

REPAIR CAFÉS – APPLYING THE ACTOR-NETWORK THEORY (ANT) TO UNDERSTAND REPAIR INITIATIVES AS ELEMENTS OF SOCIAL INNOVATION

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ABSTRACT. As civil society initiatives, repair cafés make an important contribution to the circular economy and to social change. With more than 3,500 worldwide, the number of repair cafés in practice is high, but the conceptual basis for their analysis is still underdeveloped. Actor-Network Theory (ANT), which emerged in the 1980s from the sociology of science and technology, is today one of the key theories of the knowledge society. It differs from other theories in its close conceptual interweaving of human and technical elements, and its focus on relationships and constellations that make an actor act. However, ANT has so far given little attention to the topic of repair. This paper explores the potential of ANT for the analysis of repair cafés as technology-related social phenomena. With its lens on changing constellations of actors that mutually influence each other, ANT is found to be a powerful analytical approach for understanding the characteristics of specific repair initiatives, their challenges and success factors. This is relevant more broadly to the relationship between technology and society, including with view to the adoption of circular economy practices across society.

Keywords: Repairing, circular economy, social innovation, analytical framework, technology and society

Introduction and aim of the work

Repair of consumer goods is now prominently placed on many policy agendas, including the Circular Economy Action Plan for the European Union

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(EU) as one of the building blocks of the European Green Deal (European Commission, 2025). Repairing can manifest through different solutions, such as professional commercial repair services carried out by dedicated businesses or independent repairers, activities performed by repair communities or groups, unpaid repair offered in an informal setting (e.g. by relatives or friends) or do-it-yourself repair (Lundberg et al., 2024).

Repair cafés (also known as repair bars, repair meetings or similar) are civil society initiatives that bring people together to repair everyday consumer goods that no longer work, often technical devices such as radios, kitchen appliances or communication devices, and the repairing is typically accompanied by the opportunity to enjoy drinks, cakes or other refreshments and snacks (hence the reference to a 'café'). Repair cafés combine technological and social aspects. In such a setting, the repair is either done by the owner of the defective device or it is performed together with or solely by (self-declared) experts, who often make available their expertise on a pro bono basis or in exchange to a relatively small (often flexible) financial contribution, at a rate that is significantly below the costs charged by regular commercial repair services. Usually, repair cafés are established as free community repair events or meetings (Luukkonen and Van den Broek, 2024). As civil society initiatives, repair cafés contribute to the conservation of resources and a more sustainable use of products, while in parallel they promote social participation and new forms of collaborative interactions across society and different communities (Grewe, 2017; Pesch et al., 2019). Repair cafés have been recognised as examples of social innovation (Keiller and Charter, 2018; Rabadjieva and Butzin, 2000), where social innovation is understood as the introduction of new practices for shaping social interactions and lifestyles.

With several hundred facilities in Germany alone (Kannengießler, 2018) and more than 3,500 worldwide (Repair Café International, 2025), the number of repair cafés is now remarkably high. If their operation is sustained over longer periods of time, repair cafés make important contributions to a circular economy by promoting practices that preserve the value of products and resources and by instilling respect for goods, including long-lasting and repaired items, thus counteracting throw-away attitudes and wasteful affluence (Lazzarin and Kusch, 2015; Madon, 2021). At the same time, the conceptual basis for analysing the social phenomenon of repair initiatives initiated and supported by civil society is underdeveloped (Jaeger-Erben et al., 2019; Luukkonen and Van den Broek, 2024), making it difficult to understand why such initiatives exist at all, what their typical and atypical characteristics in practice are, how they evolve over time, what main challenges they face and which factors contribute to their success or failure.

