

WEEE repair behaviour of consumers in Greece

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Abstract

This study aims to depict consumer behavior regarding laptops, tablets, and TV devices (EEE and WEEE) in Greek households. In order to achieve this goal, a web-based questionnaire was contacted to explore consumers' habits of using these devices throughout their life cycle. More specifically, it aims to estimate the current habits and practices of storage, repair, second-hand purchase, and disposal of laptops, tablets and TVs. The survey was conducted by using a detailed questionnaire, which was sent via email. The questionnaire is targeted at citizens between 18 and 80 years old and distributed to 100 households. The first page of the questionnaire explained the purpose of the research. A total of 61 people participated in the survey. The survey results show that consumers have obvious storage habits, doubts about repair their devices, uncertainty about purchasing and using second-hand equipment, and limited recycling rates. Next step, a nationwide study involving more than 1000 Greek households.

Keywords: WEEE, consumer behaviour, storage habits, repair, second hand

1. Introduction

The rapid technological evolution and the reduced production cost have led to a dramatic increase in the volume of waste of electric and electronic equipment (WEEE). Globally, WEEE generation is rising, with around 53,6 million metric tons of WEEE being generated in 2019, while it is estimated that it will exceed 74 Mt in 2030 [5]. Additionally, to that depiction, the recycling activities cannot keep up with the continuous growth of waste of electric and electronic equipment; it is reported that in 2019, the formal documented collection and recycling was only 17.4% of the generated WEEE.

While new products are designed and manufactured, offering potentially lower environmental impacts, it is unclear if these changes lead to product design complexity and potentially increased repair difficulty. Products' density, combined with manufacturers not sharing any repair information of their products with the public, may lead to a decrease in consumer interest and participation in the repair process [9].

Consumers and their storing-repair-reuse-disposal of EEE and WEEE decisions contribute significantly to the WEEE generation. According to Perez-Belis et al. (2017) [11], sometimes, due to the small size and low cost of a small EEE, "when its lifetime ends," consumers usually dispose it or store it at home but rarely take it for repair if it malfunctions or breaks.

The devaluation of a product's worth due to age and cost, combined with the restrictions in maintenance/repair procedure or economically-driven reasons such as high repair costs, may lead to consumer behavior that does not align with the sustainable consumption principles promoted by the circular economy.

However, any increase in consumers' interest in repair will contribute to environmental sustainability by elongating an electronic/electrical product's life span while reducing e-waste generation. The consumer's perspective should be examined and changed to avoid the significant impact of storing devices at home and promote the repair procedure and reuse potential that functional equipment has but can lose due to obsolescence.

2. The survey

To serve the purpose of the survey, "snowball sampling" [8] was used to send the questionnaire to potential participants via email. A total of 100 emails were sent, which contained a text explaining the purpose of the research and a link to an online questionnaire conducted using Google Forms (provided by Google Inc). The survey's target group was citizens between 18 and 80 years old, and in total, it was completed by 61 households. Participation in the survey was anonymous. The questionnaire included 20 "yes" or "no" questions and multiple-choice questions with one or more answers. The first part of the questionnaire was designed to collect social demographic information of the respondent, such as gender, age, education level, family size, employment type, income, and location, followed by other four parts, dedicated to laptop-tablet-TV use and maintenance, general recycling issues, habits related to purchasing, second-hand use, and consumer awareness. Also, a pre-test was completed to make some adjustments clarifying potential misunderstandings.

3. Results

3.1 Sociodemographic characteristics of the responders

Sixty-one persons responded to the survey, of which 32,8% were males, and 67,2% were females. The age group with the most participation was the group of 25-34 years old (63,9%), following responders between the age of 18-24 (18%) and responders between the age of 35-44 (13,1%). The responders' level of education is exceptionally high, with 59% having a technological or university degree and the 18% having a master's degree. Most of the responders live in a one-person household (47,5%), followed by four-person (21,3%) and two-person (18%) households. When asking responders about their employment type, the highest percent replied that they are full-time employees (63,9%), followed by the category of students (23%). Regarding income per year, around 45,9% of households had an annual income between 10.000 and 30.000 euros, but an equally large portion of households (37,7%) live with an annual income below 10.000 euros. Most of the responders live in the capital of Greece, Athens (73,77%), with the rest of them being inhabitants in cities with a population above 50.000 people.

3.2 Consumers' use of devices

Companies worldwide try very hard to ensure market survival and higher profits through technological innovations to their products. The rapid technological development embedded in new products is what consumers crave; newly launched products with new and unique features [12]. The fact that the recent explosive growth in markets for new ICT devices (such as smartphones and tablets) and the transition of the television from a simple receiver into a digital entertainment hub made these devices dominate the global sales of consumer electronics [3] as well consumers' pockets.

