With financial support from the European Commission

Investigation into the repairability of Domestic Washing Machines, Dishwashers and Fridges

Contents

1. Introduction

The current pace of our society's consumption is increasing our demand for finite raw materials and creating an enormous waste problem. Factors contributing to this overconsumption include latest fashion trends, but also the *increasing* difficulties encountered in maintaining or repairing our products[1]. In the case of electric and electronic equipment (EEE), the inability to extend a product lifetime through repair results in a tremendous waste of resources, materials and energy which went into the production of that appliance and decreases its durability[2]. This also has a marked negative impact on the reuse and repair sector[3] which plays an important role in our economy and society, which includes the involvement of social enterprises[4]. A product designed for easy repair is a big step to improving resource and material efficiency of Energy Related Products covered by the Ecodesign Directive.

In 2014, implementing measures[5] for three key Energy Related Products will be revised, namely domestic fridges, washing machines and dishwashers. As such RREUSE has conducted an investigation into some of the main obstacles its members encounter when repairing products in these three categories. Whilst qualitative in nature, it is hoped this information will be useful for any potential preparatory studies for these three product categories and provide part of the basis for setting requirements within implementing measures to improve the reparability of products, and thus their material and resource efficiency.

2. Methodology

In June 2013, a questionnaire was sent out to members of the RREUSE network that work in the field of preparation for reuse[6] and repair of domestic fridges, washing machines and dishwashers. For each product category the following questions were asked:

1. What are the main causes of breakdowns

2. What are the main obstacles you encounter when trying to repair the appliance

3. Would you have any suggestions about how better product design would make it easier for you to repair these appliances?

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[1] e.g. COOPER, T. 2010. *Longer Lasting Products: Alternatives to a Throwaway Society,* Surrey, Gower Publishing.

[2] *the ability of a product to maintain its functions over time and the degree to which it is repairable before it becomes obsolete (JRC, 2012,* Integration of resource efficiency and waste management criteria in the implementing measures under the Ecodesign Directive*).* In other words, a product should not cease to function after relatively little usage and its reparability should not be hindered by its design.

[3] MCCOLLOUGH, J. 2009. Factors impacting the demand for repair services of household products: the disappearing repair trades and the throwaway society. *International Journal of Consumer Studies,* 33**,** 619-626.

[4] Many social enterprises use the economic activity of reuse and repair in order to provide job and skill opportunities for people distanced from the labor market

[5] Mandatory requirements in the form of regulations that determine the minimum requirements for a product or product group *http://www.eup-network.de/background/glossary/*

[6] checking, cleaning or repairing recovery operations, by which products or components of products **that have become waste** are prepared so that they can be re-used without any other pre-processing (EU Waste Framework Directive)

In total, RREUSE received responses from 9 individual reuse and repair centres from four national networks of social enterprises namely AERESS (Spain), Repanet (Austria), Réseau Envie (France) and the Furniture Reuse Network (UK).

The results provided in this paper are qualitative in nature but provide a good basis for highlighting how product design can influence the reparability of products and what potential measures could be introduced within Ecodesign implementing measures in order to improve the reparability of these products. The detailed findings can be found in the Annex of this document.

3. Summary of Findings and Conclusions

3.1. Key obstacles to the repair of fridges, dishwashers and washing machines

Rapid change of product design and difficulty in access to spare parts

Rapid changes in product design and components are hampering repair efforts often without any perceived notable changes in functionality. A lack of interoperability of key components across different brands and even within brands is making repair more difficult. When replacing an electronic board for example, it must be from the same make and model of the original appliance.

The cost of spare parts may also far exceed production costs. For example retail prices of timers for dishwashers are often much higher than production costs, but are critical components of the appliance. The length of time that spare parts are available to purchase also significantly impacts the potential repair of a given product. In addition, sometimes only a full set of spare parts can be purchased when only a single part is needed.

