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Repair research revisited. Bridging socioeconomic and epistemological perspectives

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Abstract

Repair research is an emerging research topic. Even though it has become popular due to its key role in the CE paradigm and its potential for sustainability, it was already a subject of academic research in a body of literature referred to as 'Repair Studies'. While CE approaches emphasize socioeconomic aspects of repair, 'Repair Studies' has developed a sound research body on the nature and properties of repair which draws mostly from philosophy, ethics, anthropology and sociology. In this research piece we argue that both approaches are not exclusive but rather complementary. While the more eclectic approach of 'Repair Studies' offers a great conceptual and theoretical foundation for analysing repair; the socioeconomic approach emphasises the pragmatic implications of repair and its role in socioeconomic and productive systems. Both approaches compliment each other as the former lays the conceptual foundations and the latter offers the empirical observations and evidence to sustain the promotion of repair as a key element in present and future sociotechnical systems.

Introduction

Repair is a key component of the Circular Economy (CE) paradigm and it is present in most CE conceptualisations often inside the broader category of reuse practices (i.e. Ellen McArthur Foundation, 2015; Blomsma & Tennant, 2020; Stahel, 2013; Kirchherr et al., 2023). Interest in repair has been rising steadily often tied to the debate around the Right to Repair (R2R), which has been debated at the national and international stages and has even materialised into specific regulations (i.e. López-Bermúdez & Vence, 2024, 2025; Puentes, 2024).

The economic relevance of the debate around repair transcends the immediate preocupation with environmental concerns, central to the debate of the CE, and actually reaches into core aspects that define the socioeconomic system as a whole. The debate around repair becomes inane if these elements are not taken into consideration. These include, among other, strategies of planned obsolescence and design decisions at the firm level that discourage repair. These have become key traits of the current production-consumption system and the accumulation system that it fuels (Vence, 2023). In the case of repair of Information and Communication Technology (ICT) in particular, which is the one we are going to focus in this paper, its key role in mediating in human interactions also points to the importance of repair regarding its ability to actually exert societal control over their ICT stock. Additionally, repair cannot be understood without also taking into account the legal framework around the production-consumption sytems and in particular the role of intellectual property, both key aspects of the current socioeconomic architecture (Dalhammar et al., 2023; Nogueira, 2024). In its systemic role repair has been noted to be a fundamental tool for maintaining infrastructures and keeping up operations (Cohn, 2017; Graham & Thrift, 2007) while also been noted as a key source of inspiration for innovation and creative solutions (Jackson, 2014).

All this leads us to inquire about the epistemological aspects regarding repair: what is the stage of repair research? To answer the research question, this paper explores the more relevant literature, identifying distinct schools and tracing its connections through the assessment of the concepts reflected in them.

Socioeconomic studies of repair

Even though repair has been addressed as part of the circular economy, there has been little attention paid to the socioeconomic nature and properties of repair. Often the economic properties of repair are assumed, yet very rarely tested or examined empirically.

Regarding the aggregate economic role of repair Vence and López Pérez (2022a) have noted that repair and maintenance activities represent 7,83% of the total census of firms and 3,21% of the total labour force in Mexico (taking into account only the formal sector of those activities). The sectoral analysis of repair activities has also addressed the popular claim regarding labour intensiveness of repair activities, observing empirically that reuse activities tend to be more labour intensive than their linear counterparts (Llorente-González & Vence, 2020; López-Bermúdez & Vence, 2023). In terms of labour creation potential of repair, it has been noted that in the US 2,5% of all employment created directly and indirectly in the electric sector is related to repair and maintenance (Haerer & Pratson, 2015).

Repair has also been noted to be countercyclical, with firms using repair and maintenance expenditures as substitutes for investments and also maintenance and repair expenditures even slowing down productivity in some industries due to decaying infrastructures (McGrattan & Schmitz, 1999). This, in turn, provides empirical support to the claims regarding the structural role of repair in most economic operations (Graham & Thrift, 2007; Cohn, 2017). Local analysis circunscribed to specific places have shown how repair activities and emerging technological networks create economic feedbacks between them, particularly in the Global South (Jackson et al., 2012).