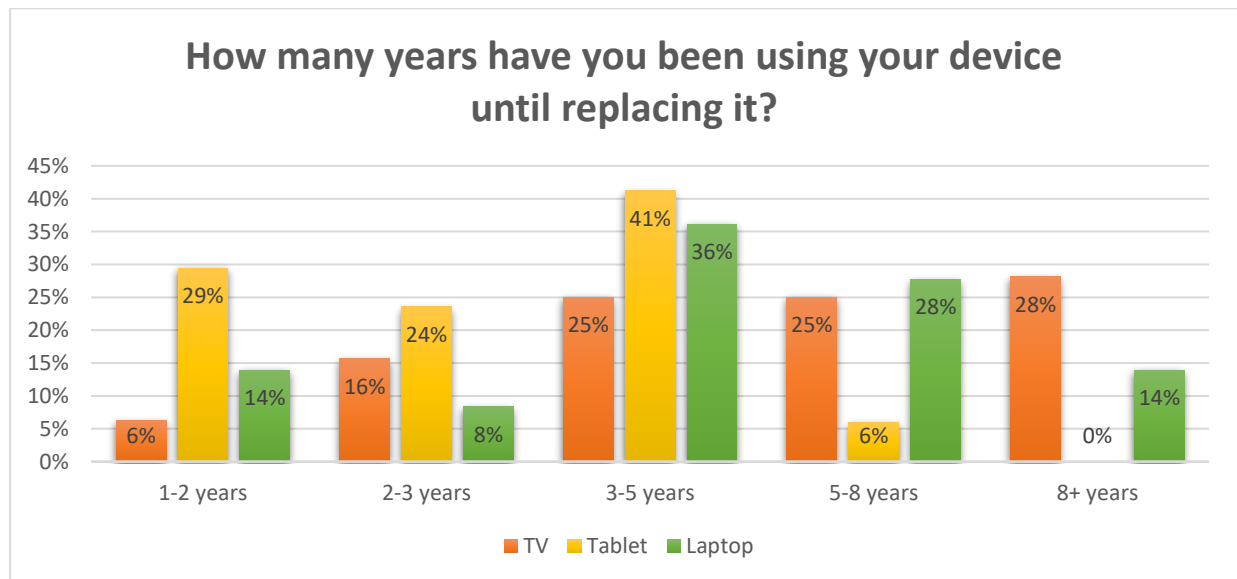


Fig. 1 Years of use before replacing

According to Figure 1, most responders in Greece are using their laptops and tablets for 1 to 5 years and TVs for over eight years before replacing them. Among the three devices examined in this study, tablets seem to have a shorter lifespan in a household, especially in contrast with a TV. Regarding tablets, as Wang et al. (2013) [13] pointed out that after the initial "novelty" effect subsided, a large number of tables were discarded, returned to the seller, or stored in a warehouse after the first year of use. Small electronics (cell phones, computers, etc.) are considered to have a life cycle of less than five years and are disposed before their end of life, in line with technological advances [4]. On the other hand, bigger appliances such as TVs are most likely to survive beyond ten years of usage [7].

Table 1

Questions related to consumers' use of devices

No.	Questions
1.	How many years have you been using your device until replacing it?
	1. 1-2 years
	2. 2-3 years

	3. 3-5 years
	4. 5-8 years
	5. 8+ years
2.	For what reason have you replaced your old device;
	1. It was broken
	2. It was functioning but with many problems
	3. I was bored, and I replaced it with a new one
	4. It was a very old model
	5. Did not meet my needs
	6. Other
3.	What have you done with the device that you have replaced?
	1. I keep it at home
	2. I gave it for recycling
	3. I threw it to the rubbish bin
	4. I sold it
	5. I gave it to someone for free

As is shown in Figure 2, popular replacement motivations are related to the functionality of the device ("functioning with problems" and "because it broke") followed by reasons which had to do with consumer needs ("did not meet my needs") and due to the old device model. At this point, it should be mentioned that consumers' decisions to replace, repair, store or discard devices are affected by product obsolescence, either actual (physical, functional, technical) or due to psychological and social reasons [15].

One of the practices that disturb the WEEE flow is the storage in the household. When asking the participants about device replacement, they have responded that they keep them at home, an option that might be related to reuse potential, resuming that these devices might be used again sometime in the future or perhaps being kept as a spare (Fig. 3). The phenomenon of stockpiling in the household may be attributed to consumers' behavior, such as lack of knowledge of WEEE disposal, perception of product value, or emotion related attitude [10]. Through this choice, consumers express the belief that their old devices at some point will be helpful, that would serve as a backup in an emergency, or that they might be valuable to another person (charity).

