs really deal with discarded devices? And how many of them do they accumulate at home or throw away mixed waste?

2 Theoretical backgrounds: literary research

Smartphones have become one of the most important things in our daily lives. The increasing integration of systems into people's daily routines, especially smartphones, requires ensuring the correctness of their functionality and even some performance requirements (Panzio & Gallardo, 2023). Technology and especially the one used in smartphones evolve every year. The expeditious developments in technology alongside the demand for a high-standard living have resulted in the massive production of electronic gadgets which eventually leads to the generation of huge quantities of obsolescence (Vishwakarma et al., 2022). The development of ICT changed our daily lives. Human capital and ICT have a significant role in determining human development. The impacts of ICT and human capital on green growth and environmental sustainability should be explored for sustainable economic development (Chen et al., 2022).

With the development of ICT and smartphones, the waste that comes with the making of all of the ICT products has become major in waste production management. In the last century, increased urbanization and population growth produced a dramatic increase in waste production, causing severe problems for the global environment and human health like never before. Currently, correct waste management represents a serious challenge that can be faced using new technologies (Baralla et al., 2023). As said by Sakthivel et al. (2022), electronic waste describes the rejected electrical or electronic products of electrical and electronic equipment which has been discarded by users as waste with the lack of reuse or recycles (Sakthivel et al., 2022). Electronic waste is becoming more and more problematic by the year. Understanding the role of information communication and technology (ICT) in environmental issues stemming from extensive energy consumption and carbon dioxide emission in the process of economic development is worthwhile both from policy and scholarly fronts (Gyamfi et al., 2022). Proper recycling and waste management start in the design process of the product. It depends on the manufacturer if the product can be reused or not. The retailer and remanufacturer should focus on increasing product sales and recycling quantity of waste products to promote the achievement of economic and environmental value (Zhang et al., 2022). One of the problems is consumer behavior toward recycling. Some countries and their citizen know how to recycle and are thorough in the process. Some countries are trying to improve the recycling situation. One of the reasons to improve recycling in the country is the transformation to a circular economy. Change in consumer behavior that leads to increased waste separation and recycling has been identified as a critical component of Chinese national strategy for constructing a "Circular Economy" (Tong et al., 2018). The concept of Circular Economy has made a crucial contribution to establishing a changed perspective on recycling, one in which recycling is no longer regarded as merely a part of waste management, but rather intimately linked with preceding stages of production, such as product design and manufacturing. It has been shown that recycling achievements significantly depend on the inputs into recycling processes where complex products require higher recycling efforts (Roithner, et al., 2022). This can be followed by the research of Hischier, Böni (2021), who focused on the reuse of electronics in the circular economy. One key strategy which can be used to promote a Circular Economy is 'reuse'. This is particularly relevant for Electrical and Electronic Equipment due to its often rather short use phase as well as its resource-intensive production phase (Hischier & Böni, 2021). The circular economy can help solve many problems. Circularity can help to prevent the depletion of the earth's limited material resources,

which are vital for human's modern society (Moraga et al., 2021).

One of the worst things that citizens can do is improper disposal of electronic waste. It can have severe damage to nature or human lives. The most severe problem associated with these wastes is their informal recycling and improper disposal, threatening the environment and human health (Preetam et al., 2023). That is followed by Wirtu & Tucho (2022) dumping and improper recycling and handling of e-waste cause problems such as contamination of soil and water, depletion of grazing land, health problems such as respiratory infections, various cancers, congenital disabilities, and other health issues that affect the brain and other vital organs (Wirtu & Tucho, 2022). Climate change can be affected by several reasons, and the improper disposal of electronic waste can be one of them. Climate change calls for action from all sectors of our global economy, including ICT. Therefore, it is important to change the way we develop software to address the challenges posed by sustainability (Moreira et al., 2023).

