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# Theorizing failure in digital media. Four eclectic theses

Paolo Magaudda[a] and Gabriele Balbi[b]

[a]Università degli Studi di Padova, Padova, Italy; [b]USI Università della Svizzera italiana, Lugano, Switzerland

**ABSTRACT**
This article focuses on the concept of 'failure' in relation to digital media, their development and appropriation in social contexts. In the first part, the article provides an overview of the category of failure for understanding digital media, addressing some of the most relevant contributions from several fields of study, including Science & Technology Studies (STS), History of Communication, Media Archaeology, and Post-Digital Art Aesthetics. In the second part, this sketched theoretical landscape is developed through the presentation of four 'eclectic' theses on failure in digital media, with the aim of inviting media scholars to reconsider some of the most recurrent assumptions about the development of digital media through a perspective focused on the notion of failure.

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## 1. Introduction: a perspective of 'failure' on (digital) media

This article focuses on the concept of 'failure' in relation to the study of digital media. Focusing on the category of 'failure' in digital media is important for deconstructing the currently dominant narratives surrounding the process of digitization, which over the years has been mostly described as a positive, beneficial and doomed phenomenon. Most historical reconstructions of digital media, as well as analyses concerning their social consequences, mainly focus on aspects related to their effective adoption in society and especially on those devices and services that became popular and widely accepted. In historical accounts, usually periodizations start from the moment when the devices are put on the market, as if this step corresponds to their actual diffusion and thus to their uniform success; abandoned digital technologies, even those that were very popular in a certain historical period, are commonly relegated to the margins of research, as marginal episodes somehow predestined to disappear for various reasons; the processes of abandonment of digital media are hardly addressed, foregrounding the role played by a constant pace of technological innovation that does not allow for mistakes and failures. In other words, most accounts of digital media in the social context mainly focus on them as a successful, positive and effective phenomenon.

In order to rebalance these biases, in this article we aim to contribute to a 'normalization' of digital media innovation by addressing the notion of failure and by adopting it not just as a residual outcome of the ultimate final success of new media, but as a structural dimension in the media-society relationship, highly relevant for understanding the intricate interaction between media technologies and the cultural, social and material elements underpinning them.

Only recently has social science and humanities literature begun to take a closer look at cases of media abandonment or obsolescence, at failures and problems in media innovation processes, at

**CONTACT** Gabriele Balbi gabriele.balbi@usi.ch USI Università della Svizzera italiana, via Buffi 13, CH6900 Lugano, Switzerland

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forgotten media trajectories, and at marginal or residual media practices. However, the concept of failure has rarely been explicitly addressed in relation to digital media, and existing studies that do adopt such a perspective remain largely disjointed and poorly organized. The contribution of this article is therefore twofold. On the one hand, we aim to provide a concise overview of the scholarly perspectives in media and technology studies that have drawn attention to the failure dimension, particularly in relation to the historical development of digital media and their social adoption. On the other hand another aim is to outline, in the light of this secondary literature, four analytical dimensions that future research on failure and digital media could fruitfully adopt as a kind of agenda. These dimensions are presented as four 'eclectic' theses, with the aim of providing a more solid framework for understanding the relationship between the development of digital media and the social, economic and cultural practices in which they are embedded. To this end, the article is structured as follows.

In its first part, the article presents an analytical overview to carefully reconsider the dimension of failure for the study of digital media, starting from the recognition of the need to rebalance the dominant discourse on the development of digital media that has emerged at least since the 1990s, focusing on the positive aspects and forms of success of digital media. To this end, the second part presents some of the most relevant contributions from several fields of study that have developed a specific interest in failure and error, including Science & Technology Studies (STS), media history, media archaeology, and the study of post-digital artistic aesthetics. Finally, in the third part, based on this literature on failure, the article presents a theoretical proposal in the form of *four eclectic theses* on failure in digital media, which in their very name pay homage to the ten eclectic theses proposed by the historian of technology David Edgerton (1999). Just as Edgerton critically rethought the historiography of Anglo-Saxon technological innovation, our four theses on digital media failure aim to provide media historians and media scholars with a tool for a more sensitive and nuanced understanding of failure in the context of digital media.

## 2. From studying success to understanding failure

Digital media and the whole process of the digitalization of contemporary society have long been addressed as winning and irresistible phenomena, increasingly associated with the idea of success (economic and social), democratic progress, and overall connected with the vision of a positive inevitable future that our digital society seems to be striving for. This exaltation of the 'winning' dimension of digital media has its roots in the first phase of the social appropriation of the Internet and is exemplified by two very influential books published in the mid-1990s: *Being Digital* by Nicholas Negroponte (1995) and *The Second Media Age* by Mark Poster (1995). These two texts argued that the Internet would trigger a 'democratic revolution' that would herald the end of traditional media monopolies and transform our society on the basis of new technical features. According to these narratives, pre-Internet media would inevitably be replaced by digital infrastructures that would allow the horizontal distribution of knowledge, leading to the realization of an imaginary frictionless capitalism based on the perfect matching of supply and demand, and the impossibility of the emergence of new dominant positions in a digital market of perfect competition.

In the first decades of the 2000s, the exaltation of the positive consequences of digital media gradually faded away and a number of critical perspectives emerged (Fuchs, 2014; Lovink, 2003; Morozov, 2011). This critical turn in digitalization studies has highlighted, among other things, the concentration of ownership of large digital companies such as Google, Apple, Amazon, Facebook (contrary to the rhetoric of the end of monopolies), the exploitation of workers (i.e Delfanti, 2021) the growth of surveillance phenomena (Lyon, 2019), the problem of echo chambers and filters in social media, as well as the exploitation of energy resources and raw materials for the production of digital devices and the maintenance of services (Gabrys, 2011; Crawford, 2021).

However, despite this growing critical literature highlighting the negative consequences of the digital, the dominant rhetoric and narratives surrounding digital media have remained largely

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dominant and there has been only marginal space to problematize failures in the processes of their innovation and appropriation. What is still lacking is a greater recognition that the development of digitalization is an uncertain phenomenon, that it is trial and error, that some technologies may disappear, and that some media practices may die out and be abandoned.

