EVALUATING MOBILE PHONE REPAIRABILITY IN KERALA

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Abstract

THE E-waste has been increasing day by day, which in turn has a negative impact on our environment and our health. Also to hold the consumer right the Indian government and as well international organization has implemented various measures and laws. Here we evaluate the repairability of mobile phones and how well each popular brand of smartphones can be repaired. In Kerala there are many consumers who prefer to repair their phones rather than buying a new mobile phone. A survey is conducted among several repair persons of different repair shops to obtain the feasibility and cost of repairing each popular brand of smartphones. Moreover, a survey has been carried out among consumers to gather their views on the repairability and the features they desire for prolonged use. By analysing the current state of mobile phone repairability in Kerala, this research can contribute to promoting sustainable e-waste management practices, empowering consumers, and influencing policy decisions. This statement highlights that most repairable issues are related to hardware, which can typically be fixed. While software problems are somewhat fixable, it is important to emphasize that hardware issues are more common and usually repairable. The proposed survey and analysis framework provide a starting point for further investigation and action.

Keywords: Repairability, Mobile phones, Kerala, Consumer rights, Sustainability, Spare parts, Repair infrastructure, Policy decisions.

Introduction

In recent years, the Mobile phone industry has experienced unprecedented growth, driven by rapid technological advancements and changing consumer preferences. It has become an integral part of modern life, offering convenience, connectivity, and efficiency.Some of the major players operating in the market include: Apple inc., LG Electronics, SAMSUNG, HTC Corporation, Motorola Mobility LLC, Xiaomi,Vivo,Oppo,Realme.

The consumers are given large choices of smartphones ranging from low spec , middle spec and to high spec mobile devices. So there is a large chance of consumers replacing the smartphone earlier if a problem arises or its performance deteriorates the consumers may replace the devices. Also with the average lifespan of electronic devices decreasing and the rate of product obsolescence accelerating, there is a pressing need to shift towards a more repair-centric approach to electronics consumption.

The importance of repairability cannot be overstated,With the e-waste management problem rising in India especially regions like Kerala where it is densely populated ,the implementation of disposal of the e waste is difficult.

We explore the concept of repairability in consumer electronics with repairability and its significance in India. Repairability refers to the ease with which electronic devices can be repaired, maintained, and serviced throughout their lifecycle. It encompasses various factors, including design considerations, access to spare parts, repair infrastructure, and consumer empowerment.

The repairability of smartphones consist of mainly two types : hardware and software repair. The consumers visit the repair shops mainly when problems in hardware components arise. Also the company owned or authorized repair shops charge almost double the cost of repairing in third party repair shops.

The right to repair law in India and other international law helped in aiding the repairability of the electronic devices. This proposed a right to repair framework, aiming to empower consumers by allowing third-party repairs for electronic devices, including smartphones without any manufacturer or technical restrictions. The idea behind this concept

is to render electronics easier and cheaper to repair with the goal of prolonging the life cycle of such devices and reducing electronic waste caused by broken or unused devices.

Through an interdisciplinary analysis of the data collected we can conclude about the repairability of each brand of smartphone and the quality of repairability with each year progressed.

Technical challenges of repairing a smartphone

Design of electronic components. The densely packed electronic components in a smartphone affects the complexity of repairing . Also its modularization (where the smartphone components can be independent and interchangeable.) and how it's fixed like fasteners or adhesives.

Availability of the components. The availability is affected by the manufacturer's choice. The manufacturer may not avail the components to independent repairers. Also, the manufacturer may discontinue the components.

Repair manuals and tools or knowledge. The manufacturers provide or withhold the manuals or guide from the third-party repair person. Also, the tools and knowledge of know-how is also a factor.

Understanding whether the phone is repairable or not depends on the customer's knowledge. The device may be repaired depending on the perspective of the consumer whether the device is repairable or not

Objectives of study

Assess the Current State of Repairability:

- Evaluate the repairability of popular smartphone brands available in Kerala.
- Identify common issues faced during the repair of these devices.

Consumer Preferences and Behaviours:

- Understand consumer preferences regarding repairing versus replacing mobile phones.

- Analyse the demographic factors influencing repair decisions among consumers in Kerala.

Economic and Technical Feasibility:

- Determine the cost-effectiveness of repairing popular smartphone brands.

- Assess the availability and accessibility of spare parts and repair services in Kerala.