Regarding management of the value chain/supply chain of repair activities some authors have identified the main actors as producers, retailers, network providers, repair services, second hand sellers and accessory producers/retailers, yet little contact exists between producers and repairers, since parts must be bought for the most parts from third party retailers (Türkeli et al., 2019). Repair has also been addressed as a circular business model (Watson et al., 2017).

Nonetheless, most analysis of repair have been circunscribed to firm or consumer approaches regarding barriers or price considerations, with little to no attention paid to the overall impacts of repair in the economy as a whole. This constitutes a fundamental gap in the research on repair.

Repair in repair studies

The interest on repair has been twofold: Academic interest in repair began outside the field of economics and only later on became popular as part of the broader circular economy concept. While the former took a more nuanced approach and emphasized repair as a key element in human-technology interactions and as a fundamental component of operations (Graham & Thrift, 2007); the latter took a more utilitarian approach to repair as another element of the circular economy (Ellen MacArthur Foundation, 2015). Both approaches developed in parallel without much exchange between them. While the utilitarian approach got mixed in the broader circular economy research, the more nuanced approach got informally referred to as repair studies. In this section we explore the notion of repair developed in repair studies from the fields of sociology, ethnography and technology studies.

Repair in this framework does not have a technical definition but rather focuses on the empiric realities and consequences of repair in the real world. Rosner & Turner (2015) conceptualize “repair as the process of sustaining, managing, and repurposing technology in order to cope with attrition and regressive change”. This introduces technology and adaptability and presents repair as a dynamic process rather than a static one. Sennett (2012) in Aas-Ahnfelt (2016) mentions that repair is “making an object seem just like new, improving its operation, or altering it altogether”. Contrary to technical definitions, repair can change or even

improve the object. The broader nature of the term repair is also mentioned. “Repair is a useful concept from a sustainability perspective because, like sustainability, it can relate both to fixing material (garments) and non-material (industry practices and values)” (Bennet, 2012, p. 9). It is no longer tied to materials, but also values and practices, thus tying it to the realm of values.

This broad consideration of repair which exceeds the strictly physical is also addressed by Lepawsky et al. (2017), which consider repair in a spatial way, recognising repair as one spatialized notion. This can include the repair of natural stocks and resources and of landscapes but repair can also tackle science itself as “it was foundational to imperial, colonial, and capitalistic practices of extracting value from the Indigenous periphery for the colonial centre” and the creation of adequate repair spaces in the form laboratories may contribute to correct these issues. This broad notion of repair is strongly connected to the notion of care (Eisler, 2008).

Graham & Thrift (2007) initiated what in their own words was “the resurrection of the activities of repair and maintenance in the social sciences”. They analysed repair and maintenance from the Heidegger’s perception hypothesis: the world of things is but a background that becomes noticeable only when it fails and must be restored. Today, the material background in which our lives are inserted is bigger and more complex and intertwined than ever before due to the amount of energy being used (Common & Stagl, 2008). In this background ICT equipment is becoming predominant, not necessarily in terms of raw weight which is also increasing (Eurostat, 2019), but also in importance due to the key mediating role that they play in everyday life. As a result, the process of wear has not reduced, on the contrary, it has sped up in many cases; as proven by the increasing amounts of waste (Bakker et al., 2014; Oeko-institut, 2019).

The restorative potential of repair means that it can help sustain socioeconomic systems by keeping them intact and by preventing catastrophic collapse. Jackson (2014) following this argumentation proposes ‘broken world thinking’ as a thought process that proposes “erosion, breakdown, and decay, rather than novelty, growth and progress as our starting points in thinking through nature”. Broken World Thinking proposes a way of looking at sociotechnical systems not through the lens of growth and novelty but through the lens of contesting decay and circumventing it. This implies thinking upon innovation as creativity to sustain value or repurpose it, rather than create something new. This emphasizes the role of entropy in our lives, against which we ought to fight continuously. To Jackson, repair can be seen as:

> The subtle acts of care by which order and meaning in complex sociotechnical systems are maintained and transformed, human value is preserved and extended, and the complicated work of fitting to the varied circumstances of organizations, systems, and lives is accomplished. (Jackson, 2014, p. 222)

Repair does not simply restore, it is also an adaptability tool. It enables reproducing technologies in the face of changing contexts. This definition already addresses repair as a form of care. This is in fact a common element to most repair studies: repair is understood as a form of caring for the material world.