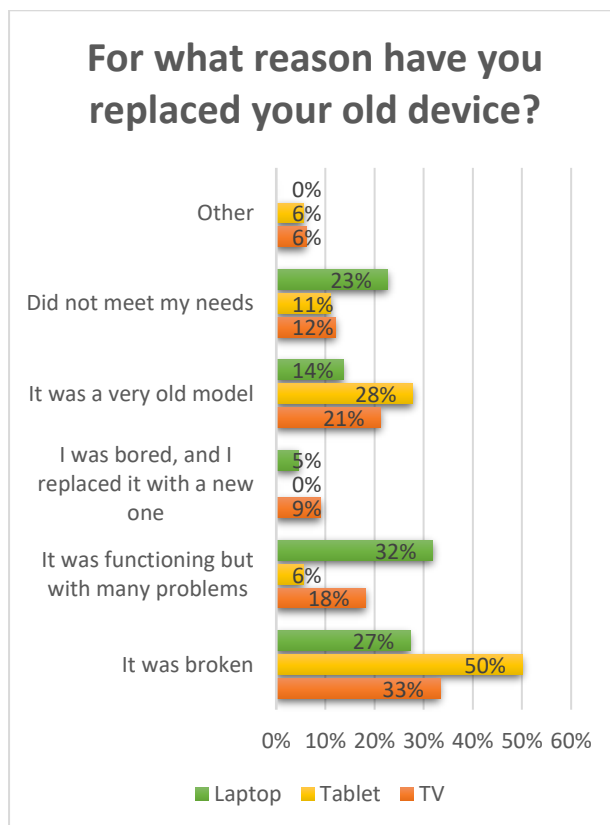


Fig. 2 Reason for replacing devices

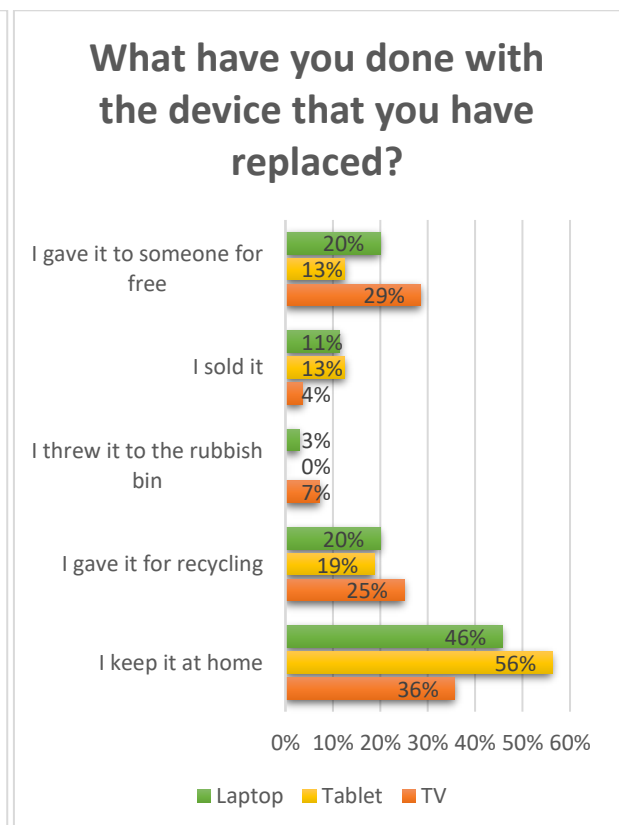


Fig. 3 The fate of old devices

3.3 Consumers' repairing behavior

Regarding “consumers' repairing behavior”, if in the past ten years responders had had a nonfunctional device, most of the problems were related to reason regarding the software and the battery (regarding laptops, tablets) and hardware problems (regarding TVs) (Fig. 4).

Table 2

Questions related to consumers' repairing behavior

No.	Questions
4.	In the past ten years, did you have a device that it was nonfunctional anymore? If yes, for what reason your device did not function?
	1. Did not power on
	2. A part of the device was missing
	3. I am afraid to use it. It is not safe
	4. Button/Buttons did not function
	5. The power cord was worn out
	6. Problems with the software
	7. Problems with the battery
	8. Other
5.	In the past ten years, did you had a device that it was nonfunctional anymore, did you take it for repair? If yes, how much did the repair cost?
	1. It could not be repaired
	2. It cost nothing. It had an active warranty
	3. Less than 20 euros
	4. 21 to 50 euros
	5. 51 to 100 euros
	6. over 100 euros
6.	How much time was your device functional after the repair?
	1. It could not be repaired
	2. Less than 6 months
	3. 6 months to 1 year
	4. 1 to 2 years
	5. 2 to 4 years
	6. Over 4 years
	7. Other
7.	Did you own a device that was nonfunctional and you choose not to repair? If yes, why?
	1. I did not know where to take it for repair
	2. I think that it cannot be fixed
	3. Why bother? I can buy another one
	4. I do not trust devices after repair
	5. The repair procedure is complex and time consuming
	6. The device did not have a warranty anymore, and I had to pay for the repair
	7. The repair cost is high
	8. Other
8.	Do you think that the price you paid for buying a device affect your decision of repairing it? (Yes/No/Do Not Know)
9.	Which of the following do you trust to repair your device?
	1. To the service department of the store that I bought the device
	2. To the authorized service of the company of the device
	3. To a neighborhood repair store
	4. I arrange an appointment with a technician through a web platform
	5. I have a technician that I trust
	6. I repeat it by myself
	7. Other

When asking the responders if they managed to repair their devices and how much did they cost, the majority answered that they could not repair their devices (Fig. 5). However, those who manage to fix their broken devices report that:

- The repair cost ranges from zero euros (due to an active warranty) to over 100 euros for laptops and TVs.
- For tablets, if they can be repaired, the repair costs less than 20 euros.