Impact of Legislation and Policies:

- Examine the influence of the right to repair laws and other regulatory frameworks on repair practices.

- Analyse the effectiveness of these laws in promoting repairability and reducing e-waste.

Repair Infrastructure and Industry Practices:

- Survey the repair infrastructure in Kerala, including both authorized and third-party repair shops.

- Evaluate the quality and reliability of repairs conducted by different types of repair shops.

Consumer Awareness and Education:

- Measure the level of awareness among consumers about repair options and their rights under the right to repair laws.

- Identify gaps in consumer knowledge and suggest strategies to enhance awareness and empowerment.

Technical Challenges and Solutions:

- Identify the primary technical challenges encountered in repairing smartphones.

- Propose solutions and design recommendations to improve the repairability of future electronic devices.

- Highlight best practices and design features that enhance or hinder repairability.

Recommendations for Stakeholders:

- Provide actionable recommendations for manufacturers, policymakers, and repair service providers to enhance the repairability of mobile electronic devices.

- Suggest strategies to foster a repair-friendly culture among consumers and industry stakeholders.

Significance of the study

For a variety of stakeholders, this study on the repair ability of mobile electronics in Kerala is highly valuable since it encourages sustainable e-waste management, which lowers electronic waste and supports environmental conservation. By strengthening their rights and knowledge, it gives customers more power and allows them to make well-informed decisions about fixing their gadgets, which lowers costs and increases the lifespan of electronics. Insights from the study will help legislators develop and execute strong right-to-repair legislation, supporting efforts to increase repairability and lower e-waste. By recognizing and resolving their issues, it helps small-town repair companies financially and may even spur industry expansion. In addition, it provides manufacturers with suggestions for design enhancements that increase mobile device repairability, promoting an industry that is more repair-friendly. Through increasing knowledge about the financial and ecological advantages of fixing gadgets, the research fosters a sustainable mindset among customers and business stakeholders. In terms of Kerala's capacity to repair electronic devices, its overall goals are to significantly advance sustainable development, consumer empowerment, and efficient policy making.

Literature Survey:

1.Technological Developments and Design Considerations:

- Modular design has come to light as a viable means of improving repairability, as it permits the replacement of specific parts without requiring a whole disassembly. Research on the advantages of modular structures in lowering maintenance time, cost, and environmental effect has been done by authors such as Johnson and Brown(2020).
- A lot of literature has been written about the need of repair-friendly characteristics, such readily replaceable parts, accessible fasteners, and standardized connectors. Green et al. (2018) found that design decisions impact repairability results and customer experiences, highlighting the relevance of user-centric design principles.

2.Environmental Consequences and E-waste Handling:

- Scientists have explored on how fixing things can help reduce the amount of electronic waste created and encourage buying products that has less impact on the environment. By 2017 study done by Jackson and Smith showed how a culture focused on repairing can make electronics last longer and also lessen their effect on the environment.
- Methods for evaluating the environmental impact of electronic devices throughout their entire life cycle, from the mining of raw materials to their final disposal, have

been studied. These methods or process known as Life Cycle Assessment (LCA) techniques, have been applied in studies such as Lee et al. (2019) to evaluate the environmental benefits of designs that can be repaired and to helps to make better decisions.

3.Consumer Rights, Policy Initiatives, and the Regulatory Frameworks:

- There has been an up voice in action around the "right to fix" drive, pushing for decides that would enable the buyers to fix their own gadgets or fixed by another substance like outsider fix shops. Patel and Jones (2018) have analysed the legitimate and administrative structure for right to fix regulations, featuring both the open doors and difficulties looked by those pursuing these arrangement choices.

- The administrations and global entities have made moves through the presentation of eco-accommodating marking programs, expanded maker obligation (EPR) drives, and administrative measures. Concentrates by Wang et al's. (2019) work which assesses the viability of these approaches in advancing roundabout economies and supportable techniques for dealing with the electronic waste.

4.Economic Considerations and its Business Strategies:

- The financial aspects of repairability have drawn revenue from researchers and industry partners the same, with concentrates on taking a gander at the expense suggestions, market elements, and plans of action related with repairable items. Kim and Lee (2020) led an examination of the financial practicality of buyers deciding to fix versus supplant an item, representing factors like fix costs, item life expectancy, and resale esteem.

