1

Media and Digital Technologies

Digital media have become part of everyday life. In order to understand the consequences of this, we need not only consider the technological features of digital media. We must also analyze the social, political, and economic contexts within which digital media have emerged. Technologies are not neutral, but have complex histories that weave together social, cultural, and political factors with technical and material possibilities. The social sciences have developed various approaches aimed at understanding the relation between technology and society, and the ways in which they influence each other and co-evolve.

1.1 The Digital Environment

Contemporary societies are marked by the omnipresence and pervasiveness of digital media. Through the mass diffusion of personal computers, smartphones, tablets and other mobile technologies, and an accompanying near-ubiquitous connectivity, in the last two decades digital media have entered into the daily life of ordinary people. Processes of mediatization, that is the increasing presence of media in all aspects of life, have pushed social theorists to propose that we live what Mark Deuze calls *media lives* (2012). The digital media environment that we live in is widespread, fluid, and highly efficient. Indeed we have come to take digital connectivity for granted. We only note its absence: when we are disconnected, it is stressful and problematic. Think of when your phone stops working as the train you are riding goes into a tunnel. Furthermore, the billions of microprocessors and computers diffused worldwide are used in a wide range of human activities, from agriculture to industrial production, services, entertainment, and education. Overall,

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the transformations introduced by digital technologies are changing the ways in which we produce and distribute information and knowledge, as well as the ways in which we work and socialize. Mediatization is indeed a process with far-reaching consequences. On the one hand, as media studies scholars Nick Couldry and Andreas Hepp put it, the term refers to "the increasing temporal, spatial and social spread of mediated communication": we are surrounded by more and more media technologies in all aspects of our lives, in many different contexts, and across time and space. On the other, the concept stresses "the social and cultural differences that mediated communications make at higher levels of organizational complexity," which means that the outcome of such processes goes far beyond human communication and invests all human relations (2017, p. 35). In sum, digital media have become so pervasive that the changes, challenges, and opportunities that they bring along assume a ubiquitous reach. Media theorist Felix Stalder describes this as the "digital condition," a state in which computer networks have become "the key infrastructure for virtually all aspects of life" (2018, p. vii). This deep shift means that we now need to rethink the significance of terms like "democracy," "participation," "work," "property," and "power" in the light of the transformations linked to the emergence of digital technologies.

The evolution of computers is part of the history of the information society, which began centuries ago with the idea that information about social and economic facts could be collected, stored, and calculated. But the history of the electronic computers and computer networks that constitute digital media goes back several decades too (see Sections 2.4 and 2.5). Yet some recent events were crucial to give shape to the internet and computers we know today. The spread of digital media has grown steadily since the 1980s. Since then, we have seen the diffusion of (relatively) cheap and easy-to-use personal computers, themselves an effect of the evolution of microprocessor technology. The introduction of the World Wide Web in the 1990s brought internet connectivity into most homes and businesses in the advanced economies. The 2000s gave us the collaborative web: software and online platforms that allow all users to produce and distribute digital content. More recently, mobile technologies such as smartphones and tablets have transformed the daily experience of the internet, further integrating digital media into the flow of everyday life. In 2018, in the US, Canada, Italy, and many other Western countries, about 90% of the population use the internet on a daily basis, and almost as many own a smartphone. Globally, the number of internet users has passed four billion, or more than half of the world's population. The spread of digital media has been explosive. From 2000 to 2018 internet users increased 10-fold, and the massive spread of smartphones

and internet use in areas like Asia, Africa, and South America in the last decade has changed the geography of the information society. China alone has 700 million internet users, and the rate of penetration has recently passed 50%. This challenges established assumptions about development and is rearranging the global role of some countries and areas of the world.[1]