Care has historically been associated with interpersonal relations in the private or family sphere. In recent years care has been experiencing a conceptual expansion, becoming a framework and inspirational principle for broader societal and economic processes (Eysler, 2008; Chatzidakis et al., 2020; The Care Collective, 2021). Repair can be seen as a form of care for the physical world, which involves nature and the environment but also and most importantly societal systems (Eisler, 2008). Repair as a form of care permeates, either implicitly or explicitely repair studies. To Jackson (2014, p. 231) “[repair and maintenance are] in fact a very old but routinely forgotten relationship of humans to things in the world: namely, an ethics of mutual care and responsibility”. To Graham & Thrift (2007) “the city is able to reproduce itself because of

never-ending activities of repair and maintenance, which are not just incidental but provide a good part of its dynamic".

Cohn (2017) mentions caring as an intrinsic principle in operations. Technology has two main processes, design and operations. Design, or development, is based around planning, anticipating problems and trying to create something resistant and lasting, even though the world of design has experienced a profound shift due to planned obsolescence, as noted by Packard (1960). Design takes place in industrial contexts.

In contrast, operations, which refers to the process of testing and dealing with that technology on the field involve dealing with unexpected problems, inevitable decay or unforeseen systemic consequences. This implies a process of fitting. Operations are contingent and take place locally, involving repairing and maintaining. Repair is a form of reproductive work applied to technology. In the context of a space mission, which is used as a showcase, it is noted that:

> The changeover of personnel from development to operations on the Mission is also gendered in that this changeover comprised a male attrition from top roles which have mostly been taken over by women. This leads to a feminization of operations work which likely contributes to its marginalisation. In this sense operations acts as a form of reproductive labour in that it continues to accrue success to the mission's designers even as it is seen as merely maintaining the status quo. (Cohn, 2017, p. 10)

Both dimensions, design and operations, are noted to be largely disconnected from one another to the point that specific identities have to be created to try and link between them, like DevOps in the context of software engineering. In Cohn's (2017) research, feminization of operations work contributes to its invisibility. The notion of invisibility is often associated to repair. Graham & Thrift (2007), Jackson (2014) and Denis & Pontille (2017) all refer to repair as invisible work, which Leigh-Star & Strauss (1999) use to refer to work that due to its nature receive no to little attention and statues, particularly when taking into account the actual importance of that work. Reproductive work is a paradigmatic example. Repair is often invisible work that holds economies and societies together, for example, through repair and maintenance of capital and infrastructures. Denis & Pontille (2017) noted the role of repair in transport and telecommunications infrastructures, constantly tackling wear and defects to avoid them piling up to cause collapse. Visible repairs have a more open character and are conceived for novelty, adaptation and diversity. Other forms of repair may be rather visible, they argue, as they may be conceived to ensure adaptability and novelty to extend the useful lifespan of objects.

In some socioeconomic contexts, repair and maintenance are key to sustain production and communication systems and are crucial for creating and sustaining technological networks, especially in places outside distribution channels where there is little buying capacity. Jackson et al. (2012), Houston et al. (2016), Houston & Jackson (2016) noted how in Africa repair and maintenance help keeping an incipient technological network in working order. Repair and maintenance in the sense of tinkering ought to keep equipment in working order often bypassing obsolescence locks that were conceived for industrial countries and that make little sense in developing ones.

Programmed obsolescence, unrepairable designs, legal previsions that impede the process of repair… the privation of users from sovereignty over their things and the institutional arrangements that discourage repair and reuse can be seen as forms of carelessness in the context of human-things interaction. Repair can be considered a form of care for the material world (Jackson, 2014; Graham & Thrift, 2007) and, consequently, a form of care for one another through the things that mediate in our relations, from infrastructures to conveniences. Repair and maintenance permeate our presence in the material world and sometimes even our ideologies (Lepawsky et al., 2017; Eisler, 2008). Thus, repair as care connects with the idea of shifting

economics towards restoration and slow metabolism rather than growth and expansion which are drivers for resource depletion and enablers of capitalism.