- Manufacturers and also service providers or vendors have answered purchaser interest for repairable items by giving fix administrations, spare parts, and maintenance agreements. Chen et al. (2019) made findings on the essential ramifications of repairability for organizations, including brand notoriety, client steadfastness, and edge in edge in competition.

Methodology

Research Design

To find the repairability of mobile electronic gadgets among customers in Kerala, this study uses a quantitative research approach. The data is then analysed and comprehend the viability, expense, and general repairability of well-known smartphone brands.

Population/Sample

The repair technicians and consumers make up the study's population. Stratified sampling was employed to choose the number of respondents in order to guarantee representation across types of people, including preference, age. Furthermore, repair businesses were selected to offer technical insights degree of repairability of smartphones.

Data Collection Methods

A two separate questionnaire survey was used to gather data from the chosen sample of repair personnel and customers. Multiple-choice questions is created for the repairability-related topics, including repairing costs, simplicity and ease of repair, availability of replacement parts, and satisfaction with repair services, were also determined included in the questionnaire.

Factors Measured

Statistic Factors: age gather, Sex.

Repairability Factors: Ease of equipment repair, ease of computer program repair, accessibility of save parts, taken a toll of repairs.

Customer Conduct Factors: Recurrence of repair vs. substitution, mindfulness of right to repair laws.

Specialized Factors: Commonly repaired components, normal repair times, victory rates of repairs.

Discernment Factors: Fulfilment with repair administrations, discernment of repair fetched vs. substitution taken a toll, seen life span of repaired gadgets.

Measurable Examination Strategies Utilized The collected information was subjected to an assortment of factual procedures, such as:

Expressive Insights, which was utilized to summarize statistic characteristics and overview reactions;

Chi-square Test for Autonomy, which was utilized to discover connections between categorical factors, like age bunch and inclination for repair over substitution;

Likert Scale Examination, which was utilized to gage the degree of understanding or difference with articulations with respect to repair fulfilment and seen repairability;

Relapse Investigation, which was utilized to examine the impacts of different components, just like the accessibility of save parts and repair costs, on buyer fulfilment and repair choices.

These strategies were utilized to meet the study's goals and offer bits of knowledge into the repair prepare.

Information translation:

The measurable examination revealed many basic connections between distinctive factors and repairability of smartphone in Kerala. The revelations are presented underneath nearby comparing visual charts:

1. **Age and Repair Awareness (Customers):**

- This indicating a significant relationship between age and repair awareness (p-value = 0.0292 < 0.05). Older customers tend to have higher repair awareness compared to younger ones.
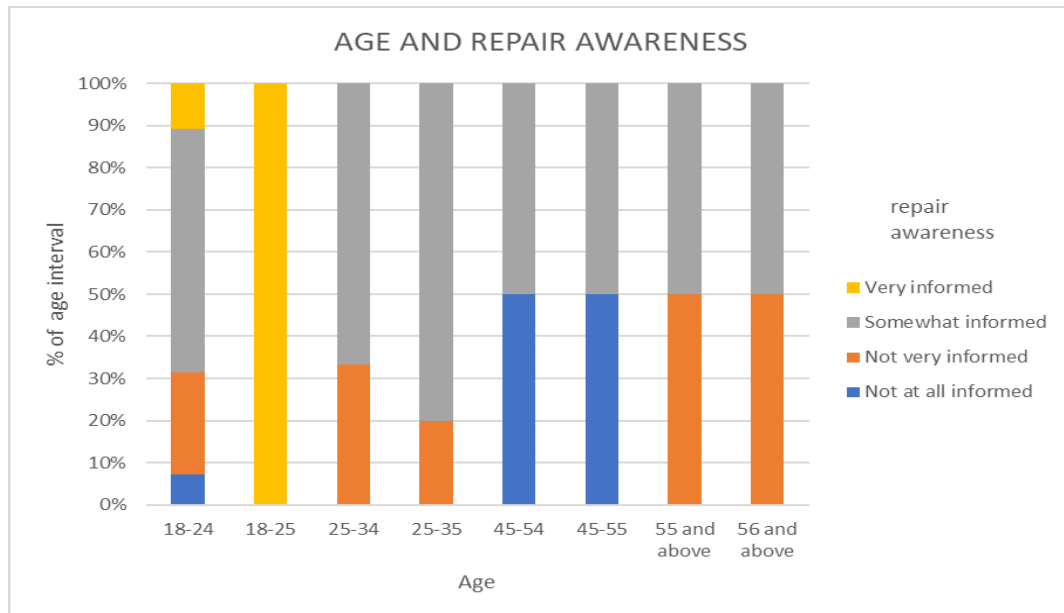

2. **Repair Experience and Repair Decision (Customers):**

- Indicating a significant influence of repair experience on repair decision (p-value = 0.0003 < 0.05). Customers with prior repair experience are more inclined towards choosing repair over replacement.