Another crucial thing is the sustainability of the product. Sustainability is a very complex concept made up of a multitude of interacting aspects that do not necessarily work synergistically with each other (Pérez-Martínez et al., 2023). As in the recycling process, the sustainability of the product starts with its design. Designing a sustainable system of recycling used mobile phones (UMPs) is an urgent concern in terms of cleaner production ideas (Wan, Yu, 2022). This can be followed by Gutiérrez-Ángel et al. (2022), who focused on the improvement of ICT and digital competence. The process can positively influence the design of the product. From this point of view, it is considered that an improvement in digital competence has a positive impact on the use made of ICT and also on its link with sustainable development (Gutiérrez-Ángel et al., 2022) and according to Biedenkopf et al. (2018). Achieving sustainable consumption and production requires a break from current practices in many sectors, including the smartphone sector. Leaders are central actors in catalyzing such change by developing, implementing, and promoting innovative ideas, products, and practices (Biedenkopf et al., 2018).

The recycling process of electronic waste is another interesting topic. Firms can appropriately recycle used products to, not only save material costs but also bring back customers to make repurchases. However, customers may return their used products at any time and in any condition, and firms may thus be unable to fully utilize the returned items in their remanufacturing activities (Huang et al., 2019). For future development, it is important to design recyclable products. It is thus necessary to develop new eco-designed devices that allow the recycling of all the components and recovering the valuable materials through sustainable methods (Cocchi et al., 2021). As said the process of the future product should start with the design to be more recyclable and sustainable. With a modular design, it becomes easier to repair the product or replace parts, allowing for an extended lifespan (Frantz Schneider et al., 2018). Every year millions of smartphones are bought and the old one is kept by other members of a family, sold or kept in the household. But it could be better if smartphones could be recycled. Recycling is one option for reducing waste and, consequently, pollution. Various efforts have been made to create more sustainable phones, promoting recycling (Cheng et al., 2022). One of the options to promote recycling can be provided. If not, provisions should be made for better identification and more efficient recycling so that materials designated as critical can have increased potential for more than a single functional use (Graedel et al., 2022).

Considering the nature and complexity of electrical/electronic product materials, their energy consumption, and the e-waste they create, sustainability should be included in their design and innovation (Liao & Chuang, 2022). Smartphone development is becoming faster and faster. Smartphones change by the year and are thinner, bigger, and faster. The more modern electronics are, the smaller and more complex printed circuit boards are. Thus,

these materials are continually changed (physiochemically), increasing the copper concentrations in smartphones. In this sense, it is challenging to set standardized recycling processes to improve metal recovery (Andrade et al., 2022).

One of the reasons to not send the phone to recycle or resell it can be the fear that the information that we had can be stolen. The IT support can assist smartphone users to decide whether to sell their smartphones in a second-hand market and at the same time encourage developers and researchers to design methods of social media data sanitization (Benrhouma et al., 2021). Today we cannot imagine our lives without ICT. The increasing consumption of electrical and electronic devices is alarming. Therefore, the transition from a linear to a circular economy becomes essential. The key solution to support this transformation is artificial intelligence. This work presents a transfer learning approach to support the recycling of electrical and electronic waste (Ewaste) (Abou Bake et al., 2022).

3 Methodology and Data

The survey (VŠIT) is representative of the population of persons aged 16 and over to 64 living in the Czech Republic. In 2022, this was a group of 8.8 million people and 4.5 million households. In terms of conversion to the basic population, the acquired data are weighted by the post-stratification weight of the predominant individual in terms of gender, age, region, and economic activity. The data talks about the treatment of information technologies that people have stopped using. The questions always asked about the last device used, as people may have had multiple phones, that they used during their lifetime. The data are from Czech statistical office (CSO, 2022).

The data were divided into categories based on the age of the respondents.

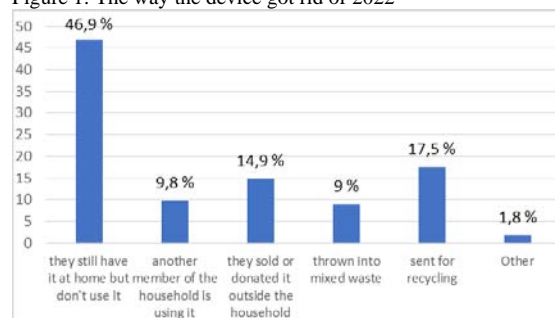
Category:

Overall (include all the respondent's data)

- 16-24 years old respondents,
- 25-34 years old respondents,
- 35-44 years old respondents,
- 45-54 years old respondents,
- 55-64 years old respondents.