Repair cafés represent elements of social change in which the direct handling of technology and the response of individuals to defective devices are essential components. Within the canon of sociological theories, the actor-network theory (ANT) stands out through the fact that it sees activities as embedded in a network in which both human and non-human entities interact and may collectively act together (Aka, 2024; Akrich, 2023). This means that technical devices can also take on the role of actors and consequently be the originators of effects in social actions (Latour, 2005), i.e. any actions in a social context or a social environment. Social in this context, in line with the sociological thinking, is understood as the setting where people live, interact and relate to each other. ANT conceptualises a technological solution as an at least temporarily stabilised network carrier of technical and social relations between human and non-human actors, and it seeks to disclose why and how a specific technological solution, i.e. a specific actor-network has been created (Latour, 1987). Due to the close conceptual interweaving of human and technical elements, the actor-network theory appears suitable for analysing the social phenomenon of the Repair Café. The aim of this paper is to test this hypothesis. The research question to be investigated is: What are the central characteristics of the actor-network theory and what potential does this approach have for analysing repair cafés from a sociological, more precisely a socio-technical perspective?

Section 2 of this paper presents the actor-network theory. Section 3 relates the theory to the social phenomenon of the Repair Café, evaluating the explanatory power of this approach when used as an analytical framework for sociological research in this area. The final section summarises the results of the work. The paper applies a theoretical lens in so far that it does not analyse a case study in the form of a specific repair café. Instead, the goal is to explore ANT as a conceptual analytical framework that integrates technical and non-technical aspects of repair cafés, thus offering a methodological approach to capture the complex relationships between a defective technical object and its surrounding on one hand and the technical and social relationships that constitute a Repair Café on the other hand. This also enables insights more broadly to the relationship between technology and society, including with view to the adoption of circular economy practices across society.

Actor-Network Theory (ANT)

The actor-network theory (ANT) was founded in the 1980s by Bruno Latour, John Law and Michel Callon out of the sociology of science and technology (Peuker, 2010) and has since then been developed into a

comprehensive and widely applied social theory (Akrich, 2023). Today, it is one of the key theories of the knowledge society (Bellinger and Krieger, 2016). This section in the following introduces actor-network theory and explains key concepts such as actor, network, translation and hybrid. Since this paper ultimately aims to clarify whether ANT can be used fruitfully to analyse repair initiatives, i.e. initiatives that deal with defective devices, the presentation below will focus in particular on how ANT conceptualises technical devices as potential actors. To portray ANT, this work is primarily guided by the work of Bruno Latour and utilises primary and secondary literature for this purpose. Bruno Latour, French sociologist and philosopher and co-founder of ANT, is still one of the most important representatives of this approach.

Core elements and key terms

The core idea of the ANT approach is an understanding on action as the result of the alignment of a heterogeneous collective (network) of human and non-human entities, which can include material elements, such as technical artefacts, and non-material elements, such as discursive concepts or special knowledge (Peuker, 2010). According to this, a society is not only constituted through social relationships between human actors, but also through the influence of material things and non-material entities (Latour, 2005). Consequently, objects and other non-human elements do not form a passive background for human action, but directly influence courses of action (Kneer, 2013). The entities associated in a network, their connections and the types of their links are relevant for explaining social phenomena. Latour also refers to ANT as the 'sociology of associations' (Latour, 2005), thus emphasising the need to adopt an analytical perspective that traces associations, as a type of connection between things that are not themselves social.

Actor and actant

In the ANT approach, the originators of effects in social actions and thus actors can be a variety of concrete or abstract things in addition to people, such as a coronavirus, a book on ANT or a technical device like a radio or a coffee machine. The actor-network theory thus categorises any element that acts as an agent of action under the concept of the actor, regardless of the physical characteristics of the actor. In the context of a Repair Café, this would be, for example, the operator of the facility, the knowledgeable expert with her supportive offers, the pensioner as a customer, the coffee counter where customers start a conversation, the defective radio, the spare part, the collection of instructions for use and repair, the city's subsidies, legal regulations, and many more.

An actor, however, is not an isolated, self-determined entity whose activities directly reflect an intrinsic motivation and achieve self-defined goals. Rather, an actor is a unit that is ‘brought to action by many other entities’ (Latour, 2005). An actor’s ability to act is therefore not an autonomous potential of his or her own, but an expression of a complex potential for action that is enabled and limited by a multitude of other entities (Kneer, 2013), i.e. by the network of actors described below. The creation of reality takes place through the network.