Repair awarness and repair awareness
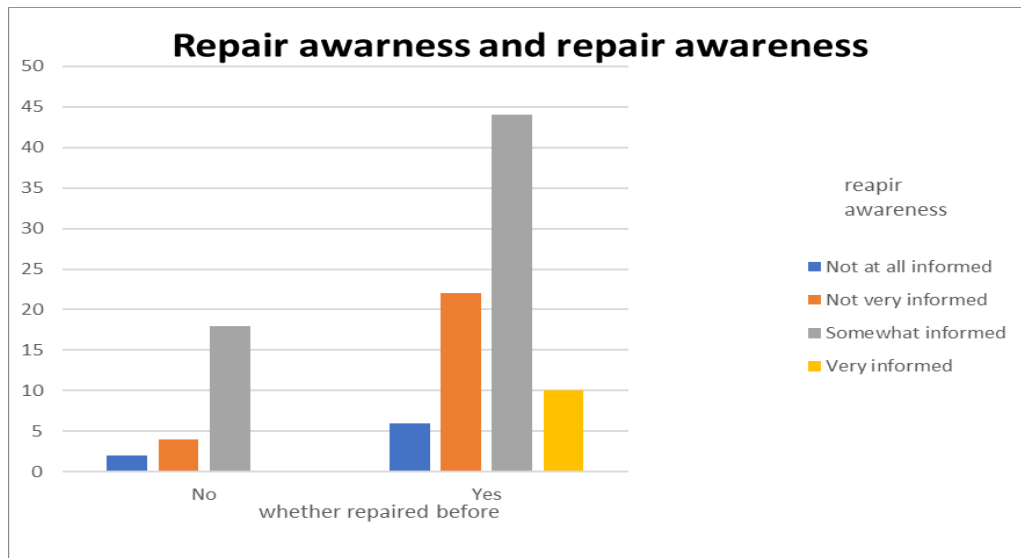
3. Preference for Future Repairability Features (Customers):
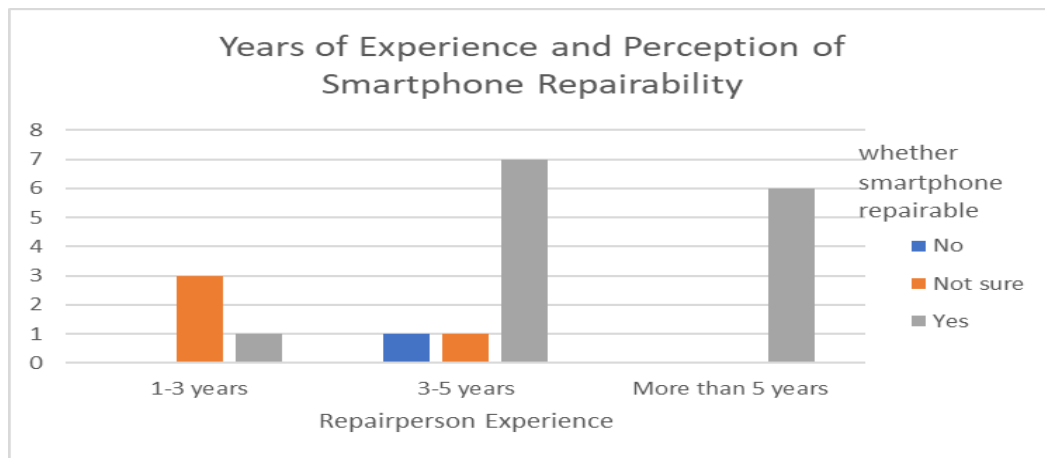
- Indicating a significant relationship between desired repairability features and prioritizing repair over replacement (p-value = 1.8651e-06 < 0.05). Customers expressing preferences for repairable features in future smartphones are more inclined towards prioritizing repair over replacement
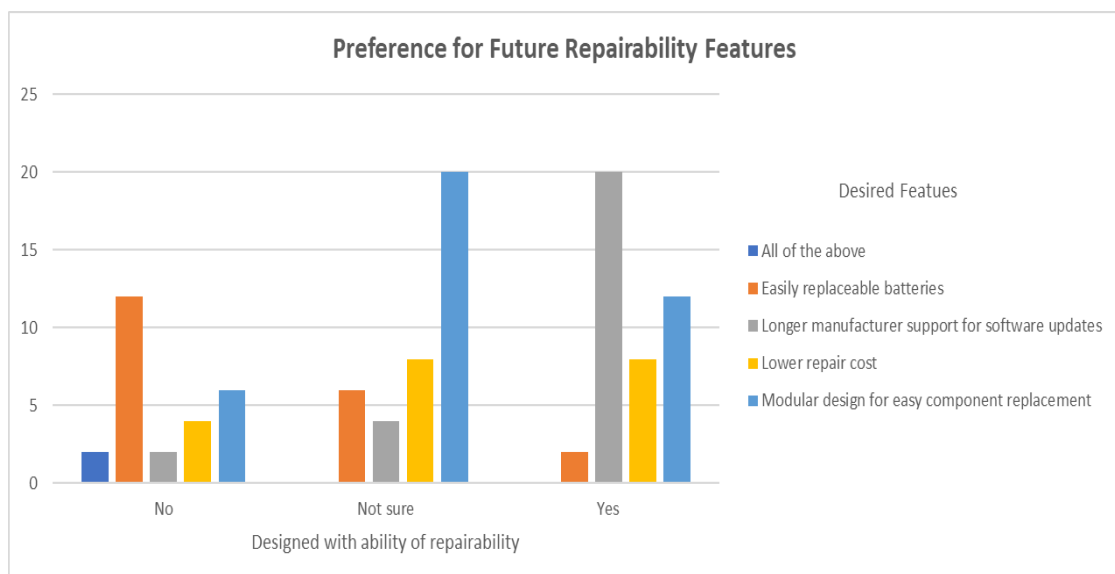
**4. Years of Experience and Perception of Smartphone Repairability (Repair person):**