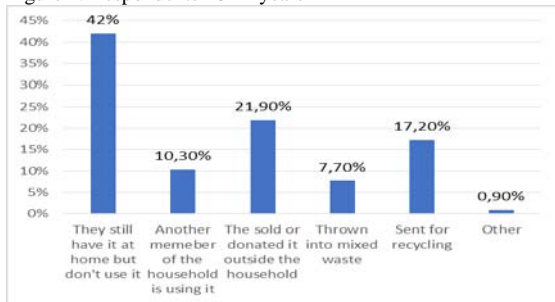
4 Results

Figure 1: The way the device got rid of 2022



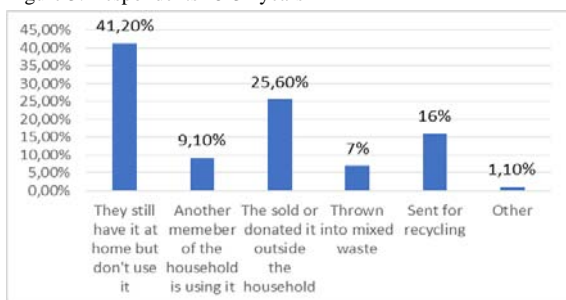
In Chart 1 we can see how the respondents got rid of their smartphones. We can see that the most popular option is to keep the phone at home. Keeping the phone at home can be beneficial if the new one stops working and suddenly, we must switch to a different phone. The old one is just right there. The other popular option is to send it for recycling, 17.5 % of respondents do that. 14.9 % sold the old phone or donated it. The most alarming result is that 9 % of respondents throw their old smartphones into mixed waste. As we discovered earlier, we concluded that this is the most dangerous way to get rid of an old phone.

Figure 2: Respondents 16-24 years



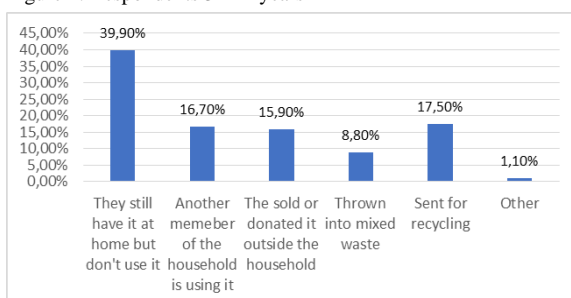
In Chart 2 we can see the results of respondents in the years between 16 and 24. The biggest number we can see is in the first category. 42% still have old phones at home, which corresponds with the overall trend we see in Chart 1. The second most popular option is to sell it or donate it outside the household. This option is chosen by 21,9%. 17,2% sent it to recycle which is 0,3% less than the overall results. But it is still a good amount. The fact that 7,7% of respondents throw it into mixed waste is still better than the overall results, specifically 2,3% less.

Figure 3: Respondents 25-34 years



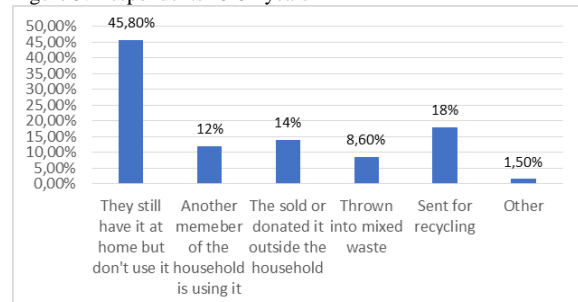
The results for the category 25 to 34 years which we can see in Chart 3 are very similar to the results in the previous category. Most of the people (41,2%) store their old phones in the house. The second most popular option is to sell it or donate it. The recycling trend and giving it to the other member of the family are really close to the overall results as the difference between Chart 1 and this is in the option giving it to other member is 0,7% and recycling is 1,5% difference. Thankfully this category shows the smallest number of respondents that throw it into mixed waste.