Increasing lack of access to repair and service manuals, software and hardware for reuse and repair centres

Repair and service manuals used to be widely available from the manufacturer to reuse and repair centres. Today, however, approved reuse and repair centers/networks often have to pay high prices for this information if they are not the direct after sales service providers of the manufacturers. In addition, large household appliances are now often fully operated by electronic control boards. If there is a problem, the appliance can be hooked up to a laptop using relevant hardware and tested with fault diagnosis software. However, this software and hardware is often only available to the after sales service providers of the manufacturers and not to all approved reuse and repair centres/networks. Lack of access to such tools and information significantly hinders repair.

Increasing difficulty to disassemble products for repair

Increasing difficulty in separating individual components from the casing or in accessing key parts in the interior of appliances hinders replacement and repair and therefore renders many appliances without reuse potential. For example if you cannot open the outer case of a product without breaking it, then you completely lose any reuse potential.

All the above issues result in repair activities being very costly, resulting in a high rate of direct replacement with a new model.

3.2. Suggested horizontal measures within Ecodesign Implementing Measures

1. The product should be able to be disassembled non-destructively into individual components and parts without the need for special proprietary tools to do this. If special tools are required however, these must be readily and freely available to all approved reuse and repair centres/networks (not just to the after sales service providers of the manufacturers).

2. The availability of replacement parts must be guaranteed for a minimum period of 10 years following the last product batch.

3. Free of charge access to repair service documentation of the after sales service providers of the manufacturers for all reuse and repair centres, together with any relevant fault diagnostic software and hardware [7]

4. Simplification of specific components and potential standardisation of certain components across different brands would significantly increase the efficiency of repair as it would allow greater interoperability of components across different machines

4. Further Thinking

RREUSE aims with these case studies to give impulse for further investigation in other appliance categories to identify possible specific product category measures which will

[7] Points 1-3 in line with the Austrian Durability Mark for Electrical and Electronic Appliances designed for Easy Repair - ONR 192102

ensure ease of repair as well as application of the above horizontal measures. Whilst the case studies presented in this paper are reflections of experts active in repair from the social economy, it may be useful, for example, to provide a deeper statistical and quantitative analysis concerning the most common reasons for the breakdown of these product categories to highlight further hotspot issues. It is hoped that the issues raised here will be taken on board during the creation of the preparatory studies.

Annex 1: Case Study A. Domestic Washing Machines (ENER LOT 14)

1.1. Examples of common causes of break downs

Respondents to the survey highlighted a number of reasons that they feel are responsible for the breakdown of washing machines.

Concerning the durability of components, many washing machine shock absorbers cannot withstand 1600 rpm for a long period of time and wear out quickly. Ball bearings which were designed for washing machines which centrifuge at 300 rpm are also often used in today's washing machines which operate at 1000 or 1200 RPM, which also leads to quick degradation. In addition, it can happen that the bearings can get pressed into the plastic outer casing of the washing machine drum and stops the drum from rotating, which can also deform or even break the drum spider.

The seals of the pumps which are made out of rubber degrade quite often and this can easily block the pump. Finally, the membrane of pressure switches (pressostat) can degrade over time which leads to the washing machine to take on more water than it is originally designed for.

Other key problems included:

- The heaters can stop working prematurely, especially in regions with hard water (high lime content), often due to a lack of yearly maintenance of the machine

- The electronic steering components linked to the timer can fail, which is a problem as it is increasingly difficult to identify the problem. These problems were not encountered in the past when the steering mechanisms were primarily mechanical.

- Faults relating to the interlock

1.2. Common obstacles in repairing washing machines

1.2.1. Lack of access and cost of spare parts

Respondents noted a lack of access to spare parts both from the point of view of their availability and price. For example, when ball bearings are pressed into the plastic casing of the drum, in order to replace them, not only do these have to be replaced but also at least part of the casing. However, in many cases reuse and repair centres are forced to purchase the complete casing including the drum which is very expensive, which makes it uneconomic to repair the machine.

Replacement costs of the electronic card and timer are very expensive as one needs exactly the same component from the original manufacturer in order to repair a washing machine. Whilst reuse centres can repair the appliance using tested salvaged components from obsolete machines, stocking up key used spare parts such electronic boards, timers and pumps is very difficult due to the sheer volume of different types of makes and models of products on the market.

1.2.2. Lack of access to service manuals, software and hardware

In order to repair washing machines nowadays one needs to have the exact documentation, service manuals and relevant software and hardware to diagnose the faults of the product. These are difficult to access for reuse and repair operators that are not official after sales service providers of the manufacturers.