This lack of reflection on errors and failures is partly the result of the fact that failure, as an analytical category, has only been marginally addressed in the various approaches to the history, development and appropriation of digital media technologies, leaving the literature on digital media struggling to advance a more nuanced conceptualization of media-related processes and practices in society. In fact, in today's techno-capitalist imaginary of the digital society, reflections on failure and mistakes have mostly been limited to an ideological exaltation of the failed attempts of start-ups (the mantra 'fail fast, fail often'), or to the mythological narratives of the mistakes leading to an inevitable success, as exemplified by the narratives surrounding the trajectory of Apple founder Steve Jobs (Buschow, 2020; Cavicchioli & Kocollari, 2021) as well as those of many other digital 'gurus' with strikingly similar bibliographies. These narratives often focus on the *topos* of a hero who encounters some kind of obstacle to be overcome in order to achieve victory and success. These examples confirm the idea that failure is only treated as meaningful and relevant only insofar as it is preparatory and functional to eventual successes.

From this general framework arises the need to 'normalise' the phenomenon of failure in relation to digital media. In order to do this, it is useful to first to offer a more articulated discussion of the category of failure, transforming it into a specific perspective of analysis, thus purifying the ideological charge – positive or negative – with which this issue is treated by different perspectives related to the study of media. As we will see, it is important to go beyond the 'official story' of digitization, which is seen as an inevitable 'winning' force, and to analyze different cases of failure in a more comprehensive and multifaceted way, at the intersection of media, media-related social practices, technological cultures, political choices and entrepreneurial strategies (Balbi & Magaudda, 2018 ).

Since the second decade of the 2000s on, we have witnessed the emergence of a multifaceted literature that, in various forms, has addressed the phenomena of error or failure in relation to digital media (Krapp, 2011; Parikka & Sampson, 2009; Nunes, 2011). From this literature we can identify at least two relevant dimensions through which the study of failure in the digital media sector has been articulated. On the one hand, we can recognize 'failure' as an analytical category adopted by scholars in order to conceptualize some of the processes that characterize the development of digital media in society; on the other hand, failures are also rhetorical and symbolic constructions adopted by the same actors involved in innovation processes in order to interpret and make sense of phenomena typical of their own fields of activity. However, as Matthew Bellinger (2016) has already noted, the picture that emerges from this literature is far from constituting a conceptually homogeneous framework, but instead shows significant divergences in how errors and failures have been treated, and, in most cases, fails to identify the category of failure as an interpretive key to their analyses.

## 3. Relevant approaches to understanding failures in digital media: a literature review

Let's start by reviewing some of the perspectives that have developed analytical categories to further the study of failures, failed paths and forgotten options in the history of digital media technologies. The picture that emerges points to a common sensibility, articulated in different scholarly perspectives and approaches. We will now focus on four of these perspectives, particularly in the social studies of science and technology, media history, media archaeology and the study of post-digital aesthetics.

First, the focus on the role of failures and errors in technological innovation processes is a constitutive part of Science & Technology Studies (STS), an interdisciplinary field that since the 1980s has highlighted how technological evolution depends on non-linear and heterogeneous processes

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(Pinch & Bijker, 1987; Latour, 1987). According to the STS perspective, innovations almost never work according to a linear model (from invention in the laboratory to successful technology), but are the result of a constant and unstable work of alignment, or rather articulation, between heterogeneous elements that include technical aspects, social needs, cultural expectations, economic constraints and local contingencies. For this reason, innovation processes have been described as forms of engineering the heterogeneous (Law, 1987). In short, this work of alignment and articulation implies failure and error as constitutive parts of innovation processes.

A starting point for STS, directly influenced by the sociology of science, is the adoption of a 'symmetrical approach' in understanding innovation processes, capable of accounting for both 'successful' theories and scientific ideas that subsequently turn out to be wrong (Bloor, 1976, p. 5). In other words, it means taking a neutral stance on the success or failure of a theory, a scientific paradigm, and thus a communication and media technology. At the end of the 1980s, one of the proponents of Actor Network Theory, Bruno Latour (1993), used the 'failed' project of an automated metro in Paris, Aramis, to unravel the complexity at play in innovation processes, showing how there was a lack of alignment between the technical, economic, political and cultural aspects involved in the realization of this technology.

In the late 1990s, STS infrastructure scholars Bowker and Star (2000) pointed out that fragile, malfunctioning or breaking technologies are not residual or episodic, but on the contrary are inextricably woven into our technological routines. Malfunctions and failures thus become revealing of our relationship to technologies, since it is often easier to observe the fundamental role of these technologies in the functioning of society when something is not working, rather than when devices and systems seem to be working, at least apparently. In this line of research, the study of the processes involved in the maintenance and repair of technologies and infrastructures has become particularly important (Graham & Thrift, 2007; Denis et al., 2016; Vinck, 2019; Henke & Sims, 2020; Weber & Krebs, 2021). This literature has also been applied to the field of media and communication (Balbi & Leggero, 2020 ), highlighting that the proper functioning of media devices and infrastructures can never be taken for granted, and that – as Steven Jackson (2014, p. 234) writes – 'moving maintenance and repair back to the center of thinking about media and technology can help develop deeper and richer stories of relationality to the technological artefacts and systems that surround us, positioning the world of things as an active component and partner in the ongoing project of building more humane, just and sustainable collectives.'

A second relevant analytical perspective on errors and failures in media development comes from what might be called a *nouvelle vague* of media history, which since the early 2000s has pushed for a progressive deconstruction of classical media narratives and 'winning' rhetoric. Inspired among others by the work of communication historian Carolyn Marvin (1988), scholars such as Lisa Gitelman (2006; 2014) and Jonathan Sterne (2003; 2012) have both questioned the myth of the linear progress of media technologies, which was typical of 'diffusion theories', thus calling for a 'denaturalization' of media history, i.e. to avoid conceiving of the evolution of media technologies in terms of a linear and evolutionary process, a 'biological' perspective, from simple to complex media or as the result of a Darwinian selection of the 'stronger' over the 'weaker'. In order to 'denaturalize' media history, it is necessary to question the most recurrent conceptual categories (such as what is 'new'; see Lesage & Natale, 2019) and to infuse historical work with a renewed charge of cultural and political critique.