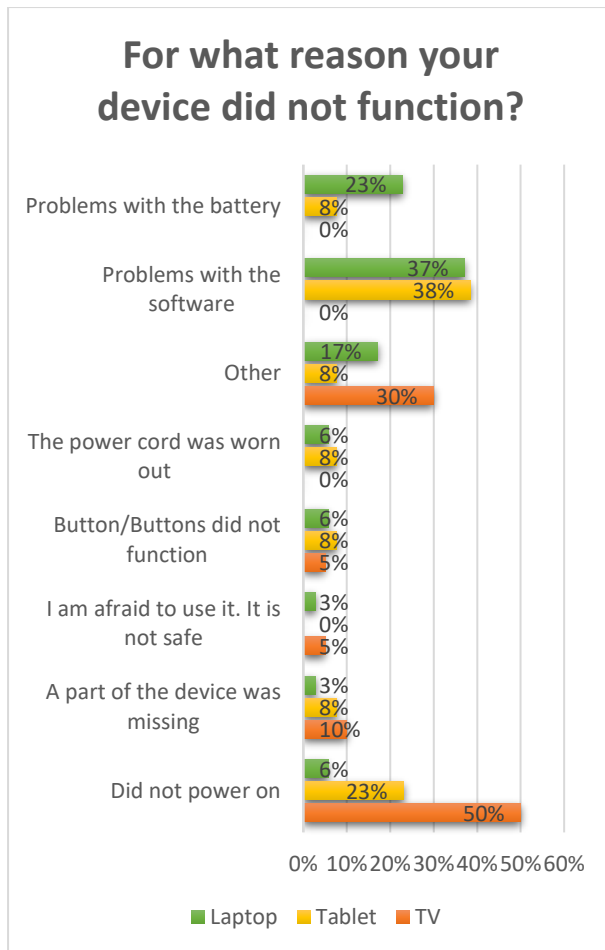


Fig. 4 Reasons making devices nonfunctional.

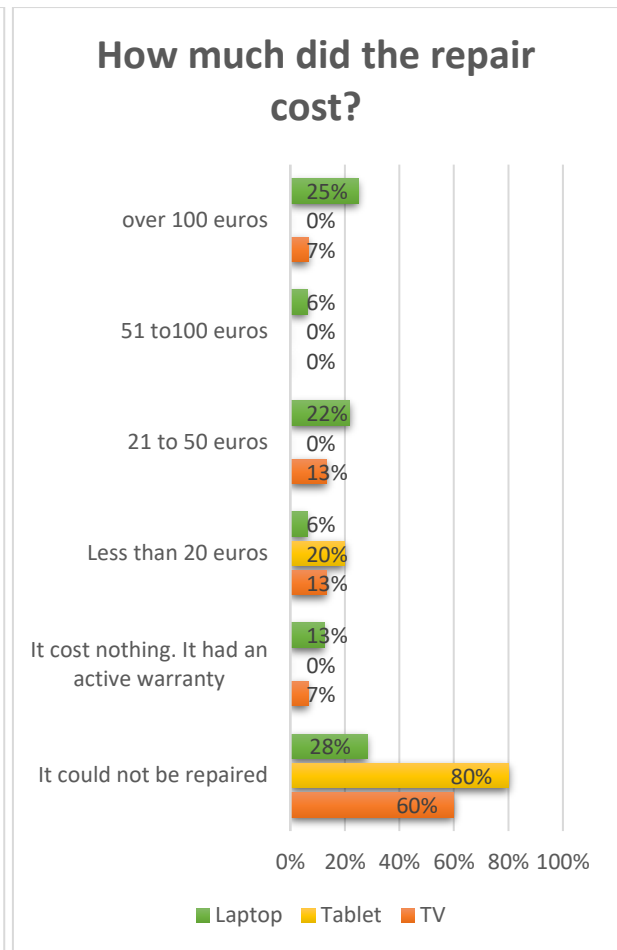


Fig. 5 Repair cost for laptops-tablets-TVs

However, the group of responders that owned a nonfunctional laptop, tablet or TV, driven by the fear of how much may the repair procedure cost («The device didn't have a warranty anymore, and I had to pay for the repair», «The repair cost is high»), decided not to repair their device. In the same group, some responded in order to avoid the repair procedure of a non-functional device, preferred to buy a new one (Fig. 6).