As the term ‘actor’ is commonly used to refer to people (human beings), it is sometimes replaced by the term ‘actant’ in ANT studies in order to emphasise that agency is not exclusively attributed to people (Latour, 1999; Peuker, 2010). Actor and actant are generally used as synonymous terms in ANT. Latour himself has worked out particular nuances of both terms by characterising the actant as an entity capable of acting, but which has a prefigurative effect in a given case (remains without a concrete appearance in a particular narration), while the actor is a distinctive agent who takes on a concrete configuration of distinct identity and characteristics in a narration (distinct figuration) (Kneer, 2013; Latour, 2005, 2006). The reception of this nuance is rather restrained and limited in ANT-related literature (compare for example in Wieser (2012)). The term ‘actor’ is also already woven into the term ‘actor-network theory’, which may explain why it is often favoured in publications. This paper also uses the term actor in the following.

Network, collective, hybrid

Actors represent the nodes of a network. Here, the formation of the network reflects the processes in which actors indeed become actors, i.e. bearers of agency in social actions. Entities form relations (connections) that are modified in a context-specific manner and under the mutual influence of the involved units, so that heterogeneous associations, i.e. various types of links, arise between actors with potential for action.

Actor and network form a unit (the ‘actor-network’). The formation of the actor-network is based on the connection of actors, but these actors do not precede the network (Peuker, 2010), rather they themselves are modified in their characteristics in the networking process and are thus first constituted in their function and characteristics. The actors are both agents and the result of network formation (Schulz-Schaeffer, 2000a). Attributions of characteristics to actors only emerge within (during) the network formation process (Peuker, 2010). The construction of an actor-network is thus a transformation process that integrates elements with their characteristics in a contextualised manner and changes them at the same time. Actor-networks are pre-structured by the

elements present in a given situation (Peuker, 2010), but they are not determined. Nor is an actor-network an unchangeable entity. Rather, a rearrangement of the elements involved leads to changes in the characteristics of the actors and thus to modifications of the links between the network nodes and, accordingly, their potential for action (Philipp, 2017).

An actor-network brings together a collective of heterogeneous units. Latour (2005) assigns the term collective a similarity to 'society', understood as an assembly of entities with the capacity to act. At the same time, ANT rejects the idea of including only humans here – hence Latour's criticism of the common use of the term 'society' in sociology, which usually refers only to humans, and the introduction of the alternative 'collective' (Latour, 1999). Since ANT does not distinguish between human and non-human actors, the assembly of a collective typically involves the appearance of hybrids: 'hybrid beings between nature and culture' (Latour, 1993), in the form of entanglements of human and non-human, often material elements (Schimank, 2000). A facility established as a Repair Café would bring together a collective consisting of employees, customers, defective devices, functioning devices, furniture, printed matter, tools, drinks, the rental agreement for the premises, tax regulations and many other elements.

In addition to the heterogeneity of the elements of an actor-network, their non-equality is a central attribute (Peuker, 2010). While ANT fundamentally grants each entity the ability to act, it also postulates that each entity is also part of an asymmetry of the network that distinguishes between nodes at the centre and nodes that belong more to the periphery. In the course of the stabilisation and alignment of the network, actors will crystallise whose perspective is more assertive and to whom more influence is attributed. There is a moment of power here (Peuker, 2010), which is less intentional and more the result of network dynamics (Conradi et al., 2013; Röhle, 2013). The concept of translation (see below) is crucial for the occurrence of network dynamics and the shaping of the processes that take place.