The peculiarity of old, abandoned and failed media lies precisely in the fact that, although they seem hopelessly out of place today, as Lisa Gitelman (2006) argues, they remain the bearers of media practices and needs that may be incompatible with today's reality, but are somehow coherent with their past and thus able to shed light on the evolution of our relationship with forms of technological mediation. This is what Jonathan Sterne (2003) has done, for example, by highlighting the crucial role played by certain media uses, which have subsequently disappeared, in the cultural construction of music listening practices: think of the telegraphers' headphones at the end of the nineteenth century or the collective earphones of Edison's first phonographs at the beginning of the twentieth century. Although they have now disappeared and can therefore be categorized as

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failed, they are in fact media uses and technologies that have been transformed into something else, and for this very reason are highly significant: they present themselves as technological and material 'crystallizations' (Sterne, 2003, p. 172) of forms of mediation and transmission of culture that belong to a particular historical moment, forms that we are now able to understand precisely thanks to the work of contextualizing old, forgotten or failed media. In short, some media objects of the past can acquire a second life, at least partly independent of the first.

We come to the next source in this exploration of digital media failure, represented by the field of media archaeology, a specific area of research within media studies (Huhtamo & Parikka, 2011; Parikka, 2012). Media archaeology draws on a wide range of intellectual influences, from Walter Benjamin's work on the meaning of technical reproduction, through Michel Foucault's archaeology of knowledge, to the media reflections of German theorist Friedrich Kittler. Media archaeology is characterized not only by the historical reconstruction of the media's vanished past, but also by a special interest in the less obvious and more unusual folds of media technologies, recognizing precisely in errors, failures, vanished media and even imaginary media the focus of a new, decentralized point of view for making sense of the past, but also of the contemporary digital media landscape. As Jussi Parikka (2012, p. 2), one of the leading theorists in the field, has written, media archaeology is, in short, 'a way of exploring new media cultures through contributions from the new media past'. More than other perspectives, media archaeology recognizes that media failures of the past are resources for better understanding the media world of the present, with an emphasis on forgotten, eccentric and exceptional devices, practices and inventions.

It is Jussi Parikka (2012) himself who has focused on the culture and phenomenology of computer viruses and the problems and failures that have developed around these phenomena, as part of an alternative history of media technologies that focuses on 'how it does not work; how it breaks down; how it frustrates and messes things up; how it disappoints and fails to live up to expectations that are always rather sublime compared to the mundane everyday' (Parikka, 2012, p. XIV). Similarly, Peter Krapp (2011) has focused on the study of media cultures by looking at forms of inefficiency in communication, concentrating on the role of noise, errors and glitches, thus showing how the development of digital cultures does not emerge as a progressive overcoming of errors and problems, but also from the creative practices of appropriating these same problems and limitations.

This is especially true of the category of glitch and scratch in the digital age, which, according to Thomas Levin (1999, p. 162), 'is no longer the sign of a malfunction but rather the almost nostalgic trace of a bygone era of mechanical reproducibility, one can say that it has become *auratic*, and as such is suddenly becomes available for aesthetic practices of all sorts.' Moreover, the malfunction, or what appears to be a malfunction, can also acquire a further productive significance: it can become a source of nostalgia and a tangible (or rather audible) sign of a supposed pre-digital authenticity, simply because it recalls an analogue era in which malfunctions were apparently more common, more ordinary. Although this exaltation of the analogue communicative past (portrayed as more humane and tolerable than the present) is inevitably transitory, the theme of the productivity of malfunction and failure, which we will explore below, emerges here in all its force.

In short, media archaeology invites us to consider the material dimension and technical detail of past media as revealing elements of our relationship to the technological mediation of experience. It also has the merit of having catalysed a widespread sensibility at the intersection of humanistic and social studies of digital media, a sensibility that has also been embodied in contemporary forms of reappropriation of technologies considered obsolete, residual media or 'retromedia', which have acquired a new role in media use and consumption practices, such as vinyl, audiocassette or arcade consoles (Acland, 2007; Niemeyer, 2014).

A fourth perspective on the creative dimension associated with errors and failures has also developed within the study of post-digital aesthetics (Betancourt, 2016; Menkman, 2011). In this field, attention has primarily been paid to the relationship between failure and digital media aesthetics, with a particular focus on the capacity of mistakes and errors to form the basis for the development of new languages and forms of expression in the digital context. As the scholar and musician Kim

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Cascone (2000, p. 13) first pointed out, failure 'has become a prominent aesthetic in many of the arts of the late twentieth century, reminding us that our control over technology is an illusion, and revealing that digital tools are only as perfect, precise and efficient as the people who build them'. To return to the case of glitch, it is used as a synonym for bug to indicate an error in computer software, but it is mainly used in the field of music to indicate a 'jump' in the sound of a vinyl, CD or, more generally, an analogue and digital audio track (Sangild, 2004). However, what appears to be an annoying technical issue, has also been reinterpreted as an artistic form: some authors have indeed deliberately introduced glitching into their musical works, producing a dirty audio track in which a jump or noise caused by a technological malfunction is clearly present. Since the beginning of phonography, there has been deliberate damage to vinyls or cassettes (so-called cracks and breaks) that cause a temporary or permanent disturbance, reinforcing the same cultural dynamic that has led also to the performative moments when musical instruments are destroyed during a concert (Kelly, 2009). In this case, the malfunctioning of audible media not only is deliberate and intentional, but it also produces a different and richer set of aesthetic and performative opportunities when compared to those offered by the same technology functioning in an usual way. After all, a functioning, undamaged vinyl or CD exists in millions of copies, while the same product that is artistically damaged becomes unique, acquiring a kind of aura that is conferred precisely by its dysfunctionality.

## 4. Four eclectic theses on failure

From these multiple perspectives that have addressed the category of failure in the context of digital media, we will now present 'four eclectic theses' for the study of failure in the context of digital media, which will be discussed in the following sections. These four theses are based on an analytically driven reassembly of the research on digital media, mostly rooted in the perspectives addressed in the previous part of the article, and are organized around four distinctive dimensions: the *transience of failure*, the *transience of success*, the *productivity of failure*, and the *explicability of failure*. Each of these propositions is accompanied by examples from the secondary literature that illustrate how they have been articulated in previous research and can also be fruitfully applied to other empirical cases in digital media.