The emergence and success of technologies that process information in digital formats have brought about profound changes in the way the media works. Thanks to the ability to integrate and interact with most other existing technologies, digital media have assumed a key role in the organization of communication and information flows. These changes have an impact on the overall *ecology* of the media. According to this metaphor, new life-forms like search engines, social networks, and mobile phone operators grow and prosper. They thrive on new survival strategies. For example, social media provide free services in exchange of user data. At the same time, older organisms adapt and change within this new ecology. Newspapers use social media to distribute their content and compete for reader attention. Political parties use the internet to experiment with new communication strategies. Governments exploit their power over digital infrastructures to enact new forms of censorship and social control. Law scholar Yochai Benkler (2006) has suggested that we have witnessed the birth of a new digital environment. This environment is marked by new possibilities, challenges, conflicts, and controversies. Among those there are issues related to copyright, ownership, and management of the technological infrastructure of the internet, organization of work, freedom of information and censorship, and social and political participation. The increasingly central role of digital media in the ecology of information and communication has made them an important political and economic battleground. In today's society, digital technologies come to mediate social relationships and are crucial to the construction of individual identities. The emergence of a digital public sphere, in the form of a multitude of platforms and practices that enable masses of people to collaborate in the creation of content and information, is a phenomenon with implications that go far beyond technology. This has inspired radically diverse visions of the future that this book will explore in the coming chapters. The rest of this chapter discusses the cycles of evolution of media, and lays the ground for an analysis of the socio-technical characteristics of digital media, including their infrastructural features. Finally, the last section provides an overview of some of the most important theories of the relation between technology and society.

1.2 New and Old Media

In early scholarship about the rise of digital media, the definition "new media" was used to describe information and communication technologies based on digital code. "New media" signified the set of media technologies that had emerged since the last decades of the twentieth century. This distinguished them from "old media," which was a definition used to identify traditional mass media like television, newspapers, or radio. While stressing such difference, one of the most influential theorists of the time, Lev Manovich, described new media not only in terms of their underlying technologies, but also through an analysis of their aesthetics, cultures, and media practices: their "language" (2001). Doing so allowed him to discuss the emergence of computer-based media as part of a long cultural and technological history which involves expressive forms such as cinema, press, or visual art, while stressing the new possibilities offered by digital media. Almost 20 years later, today's media studies scholarship would see equating digital media and "new media" as problematic in many ways. To be sure, digital media have certain common characteristics that distinguish them from analog media (see Section 1.3). Yet media that have emerged in the last 40 years or so are based on heterogeneous computing technologies and are very different from each other. Think of the radical difference between two digital technologies such as GPS navigators and digital cameras. Furthermore, digital computers have by now been around for many decades. They are not really "new" anymore. The term "new" also implied a linear view of the evolution of the media, which can lead people to overlook the context in which they emerge and think that they are somehow better than the "old" ones. Conversely, old media are sometimes held to be better than new media, as older technologies can be represented as more authentic. For example, many claim to have a deeper relationship with books than with e-books, or with vinyl records than with MP3 files.

Yet this does not mean that the difference between old and new media is uninteresting. For example, when studying media evolution, we must acknowledge that all media are "new" when they have just been introduced. The press is a dated technology by now, but at the time of its introduction it had a revolutionary impact on the transformation of modern societies. And yet today we tend to think of the press as a taken-for-granted "old" media technology. The notion of newness also usually entails certain visions of the future in which the "new" media play a key part. These visions can be hopeful or bleak. This has happened throughout history. It happened with the novel, with the telegraph, with movies, and with television. To some extent, such new media have changed the way in which people go about their everyday life, but often