Today's increasing use of electronic instead of mechanical components means that one can often only identify the problem with the appliance by attaching it to a laptop using special hardware and using fault diagnosis software. Use of these tools requires training and are often only available to the after sales service providers of the manufacturers which makes repair of washing machines for reuse centres often impossible due to a simple lack of information.

1.2.3. Examples of design that hinders disassembly for repair:

Control board: Finding the defect in the electronic board is becoming increasingly difficult, especially if some boards are sealed with resin. This means that electronic board components which are most known to fail the quickest can often be very difficult to access and replace.

Door Hinges: Door hinges that are fused to the washing machine are extremely difficult and time consuming to replace due to accessibility

Repairing the **drum spider, seals, bearings and drum casing** is often impossible, especially if the bearings are forced into the 'plastic' outer casing of the drum. This is especially because of the price needed to replace these components (See 1.2.1) and also because there are some instances where the drum casing is impossible to open as it is physically sealed.

1.3. Suggestions to help improve reparability of domestic washing machines

1.3.1. Design for disassembly for repair

The product should be able to be disassembled non-destructively into individual components and parts without the need for special proprietary tools to do this. If special tools are required however, these must be readily and freely available to every repair shop (not just to the after sales service providers of the manufacturers). For example seals on electronic boards should be easily removable for repair of the electronic board and the casing of the drum must be able to be opened.

1.3.2. Potential standardisation of components and availability of spare parts

Simplification of specific components as well as the potential standardisation of key components across different brands would significantly increase the efficiency of repair. This could include, for example, the rubber tubes or sealants, especially for the drum shaft.

The availability of replacement parts must be guaranteed for at least a period of 10 years following the last product batch and not at a prohibitive price.

1.3.3. Improved durability of components

Increasing the durability of parts that are known to get damaged easily such as the bearings and shock absorbers can significantly prolong the lifetime of a product. Further examples of parts which wear out easily and need to be more durable are the drum shaft seals and door hinges.

Concerning motors, choosing a motor known to not degrade too quickly as for example brushless motors or single-phase motors would also help prolong the lifetime of a washing machine, although it is recognized that these are more expensive and less commonly used motors nowadays than AC motors with carbon brushes.

1.3.4. Access to service manuals, software and hardware

Free access to repair service documentation of the after-sales service providers should be provided for all approved reuse and repair centres together with any relevant fault diagnostic software.

1.3.5. Protection of electronic and mechanical components

Construct electronic boards to be protected by fuses. In addition a fuse should be included at the input of the device to protect the electronics from power surges.

Annex 2: Case Study B – Domestic Fridges (ENER LOT 14)

2.1. Examples of common causes of break downs

The most common problems that were raised concerning fridge break downs were problems with the thermostat sensor and the electronic circuit board. In addition, issues with the compressor are quite common, as the valves are often not strong enough or the compressor can become burnt due to a lack of internal thermal protection.

Other common causes of breakdowns included leaks in refrigerant fluid, blown out resistors (10k) and breaks/cracks in the rubber seals of the doors.

2.2. Common obstacles in repairing a refrigerator

2.2.1. Lack of access to spare parts and costs of spare parts

The electronic boards in particular are subject to rapid changes in design and often very expensive to replace and extremely difficult to find spare parts. One has to buy exactly the same component for that make/model which increases the price. Finding the right type of rubber sealants for a specific appliance and replacing them is also difficult. Often reuse and repair organisations try to salvage components from an obsolete appliance in order to repair one with potential reuse value. However this requires a lot of work and not all parts are recoverable from old appliances. For example rubber sealants and thermostats can hardly be gained from old appliances whilst at least handles and shelves are easily removed.

2.2.2. Examples of design that hinders disassembly for repair

Separating individual component parts from the casing of the fridge has been noted as a problematic design feature in view of repair. For example, the controller keypad is more often being built into the door. Furthermore replacing the resistor can be very difficult due to its location within the fridge which can make it impossible to access.