Finally, while repair can be considered a form of direct care for the material world, it can also be considered indirectly a form of caring for other people due to the role of repair in sustaining technology and the key role of technology in mediating in our everyday interactions. Physical objects, despite having often been considered outside the scope of human ethics, are in fact inseparable of them due to its mediating role in our social interactions (Verbeek, 2011; Forlano, 2017; Corwin & Gidwani, 2021). Never has this been this true as it is in the case of ICT equipment. Since ICT mediates almost all of our interactions and is the means by which we can actually interact with the world and lead our lives; sustaining these objects and their accompanying infrastructure is more than simple care for the material world but actually a form of sustaining human life. The recent collapse of the Spanish energy infrastructure exemplifies perfectly the risks of letting a key system disappear, which more than an economic branch in the production system is key for human survival.

The repair environment

Repairs can take place in various contexts, where the fundamental distinction lies on its placement regarding the market. Repair can be performed by a single individual as a way to overcome a failure or correct a defect. This we could call self-repair and it takes place outside the market. Strongly related to self-repair is community repair. Community repair involves the provision of repair services outside the market. They do not involve a commercial relation, there is no fiduciary exchange and hence they take the form of non-capitalist interactions, even though there may be multiple participants and specialists involved. Community repair is often associated with activist movements where ideals about sustainability, justice or sovereignty over societal stocks drive either repairers, consumers or both; but it can also involve convenience on the part of the participants (Aas-Ahnfelt, 2016; Cole & Gnanapragasam, 2017). Some of the most popular community repair initiatives include Repair Cafes or the iFixit platform. These types of initiatives are very well known, yet their presence is very territorialized and often circumscribed to metropolitan environments in the Global North (Lepawsky, 2020).

Besides community repair there is also commercial repair. Commercial repair involves the provision of professional repair services by firms or individuals at either shops or on location. Commercial repair is done in a market context where there is a fiduciary exchange. We can further distinguish two basic forms of commercial repair: formal and informal. Informal repair is particularly popular in parts of the world where the economic conditions favour the emergence of significant informal economies, this form of repair takes place outside the fiscal and regulatory framework and hence is not present in the official statistics (see Vence & López Pérez, 2022a; Houston, 2019; Houston & Jackson, 2016). Formal repair, on the other hand, is done under the fiscal and regulatory framework, which means that repairers and firms declare and charge taxes and its economic information is collected in the official statistics. Formal repair can be further distinguished into two main branches: repair performed by independent repairers and repair performed by the official repair services of manufacturers. Independent repairers often embody the values of tinkering, innovativeness and overall Broken World Thinking often associated with repair processes (Jackson, 2014; Riisgard et al., 2016). Official repair services are done by either the manufacturers or the sellers themselves or by repair services that enjoy special contracts and agreements with the manufacturers and are hence forced to adscribe to their rules to operate (Houston & Jackson, 2016). Manufacturers' involvement in the repair market is not new (Orr, 1996; McGrattan & Schmitz, 1999). In the context of the circular economy, manufacturers may encounter incentives to get involved in an emerging repair market as a form of post sale services, which would be a form of servitization (Pereira, 2023).

Research on repair

As we have seen, there have been several forms to approach the study of repair. One of the main ones we have deemed repair studies. They approached the study of repair from a sociological and anthropological perspective and addressed its structural role in societies at large (see for instance Graham & Thrift, 2007; Graziano & Trogal, 2017 & 2019). Additionally, repair has also been addressed as part of the circular economy, in what some authors deem in a utilitarian manner (see for instance Niskanen et al., 2021). Little exchange has taken place between both branches researching on repair and so repair in the context of the circular economy has barely been studied from a socioeconomic perspective but mostly from a business perspective.

Regarding the different research approaches to repair we have seen that their focus has also differed. While repair studies address repair in more infrastructural contexts (Graham & Thrift, 2007; Denis & Pontille, 2017), research on the subject of the circular economy has almost exclusively addressed consumer goods and mostly from the perspective of the demand of the service. This approach to repair is mostly neoclassical in nature, since the focus is on the demand side, while the offer is considered to be selfadapting. A sensible assumption, despite ignoring the actual complexity of socioeconomic systems and the interests of corporations, pressure groups, lobbies as well as path-dependencies from past technological developments and innovations.