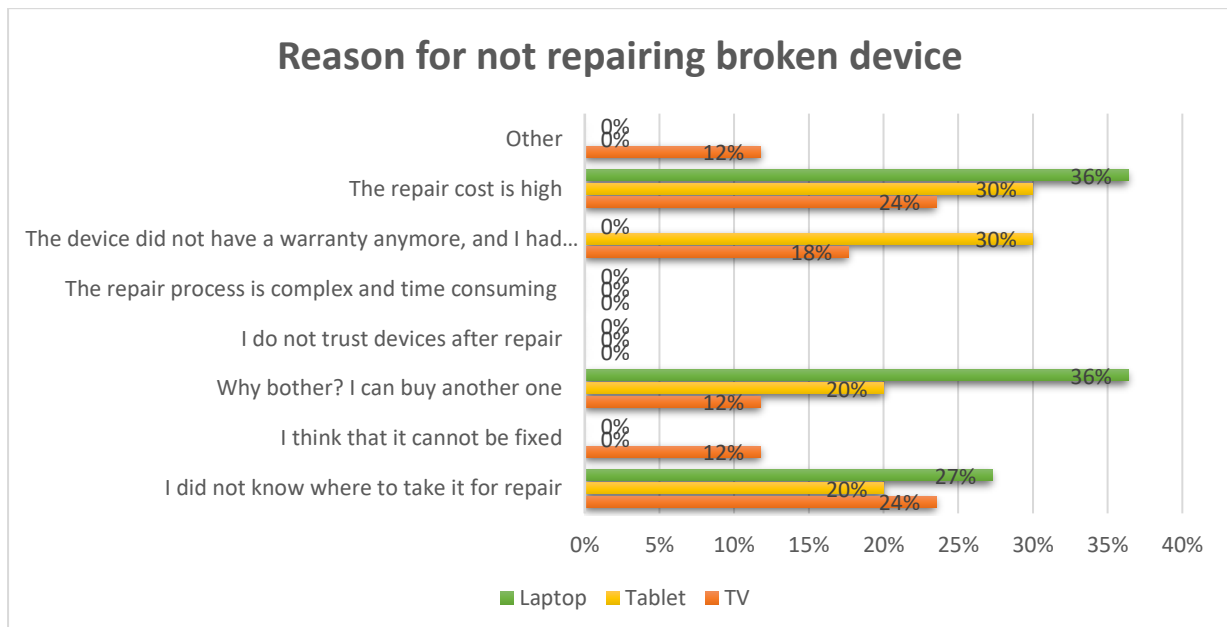


Fig. 6 Reasons for not repairing broken devices

In total, 82% answered that the price they paid for buying a device affects their decision to repair it. When it comes to the repair service they trust, they indicated through their answers the service department of the store they bought the device (34,4%) and the brand's authorized service (32,8%) (Fig. 7).

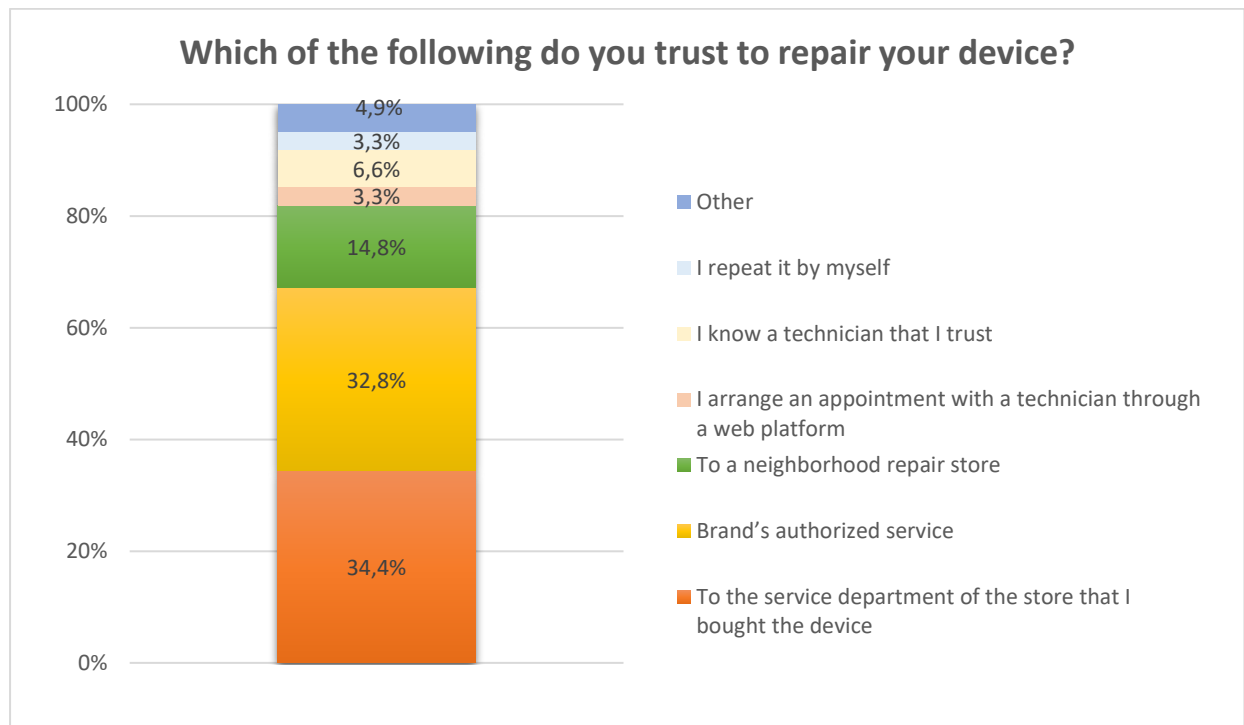


Fig. 7 Categories of repair experts consumers trust the most for repairing devices

The harmful effect of continuous EEE production is unyielding, with the lifespan of products being reduced in response to the demand for continuous innovation and upgrading [2]. The main obstacles to EEE and WEEE repair are often the complex disassembly/assembly, the high repair costs, the time-consuming repair process, the difficulty finding spare parts, and the lack of manufacturer's support regarding repair protocols [1]. Repair of electrical and electronic devices reduces WEEE generation and gives EEE and WEEE a second chance to live. However, sometimes, EEE manufacturers through product design affect the life span and the reparability of their devices leading to limitations and setting an "expiration date" [6], since the benefits of repair and reuse are at odds with their interests [14].

3.4 Consumers' perception about second-hand devices

An overview of Greek consumers' intention to buy and use second-hand laptops, tablets, or TVs manifests a reluctance, but they are not totally against. Justification to this statement is displayed by the percentage of those who would buy and would not buy a second-hand device at all, as long as those who would have a second-hand device only if someone gives it to them for free (which indicated an intention for reuse) (Fig. 8).