The tubes through which the refrigerant gas flows (refrigerant/evaporator coil) are increasingly integrated into the cabinet of the appliance itself which can make it impossible to locate (internal) leaks. This can be a hazard to organisations both repairing and recycling fridges. If it is impossible to diagnose the leak it can be impossible to repair the fridge.

Problems also occur when repairing problems with the rubber door seals. Increasingly, the rubber seals on the doors are also fused together (irremovable) so it is impossible to replace them and one needs to replace the whole door. There are, however, models where the seals are easily removed and can be replaced.

Lastly the use of proprietary screws and fixings, requiring specialised tools poses a great problem for disassembly if these are only available to the after sales service providers of the manufacturers. For example one needs specific tools for diagnosing and handling fridges together with the appropriate qualifications to work with refrigerant fluids especially R134a. One also needs to have the appropriate hardware for mechanical connections (Lokring ®) if the circuit is loaded with R600a (flammable fluid).

2.2.3. Lack of access to service manuals, software and hardware

A general issue is a lack of availability concerning technical information of the components and parts of each individual brand as well as their compatibility to be used across different brands. This is mostly due to a lack of access to specific documentation of the after sales service providers of the manufacturers for third party reuse centres and repair shops. For example thermostat sensors in one fridge will not necessarily be compatible with another, and knowing such information is crucial to the repair of the appliance.

Because of a lack of access to information relating to changes in fridge design and servicing/repair it is becoming uneconomic to repair them, resulting in a waste of embedded materials, chemicals and energy if having to then dispose of the appliance.

2.3. Suggestions to help improve reparability of domestic fridges

2.3.1. Design for disassembly for repair

The product should be able to be disassembled non-destructively into individual components and parts without the need for special proprietary tools to do this. If special tools are required however, these must be readily and freely available to every repair shop (not just to the after sales service providers of the manufacturers). Design for better disassembly could include:

- Rubber seals on doors must be easily removable and not physically sealed to the frame in order to easily replace them

- Design components such as the gas coil thermostat to be easily replaceable. Do not integrate the refrigerant coil into the casing of the fridge, making it impossible to remove. In addition, putting valves on the cooling circuit would make it easier to recharge the cooling fluid following a leak.

- Screws and fixings must be possible to be removed without the need for special proprietary tools

2.3.2. Potential standardisation of components

Simplification of specific components as well as the standardisation of key components across different brands would significantly increase the efficiency of repair.

Examples could be to unify the references and dimensions of spare parts to increase compatibility: starting relays, heating resistors (no-frost), gas thermostats, NTC, door gaskets, drawers and shelves

The availability of replacement parts must be guaranteed for at least 10 years following the last product batch and not at a prohibitive price.

2.3.3. Access to service manuals, software and hardware

Provide free of charge access to service manuals, documentation, fault diagnosis software and hardware to all approved reuse and repair centres/networks, not only those of the after sales service providers.

2.3.4. Further suggestions

Make the input and output tubes to/from the compressor in such a way as not to allow oil to get trapped and unable to return to the engine.

Lastly adequate insulation and protection for the internal motor should be provided. In addition one could also install voltage limits at the input of the device to protect the electronics from power surges.

Annex 3: Case Study C: Domestic Dishwashers (ENER LOT 14)

3.1. Examples of common causes of break downs

- Motor break down: This is often caused by the use of low quality rolling element bearings instead of plain bearings. In addition, if there is water leakage from the seals of the water pump, the leakage causes oxidation, flooding and / or the activation of the security sensor, but also the eventual oxidation of the plain bearings.

- The pump can break down as water can leak from the pump seals due to low quality joints and / or their bedding.

- Timer break down: If the timer is mechanical, a breakdown is caused due to the wearing out of the cams and contacts. In case of an electronic timer, it is due to the breakdown of an individual component.

- Problems with the electronic board: These are often caused by the lack of current and voltage protectors that protect sensitive electronic components. Furthermore the electronic steering components linked to the timer can fail, which is an issueas it is increasingly difficult to identify the fault. These problems were not encountered in the past when the steering mechanisms were primarily mechanical.

- The hoses can become damaged because of excessive heat due to the proximity of the hoses to the resistor or because of the poor quality of the tubes used.