### *Thesis 1 – The flexibility of failure*

*Digital failure is not a monolithic phenomenon but is always temporary and transitory. Failure is essentially a temporally and spatially situated process. A digital medium or the related ideas associated with it can fail in one historical period and re-emerge or become successfull in another, or vice versa. Or again, a digital medium may be 'successful' for some social groups or in some places, and a failure in other cultural contexts.*

Digital media, like analogue media, are not stable and defined once and for all, but are objects in constant flux and transformation. This constant logic, which has become one of the dominant narratives of the digitization process (innovation is always in motion), also has a downside: more and more digital media fail and are replaced with new ones. But again, failure is not forever, as at least two of the already mentioned theoretical perspectives on the study of media and technologies remind us.

On the one hand, STS have pointed out that technologies, especially in the early stages of development, have a high degree of interpretive flexibility (Pinch & Bijker, 1987), i.e. that the same medium can be conceived, used and thus appropriated by different relevant social groups in different ways and in different contexts. Of course, the social actors around digital inventions very often do not have a clear idea of the forms that the new tools will take, and decide to assign certain meanings to them and discard others. Discarded meanings and uses, however, are not final either, but may reappear later, reopening the flexibility that has been established in the

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meantime (on the interpretive flexibility of technological failure, see Gooday, 1998). On the other hand, theories of 'double (or sometimes even triple) birth' argue that media, including digital media, are born more than once and that each rebirth brings different meanings and, moreover, is the driving force behind the generation of new media (Gaudreault & Marion, 2005; 2013). In the history of digital media, there are several cases of 'double birth' that have been highlighted in the literature: for example, mobile or wireless telephony reemerged in the last two decades of the twentieth century after having been introduced in the late nineteenth and early twentieth centuries; artificial intelligence, at least since the Second World War, has experienced summers and winters that bring it to light as a crucial contemporary issue and then overshadow it.

A lesser known example is WAP. In June 1997, Ericsson, Motorola, Nokia, and Unwired Planet joined forces to create the WAP standard, enabling mobile phone users to access online content and services via their mobile devices (Sigurdson, 2001). The companies that created WAP were convinced that this standard would repeat the success of GSM, while it is now remembered as a technological failure for at least four reasons. First, the limited nature of the services that could be accessed: in fact, WAP was designed as a kind of subset of the Web, and users could only access certain content. Second, as even the Ericsson manager involved in the project admitted, the major shortcoming was the lack of attention to the usability of the phones that were supposed to surf the Web: it took a long time to access online content, the cost was high, the interface had several problems, and even after a long period of practice, the usability did not improve. Moreover, the telephone companies had designed the new devices as adaptations of traditional telephones (think of the famous Nokia Communicator, which was even aesthetically similar to a telephone and a digital organizer with a keyboard), whereas what was needed was a completelly new object created specifically for surfing the web, as would happen a few years later with smartphones. Finally, with the gradual penetration of desktop computers or laptops in homes, by the end of the 1990s the standard for surfing the web had became that offered by PCs, and the 'poorer' version offered by WAP was not attractive to users.

Nevertheless, taking a global view, we can also note that WAP mainly failed mostly in Western countries, while for example in Japan, where a standard using a more network-friendly language such as XHTML was implemented, this standard achieved considerable success and contributed to the early spread of mobile Internet in the country. In fact, in Japan, WAP even changed the role and public dimensions of the cell phone. From being an object almost exclusively associated with youth subcultures and viewed with suspicion and apprehension because of its potential to undermine pre-existing rigid social relations, the *ketai* (cell phone in Japanese) with Internet access became a 'serious' cultural object, useful for checking work emails and, over time, so fundamental to Japanese society that it even triggered forms of 'techno-nationalism' (Matsuda, 2005). In short, the history of WAP shows us at least two elements central to this first thesis: the fact that surfing the Web was not a failed idea per se, so much so that it would reemerge years later, and the fact that a failure is geographically located, so much so that the same technology was a failure in one part of the world and popular in another.

Of course, the reasons why some 'failed' digital technologies reborn, achieving new success can be many. Rebirth can occur in a favourable historical period and where certain economic-cultural conditions have changed or new technologies have arrived, as in the case just mentioned of the smartphone, a new mobile object different from previous phones that facilitates mobile browsing. New political directions or the rise of innovative digital companies can contribute to the recovery of past problems and needs in a new fashion. Failure can also be turned into success by the emergence of new social groups that were not part of the original innovation process and that articulate the same object from a new point of view, thus highlighting new uses for it. Then there is another issue, which we might rename the forgetting of failure, and which is recalled in Kenneth Lipartito's (2003) well-known study of the failure of the first version of the videophone (or picturephone) in the 1970s. Interestingly, is also the fact that the short memory of failure can even have a positive effect, stimulating the return of an idea in contexts where the original idea has largely disappeared.

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### *Thesis 2 – The Flexibility of success*

*Like failure, success is flexible and sometimes destined to turn into failure. Moreover, what may appear to be success may be a betrayal of an original idea and, as such, may prevent the achievement of an originally imagined goal. In addition, there are several degrees of flexibility between success and failure, which can be considered two ideal types, and decline is one of them.*

According to STS, after a stage characterized by a high degree of 'interpretive flexibility,' the social interpretation of new artifacts tends to stabilize (Pinch & Bijker, 1987). When the cultural interpretation of a new artefact has been agreed upon by all actors and has thus taken on a definite form, there is a 'closure of flexibility'. But flexibility can always be reopened, and so a 'successful' digital medium can always be challenged in the course of its subsequent history. There are numerous examples of digital successes that later became failures or otherwise declined in the consumer market: think of the CD or minidisc in music, the floppy disk or CD-ROM as information storage media, or the model of physical distribution of films in VHS à la Blockbuster, which was first borrowed by Netflix with DVDs, only to be quickly replaced by digital streaming.