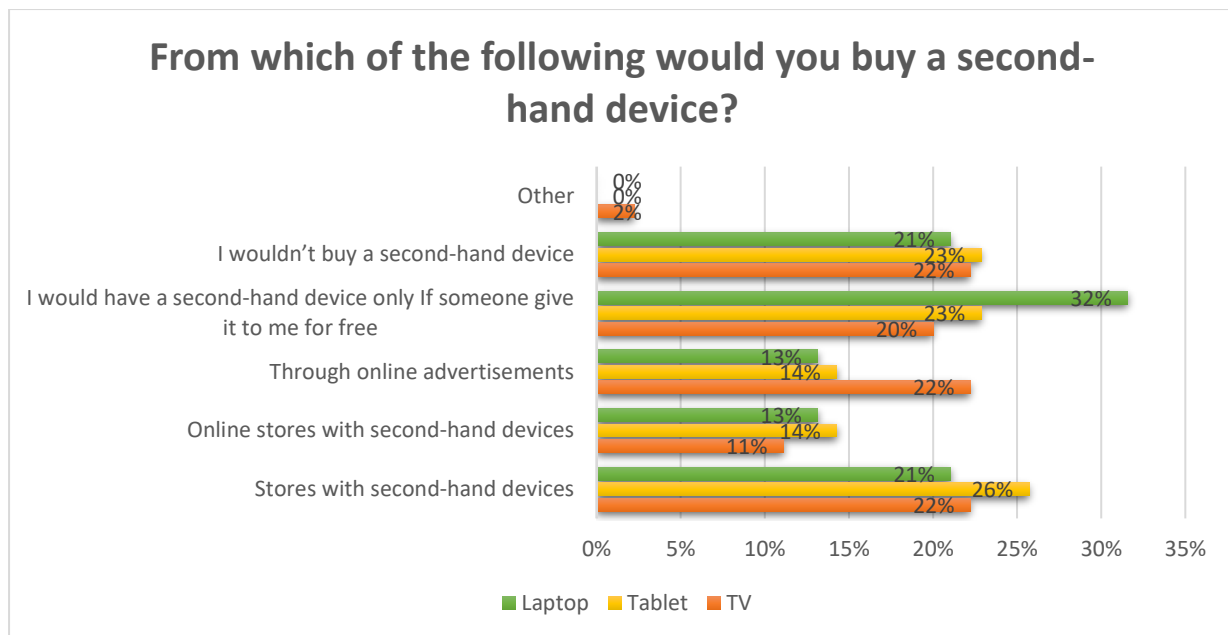


Fig. 8 Second-hand devices purchase source

Table 3

Questions related to consumers' perception about second-hand devices.

No.	Questions
10.	Would you buy a second-hand device? From which of the following sources would you buy it?
	1. Stores with second-hand devices
	2. Online stores with second-hand devices
	3. Through online advertisements
	4. I would have a second-hand device only If someone give it to me for free
	5. I wouldn't buy a second-hand device
	6. other
11.	If you bought a second-hand device, how much did it cost?
	1. Less than 20 euros
	2. 21-50 euros
	3. 51 to 100 euros
	4. 100 to 300 euros
	5. Over 300 euros
	6. I have never bought such a second-hand device
12.	If you had never bought a second-hand device, what reason made you to not buy such a device?
	1. Maybe the last owner wasn't using the device in the right way
	2. Second-hand devices may not function properly
	3. Second-hand devices are defective
	4. Due to reasons regarding hygiene
	5. Second-hand devices are for people that don't have the money to buy new ones
	6. I don't trust the quality of second-hand devices
	7. I don't know where second-hand devices are sold
	8. I trust and I would buy a second-hand device
	9. Other
13.	Which of the following do you think that is prerequisite for you to buy a second-hand device?
	1. Not over a year older
	2. The device has characteristics that mine doesn't have
	3. Is cheaper as second-hand rather than brand new
	4. Knowing the previous owner
	5. Under any circumstances, I wouldn't buy a second-hand device
	6. Other
14.	Which of the following suppliers you would trust to buy a device?
	1. Stores with second-hand devices
	2. Online store with second-hand devices
	3. Online advertisements
	4. I would use a second-hand device only if it was a gift
	5. I wouldn't buy or use second-hand devices under any circumstances
	6. Other

Regarding the following questions about consumers' perception about second-hand devices, responders claim that most significant reasons discouraging them from purchasing second-hand device are their lack of trust in those devices regarding the quality of the device (19,3%), possible misusing of equipment by previous owners that may raise concern (34,4%) and hygiene reasons (23%). In the contrary, when asking responders reasons that make them buy a second-hand device, they claimed that knowing the previous owner (27,9%) and buying cheaper a device as second-hand than band new (50,8%) are significant reason to make them invest in second-hand devices.

3.5 Consumers' recycling behavior

The attitude towards the recycling process plays a crucial role in WEEE disposal. However, when the responders were asked about their recycling activity:

- 10,3% of them answered that in the last ten years had recycled a laptop,
- only 3,4% of them answered that in the last ten years had recycled a tablet,
- 12,1% of them answered that in the last ten years had recycled a TV.

This approach indicates an attachment to the devices since they prefer keeping the old device (functional and non-functional) at home as backup. Equally important, however, is the percentage of the responders that claim that they are having difficulties finding a recycling point (24%).