3.2. Common obstacles in repairing dishwashers

3.2.1 Lack of access and cost of spare parts

The entire replacement price of replacing a new motor, pump and electronic board is often too high and prohibits repair. In addition, the retail prices of components such as pumps can be extremely high compared to the cost of production and yet they play a critical role in the functioning of the machine.

The rapid change of component design is making it difficult for reuse centres to stock up with the parts needed for repair especially in the case of motors and electronic boards. For example dishwasher trays and accessories are often very difficult to replace because their designs vary significantly from model to model

For older machines in need of repair, sometimes the spare parts are simply not available from the manufacturer anymore.

The main problems are the mechanical timers and electronic circuit boards, as for these you need a specific replacement part. The costs of the electronic circuit board are too high and you need specific ones. It is difficult to stock up on these items from older machines as one needs the specific design.

3.2.2. Lack of access to service manuals, software and hardware

In order to repair dishwashers nowadays one needs to have the exact documentation, service manuals and relevant software and hardware to diagnose the faults of the product. These are difficult to access for reuse and repair operators that are not official after sales service providers of the manufacturers.

Today's increasing use of electronic instead of mechanical components means that one can often only identify the problem with the appliance by attaching it to a laptop using special hardware and using fault diagnosis software. Use of these tools requires training and are often only available to the after sales service providers of the manufacturers which makes repair of dishwashers for reuse centres often impossible due to a simple lack of information.

3.2.3. Examples of design that hinders disassembly for repair:

Respondents noted that access to product interior and separation of individual components can be difficult. For example**,** the casing of the dishwasher is becoming increasingly difficult to open in order to access the internal components. This is especially true in the case of opening the casing at the bottom of the machine to access the internal components as it can be extremely time consuming, and one has to turn the machine on its side which is not easy. In addition, the internal components cannot be accessed and removed easily e.g. heating resistors are fastened and must be physically broken due to space restrictions as well as the use of clips. Some respondents noted that access to internal components is in general more difficult on a dishwasher than a washing machine.

The large number of different models and levels of performance of components make it difficult to interchange components across different machines even from the same manufacturer

It is often difficult to diagnose the problem, especially if the problem is a result of washing use and testing for problems is time consuming. This can be for example due to the inaccessibility of certain components within the dishwasher.

3.3. Suggestions to help improve reparability of dishwashers

3.3.1. Design for disassembly for repair

The product should be able to be disassembled non-destructively into individual components and parts without the need for special proprietary tools to do this. If special tools are required however, these must be readily and freely available to every repair shop (not just to the after sales service providers of the manufacturers). Design for better disassembly could include:

- Making the casing of the appliance in such a way that it can be easily and quickly opened, especially the bottom- would help facilitate easy access to the internal components.

- Designing the internal component structure in a way that would facilitate easy removal and separation of components would be very helpful e.g. the heating resistor should be easily accessible in order to be able to remove limescale.

- Regarding the motor, it should be able to be easily separated from the pump in order to change the damaged part whilst at the same time maintaining the operational part of the pump

3.3.2. Potential standardisation of components

Standardisation of critical component design such as timers and electronic boards would help to enhance ease of replacement and thus repair. Electronic boards are very fragile and only a specific and identical component can be used as a replacement for a given make or model of a dishwasher.

In addition, critical components such as timers, pumps and motors should be available at a reasonable price. Better qualityseals on the motor would make them last longer.

3.3.3. Access to service manuals, software and hardware

Provide free of charge access to service manuals, documentation, fault diagnosis software and hardware to all reuse and repair centres, not only those of the after sales service providers

Who we are

The Reuse and Recycling EU Social Enterprises network (RREUSE) is a European umbrella organisation for national and regional networks of social enterprises with re-use, repair and recycling activities. Approximately 42,000 Full Time Equivalent (FTE) employees and over 200,000 volunteers work throughout our 22 member organisations across 12 EU Member States. Although structures and national contexts are diverse, RREUSE members share common elements such as the protection of the environment, the fight against poverty and, especially, the progress of disadvantaged people back into the labour market. RREUSE's main goal is to put sustainable development into practice by encouraging job creation and social inclusion in the field of waste prevention and sustainable waste management activities.

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