- Indicating a significant relationship between years of experience and perception of smartphone repairability (p-value = 0.0372 < 0.05). As individuals gain more

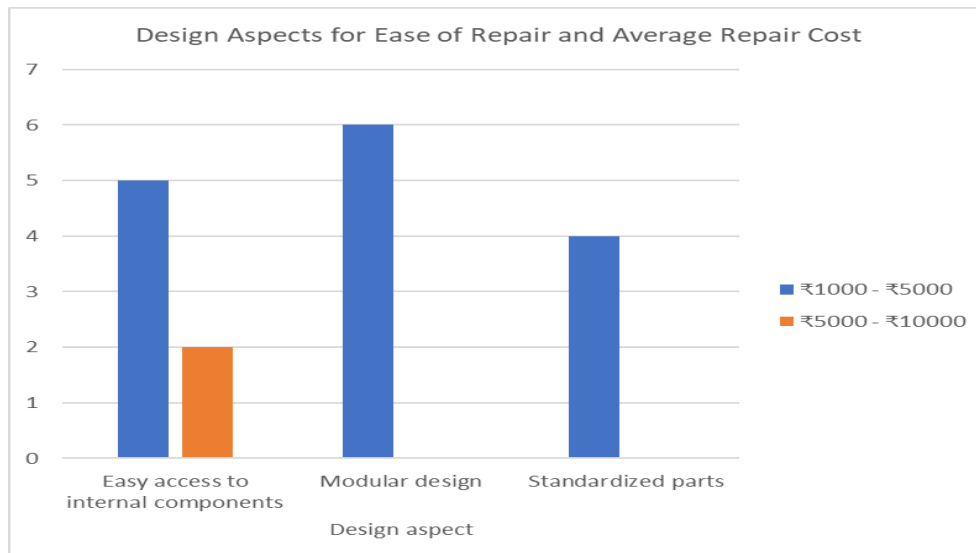experience in repairing smartphones, their perception of repairability may become more critical or refined.

Years of Experience and Perception of Smartphone Repairability

5. **Guidance to Customers and Average Repair Cost (Repair person):**

- Indicating a significant relationship between providing guidance to buy new smartphone to customers and the average repair cost (p-value $= 0.0104 < 0.05$). The repairperson guides the customer on buying new smartphone depending on the repair cost.