Translation, black-boxing, punctualisation

The central process for the creation and alignment of actor-networks is the progression of translation operations that mediate content between entities, i.e. delegate information from one actor to other actors. Only those who are involved in such operations are actors in the network, and only what is passed on (mediated), i.e. translated, exists as content here. Translation is the endeavour to create two equivalent expressions, but this is inevitably also accompanied by a change in content (transformation), as there are generally no two completely equivalent expressions (Law, 2013). Consequently, in the act of communication (i.e. moving content from one entity to another), change and

narrowing also occur (Schmidgen, 2011). Translations are prone to error and can also fail (Law, 2013). At the same time, they are the basis not only for connecting actors but also for organising the network and enabling action. Through translations, actors are defined and redefined, groupings are created and dissolved again (Kneer, 2013). This takes place in multi-stage processes. Figure 1 shows the phases of translation according to Latour (1987, 1999, 2005).

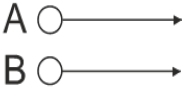
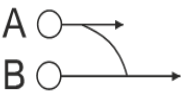
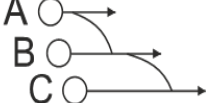
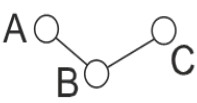
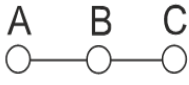

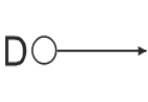
	<p>Step 1: Disinterest</p>	<p>Individual actors act without mutual interest in line with their own programme of action</p>
	<p>Step 2: Interest (Disruption, diversions, recruitment)</p>	<p>Actor A encounters a problem and becomes interested in Actor B, influencing Actor B's power to act</p>
	<p>Step 3: Composition of a new goal</p>	<p>Different actors involved recognise a common goal</p>
	<p>Step 4: Obligatory point of passage</p>	<p>Actors come together to interact by dynamically assigning their roles, which creates the nodes of the network</p>
	<p>Step 5: Alignment</p>	<p>The collective of actors assumes a common ability to act, with a common programme of action</p>
	<p>Step 6: Blackboxing</p>	<p>The aligned collective functions as one unit (one actor) and can also be addressed so by other actors (regardless of inner complexity)</p>
	<p>Step 7: Punctualisation</p>	<p>A given input reliably leads to a specific output, i.e. the elements contained in a black box act as one stabilised, predictable actor</p>

Figure 1: Progression of translation operations in actor-networks

Source: based on Latour (1987, 1999, 2005) – modified; A, B, C, D indicate actors (human or non-human)

Initially, the actions of individual actors are without mutual interest and their activities follow their individual programme of action. A programme of action characterises what makes an actor act, i.e. goals or intentions in the case of human actors and functions in the case of technical actors (Wieser, 2012).

When an actor encounters a problem, interest in another actor arises and the identity and power to act of individual actors is influenced. Based on this, different entities recognise a common goal. At the obligatory point of passage, the actors come together, and roles are dynamically assigned – the nodes of the network are formed. With the alignment, the collective forms a common ability to act, and a common programme of action emerges. A collective aligned in this way acts as a functional unit (as one actor with its own identity) and can also be treated as such by other actors, namely as a black box whose inner complexity is of no interest. Of interest is only which input is supplied to the black box actor and which output is delivered by this actor. With the punctualisation, the output is defined for a given input. The elements contained in a black box then act as a stabilised actor that acts predictably. In the example of the Repair Café, this would for example be the institution with its catalogue of services, the prices for repairs and drinks, the opening times, the working hours of the employees, etc. Parts (sub-sections) of the Repair Café can also themselves represent a black box, e.g. the food and drinks service, the handling of costs and the procurement of spare parts.

Black-boxing and punctualisation shorten the chain of translation operations, and the resulting reduction in the number of transformations also reduces the risk of translation errors. This stabilises the internal order of the network, simplifies interaction with other actors and thus enables the expansion of the network (Schulz-Schaeffer, 2000b; Wieser, 2012). The Repair Café becomes available to customers, it can be obliged to pay taxes, it can receive subsidies, it can network with other repair initiatives, it can enter into co-operations with recycling centres, etc.