A second element of the flexibility and transience of media success is that an apparently successful idea may in fact contain a 'betrayal' of an original intuition. In the history of the Internet (a technology that we can undoubtedly call successful beyond all issues related to the digital divide), there seems to be a betrayal of an original idea over the decades. Even if the mythologies and utopias surrounding Internet history are more complicated (see Flichy, 2007), the hacker ethos and the countercultural vision of the network that developed especially in the US since the 1970s saw the Internet as a tool capable of embodying communal socio-cultural values and making knowledge available to as many people as possible (Streeter, 2010). This has been transformed in the following decades into something very different, if not opposite, both by the commercialization of the network since the 1990s, and by the acquisition of dominant positions by a few large companies, often adopting rhetoric centered around the idea of freedom and democracy as a driver of their own commerce. This is also true when focusing on the most relevant Internet service: the Web. Even if it can be seen as a clear example of digital success, its current configuration has fundamentally betrayed the libertarian and anti-authoritarian spirit of its beginnings: this is argued by one of the inventors of the World Wide Web, Tim Berners Lee, who, not surprisingly, proposes different Web models other than the established one. The history of the web is useful in this regard, and Megan Ankerson (2015), for example, has studied the development, launch and afterlife of two commercially sponsored web projects from the mid-1990s: Massachusetts Institute of Technology Media Lab's Day in the Life of Cyberspace and Rick Smolan's 24 h in Cyberspace. Applying the theoretical lenses of configuration and afterlife, Ankerson (2015, pp. 2 and 10) shows how these two technologies and related discourses were 'reconfigured as solutions to other problems […] and both became attached to new cultural imaginaries as they were reconfigured to address new problems in different contexts'. When we look at success, in other words, we should always ask ourselves: Success for whom? Success in what context?

This second thesis also reminds us that the relationship between success and failure intersects with the categories of 'analog' and 'digital'. Digitization has profoundly affected analog media in all three classical phases that characterize the trajectory of a media product: production, distribution, and consumption. New forms of production, often 'from below' (from citizen journalism to YouTube videos), unprecedented possibilities of distributing content online, often for free (streaming and file sharing, which have affected music and cinema), new possibilities of personalized consumption (on-demand or radio podcasting) suggested that we are living in a different media universe from the analog one. On the other hand, digitization has not wiped out the universe of traditional media, has not caused them to fail altogether, but even seems to have stimulated some 'rebirths,' as in the case of the vinyl record, the cassette tape, the paper book, or analog photography, whose 'second lives' exemplify how analog media can take on new meanings and cultural values in the digital context.

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But it is equally undeniable that some everyday practices associated with earlier media have changed over time, fading into the background or being reduced to specific niches, as new digital media practices have emerged. For instance, in many Western countries, the habit of reading the printed newspaper is slowly becoming a niche phenomenon, replaced by new ways of getting information through social media or other mostly free resources. Linear television consumption (although it slightly increased during the pandemic around 2020–2021) has declined, replaced by more personalized, catch-up audiovisual consumption practices, where the viewer's time is more relevant than the time imposed by the broadcaster. These are two examples of media practices that were popular in the second half of the twentieth century (and even in the nineteenth century in the case of the newspaper), but which have declined significantly in a short period of time in parallel with the appropriation of digital media. And it is precisely this view of decline that might be useful in approaching digital media, as McCammon and Lingel (2022) have done in studying the declining, dead or abandoned web platforms. The theoretical category of decline can also be useful in imagining a 'different' digital future (can we imagine, for example, a digital world without the smartphone?), and in moving beyond the ideal types of success and failure: when a technology declines, it has not yet failed, it needs to be updated and maintained, and may still be relevant for a niche of users. The former success, in sum, can also be sticky over time.

### *Thesis 3 – The legacy of failure*

*In the history of digital media, missteps and failures are as relevant as successes. Some failures have proven to be so influential that they have determined the evolution of some media, representing 'negative constitutive choices', and are remembered as emblematic examples not to be followed, thus helping to limit subsequent choices. Moreover, from a systemic and 'ecological' point of view, failure is a junction in a process that can be generative of other paths: companies that fail reorient themselves, but also technologies that fail leave room for other paths of innovation and development.*

This third thesis emphasizes that failure can become productive in several ways. Let's start with the perspective of 'path dependency': according to this theory, the QWERTY keyboard (David, 1986; Kittler, 1986) went from mechanical typewriters in the late nineteenth century to early computers to smartphones, not for any particular technical reason, but thanks to the social groups that revolved around the artifact and imposed it as a standard, making it the main writing technology of the first analog and then digital media universe: it was a resounding and lasting success. However, applying the central idea of path dependency in reverse, a 'resounding failure' may constitute such a shock that it is remembered for a long time and somehow binds the system by preventing it from recovering this idea in the future. To use a phrase introduced by Paul Starr (2004), a resounding failure may constitute a 'constitutive choice in the negative'. 'History matters' is another of the slogans of path dependency (Arthur, 1989) and is also valid in the negative: firms, political actors, and end users sometimes remember a past failure and decide not to follow in the future the path from which they were burned out. Failure can thus be generative and propaedeutic for future directions and trajectories – and so, once again, the success/failure dichotomy seems more complicated and less crystal clear than one might expect.

In the digital sector there are also cases of failure that can generate positive outcomes. For example, what is now seen as the real revolution of 3G networks, i.e. the ability to surf the web from a mobile phone, was an option not even considered by those who developed the standard. The idea of a third generation network emerged within the International Telecommunication Union (ITU) in 1992, with two main killer applications: the creation of a mobile phone standard that could be adopted worldwide, leading to some form of universal roaming, and the introduction of a unique personal number for mobile, fixed and business telephony (Green & Haddon, 2009, pp. 22–23). Many countries only began to allocate Hertzian spectrum for 3G networks between 1999 and 2001, granting frequencies and concessions to private companies. The first 3G commercial services were launched in 2001 in Japan, Korea and Italy (Srivastava, 2008, p. 20). In particular,

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Hutchison Whampoa, better known as H3G or simply 3, pursued an aggressive licensing policy especially in Europe and some Asia-Pacific countries, focusing on the promotion of video calling (with little success, as had already happened in the case of fixed telephony, as recounted in the classic failure studies Lipartito, 2003) and mobile TV. Mobile Internet was not yet a suitable application. However, this marketing strategy proved to be unsuccessful, and soon the interest generated by the possibility of watching TV on mobile screens or making video calls faded, only to reappear recently. This 'failure' story of how to imagine the uses of 3G has strategic importance for the development of what we now call the mobile Internet: when a network access device such as the smartphone arrived, 3G networks were 'filled' with streams of data, video, images, and any other content exchanged in real time by users. A failure, or at least an investment that did not seem to lead to widespread use, can then serve as the basis for later innovations or for the emerging of new practices such as surfing the Web with a phone.