the hopes (or fears) attached to them turn out to be exaggerated. Finally, when new media are introduced they do not replace old media, but rather integrate or change them. The introduction of television has not caused the disappearance of the newspaper. The introduction of the tablet did not cause the disappearance of the book. Rather, books evolved into different technological formats. This process of evolution, called *remediation*, entails competition as well as coevolution and cooperation among different media (Bolter and Grusin 2000). A practice, content, or format can be re-mediated by a new technology that mimics or reworks previous formats. For example, the design of some web radio receivers reproduces 1950s radio sets. Wikipedia mirrors and is structured like a traditional encyclopedia, so that cross-references between entries allow a non-linear reading path, although this is made possible via hyperlinking technologies rather than by manually turning the pages. Some social media look like the cut-and-paste fanzines of the 1980s, produced with scissors and Xerox copiers. After all, even the first printed books of early modern Europe resembled manuscripts. In turn, the e-book is technologically very different from the printed book, but readers will immediately recognize the common genealogy, anchored in common features like the pages, cover, or table of contents, which make the reading experience similar. Overall new media do not come out of nowhere, but rather evolve from existing practices and media technologies. The concept of remediation allows the recognition that the history of media is a continuous, non-linear process that can go in several directions, as old and new media continue to influence each other. For example, newer formats can provide content and aesthetics that are adapted in older formats: *Assassin's Creed* is a franchise based on a video game but its stories are expanded to a broader set of media, such as films, comic books, and novels (Veugen 2016).

If instead of individual media we focus on the more general aspect of the continuing development of communication technologies, novelty becomes an important factor. In fact, part of the experience of digital media lies in the continuous succession of rapid technological cycles that bring new gadgets, new applications, and new services to the market. This is important because the early stages of life of an emerging media technology are characterized by uncertainty about its role. New media are not immediately accepted as natural components of the social world, and their meaning is initially open and contested. This phase has been defined as the "identity crisis" of new media (Gitelman and Pingree 2003). After its introduction, the meanings and functions of a new technology are slowly shaped by existing patterns of media usage and by the habits and desires of new users, as well as by technological characteristics. For example, new media such as the telephone in the

mid-twentieth century or image messaging technologies in the early twenty-first century have both been met with anxieties about their role in the life of teenagers (see Section 3.6). The phase of crisis and novelty is resolved when a new technology becomes a mass consumer product. In a process of "domestication," the new technology is accepted in a society, it becomes everyday and understandable and tends not to cause rejection or fear anymore (Pantzar 1997).

If all old media were new at some point in their evolution, it is also true that sooner or later all new media are destined to grow old, fall behind, or be superseded by newer technologies. Some media may be abandoned, as happened to the phonograph or the telegraph. Some can even disappear and be forgotten, as the zograscope, an eighteenth-century device that used a lens to artificially provide depth to two-dimensional images; it now survives only in museums. However, often times media that seem to have disappeared leave traces behind, or are updated onto new media formats and technologies. Contemporary 3D media are indebted to a series of previous technologies, from the zograscope to the red and cyan glasses used to obtain anaglyph stereoscopic effects. In other cases, a medium can instead survive in niche markets or at least partially come back into fashion, like vinyl records in the 2010s. Many old media can be seen as "undead": their imminent death is announced or assumed but they refuse to disappear. This is the case of the printed book, which was thought to be doomed by the emergence of e-books, or the analog radio, which was to be killed by podcast and streaming technologies. Instead, both have experienced a resurgence in the last few years. Finally, abandoned media can be brought back to life by users who attach new meanings to them, somewhat making them "new" again: we could call these "zombie media." Media archeology studies once forgotten technologies, analyzing how they fell into disuse and how they are revitalized, often by means of artistic practices or user reappropriation (Parikka 2013). For example, the Gameboy, a portable video game console produced by Nintendo which had widespread commercial success in the 1990s, is now used to produce "8bit" techno music through do-it-yourself musical software.

1.3 Digital Media

While it is important to acknowledge that they are not completely different from older media forms and technologies, one of the defining technological characteristics of contemporary media technologies is that they are digital. This core technological feature brings with it a number of other key characteristics that distinguish them from analog media. In

turn, these features are critical to understanding the ways in which digital media impact overall social dynamics, as well as economic and political relations. This book adopts a broad definition of media, as it includes many technologies that share the ability to mediate human activities, even beyond communication practices. Personal computers, mobile phones and smartphones, tablets, digital cameras, video game consoles, telecommunications satellites, credit cards, MP3 players, RFID (radio frequency identification) chips, televisions, servers, browsers, social media services, or self-tracking gadgets are all based on the processing of information in digital formats. This means that they carry information represented by a numeric code and then transform it into human language. This code is "digital" in the sense that it is based on the binary distinction between two symbols, 1 and 0. Analog media instead rely on continuous scales, like the scale of colors that can be represented by the chemical composition of a piece of celluloid film, or the letters of the alphabet that can be rearranged into words and expressions. Thanks to their binary code, digital media can carry information very efficiently and, most importantly, they can transform any analog code into their own binary language. For example, a digital camera converts an analog signal (the light entering the lens) into a digital code (the file in which the image is stored in the camera). Conversely, an MP3 player transforms a digital code (the MP3 file) into an analog signal (the music that streams to the speakers or headphones).