Figure 4: Respondents 34-44 years



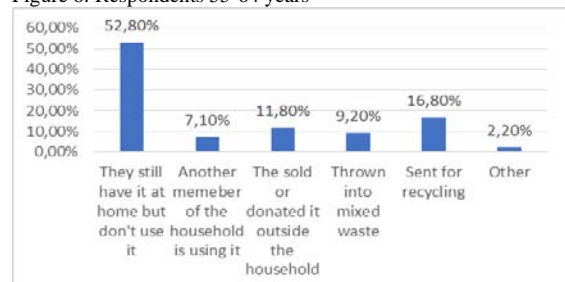
In Chart 4 we can see the results in the category of 35 to 44 years old. The trend of keeping the old phone in the household stays here too, but from all the categories is the smallest amount. It's even a 7% difference between the overall results and this category. Results in the three categories are very similar, in that other member of the family uses it, they sold it or donated it and recycling it varies less. 8,8% of the responders throw it into the mixed waste which is a 0,2% difference from the overall results.

Figure 5: Respondents 45-54 years



The results represented in Chart 5 are from the category 45 to 54 years. The second most popular option is recycling the old phone which in this case 18% is the highest amount compared to the other categories. It's even 05% more than the overall results. A significant number of respondents (14%) sold it or donated it to someone else. And 8,6% throw it into the mixed waste.

Figure 6: Respondents 55-64 years



The last Chart 6 represents the category 55 to 64 years old. This category has the highest number of respondents that store their phone in their home, which is 52,8%. But also has the highest number of people who throw it into the mixed waste with 9,2%.

5 Discussion and conclusion

In all the categories the number one option how to get rid of the old phone is to keep it at home even if they don't use it. The overall number is 6,9% and the highest amount recorded is in the category of 45-54 years old with 45,8 which is a 3,8% difference. The smallest amount is in the category of 35-44 years old. This shows us that keeping the phone in the home is the most popular way of getting rid of the old phone. Because smartphones become one of the most important things in our daily life is safest to keep the old one if the new one just stopped working. As said by Shi et al. (2023). Smartphone use has become an indispensable aspect of daily life for billions of people (Shi et al., 2023).

Giving it to another member of the family or household is the least chosen category (if we exclude the "other" option) with overall results of 9,8%. The highest amount in this option is recorded in the 35-44 years old category with 16,7% and the smallest amount is 7,1% in the 55-64 years old category. This corresponds with the research done by Gray & Charness (2022). However, they may be more likely to own more dated devices, such as non-smart mobile phones. Models of device age showed that older adults are more likely to own older smartphones, as well as older desktop and laptop computers (Gray & Charness, 2022).

Selling or donating the old phone is the option that's "in the middle". The results show that overall, this option was closed by 14,9% and the category that picked it most is 25-34 years old. The least amount was recorded in the last category which is 55-64. This shows that the 25-34 category is most likely to sell their old phone to have more money for the new one. Since these days smartphones become more and more expensive. Considering short replacement cycles and low recycling rates of smartphones, establishing effective return mechanisms for unused

smartphones is necessary to prolong product use phases and thereby reduce the environmental impact of smartphones. Consumer-to-business return options provide a novel, accessible way to return unused devices but require consumer acceptance to fulfil their ecological potential (Ratay & Mohnen, 2022).

The literature research proved that the least favorite option how to get rid of an old phone is to throw it away. This option was closed by 9 % of respondents overall. The highest amount was reported in the category of 55-64 years old. The least in 25-34 years old. This can prove that the older generation is most likely to not know other ways to properly dispose of the device or how to give it for recycling. The discourses of sustainability are inextricably linked to the influence of technology in shaping the future. Information and Communication Technology (ICT) in particular plays a crucial role in our understanding of the environment and human impacts as well as our search for future solutions to mitigate climate change (Admo & Willis, 2022).

The most interesting category for this research is how many respondents chose to recycle their old phones. The overall number of respondents that chose this option is 17,5 % Which is the second overall highest number. All the categories got similar results being 16 % the smallest and 18 % being the highest. The highest amount is 45-54 is the number one in recycling. Repeated actions and behaviors are characteristic of people's daily lives. However, there is a dilemma when this repeated action is associated with mobile phone recycling since convincing mobile users to recycle sustainably is challenging (Ben Yahya et al., 2022).

For all the categories is the most favorable option to keep their old phone at home "Just in case". For the younger generation changing their old smartphones for new ones every other year, they are more likely to keep the old phone "just in case" or sell it to get more money for a new one. All the categories tend to recycle their old phones or give them to another member of the family 9 % overall of the respondents, unfortunately, throw it into the mixed waste.

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Secondary Paper Section: DM