Failures can also leave legacies, as Michael Stevenson and Anne Helmond (2020) point out in a special issue of the journal *Internet Histories*. The nature of these legacies can be multifaced: they can constrain future actions and future technologies, they can create o kind of path dependency on contemporary technologies (as in the case of legacy software, Bennett, 1995) and they can leave ways of thinking at the technology. For the latter case, Niels Kerssens (2020) studied Euronet, a pan-European network developed in the 1970s in the footsteps of ARPANET and under the impetus of the European Commission. This network, which has now disappeared, was conceived and built according to classical European cooperation logics and left a legacy system in the understanding of the later network that is still visible today. Failures leave legacies and this complicates again the distinction between successful and unsuccessful digital media: if there is a legacy of an outdated, maybe disappeared or abandoned system, can we still talk of failure?

### *Thesis 4 – The explicability of failure*

*Failure is often described with a 'teleological' attitude. That is, the failure of digital media is often narrated as an inevitable fate caused by political short-sightedness, blatant corporate blunders, or the unpreparedness of users, as if the winning technology should have inscribed in itself the reasons for its own success. Instead, historical analysis must be able to go back in time and understand why social needs, technological constraints, or cultural frameworks at a given moment led to choices that only in retrospect appear to have been patently unsuccessful.*

Contrary to what is often implied in linear historical narratives with a teleological flavour (i.e. suggesting a linear trajectory and an ultimate end to evolution), failures and successes are not predetermined, and not all unsuccessful choices made in the past could have been easily foreseen and thus avoided. Research in media archaeology has often pointed out that media histories could have been different, that under different circumstances an abandoned artefact could have found its place in society, and that at some point in history, media that would turned out to be 'losers' were instead just ahead of their competitors. Standards and protocols such as Gopher, Archie or FTP could have become dominant technologies compared to the World Wide Web, and indeed they were at one historical stage, only to gradually decline when the Web was released for free by CERN in Geneva in 1993 (Fomasi & Balbi, 2023). The so-called 'netbooks' – small, low-cost, low-power laptops – were very popular for a few years that Acer became the world's second largest personal computer manufacturer in 2009 precisely because of this momentary success. However, this was a passing trend that died out with the arrival of a new generation of tablets, and especially after the success of the Apple iPad introduced in 2010. These are just two examples of how the history of digital media could have taken many different directions at many different times.

But it is also true that media history is full of examples which, when analyzed in retrospect, are surprising for the lack of foresight of their protagonists. The history of the computer, for example, offers a few of them. In the 1970s, when the personal computer first appeared, the large mainframe industries, accustomed to selling very expensive equipment to governments and multinational

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corporations, were not able to understand the emergence of a new mass market of small computers for families at home. The story is well known of how Steve Wozniak, before founding Apple in 1976, went to his bosses at HP, where he was a part-time employee, and proposed to exploit the idea of personal computers, only to see the company's management reject the offer on technical and business grounds (Wozniak & Smith, 2006, chapter 12). These two episodes translate into practical cases what Clayton Cristensen (1997) has defined as the *innovator's dilemma,* that is, the reluctance of large firms that have achieved a dominant position in a given market to support technologies that could revolutionize their own sector and thus encourage the entry of new competing firms. From this perspective, what appears in retrospect to be a macroscopic miscalculation becomes the logical choice based on a winning business strategy at the time.

The innovator's dilemma is only one way to plausibly explain resistance to a change that later proves successful. In fact, there is a second, recurring reason that helps to explain several cases of media failures: the inability to change. For example, politicians, firms, users, and other social actors have often tended to interpret digital media through the same lens through which they viewed older analog media. Indeed, it is not easy to change mindsets and make paradigm shifts, with the result of remaining tied to old approaches, practices and ways of imagining: an 'horizon of thought' or a 'socio-technical frame' (Bijker, 1995) that is applied to an earlier medium and tried to be replicated for the next one.

One of the most famous cases of inability to abandon a previous socio-technical frame at firm level is that of Kodak, which failed to make the transition from analog to digital photography. During the twentieth century Kodak became the leading producer of photographic film in the United States (where it controlled 90 per cent of the market in the 1970s), and its name was for many years synonymous with photography itself, at least in Western countries (in Asia, by contrast, it was Japan's Fuji that enjoyed a similar position of economic and symbolic privilege – again success is geographical-oriented). Kodak was also the first company to create a digital camera in the 1970, but over the next two decades many of the strategic choices the company made in its transition to the digital world turned out to be wrong. In particular, according to Lucas and Goh (2009), three management mistakes led to the company's failure: middle managers' resistance to the new business model (in fact, digital photography eliminated the need to print photos, radically changing the industry's supply chain of the industry in which Kodak had a dominant position); the company had been the market leader in film and film printing for decades, and thus found itself immersed in a monopolistic culture that did not fit well with the new markets; and finally, at least in the early stages, Kodak focused more on the professional market than on the amateur photography market. In essence, Kodak's failure can be explained in part, and above all, by its failure to change its corporate culture at a time when the photographic market was instead undermining it.

A third and final dimension to consider in understanding the explicability of failure in relation to digital media deals with the future. Here we can point the attention to some interesting examples of failure due to overconfidence, that is, driven by what seemed as an inevitable future shared by the network of actors involved. In fact, both the future and the past in the form of narratives and expectations exert a preponderant and magnetic force on the development of new media technologies (Natale & Balbi, 2014 ); very often the future is imagined as mono-directional, in some cases committed to distinctive and taken-for-granted vision about what the next media will be. For example, the vision about the phenomenon of 'media convergence', stimulated by digitization since the 1980s, has long taken for granted that sooner or later different media content would be accessed through a single device in any context of social life: this is the 'über-box' narrative, which can be partially linked to the role of the smartphone in today's society, but which has in fact been gradually defeated by the multiplication of digital devices that people use anyway to access content and communicate (Balbi, 2017). However, this idea of an inevitable future of digital convergence has strongly influenced policy decisions and, more importantly, has led to massive investment by private companies in search of the perfect single device.