The dichotomy between repair and replacement, which is at the core of the discussion about prices, is also a very recent historical phenomenon. For most of our history replacement was not always feasible and goods were used until no longer repairable. In the developing world, extending the lifespan of products through several forms and rounds of maintenance and repair is still a priority (Patwa et al., 2021). Even in developed economies the culture of repair never fully disappeared. Consumeristic societies thrived alongside strong repair services (Krebs & Hoppenheit, 2022; Packard, 1960) and even today capital goods and infrastructures are being constantly maintained and repaired not only to prevent collapse but because these practices can be more economically sound in the long run (Sandborn et al., 2011).

Today, mass production and availability of cheap resources turned replacing more economically attractive and even more convenient than repairing. This was the result of a systemic process in which manufacturers exploited the economies of scale available in a globalized production system, being able to minimize its costs per unit, while showing complete disregard for the depletion of resources (Malik & Lan, 2016). This was reinforced by cheap labour costs in emerging economies and cheap energy, which allowed products to be mass produced and transported around the world (Stahel, 2013). Programmed obsolescence (or simply obsolescence) infiltrated the consumption culture, discouraging repair, encouraging fast change and even rendering functional objects useless due to technological and systemic changes (Oeko-institut, 2019; Packard, 196; Burns, 2010).

In addition to the different branches in the study of repair, we encounter two main methodological approaches in the literature: quantitative and qualitative. Quantitative research, often linked to circular economy studies, and qualitative research, which may appear in either repair studies or circular economy studies dimensions. Quantitative research on repair has been for the most part scarce, with few studies tackling repair aggregates or sectoral issues (i.e. Vence and López Pérez, 2022a; Llorente-González & Vence, 2020; Deloitte, 2018). Qualitative research has been done through both questionnaires and interviews. Participants in questionnaires and interviews on repair are either consumers or repairers in either community or commercial repair contexts. The questions often involve barriers to repair and motivations to partake in the repair process.

Research on repair has taken place on a planetary scale but particularly in rich and industrial countries. This type of research has often focused on consumer perceptions of repair, either in community repair contexts

(Terzioglu, 2021; Rogers et al., 2021) or in commercial repair contexts (Ackermann et al., 2018; Richter & Dalhammar, 2019). Research in developing countries has taken place, but the aims have been less utilitarian and it has rather looked at the institutional and structural roles of repair (Houston, 2019; Houston & Jackson, 2016; Jackson, 2014; Jackson et al., 2012). Unpopularity of repair of consumer goods was a phenomenon quite focalized in the Global North, while the South still relies strongly on repair to overcome scarcity while also having to overcome obsolescence barriers imposed by consumeristic logics imposed in the Global North in contexts of relative abundance and nonsensical in contexts of relative scarcity (Patwa et al., 2021; Houston & Jackson, 2016; Jackson et al., 2012).

Ultimately, the ability of a society to repair is going to be determined by a variety of factors, some of them out of reach of the consumers themselves. The perception of repair and replacement as simply dichotomic consumption alternatives is akin to the common view in neoclassical economics. Neoclassical economics focuses on exchange between competing options and so consumption is the main stage in the analytical process. Since the problematization of repair is broader, as we have seen, and repair determinants are often structural, research on repair requires a more holistic and informed approach than neoclassical economics can offer (Stahel A., 2021). We ought to take into account the entire economic process and a variety of methodological approaches can be used to render more informed and nuanced analysis.

Towards a more nuanced notion of repair

Repair is an intrinsic element of the circular economy paradigm (Stahel, 2013; Ellen MacArthur Foundation, 2015; Gharfalkar et al., 2016). Repair is not only a reuse practice, but a particular form of reuse transversal and porous to other forms of reuse (International Resource Panel, 2018). Literature on repair remains fragmented and some key gaps exist, particularly regarding the socioeconomic embeddedness of repair and its ability to sustain sociotechnical systems.

The two main approaches mentioned here: the socioeconomic study of repair, often linked to the CE; and Repair Studies; have had very little interaction and exchange between them.