At the same time, collectives and thus the direction of action of actor-networks, even after black-boxing, never achieve a final, unchangeable form, but instead remain in a state of constant change to a greater or lesser extent (Schmidgen, 2011). For example, the Repair Café will start working with new companies or give up existing collaborations, may digitise repair instructions and make them available to its customer base online, may specialise in certain product ranges or might change its legal form from an association to a commercial enterprise. It is precisely the presence of technical things and infrastructure, i.e. non-human actors, that leads to a certain stabilisation and permanence that goes beyond the current situation (Schroer, 2017).

Unique features of ANT compared to other sociological theories

The systematic comparison of different social theories is not part of this work. However, in order to facilitate an assessment of the extent to which actor-

network theory enables an independent approach to analysing social phenomena such as repair cafés, this section highlights key features that fundamentally distinguish ANT from other social theories. Identifying such distinguishing features forms an integral element of the presentation of this theory, as the ANT founders themselves and their representatives clearly distance themselves in key aspects from the prevailing concepts in sociology. ANT presents itself as a radically different social theory (Kneer, 2013).

One of the most striking unique features of ANT is the dissolution of the boundaries of the social (Höhne and Umlauf, 2014; Kneer, 2013), negating the meaningfulness of a dichotomy between social (human) actors and non-social (non-human) elements that is typical of other social theories. In the ANT perspective, society is not an area to be separated from other areas such as nature and technology, but rather the social world is made up of a wide variety of elements, including people, but also animals, things and non-material entities, all of which can be actors with agency (see Section 2.1 above). The social is not bound to a specific physical basic type of participant (namely people), but rather it is the types of links between the heterogeneous nodes (actors) of the hybrid actor-network that describe the social in ANT (Latour, 2005). The social is thus conceived as a fabric of associations between human and non-human entities. Ultimately, the social is a complex assemblage of networks (Höhne and Umlauf, 2014). Latour (2005) argues that other social theories take a selective view of the ‘sociology of the social’, whereas ANT takes a holistic approach as a ‘sociology of associations’. Correspondingly, one of the central questions of other social theories is not even on the agenda of ANT, namely the question of the relationship between the individual and society (Schroer, 2017); rather, it centres on the exploration of interdependencies between people, nature, technology, etc.

By rejecting the separation between human social actors and non-human non-social entities, the dichotomy of subject and object is also declared to be incoherent. ANT counters the usual hierarchisation (i.e. asymmetrical conceptualisation) between thinking subjects (humans) and passive objects used by the intentionally acting subjects to carry out actions with the principle of generalised symmetry (Latour, 1993). According to this principle of generalised symmetry, the natural, technical or other aspects of a phenomenon are all to be analysed using the same terminology and the same categories (Kneer, 2013). However, the symmetry principle does not imply an equal ranking of elements of an actor-network; rather, the non-equal ranking of the elements (asymmetry in the force of action between more central and more peripheral nodes of the network) is a specific feature of the ANT network concept (Peuker, 2010) (see also Section 2.1).

The distinction between action and structure also becomes obsolete in ANT (Kneer, 2013). Action and structure are a unit, as action is understood as the orientation and alignment of the network. An actor/system dilemma does not even arise in the ANT perspective, as an actor only exists if the entity indeed has links to other entities, and it is always the individual network of links 'that makes an actor act' (Latour, 2005).

ANT also overcomes the separation of micro, macro and meso levels postulated in other sociological theories, as such boundaries cannot be drawn coherently within the ANT theoretical architecture. In contextualised micro-processes, actors in a network enable and limit each other's activities (Peuker, 2010), but at the same time, actors can maintain connections at various far-reaching levels (Latour, 1993, 2005), and the resulting actor networks can certainly also operate as actors in macro-phenomena (Peuker, 2010), so that a wide variety of local and global phenomena overlap and modify each other.

ANT also differs from other social theories in that it does not claim to present a theoretical framework that can explain social phenomena by referring back to consistent statements on the organisation and functioning of society (Kneer, 2013). ANT leaves behind the common paradigmatic approach to apply a clearly delineated theory-grounded perspective to explain social phenomena. Instead, ANT focuses on the diversity of actors and their interlinkages in a given setting, and in doing so it seeks to capture the genesis of networks in their complexity and to clarify the associated emergence of characteristics of the entities involved (Peuker, 2010).