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## 5. Conclusions

The main aim of this paper has been to provide the background and some analytical proposals for the development of an alternative perspective for the study of digital media, foregrounding the category of failure as an interpretative key to address the interactions between media production and its social appropriation and use, thus complexifying the relationship between 'success' and 'failure' in the realm of media. Instead of emphasizing the successful trajectories of new digital media, or instead of looking at failures and mistakes only to glorify them in the face of later successes, we have developed a third and more nuanced path: approaching failures (and successes) historically, interpreting them as constitutive elements of the evolution of digital media, making their understanding more multifaceted, sensitive to the flexibility of innovation processes, attentive to the transient nature of media evolution, and focused on explaining in a more symmetrical way the social, cultural and economic context in which they take place. From this perspective, the 'meaning' of failure itself becomes a dimension 'in question,' since an apparent failure can subsequently become a success or a resource for opening up new directions of innovation, at the technological and industrial level, as well as in terms of new cultural uses and understandings of digital media and of their aesthetic implications.

But even success, which is always transitory and socio-culturally situated, must be questioned and followed in its long-term trajectories, where what is expected to be an inevitable 'victory' can often turn into defeat or decline. Therefore, we proposed to place success and failure on the same level – following a symmetrical approach typical of STS – and to interpret them as subsequent steps of the same overall dynamic, two phases that alternate in a circular relationship, coexisting within the same trajectories of innovation and appropriation of media technologies (on this circulare relationship, see Scolari, 2023). What emerges from our four theses is thus that success and failure co-evolve together with the economic, political, and cultural transformations of the society in which the media themselves are created and used. This approach allows to offer a new perspective on the 'normalization' of failure and on the de-mythologization of success, to address media trajectories that could have taken hold but have disappeared, to make room for media decline or the influence media legacies have in the social context. In doing so, we hope to have contributed to challenging the dominant narratives of digital media, and to have provided media scholars with a set of 'sensitizing concepts' to broaden their research into the role of digital media in contemporary society.

## Disclosure statement

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## References

Acland, C. R. (2007). *Residual media*. University of Minnesota Press.
Ames, M. G. (2019). *The charisma machine: The life, death, and legacy of one laptop per child*. The MIT Press.
Ankerson, M. S. (2015). Social media and the "read-only" Web: Reconfiguring social logics and historical boundaries. *Social Media + Society*, *1*(2), 205630511562193–12. https://doi.org/10.1177/2056305115621935
Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-In by historical events. *The Economic Journal*, *99*(394), 116–131. https://doi.org/10.2307/2234208
Balbi, G. (2017). Deconstructing "media convergence": A cultural history of the buzzword, 1980s-2010s. In S. Sparviero, C. Peil, & G. Balbi (Eds.), *Media convergence and deconvergence* (pp. 31–51). Palgrave Macmillan.
Balbi, G., & Leggero, R. (2020). Communication is maintenance: Turning the agenda of media and communication studies upside down. *Hermes: Journal of Communication*, *17*, 7–26.
Balbi, G., & Magaudda, P. (2018). *A history of digital media. An intermedia and global perspective*. Routledge.
Bellinger, M. (2016). The rhetoric of error in digital media. *Computational Culture*, *5*.
Bennett, K. (1995). Legacy systems: Coping with success. *IEEE Software*, *12*(1), 19–23. https://doi.org/10.1109/52.363157
Betancourt, M. (2016). *Glitch art in theory and practice: Critical failures and post-digital aesthetics*. Routledge.
Bijker, W. E. (1995). *Of bicycles, bakelites, and bulbs toward a theory of sociotechnical change*. MIT Press.
Bloor, D. (1976). *Knowledge and social imagery*. University of Chicago Press.