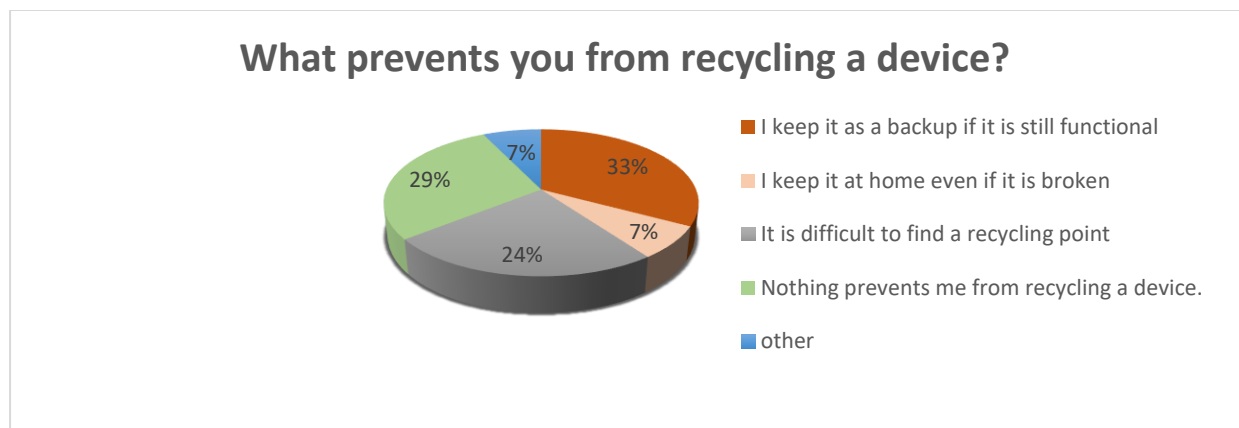


Fig. 9. Recycling barriers

On this point, it should be mentioned that last year, Greece produced a total of 181,000 tons of e-waste (16.9 kg per capita), of which approximately 56,000 tons were collected and recycled. However, the recycling rate in Greece (around 31%) is still below the European average (43%) [16].

Table 4

Questions related to consumers' recycling behavior of mobile phones.

No.	Questions
15.	In the last ten years, have you recycled a mobile phone device? (Yes/No)
16.	What prevents you from recycling a device?
	1. I keep it as a backup if it is still functional
	2. I keep it at home even if it is broken
	3. It is difficult to find a recycling point
	4. Nothing prevents me from recycling a device.
	5.Other

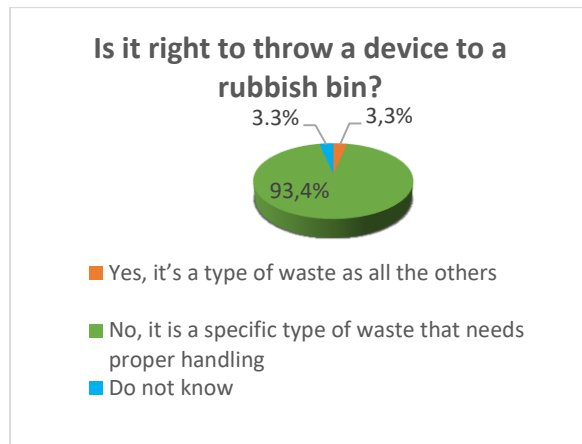
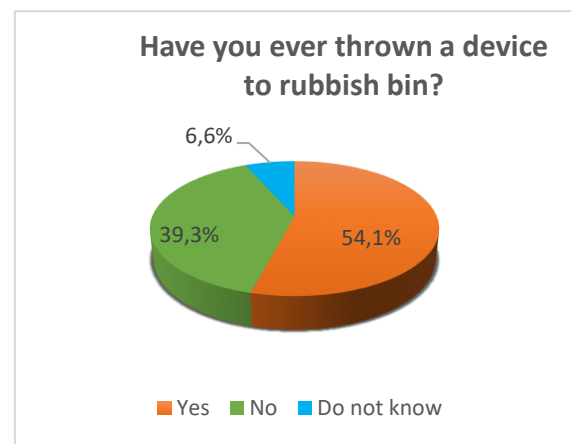
3.6 Consumers' awareness

The final couple of questions of this survey aim to identify consumers' awareness regarding WEEE. The given answers indicate a public well informed about the importance of this particular type of waste stream (93,4% answered that WEEE is a specific type of waste that needs proper handling) (Fig. 10) as well as and the fact of the harmful toxic substances (87%) and the rare earth materials (62%) hidden inside every device. Unfortunately, in practice, the inconvenient truth is that 54,1% of the responders confirmed that they had thrown a device, sometime in their lives, to the rubbish bin (Fig. 11).

Table 5

Questions related to consumers' awareness regarding WEEE.

No.	Questions
17.	Have you ever thrown a device to rubbish bin? (Yes/No/ Do Not Know)
18.	Is it right to throw a device to a rubbish bin? (Yes/No/ Do Not Know)
19.	Do you know that WEEE contain toxic and other harmful substances like lead, nickel, cadmium, etc.? (Yes/No)
20.	Do you know that WEEE contain rare earth and recyclable materials like cobalt, palladium, platinum, etc.?