Yet in order to lay the ground for an understanding of the social implications of these set of technologies, we need to go beyond these mere technical aspects. Building upon a number of media theorists, we propose a list of some of the defining features of digital media: they are of course digital, but also convergent, hypertextual, distributed, pervasive, algorithmic, asymmetric, and both ephemeral and permanent.

1.3.1 Convergent

On digital media, different types of content (written, audio, visual, etc.) converge onto a single technical platform. The personal computer, for example, is at the same time a television set, a typewriter, a radio, a telephone, and countless other machines. Thanks to the digitization of information, computers are "universal machines" that can mimic other machines. This means that the production and consumption of different kinds of media content (film, text, music, etc.) no longer presupposes different kinds of hardware (projectors, books, stereos) that use different codes and technological supports (celluloid, paper, vinyl), but can happen on a set of machines, such as computers, digital cameras, or smartphones, where all these different kinds of content are represented by means of the

same binary code. This goes beyond the technical level and implies a cultural convergence between producers and consumers of media content (Jenkins 2006).

1.3.2 Hypertextual

A hypertext is a text that embodies references to other texts or other forms of content. On the World Wide Web, hypertexts are a fundamental feature that link one webpage to another. This way, digital media allow users to enjoy content in a non-linear fashion. On a webpage you do not have to read contents in a linear way, as you would with a book. Instead you can customize your reading experience, jumping from one text to another, to a video, to a Wikipedia entry, and then back to another webpage or app (Manovich 2001).

1.3.3 Distributed

Traditional mass media are centralized and unidirectional: information is transmitted from a central facility, such as a newsroom, to a large audience of readers. Digital media are instead characterized by a distributed model. Indeed the internet is composed by thousands of interconnected nodes rather than a few core hubs (see Section 1.4). Furthermore, the spread of cheap computers, tablets, and smartphones, along with widespread internet connectivity and software that foster the production of user-generated content, has allowed users to take a greater role in the creation of content. The resources for information production and distribution are at least partially in the hands of individuals who communicate horizontally via media platforms (Benkler 2006).

1.3.4 Pervasive

Mobile technologies, such as mobile phones, smartphones, and tablets, give a pervasive or even ubiquitous scope to digital media (Deuze 2012). In fact they allow people to access and post information at any time and from any location, and companies to track and surveil user behavior at an unprecedented scale. This makes it possible to produce and exchange information specifically related to the place and time of use: to upload information on a shared map, for example Google Maps, or to communicate and interact with those who are attending an event in a particular location, for example textually via Twitter or with a video via Periscope. Mobile technologies have the ability to modify and extend our social networks. In this sense, they are not only a means for creating abstract communities, but also a tool to strengthen social ties connected to specific physical locations or territories.

1.3.5 Algorithmic

Most digital media services and technologies are underpinned by algorithms. These are programs that follow procedural logics in order to generate specific outputs. The role of algorithms is made possible by the fact that digital technologies "datafy" behaviors and interactions, or transform them into data that can be analyzed and then used to make choices. Algorithms bring with them a promise of objectivity, as they are supposed to be accurate and free from bias or external influence (Gillespie 2014). And yet the study of their logics and effects has found that, like any human technology, they are not neutral (see Box 3.2). The term "algocracy" describes situations in which power is exercised by algorithms that affect action by making some kinds of interaction or organization possible and blocking others (Aneesh 2009). For example, Facebook's algorithms analyze the activities of users and estimate which content is more likely to generate interactions if shown on their timeline. Software, in sum, structures all activities mediated by digital technologies. Many algorithms are based on machine learning technologies. This means that while using a certain service, individuals contribute to training algorithms.