Network analysis as a research aspiration

ANT, which has integrated the term network into its name, has often aroused the interest of (structural) network research (Höhne and Umlauf, 2014). Latour himself has a critical view of the inflationary use of the term network and diagnoses that the term has become blunt (Latour, 2005). He points to the problematic ambiguity of the network term and thus the risk of confusion between research directions and the appropriation of ANT (Latour, 2005). While network research refers either to technical networks (electricity, railways, internet, etc.) or networks between human actors (Latour, 2005) in order to capture and organise something that already exists (Höhne and Umlauf, 2014), the ANT network is very different from this. As Latour puts it, under the ANT perspective a network does not refer to a thing in practice that would roughly have the form of interconnected points, such as a telephone, motorway or sewer network (Latour, 2005). Instead, network is a concept. It is a tool that can be used to describe something, not the thing described (Latour, 2005).

ANT considers the manifold and multifaceted interconnections between technical artefacts, scientific knowledge, natural phenomena and human action (Höhne and Umlauf, 2014). Beyond this, ANT is specifically not attempting to organise or classify an existing network, but rather to reveal the constitutive function of the links between the actors. The aim is not to reconstruct the structures of society that lie behind the actors' backs (Höhne and Umlauf, 2014), but to capture the energies and movements of the actors as well as the flows of translations and transformations within their network (Latour, 2005). As a fundamental principle for describing social phenomena, ANT postulates following the actors themselves and not bringing in a theoretical perspective from outside (Kneer, 2013). Following the actors means letting them 'unfold their own worlds' and letting them define the social themselves (Latour, 2005).

Sociological analysis of repair cafés from the perspective of the actor-network theory

Having presented the ANT in the previous section, this section focuses on the applicability of the approach for sociological research on the topic of repair cafés. In the following, important analytical strengths of the approach are recognised, and general limitations of its explanatory power are outlined. As described above in Section 2, a socio-technical phenomenon such as a Repair Café can as a whole or in its sub-structures and performances be understood as an actor network that has been created as a unique, complex web of aligned interests, including different types of people, public entities, companies, regulatory elements, technical standards.

ANT is also seen as a concept for explaining innovation (Schulz-Schaeffer, 2000a), and Latour also refers to it as the 'sociology of innovation' (Latour, 2005). Repair cafés have been recognised as important examples of social innovation (Keiller and Charter, 2018; Rabadjieva and Butzin, 2000). Despite this, ANT has so far paid comparatively little attention to the topic of repair (Denis, 2020). Bertling and Leggewie (2016) have pointed out a potentially productive connection between ANT and repair initiatives, as preserving products and raw materials through repair involves establishing complex relationships with both things and other people. Krebs et al. (2018) have also made a connection between repair movements and ANT in order to emphasise the interconnectedness of human action with the material and symbolic order. The authors highlight that practices of repairing are always integrated into socio-technical-discursive infrastructures of heterogeneous actors (Krebs et al., 2018).

Sociological research and ANT - what is it actually all about?

In developing and refining the ANT, Latour himself has called for a redefinition of what is meant by the discipline of sociology (Latour, 2005). It is therefore pertinent to attempt to clarify what is meant at all by sociological research. Looking at the neologism 'sociology' (from Latin and Greek), its immediate meaning would be 'the science of the social' (Latour, 2005). As explained in Section 2.2, a widespread approach of sociologists is to locate the social purely in interpersonal actions and to examine society under this premise, which ANT rejects. As a redefinition of sociology, Latour proposes 'the tracing of associations' (Latour, 2005), i.e. the capturing of types of connections between heterogeneous, often hybrid actors.