**Fig. 10** Is it right to throw a device to a rubbish bin?**Fig. 11** Have you ever thrown a device to rubbish bin?

4. Conclusion

It is a fact that in the last 15 years, laptops and tablets have changed the way people work, entertain, communicate and deal with everyday affairs. TVs have transformed into multimedia centers, providing user with endless entertainment opportunities. All these devices have evolved and have been so complex in structure as ever before. Due to the enormous production and consumption of these types of EEE, this paper aimed to gather valuable information regarding Greek consumers' behavior and perception. While environmental awareness is high among Greek consumers, unfortunately, they act in favor of their own. Since 2008, Greece is experiencing an economic crisis that has played an essential role in the daily life of the citizens and certainly has affected the behavior of consumers on many levels.

To sum up, this survey presents a viewpoint of Greek households. Greek consumers tend to keep their old devices at home in case of need, are reluctant towards repair, have mixed feelings regarding using and buying second-hand devices in fear of deception or malinvestment, and their recycling behavior is quite limited. Further studies should be made, hopefully expanded nationwide to achieve in-depth results. However, communication strategies and educational campaigns should continue, encouraging consumers to repair, reuse and recycle their old equipment giving them a second chance to live.

Acknowledgment

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References

Journal articles

1. Bovea, M. D., Pérez-Belis, V., & Quemades-Beltrán, P.: Attitude of the stakeholders involved in the repair and second-hand sale of small household electrical and electronic equipment: Case study in Spain. *Journal of Environmental Management*, 196, 91-99 (2017). doi:10.1016/j.jenvman.2017.02.069
2. Cole, C., Cooper, T. Gnanapragasam A.: Extending product lifetimes through WEEE reuse and repair: Opportunities and challenges in the UK, 2016 Electronics Goes Green 2016+ (EGG), pp. 1-9 (2016) doi: 10.1109/EGG.2016.7829857

3. Corcoran, P., Andrae, A.: Emerging Trends in Electricity Consumption for Consumer ICT, <http://hdl.handle.net/10379/3563> (2013) Access 30 April 2021
4. Cox J., Griffith S., Giorgi S., King G.: Consumer understanding of product lifetimes, *Resources, Conservation and Recycling* 79, 21– 29 (2013). doi:10.1016/j.resconrec.2013.05.003
5. Forti V., Balde C. P., Kuehr R., Bel G., “The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential”, Bonn, Geneva and Rotterdam, United Nations University/United Nations Institute for Training and Research, International Telecommunication Union, and International Solid Waste Association, ISBN Digital: 978-92-808-9114-0 (2020)
6. Guiltinan, J.: Creative destruction and destructive creations: Environmental ethics and planned obsolescence. *Journal of Business Ethics*, 89(SUPPL. 1), 19-28 (2009). doi:10.1007/s10551-008-9907-9
7. Gutiérrez, E., Adenso-Díaz, B., Lozano, S., & González-Torre, P.: A competing risks approach for time estimation of household WEEE disposal. *Waste Management*, 30(8-9), 1643-1652 (2010). doi:10.1016/j.wasman.2010.02.032
8. Martinho, G., Magalhães, D. & Pires, A.: Consumer behavior with respect to the consumption and recycling of smartphones and tablets: An exploratory study in Portugal, *Journal of Cleaner Production*, vol. 156, pp. 147-158 (2017)
9. Mashhadi A.R., Esmaeilian B., Cade W., Wiens K., Wu H., Behdad S.: Mining consumer experiences of repairing electronics: Product design insights and business lessons learned, *Journal of Cleaner Production* 137: 716-727 (2016).
10. Nowakowski, P.: Investigating the reasons for storage of WEEE by residents – A potential for removal from households. *Waste Management*, 87, 192-203 (2019). doi:10.1016/j.wasman.2019.02.008
11. Perez-Belis V., Braulio-Gonzalo M., Juan P., D. Bovea M.: “Consumer attitude towards the repair and the second-hand purchase of small household electric and electrical equipment, A Spanish case study”, *Journal of Cleaner Production* 158: 261-275 (2017).
12. Pessanha, L. P. M., & Morales, G.: Consumer behavior in the disposal of information technology equipment: Characterization of the household flow, 27(3) (2020). doi:10.1590/0104-530x4313-20
13. Wang, F., Huisman, J., Stevels, A., & Baldé, C. P.: Enhancing e-waste estimates: Improving data quality by multivariate input-output analysis. *Waste Management*, 33(11), 2397-2407 (2013). doi:10.1016/j.wasman.2013.07.005
14. Ylä-Mella, J., Keiski, R. L., & Pongrácz, E.: Electronic waste recovery in Finland: Consumers' perceptions towards recycling and re-use of mobile phones. *Waste Management*, 45, 374-384. (2015). doi:10.1016/j.wasman.2015.02.031
15. Zhilyaev, D., Cimpan, C., Cao, Z., Liu, G., Askegaard, S., & Wenzel, H.: The living, the dead, and the obsolete: A characterization of lifetime and stock of ICT products in denmark. *Resources, Conservation and Recycling*, 164 (2021). doi:10.1016/j.resconrec.2020.105117

Online Document

16. Global E-waste Monitor 2020 <https://www.itu.int/en/ITU-D/Environment/Pages/Spotlight/Global-Ewaste-Monitor-2020.aspx> (2020) Access 30 April 2021