1.3.6 Asymmetric

Digital media are highly commodified, as the biggest services are owned by a handful of gigantic corporations. In this landscape, power is unevenly distributed, as individual users do not have access to the information these corporations collect about their interactions and behaviors, although such information shapes the way users interact with a certain platform or service (Rosenblat and Stark 2016). Users do not know the algorithms that underpin the functioning of Tinder, and need to guess how to influence the way the platform decides to which other users one's profile will be suggested as a possible match. Indeed digital media tend to be perceived as black boxes that obscure the underlying operations that structure user experience. In many cases, users do not receive any economic benefit from their participation in such services. Finally, digital media are subject to pervasive surveillance and can be used for social and political control (Zuboff 2016).

1.3.7 Ephemeral or Permanent?

Different media have different duration and persistence. The paper book can be stored for centuries; inscriptions on stone last for millennia. In the case of the information produced and transmitted by digital media, its duration in time depends on several factors. The hard disks used to store data in digital form tend not to last more than one or two decades. The

softwares that transform human language into binary code are quickly replaced by new programs. At a stage of human history in which knowledge is archived and stored on digital media, these problems assume a central importance for institutions like libraries or archives, whose mandate includes the preservation of documents for future generations. At a different level, digital communications like messages, chats, or pictures are perceived as being highly ephemeral (Grainge 2012). However, copies and traces of these communications can be duplicated and stored for years without the author's knowledge, by the companies that manage digital communication services, by government agencies, or by other individuals.

Box 1.1 The Materiality of Digital Media

The digitization of information and media content has not made the "stuff" of technology disappear. Digital materialism is a recent object of study for the social sciences (Casemajor 2015), which have been paying renewed attention to the physical characteristics of computer and network technologies, such as cables, microprocessors, routers, or towers for mobile telephony. Studying the materiality of media makes it possible to analyze the movement of so-called digital artifacts, the objects made of bytes that make up the content of digital technologies. Furthermore, paying attention to the materiality of digital technologies permits focus on the working conditions and the ecological aspects that make the media system possible. Manufacturing, transporting, and marketing digital goods is a global enterprise that mobilizes millions of workers and makes use of a large amount of raw materials and natural resources.

The ecological impact of digital technologies is often overlooked or ignored. Computers, tablets, game consoles, cellphones, and other digital technologies contain raw materials that require large energy resources to be mined and processed, and leave behind a trail of ecological degradation (Cubitt 2016). Digital technologies have given rise to an industry of recycling that extracts precious metals from decommissioned objects and sells them back to manufacturers. However this phase is also polluting, as it produces toxic wastes and consumes a large amount of energy. The digital industry mobilizes natural resources on a global scale, from raw materials extracted in Africa or South America, via the gigantic factories that assemble digital gadgets in Asia, up to end-users around the world, and then back to landfills, often in poor countries. For example, ore minerals like neodymium or coltan provide essential components for computers and smartphones and are often mined in African countries or in China, with environmental and labor standards well below those of Western countries. Planned obsolescence is a widespread practice that

contributes to such request for resources. Computers and other commercial products are designed to have an artificially short lifespan, thus creating a continuous demand for raw materials (Rivera and Lallmahomed 2016). There is also a cultural obsolescence, as the continuous marketization of new models, for example of iPhones, pushes consumers to replace functioning phones in order to catch up with innovation cycles.

While charging a computer or a smartphone does not involve a large consumption of electricity, the data centers that store and distribute the information that we produce or download are important consumers of energy, in particular for cooling the processors. According to estimates produced by Greenpeace, internet infrastructures consume around 7% of global electricity and produce a substantial fraction of global CO_2 emissions. The growth of energy consumption is due mainly to the popularity of particularly energy-intensive services, like video streaming, which represents almost 70% of internet traffic. On the other hand, major internet companies are taking steps to transition toward renewable energy (Greenpeace 2017).