Understood in this sense, sociological research, and consequently also socio-technological research, would be the systematic search for associations between different types of actors and the identification of complex actor-networks. However, ANT certainly takes an anthropocentric view as well. Associations are always traced by a human actor. In addition, Latour explicitly wants to show how ANT can be used to reassemble social connections (Latour, 2005). Regardless of how sociology is being defined, the focus of sociological research can also be on human actors when using ANT, in particular on how they act in situations and what effects this produces in configurations of actors. Understanding human action as being embedded in a complexly networked collective of hybrids enriches the sociological research perspective, but it does not as such conflict with examining people within and as part of their society. Even though Latour himself struggles with the concept of society (see above), sociological research can use ANT to investigate the social relevance of social practices, and also to explore the societal significance of the social phenomenon of the Repair Café.

The defective appliance and the Repair Café from the ANT's perspective and entry points for sociological research to support repair initiatives

In everyday use, technical devices function as black boxes: stable elements whose composition is largely unknown and also not of interest (Denis, 2020). It is precisely this stability and everyday presence, as well as the routinised use, that give technical objects the power to act (Denis, 2020). A technical device that becomes defective has lost its actual function, i.e. its programme of action in the understanding of ANT. The black box is shattered. This also changes the integration of the device as a node in a network of actors, i.e. in the actor-network. The existing attributions of properties by other

entities are no longer realised and the defective device can no longer be prompted to act by other actors as before. The previous orientation and alignment of the actor-network is cancelled, action routines are interrupted and the network experiences dynamic shifts and changes in its associations.

It is precisely here that there are promising entry points for sociological research. For Latour and the ANT, the collective or society is constantly changing, whereby it is precisely the technical elements that ensure a certain constancy and stability (Schroer, 2017). The shattering of the black box through the occurrence of the defect and the associated disruption of routines and irritations of what was previously taken for granted can potentially reveal numerous previously unnoticed components and their socio-technical relevance. Denis (2020) has formulated: “Breakdown, in contrast to routine, brings the sociotechnical depth of technologies into light”.

A central role that Latour ascribes to ANT is the determination of the quality and stability of links and bonds, especially between people and things (Schroer, 2017). Dealing with a defective device can provide extensive insights into the nature of such connections. For example, a defective appliance can be repaired and then made available for use again (the same type of use or a different one), it can be taken to a recyclables collection centre, or it can simply end up in the residual household waste. If the defective appliance is taken for repair, an additional connection to a Repair Café is created, for example, which not only modifies but also expands the earlier actor-network, and at the time reveals a bond between the device and involved people.

The relevant actors in the context of repair cafés are highly diverse (Moalem and Mosgaard, 2021). This applies to the question in what form the actors are engaged (e.g. running the repair initiative on a regular basis, ad-hoc user with a defective item) and perhaps even more importantly to the differing purposes and differing drivers to engage. As a result, it can be assumed that expectations, linkages among actors, contributions to the circular economy, embeddedness into broader social innovation movements will strongly vary for different repair cafés and the engaged actors, and here the ANT approach is very well positioned to gain valuable insights by looking at the type of actors, their individual programmes of actions, the type and strengths of their interlinkages including with technical elements, the alignment of actors to create outcomes that classify as repairing, the attribution of roles to different actors, the stability and routines of established networks, capacities to attract additional actors.

Under an ANT perspective, the Repair Café as such can also be addressed as representing a black box, namely when it provides its services in a stable, predictable manner in the perception of other entities (e.g. users) (see Section 2.1). Compared to an everyday device (e.g. a radio) as a black box, a ‘Repair Café’

black box is much more complex, and its stability is subject to constant vulnerability. As a black box, the Repair Café represents a stabilised, very heterogeneous network in which human and non-human actors interact. Sub-areas can in turn represent a black box themselves (Section 2.1). The genesis of such a stabilised network requires role acceptance on the part of the actors and support for the jointly developed programme of action. If the network is stable, it defines the identities, competences and options for action of the actors involved in a committed manner, although this can be broken at any time (Kneer, 2013). Connections and role attributions can be called into question, which can open up the black box (Peuker, 2010). In order to ensure the stability of the network and thus guarantee the implementation of the programme of action in the longer term, the aim is to expand the network by integrating further entities (Kneer, 2013).