Guidance to Customers and Average Repair Cost
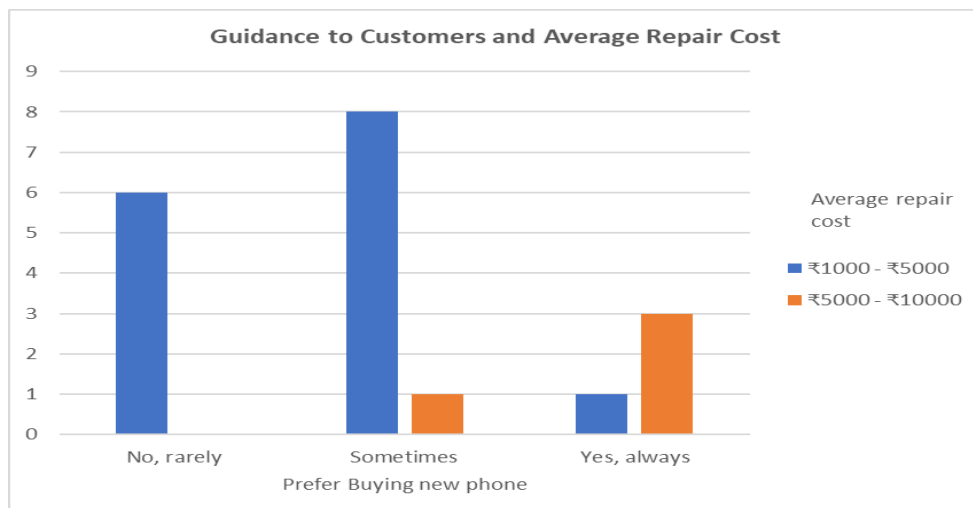
6. **Design Aspects for Ease of Repair and Average Repair Cost (Repair person):**

- Indicating a significant relationship between design aspects for ease of repair and the average repair cost (p-value $= 0.0154 < 0.05$). Smartphones with repair-friendly designs may incur lower repair costs due to easier access to components or simplified repair procedures.

Design Aspects for Ease of Repair and Average Repair Cost

Legend:
- ₹1000 - ₹5000
- ₹5000 - ₹10000

X-axis: Design aspect (Easy access to internal components, Modular design, Standardized parts)

Comparison with other regions:

1.European Union:

• Measured Phones and Repairability:
Through the Right to Repair regulation and the Eco Plan Command by the European Union there has been on the verge in advancement of the repairability methods. A study in 2021 by Cordella et al. which find the durability and repairability of smartphones in European regions discovered that independent designs promote repairability and lower e-waste. This can almost certainly can contributed with the positive experiences fruitful into how decision-making frameworks can influence the selection of repair-friendly programs and helps its people.

2. United States:
Across the Joined together States, the Correct to Repair movement has acquired a considerable measure of noteworthy, with Massachusetts in front of equipping the method for enactment identifying with the required repairs and pieces of data that manufacturers needs to offer to buyer and free repair shops. The newcomers Johnson and Brown (2020) have acknowledged in a think about that these laws have helped to improve repairability and cut maintenance costs for consumers.

3.China:

• Fabricating and Repair Environment:
China as a country with a widespread gadget manufacturing industry contains a rather peculiar repair landscape with numerous casual repair market vendors. In a meditative work by Liu et al. (2019), it raises awareness towards these markets to understand how these

markets are effective for repairability and e-waste management in the urban zones. The discoveries indicate that casual repair systems can indeed increase the longevity of portable communication gadgets, particularly the versatile phones, and decrease e-waste proportionately.

4.Australia:

• Buyer Attitudes and Repair Hones:
In Australia, shopper state of mind with regards to reparability and utilization of repair administrations has been dispensed with. Green et al., while assessing, revealed that the plan choices taken together influence repairability outcomes and engagement with clients, stressing the need for user-oriented plan frameworks in advancing repairability.

5. India:

• Neighbourhood Repair Hones and E-Waste Administration:

Considerations on India's neighbourhood repair hoses can help develop insights on how social and economic factors in repairability. In a consider by Prabhu and Majhi (2023), Indian versatile phone trade appears to be sustainable by swapping out of date Valuable instruments but with the need to implement repair-friendly plans to depreciate e-waste.