1.4 Infrastructures and Platforms

The technical characteristics that underpin digital media reach global significance through the infrastructures that compose digital networks. Understanding the architecture and design of the "plumbing" of digital media is crucial for the study of the actors and communities that populate them (Musiani 2012). According to the American law scholar Lawrence Lessig (2002), "code is law." With this formula, Lessig suggested that the architecture of the different layers of digital networks is not neutral, but rather has the power to shape the behaviors of their users. As described in the next section, this is true of all technologies. Yet digital media are characterized by a set of specific and distinctive features. Unlike broadcast media, such as a television station or a newspaper, the internet is a communication system that is not based on a single central hub. Instead it is composed by a series of interconnected nodes. Indeed the internet is a distributed structure shaped as a network, which means that information is physically located on thousands of computers called servers, to which other computers connect to request the information they want, such as that making up a website. The shutdown of a server does not shut down the network as a whole, but only makes the specific information contained there inaccessible. The internet is also a redundant network: information is disassembled into packets that can separate and travel on many different paths. Therefore, the interruption of a specific communication line

does not affect their transfer. Furthermore, the internet is an open system: anyone with access to a telephone or broadband line can access it, either with a personal computer or another device. Anyone can create a new server. The standards and the languages used to transfer information on the web are open and available to anyone who wants to use them.

These infrastructural features are based upon a global governance system (Mueller 2010). The World Wide Web Consortium (W3C) is an international organization that deals with web standards, with the task of keeping them open. Each website has an "address" where it can be reached, that is, an alphanumeric code that identifies the site and allows users to get to the server on which the information that constitutes it is stored. These codes are called domains and are managed and awarded by an international organization, the Internet Corporation for Assigned Names and Numbers (Icann). There are national domains, such as .it, .ca, or .se, or others that define the type of activity carried out by the site, such as .com for commercial activities or .org for associations and nonprofit organizations. The circulation of information is based on the principle of network neutrality. This means that internet providers cannot discriminate information packets according to the content or origin. Companies that produce content cannot pay providers to pass their information more quickly: the download speed of a site relative to another depends on the source from which it is downloaded and not by the provider's decision to assign it a privileged status. This principle is constantly under attack by connectivity providers who could generate greater profits by charging fees for the privileged treatment of some information providers (see Box 4.3). For example, major corporations such as Netflix would be willing to pay internet providers to speed up their content at the expense of other websites.

To understand digital media it is important to differentiate the levels that compose them. As argued by Yochai Benkler, digital media and network technologies are composed of different "layers," that are related to one another but have their own peculiarities, problems, and challenges (2006). The first is the physical layer: It is composed of material components such as the frequencies that are used for radio broadcasts, and the cables, computers and servers, satellites, and telephone lines that make up the internet. The second is the logical layer, composed of the software, standards, and protocols that underpin digital networks: For example, the TCP/IP protocols that allow for the transfer of information on the internet, or the software that manages an online platform, social network, or database. The third is the content layer, that is, the humanly intelligible information that is produced and exchanged within the network: for example, the text of an article in an online newspaper, the content of an email, or a picture posted on a social media. Finally, there is

also the legal layer, the set of national and international laws and policies governing the functioning of digital networks and the behavior of their users. This level is related to the other three.

Another important focus of studies of digital media is represented by one component of digital media infrastructures: *platforms*. From a technical viewpoint, a digital platform is nothing else than a software environment in which a set of programs can be executed. In this sense both a browser such as Firefox or an operating system such as Android can be seen as platforms, as they are environments for other applications – think of a Netflix movie watched on Firefox, or an app downloaded onto an Android phone. Media scholars researching social media platforms have analyzed the way these services use algorithms to organize and mediate the interactions that are carried out through their interfaces. For example, Tinder is a platform that organizes the search for romantic and sexual relationships by analyzing and coding user preferences; Instagram uses the same principles to mediate the circulation and exchange of images. In this sense, platforms are stages that allow users to perform specific activities (Gillespie 2010) while shaping how such activities can be carried out. Studying platforms requires going beyond an analysis of their software. Media theorist José van Dijck (2013b) has proposed that we look at platforms both as cultural constructs, thus highlighting the way they shape sociality and cultural production (see Chapter 3), and economic structures, therefore focusing on problems of ownership and business models (see Chapter 6). Theories of the relation between technology and society can help understand how these phenomena unfold.