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Bowker, G. C., & Star, S. L. (2000). *Sorting things out: Classification and its consequences*. The MIT Press.
Buschow, C. (2020). Why do digital native news media fail? An investigation of failure in the early start-Up phase. *Media and Communication*, *8*(2), 51–61. https://doi.org/10.17645/mac.v8i2.2677
Cascone, K. (2000). The aesthetics of failure: "post-digital" tendencies in contemporary computer music. *Computer Music Journal*, *24*(4), 12–18. https://doi.org/10.1162/014892600559489
Cavicchioli, M., & Kocollari, U. (2021). Learning from failure: Big data analysis for detecting the patterns of failure in innovative startups. *Big Data*, *9*(2), 79–88. https://doi.org/10.1089/big.2020.0047
Crawford, K. (2021). *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*. Yale University Press.
Cristensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Harvard Business School Press.
David, P. A. (1986). Understanding the economics of QWERTY: The necessity of history. In W. N. Parker (Ed.), *Economic history and the modern economist* (pp. 332–337). Basil Blackwell.
Delfanti, A. (2021). *The warehouse: Workers and robots at Amazon*. Pluto Press.
Denis, J., Mongili, A., & Pontille, D. (2016). Maintenance & repair in science and technology studies. *Tecnoscienza*, *6*(2), 5–16.
Edgerton, D. (1999). From innovation to use: Ten eclectic theses on the historiography of technology. *History and Technology*, *16*(2), 111–136. https://doi.org/10.1080/07341519908581961
Flichy, P. (2007). *The internet imaginaire*. The MIT Press (original version in French 2001).
Fomasi, M., & Balbi, G. (2023, June 28–30). *Successful Losers. The legacies of co-existent - and now failed or declining - information retrieval systems on the Web*. Paper presented at the IX STS Italia Conference, University of Bologna.
Fuchs, C. (2014). *Social media: A critical introduction*. Sage.
Gabrys, J. (2011). *Digital rubbish: A natural history of electronics*. The University of Michigan Press.
Gaudreault, A., & Marion, P. (2005). A medium is always born twice … 1. *Early Popular Visual Culture*, *3*(1), 3–15. https://doi.org/10.1080/17460650500056964
Gaudreault, A., & Marion, P. (2013). Measuring the 'double birth' model against the digital age. *Early Popular Visual Culture*, *11*(2), 158–177. https://doi.org/10.1080/17460654.2013.783147
Gitelman, L. (2006). *Always already new. Media, history, and the data of culture*. The MIT Press.
Gitelman, L. (2014). *Paper knowledge: Toward a media history of documents*. Duke University Press.
Gooday, G. (1998). Re-writing the 'book of blots': Critical reflections on histories of technological 'failure'. *History and Technology*, *14*(4), 265–291. https://doi.org/10.1080/07341519808581934
Graham, S., & Thrift, N. (2007). Out of order. *Theory, Culture & Society*, *24*(3), 1–25. https://doi.org/10.1177/0263276407075954
Green, N., & Haddon, L. (2009). *Mobile communications: An introduction to new media*. Berg.
Henke, C. R., & Sims, B. (2020). Repairing infrastructures. In *The maintenance of materiality and power*. The MIT Press.
Huhtamo, E., & Parikka, J. (2011). *Media archaeology: Approaches, applications, and implications*. University of California Press.
Jackson, S. J. (2014). Rethinking repair. In T. Gillespie, P. J. Boczkowski, & K. A. Foot (Eds.), *Media technologies: Essays on communication, materiality, and society* (pp. 221–240). MIT Press.
Kelly, C. (2009). *Cracked media. The sound of malfunction*. MIT Press.
Kerssens, N. (2020). Rethinking legacies in internet history: Euronet, lost (inter)networks, EU politics. *Internet Histories*, *4*(1), 32–48. https://doi.org/10.1080/24701475.2019.1701919
Kittler, F. (1986). *Grammophon Film Typewriter, Brinkmann & Bose (Eng. trans. Gramophone, Film, Typewriter, 1999)*. Stanford University Press.
Krapp, P. (2011). *Noise channels: Glitch and error in digital culture*. University of Minnesota Press.
Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Harvard University Press.
Latour, B. (1993). *Aramis, ou l'amour des techniques*. La Découverte.
Law, J. (1987). Technology and heterogeneous engineering: The case of Portuguese expansion. In W. E. Bijker, T. P. Hughes, & T. Pinch (Eds.), *The social construction of technological systems* (pp. 111–134). The MIT Press.
Lesage, F., & Natale, S. (2019). Rethinking the distinctions between old and new media: Introduction. *Convergence: The International Journal of Research Into New Media Technologies*, *25*(4), 575–589. https://doi.org/10.1177/1354856519863364
Levin, T. Y. (1999). Indexicality concrète: The aesthetic politics of Christian Marclay's grammophonia. *Parkett*, *56*, 162–169.
Lipartito, K. (2003). Picturephone and the information age: The social meaning of failure. *Technology and Culture*, *44*(1), 50–81. https://doi.org/10.1353/tech.2003.0033
Lovink, G. (2003). *Dark fiber: Tracking critical Internet culture*. The MIT Press.
Lucas, H. C. J., & Goh, J. M. (2009). Disruptive technology: How Kodak missed the digital photography revolution. *The Journal of Strategic Information Systems*, *18*(1), 46–55. https://doi.org/10.1016/j.jsis.2009.01.002
Lyon, D. (2019). *The culture of surveillance: Watching as a Way of life*. Wiley.
Marvin, C. (1988). *When old technologies were new: Thinking about electric communication in the late nineteenth century*. Oxford University Press.

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Matsuda, M. (2005). Discourses of keitai in Japan. In M. Ito, M. Matsuda, & D. Okabe (Eds.), *Personal, portable, pedestrian: Mobile phones in Japanese life* (pp. 19–39). The MIT Press.
McCammon, M., & Lingel, J. (2022). Situating dead-and-dying platforms: Technological failure, infrastructural precarity, and digital decline. *Internet Histories*, *6*(1/2), 1–13. https://doi.org/10.1080/24701475.2022.2071395
Menkman, R. (2011). *The glitch moment(um)*. Institute of Network Cultures.
Morozov, E. (2011). *The net delusion: How not to liberate the world*. Penguin.
Natale, S., & Balbi, G. (2014). Media, history, imaginary: The role of fantasies in different stages of media change. *Media History*, *20*(*2*), 203–218. http://doi.org/10.1080/13688804.2014.898904
Negroponte, N. (1995). *Being digital*. Knopf.
Niemeyer, K. (2014). *Media and nostalgia: Yearning for the past, present and future*. Springer.
Nunes, M. (2011). *Error: Glitch, noise, and Jam in new media cultures*. Continuum.
Parikka, J. (2012). *What is media archaeology?* Polity Press.
Parikka, J., & Sampson, T. D. (2009). *The spam book: On viruses, porn, and other anomalies from the dark side of digital culture*. Hampton Press.
Pinch, T., & Bijker, W. E. (1987). The social construction of facts and artifacts. In W. E. Bijker, T. P. Hughes, & T. Pinch (Eds.), *The social construction of technological systems* (pp. 17–50). The MIT Press.
Poster, M. (1995). *The second media age*. Polity Press.
Sangild, T. (2004). Glitch – The beauty of malfunction. In C. J. Washburne, & M. Derno (Eds.), *Bad music: The music we love to hate* (pp. 257–274). Routledge.
Scolari, C. A. (2023). *On the evolution of media: Understanding media change*. Routledge.
Sigurdson, J. (2001). Wap off – origin, failure and future. *The Stockholm School of Economics, Working Paper*, *135*.
Srivastava, L. (2008). The mobile makes its mark. In J. E. Katz (Ed.), *Handbook of mobile communication studies* (pp. 15–27). The MIT Press.
Starr, P. (2004). *The creation of the media: Political origins of modern communications*. Basic Books.
Sterne, J. (2003). *The audible past: Cultural origins of sound reproduction*. Duke University Press.
Sterne, J. (2012). *MP3: the meaning of a format*. Duke University Press.
Stevenson, M., & Helmond, A. (2020). Legacy systems: Internet histories of the abandoned, discontinued and forgotten. *Internet Histories*, *4*(1), 1–5. https://doi.org/10.1080/24701475.2020.1725854
Streeter, T. (2010). *The net effect: Romanticism, capitalism, and the internet*. New York University Press.
Vinck, D. (2019). Maintenance and repair work. *Engineering Studies*, *11*(2), 153–167. https://doi.org/10.1080/19378629.2019.1655566
Weber, H., & Krebs, S. (2021). The persistence of technology: From maintenance and repair to reuse and disposal. In S. Krebs, & H. Weber (Eds.), *The persistence of technology. Histories of repair, reuse and disposal* (pp. 9–25). Transcript.
Wozniak, S. E., & Smith, G. (2006). *Iwoz. How I invented the personal computer and had fun along the way*. Norton Company.

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