Studies on the assembling of portable modest telephones in Kerala show the significance of restoring practices inside the general environment and the effect of this contraption on the general affiliations of maintainability. This paper also includes a self assessment of its feasibility and cost of repairing brands of smart mobile phones popular in kerala by the help of four different persons of different categories of repair shop. It can thus be seen from the above study that consumers opt for repair of their phone in Kerala than buying new phones mainly due to economical and environmental reasons.
The dominance of at-home repairs is probably fuelled by economic considerations such as cost of renewal/repair. The findings of the survey indicate that Rip off third-party service centres in Kerala provides substantially lower charges compared to company-owned or approved service centre. This is made possible by the fact that prices of products are relatively cheaper, thus making more consumers lean towards repair cost than replacement cost. Also, having our phones repaired locally there are several benefits like creation of employment for people and the promotion of local business that focuses on the repair of mobile phones.
Technologically, repair means choosing the environmentally friendly option by avoiding the creation of more electronic waste. This practice is very helpful especially in regions with high population densities such as the south Indian state of Kerala wherein proper e-waste disposal remains problematic. Consumers' awareness and understanding of selective repair contributions will be improved when products are designed with repairability in mind.

The study highlights the challenges and a call to manufacturers to please design phones with easily replaceable parts, and indeed the fasteners should be easily accessible to the

independents. The influence of the right to repair laws in India and other international regulations on the repairability of electronic devices is also highlighted. These laws empower consumers by allowing third-party repairs without manufacturer restrictions, promoting longer device lifespans and reducing e-waste. The right to repair movement is gaining traction in India, with increasing awareness and advocacy for policies that support repairability. This movement aligns with global trends and regulatory changes aimed at making electronic devices more repairable and sustainable.

In doing so, the research offers an overview of global trends in relation to repairability and e-waste management, and how Malayalam praxis of repairing domestic electronics in Kerala fits into the global framework, while respecting the socio-economic and environmental context of India.

Recommendations

For Manufacturers:
Adopt Modular Designs: It means easy and cheaper repair works and, therefore, should be facilitated.
Provide Repair Manuals and Tools: It is important to support third-party repairers as they struggle to gain access to the required resources.
Design for Longevity: Concentrate on the development of products that have a long service life, but are connection with their modules that can be easily replaced by the buyer.

For Policymakers:
Support Right to Repair Laws: Some of those reforms included: Implement and enforce regulations that protect consumers and third-party repairers.
Promote Consumer Awareness: Some of the suggestions to be put in place include the following campaigns aimed at informing the consumers on their rights and available options as far as repair is concerned.
Encourage Sustainable Practices: Promote more repairs by encouraging manufacturers to produce products that can easily be serviced and reducing the incidences of e-waste.

For Repair Service Providers:
Enhance Technical Training: There should be adequate training for repair technicians in order to enable them satisfactorily meet any of the repair challenges.
Maintain High Service Standards: Develop a strategy that should involve offering quality and affordable repair services that will in the end make the consumer place his/her trust in the enterprise.
Advocate for Fair Pricing: Tackle or avoid issues that make repairs expensive and thus ensure a large number of consumers prefer to repair the damaged items.

Conclusion

The study conducted in Kerala on the repairability of mobile electronic devices has brought to light a number of important findings about customer behaviour, the viability of repairs technically, and the general sustainability of repair procedures. Due to financial constraints and environmental consciousness, the data shows that consumers significantly prefer to fix their smartphones rather than replace them. Important elements impacting the repairability of different smartphone models were found to include the accessibility of replacement components and the simplicity of hardware and software repairs.

Additionally, the study emphasizes on how right-to-repair laws empower consumers and improve the repairability landscape. The results indicate that, while customer satisfaction levels are similar between authorized repair centers and third-party repair shops, third-party repair shops offer competitive and frequently more affordable repair services.

Based on the modularity and design of smartphone components, technicians observed varied degrees of repair complexity, with certain brands being easier to fix than others. Targeted awareness efforts are important since statistical analysis showed substantial connections between consumer preferences for repair over replacement and demographics characteristics (e.g., age and gender). Overall, this research contributes valuable knowledge to the ongoing discourse on electronic device repairability, emphasizing the need for manufacturers to adopt more repair-friendly designs and for policymakers to continue supporting right-to-repair initiatives. Promoting repairability not only aids in reducing e-waste but also empowers consumers to make more sustainable choices, ultimately benefiting both the environment and the economy.

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