1.5 Technology and Society

The social sciences, like sociology and anthropology, have developed theories that allow for an in-depth analysis of the link between technology, media, and society. These can help us develop a critical view on the role and evolution of digital media. Indeed, the social sciences aim at questioning widespread views and common sense in order to arrive at more deeply documented theories that take the complexity of social phenomena into account. The most important theories of the relation between technology and society have developed from the study of the technologies that were predominant in the twentieth century (Sismondo 2011). The emergence of digital technologies poses new challenges that oblige us to rethink and renew these approaches. Yet these critical tools remain essential to studying the relation between technology and its social and political contexts.

Some theories of the relation between technology and society see technology as an exogenous factor, that is, an external force that develops independently of social phenomena. Here the important thing is not so much how a particular technology has developed, but what function it performs in relation to a society. In this view, computers are functional to the aims of the institutions or social groups that use them. A similar approach is *technological determinism*, which understands technology as an independent force that can determine the development of a society. From this perspective, the characteristics of digital media affect the way in which individuals interact with each other, giving rise to particular forms of social organization. They are also seen as responsible for changes in economic structures or business models. Some form of technological determinism is widespread in common-sense accounts, such as policy initiatives relating to digital technologies or journalism describing the changes that they bring about. For example, it has been common for some time to attribute the upheavals of the 2011 "Arab Spring" to the spread of social media technologies like Facebook and Twitter (see Box 5.2). More or less pronounced versions of technological determinism can be found also in social theory. For Karl Marx, technologies and relations of production are strictly intertwined. Trivializing his vision, we could say that the steam engine was an important factor that contributed to the emergence of an industrial capitalist society. Similar positions were taken by more recent media scholars. According to Marshall McLuhan's famous motto, "the medium is the message." McLuhan, perhaps the most influential media theorist of the 1960s, thought that the "media form" of communication technologies used in any given society had a decisive impact on its development, regardless of the content of the communications, that is, the message they transmitted. One of his most famous books, *Understanding Media*, opens by stating that "the personal and social consequences of any medium – that is, of any extension of ourselves – result from the new scale that is introduced into our affairs [...] by any new technology" (1964, p. 1). To simplify this position, we could say that the most important factor is not what is transmitted on television, but that the technology of television itself has been introduced into people's life, therefore allowing the transmission of moving image and sound regardless of space and time bounds. The determinist perspective remains one of the main ways used to interpret the social and economic dimension of digital media. It would be simplistic to think that new technologies do not have an impact in and by themselves: inventions like the wheel or means of communicating across distances, like the telegraph, have influenced deeply the development of human societies. However this view is too

one-dimensional. It does not take adequate account of complexities that mark the relationship between technology and society. For example, technologies are often used in a different way and for different purposes by different social actors. The technological determinist approach, however, can be tempered by recognizing that, with their values and choices, individuals and social groups help to determine the role played by technology.