There are again important entry points for sociological research when the black box is opened. Breaking open the black box can reveal which areas of a Repair Café, i.e. which individual actors or actor constellations are particularly vulnerable when it comes to questioning role attributions. The resilience of the actor-network with view to the defined programme of action also deserves attention. With regard to the expansion of a network and any associated enhancement of network stability, the patterns of local and extended associations appear interesting. However, when assessing the societal relevance of repair cafés, it is not only the stability of the network structure that is of interest, but in particular also which actors establish themselves as central nodes and by means of which types of connections they can assert their perspective in a dominant way. It is not only the number of links that determines the identity, agency and decision-making power of actors, but also the types of connections and relationships that enable or prevent individual development and unfolding of their potential. In other words, it is also about the quality of bonds and connections. Latour (2005) points out that to be bound and connected means both to hold and to be held; the threads convey either autonomy or enslavement depending on how they are held, and autonomy and emancipation does not mean being 'freed from ties', but being well connected.

By observing the types of connections and distortions within actor-networks, it becomes especially possible to identify which factors (including legal, financial, ideational) are beneficial for the stability, orientation and operation of a network. This will allow conclusions to be drawn about suitable measures to support existing repair cafés and to promote the establishment of further repair initiatives.

Limitations to the explanatory power

In the previous section, ANT was demonstrated to be a conceptual analytical approach that enables productive sociological research on the topic of repair cafés. However, there are also factors that limit the explanatory power of this approach. ANT is primarily centred around existing actor-networks as they change and transform themselves. This approach does not as such aim to adequately account for actors who have dropped out or have been excluded, or for networks that have failed completely. Successful innovations may be effectively traced through the ANT methodology, but the factors that have reduced and continue to reduce innovation capacity are not necessarily identified. Since failed initiatives in particular can be a rich source of substantial learning, an important potential resource remains inaccessible through the use of ANT.

In addition, some criticisers of ANT have argued that it lacks sufficient analytical and methodological tools to actually capture and analyse non-human entities in a sociologically meaningful way, and in particular to reliably determine the quality of relationships in heterogeneous, hybrid actor-networks (Kneer, 2013). This may limit the applicability of ANT as a stand-alone element and instead calls for ANT to be combined with appropriate social science methods, which can be a very complex task itself. ANT therefore is not a ready-made, out-of-the-box analytical tool to analyse socio-technical research questions, but a conceptual framework that needs to be enriched case specific by appropriate methods. As an example, such methods may include qualitative methods such as expert interviews with policy makers or repair café managers, or quantitative methods such as surveys among earlier and current users of a repair café. The explanatory power of ANT for analysing repair cafés therefore also depends on the appropriate choice and integration of sociological methods.

Summary and outlook

The actor-network theory is firmly established as a concept in the scientific sociology and is frequently used in technology research in particular. As this is generally concerned with the new formation of objects, refinements to devices or the use of technology. The aspect of repair has received comparatively little attention to date. At the same time, repair movements such as repair cafés are now recognised as phenomena of social change, or social innovation. The aim of this paper was to work out the central characteristics of the actor-network theory and, building on this, to explore the potential of ANT for the sociological analysis of repair cafés.

A key unique feature of ANT compared to other social theories is its view of social action. From an ANT perspective, it is not only human actors who shape social action and thus society, but the social arises as a result of complex webs of relationships between human activities, technical elements, natural phenomena and non-material components. This approach offers very promising entry points for sociological research on the topic of repair cafés. Actors involved in such repair movements practise a special form of social interaction with technical devices by attempting to restore defective devices to their original function. With its focus on constantly changing constellations of actors who mutually influence each other, as well as the consistent consideration of non-human entities with an effect on action, ANT is very well suited to identify elements that condition and promote innovation, including new forms of social practices or lifestyles, and thus social innovation. This means that the actor-network theory has a very high potential for advancing the understanding of the societal relevance of repair cafés. The extent to which the use of ANT can also make it possible to coherently analyse the innovation capacities of individual actors must be clarified by further research.

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