In environmental terms, repair is part of the reuse ladder, it is a value retention process, which, as we have shown, is a way of understanding value in thermodynamic terms, meaning that value is seen as usefulness embedded to materials through energy expenditures to reverse entropy. Reuse, thus, keeps value by keeping as much of the original object intact as possible. This makes repair, and reuse in general, not simply another step in the circular economy logic, but a radically and functionally different alternative to recycling, which is a material retention activity, meaning that its only role is to return molecules to a state of raw materials by breaking them apart from the objects in which they were placed during production.

Beyond the reuse logic, which makes repair less resource and energy intensive (Ijomah et al., 2005; King et al., 2006), repair has been shown to be more labour intensive and highly territorialized (Stahel W., 2013; López-Bermúdez & Vence, 2023; Llorente-González & Vence, 2020; Lepawsky, 2020), this makes it attractive from the point of view of local and regional development, yet it also makes it more vulnerable to industrial prices, which can take advantage of international production networks and outsourcing. So far, very little attention has been paid to the economic dimension of repair in the context of the circular economy, which is paradoxical since repair is the more mature and popular reuse practice and it is a consolidated activity even in modern consumption patterns. The economic assessment of repair has been mostly descriptive and confined to institutional reports (see i.e. Deloitte, 2016 & 2018) while very little attention has been paid in the academia to the economic dimension and role of repair.

Repair has been also understood as a form of care. Care has expanded upon its original meaning to become a foundational and inspirational principle in economic thinking (The Care Collective, 2021; Eisler, 2008).

Repair as care implies caring for the environment and for the material world around us, and, as a result caring for one another by caring for the things that mediate in our relationships (Verbeek, 2011; Forlano, 2017). This nature makes repair a fundamental element in sustaining all sorts of infrastructures and human made systems that are key to our societies and economies. Repair studies have shown that repair is not simply restorative or conservative, but that it implies innovativeness, adaptability and creativity by finding new ways of overcoming defects (Jackson, 2014; Houston, 2019; Jackson et al., 2012; Cohn, 2017).

Repair processes can take place in varied contexts, either community driven (based upon non-capitalist relations and exchanges) or commercially driven (capitalist and economic based exchanges). Repair may also affect consumer goods but also all sorts of human systems, namely infrastructures and production networks. Research on repair has been shown to be quite fragmentary and with little interconnections between branches, we distinguish three main approaches to the study of repair: one based around the circular economy, often framed in orthodox analysis and considerations; one labelled repair studies, which are a collection of works that address the subject of repair from a sociological and anthropological perspective; and one approach in legal studies, which is fundamentally concerned with Right-to-repair.

Our analysis has shown that repair is multidimensional concepts that can be approached from multiple perspectives. Even though repair is and will remain an intrinsic part of the circular economy; it is also and inherently a fundamental tool for sustaining human infrastructure and for mediating in societal interactions by sustaining the networks that operationalise those interactions and that are now critical to our existence. Repair is key in sustaining all forms of infrastructures, as well as production and consumption systems, particularly in countries with limited buying capacity. Hence, repair is deeper and more nuanced than some circular economy conceptualizations show, it is not simply another step in the circular activities' ladder, it is a transversal element to all forms of reuse.

We conclude that understanding repair requires understanding its systemic role and consequently conceptualisations from both dimensions are not mutually exclusive but rather complimentary. The responsibility exists to develop a more nuanced understanding of the socioeconomic properties and consequences of repair, its effects on employment, value creation, labour creation, its interactions with the economic system at large, its effects on labour allocation and its role in affecting global supply chains. Simultaneously, this approach would benefit from a more nuanced understanding of the ways in which repair is understood as a socially useful practice, the way it affects human interactions and in summary a more epistemologically sound understanding of repair. Through this paper we argue in favour of integrating both dimensions, that oriented towards socioeconomic effects as a more ends-perspective and the anthropological and sociological considerations as an epistemological foundation to inspire and orient research. This reinterpretation of repair would ultimately improve the field of repair research by adding a more sound and robust theoretical foundation while also providing more practical and far-reaching consequences in terms of the real implications of repair.

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