An opposite perspective is *social construction of technology*. This theoretical approach suggests that the development, structure, and significance of a technology depends on the strength, needs, and values of the social groups that promote and design it (Bijker 1997). The construction metaphor implies that the evolution of a technology is something in which people participate actively. This approach emphasizes how the design and meaning of technologies depend on the social processes from which they originate and by which their development is shaped. According to this perspective, the open and distributed architecture of the internet is not emerging from a vacuum, but rather due to the values and choices of the scientists and engineers who have designed its network structure and standards. For example, the political choices of programmers and hackers belonging to the counterculture of the 1970s and 1980s, influenced the decision, again by scientists, to release the standards and codes on which the web runs as open formats, so that anyone could use and improve them. Other actors would have built a network different from that which we know today. Indeed, according to the definition of Science and Technology Studies theorist Langdon Winner (1980), technologies are not neutral but rather have a "politics." The way they are designed or the decision to adopt them in different contexts might strengthen the agenda of a particular group. This approach leads to the question of why a certain technology has assumed a certain form instead of another, what are the actors who have contributed to its development and evolution, and why it has been chosen over competitive technologies. Others have focused on the "bias" that certain actors can build into a certain technological system (Friedman and Nissembaum 1997). For example, as the values of the engineers who design an algorithm play a role in their technical choices, this algorithm can reflect such values by favoring or discriminating against certain individuals or groups (see Box 3.2). Similar approaches also recognize the active role of users of technologies. Often early adopters or new users of a new technology develop practices that were never intended by the people who designed and commercialized it, or assign new meanings to a certain technology and thus contribute to shaping it.

Box 1.2 Users Matter

In studies of the relation between technology and society, the user is a crucial object of research. Indeed the user represents the human factor interacting with the machine, and must not be overlooked: "users matter," to use the title of one of the most important books on the subject (Oudshoorn and Pinch 2003). In this perspective, consumption is a complex cultural activity not only related to purchasing, but also to how users repurpose, modify, and resist technology.

On the one hand, the design of technologies has the power to "configure" users (Woolgar 1990). For example, the lack of interoperability of the software and standards of an Apple laptop pushes its users to interact only with gadgets and services commercialized by the same company, such as iPhones, iPads, or iTunes. This constrains and guides the user's online behavior. In turn, users are not just passively configured by technologies, and can contribute to shaping digital media in ways that often go beyond those imagined by those who designed and programmed a specific platform. One example of this is the practice of jailbreaking, that is, the removal of limitations built into a computer system, for example Apple's iOS operating system that runs Apple products. Thanks to software tools that provide access to the operating system, these practices allow users to install applications that are not officially provided by the manufacturer (Magaudda 2010). Users' power to reconfigure digital media also has to do with the degree to which technologies are open to tinkering and transformative interventions. Technologies are indeed marked by different levels of openness (see Chapter 4). They can be designed to be accessible and easily transformable, or may have blocks or obstacles that prevent users from changing a system or using it for unintended purposes, as is the case with Apple products.

Scholars have also noted the existence of "superusers" with specific technical skills and professional positions. In the case of digital media, these would be figures such as software engineers, system administrators (sys-admins), or hackers (Brunton and Coleman 2014). As they design and maintain digital networks and algorithms, these users occupy a privileged position. Their cultures and practices are thus particularly interesting for the study of digital technologies. Finally, non-users also matter: the individuals who resist or reject technologies tend to be invisible to scholars who study digital media, but their motivations and choices can shed light on the relation between technology and society (Wyatt et al. 2003). For example, deciding not to participate in social media communication can be a form of resistance to the widespread corporate surveillance carried on within such platforms (see Box 5.3).

Finally, some social theories speak of the *co-production of technology and society*. In this framework, both the above perspectives, which state that social forces shape technologies or that technologies determine social development, are seen as limited. Rather, society and technology influence and shape each other in a process of coevolution where one level continuously influences the development of the other, and vice-versa (Jasanoff 2004). These, and other, theoretical approaches are updated and adapted to the study of digital media and their specific characteristics. For example, sociologists use the term *affordances*, borrowed from design and engineering, to describe how technologies both enable and limit what users can do with them. As Donald Norman put it, "affordances specify the range of possible activities" (1999). New technologies can provide solutions and enable new forms of action, but at the same time this is only possible within the boundaries of the technology itself. Platforms like Twitter or wiki softwares are enabling technologies that allow users to create certain types of actions within specific limits. Twitter allows temporary publics to join an event and follow and comment on it. But at the same time this needs to be done within a format of messages that does not exceed a certain number of characters. This way, Twitter drives users to follow an established pattern that derives from the constraints imposed by the platform.

Note

1 For up-to-date data on the spread and use of digital networks see the Internet World Stats, www.internetworldstats.com.