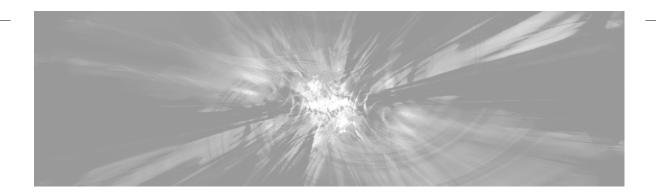# Part I

Introduction and Framing

1

The Digital Universe: A "Quick-Start" Introduction

Consumer electronic products have become so complex and feature-rich that it is now commonplace to find a brief "quick-start" guide or poster that accompanies the 100+-page manual for a new digital television set, personal computer, or mobile phone. Manufacturers understand that impatient consumers (and that includes most of us) generally skip reading the manual first – that is, until a non-intuitive feature stumps the user. Then we are likely to call the helpline instead of referring to the manual, much to the exasperation of call center agents around the world. On a positive note, quick-start guides provide enough basic information so that we can successfully install the software or power up the device and quickly begin using it.

This brief introduction serves as the "quick-start" guide for this book, which is *not* a manual or a how-to text for functioning in our digital world. Rather, this book provides a tour of the digital universe, tracing the evolution of the age of information from its inception to the crucial period in which we live today.[1] Digital universe is a term that describes a global human environment saturated with intelligent devices (increasingly, wireless ones) that enhance our ability to collect, process, and distribute information. A key purpose of the book is to stimulate readers to think critically about the pervasiveness of information and communication

technologies (ICT) in contemporary societies and how they affect our daily lives. The digital universe that we inhabit is complex and becoming more so as technology evolves and becomes more ubiquitous. "Ubiquity" is a key term that will be used frequently throughout the book – it means to be present in every place, or "omnipresent." It is often used as part of a commonly cited technology term, "ubiquitous computing," that describes an environment where computers and intelligent devices are omnipresent. This describes the future of the human environment in societies around the world.

We live in an interesting period in human evolution due to the diffusion of information and communication technologies. The future of machine-assisted communication and related developments in information-processing and artificial intelligence hold great promise for – as well as potential hazards to – human well-being. Information technologies play a central role in when, where, and how we communicate with each other, and their centrality will increase in the future. These technologies are now pervasive in our lives at work and at home, and have blurred the boundaries between these locations to the point where they are often indistinguishable. Digital citizens are connected and "linked in" 24 hours a day – seven days a week. Lewis Mumford made the observation that any widely adopted technology tends to become "invisible" – not in a literal way, but rather in a figurative sense.[2] Television and computer displays have become so ubiquitous that we don't think twice about seeing them in classrooms, airports, taverns, and certainly in the workplace. At times on a university campus it appears that everyone has a mobile phone and is busy either texting a friend or talking with them. This would have been a remarkable sight in 1995, but today it is so commonplace that few notice. We are surrounded by telematic devices to a degree that would have been unimaginable in the 20th century, and they will become even more pervasive as they become more powerful and useful in the 21st.[3]

My hope is that in the process of reading this book you will become a more critical observer of the social use of ICTs, that you will assess the positive and negative consequences of using them, and that you will gain new perspectives in the process that will add richness and depth to your knowledge of human communication and intelligence.

Three Types of Digital Literacy

Stuart Selber provides a useful model for computer literacy that we might apply to our study of the digital universe. He defines three distinct types of literacy (see Table 1.1).[4] First, people in the teleconnected world

Table 1.1   Three types of computer literacy

Category	Metaphor	Subject position[a]	Objective
Functional literacy	Computers as tools	Individuals as users of technology	Effective employment
Critical literacy	Computers as cultural artifacts	Individuals as questioners of technology	Informed critique
Rhetorical literacy	Computers as hypertextual media	Individuals as producers of online content	Reflective praxis

[a] Note that in Selber's text he refers specifically to users as "students." I prefer the term "individuals" as it describes a much larger group – all of those living in the Digital Universe.
Source: Modified from S. A. Selber, *Multiliteracies for a Digital Age* (Carbondale, IL: Southern Illinois University Press, 2004).

should have a **functional literacy** with computers and software as tools to be used in daily life. In the journalism department at the university where I teach computer-mediated communication, we devote extensive time using expensive hardware (and constantly updated software) to teach prospective journalists and communicators how to use these digital tools. In fact, much of what we term computer education around the world is focused on teaching hardware and software usage. However, Selber makes the astute observation that this type of education provides only one aspect of the literacy that humans need to function in a world filled with digital technologies; digital citizens should also be critically and rhetorically literate.

Becoming Critically Literate

The second category in Selber's model is **critical literacy.** It assumes the social embeddedness of technology in all networked global societies and highlights the cultural, economic, and political implications of its use. Critically literate users are "questioners of technology" and its applications, and they examine both the positive and negative implications of technology adoption. This is a key theme in this book and an essential aspect of becoming an educated user of technology.

Positive affirmations of information and communication technologies are omnipresent. Hardware manufacturers, software producers, consumer electronics retailers, and the marketing infrastructure that promotes these products and services all ensure that we are aware of their positive attributes. When an innovative information or communication technology is introduced, the advantages are widely touted as part of the marketing campaign. The attributes are often focused on improving the speed of telecommunication, making an information-processing task more efficient, or a combination of these two factors. As consumers adopt these products, the negative consequences are often slow to emerge.

Selber's critical-cultural perspectives of ICT are focused on the examination of hegemonic power relations in society. These perspectives are significant, especially in terms of studying the ramifications of the digital divides that exist between those who have access to information and those who do not. Economic and political perspectives are also useful in studying technology standardization decisions, among other key policy issues. However, I encourage readers to expand their critical perspectives beyond the economic and political to examine fundamental issues of human communication and its automation. For example, how does the mediation of communication (putting a machine in the middle) affect human expression and discourse? Are humans losing a key aspect of the oral communication tradition valued by scholars such as Harold Innis – or has it been repurposed by the mobile phone and the video camcorder? How have communication technologies affected human storytelling traditions and the stories we tell? The critical component of digital literacy is thus focused on the social effects of the use of information and communication technology. It is a rich field of study that encompasses consumer behavior, human psychology, political science, language, philosophy, economics, and human – computer interaction. Some of the most interesting questions about the human use of technology are investigated by social and computer scientists in these fields. In this text we examine the perspectives of critical observers of technology including Harold Innis, Lewis Mumford, Jacques Ellul, Marshall McLuhan, and Bill McKibben.

One of the more perceptive critics of the social use of technology is the late Dr. Neil Postman, a New York University professor, semanticist, and widely read social critic. Postman is the author of *Technopoly*, an insightful critique of the role that technology plays in advanced information societies.[5] His critical perspectives will be addressed in subsequent chapters, but a few key points are relevant here. For Postman and his critical colleagues, knowledge of the history of the development of

technology is essential. One cannot predict the future development trajectory of any information or communication technology without understanding its evolution to the present. The history of computing technology is filled with fascinating stories of how "computers" evolved over time from what used to be a human profession to chips found in billions of intelligent devices. While this text is not a comprehensive history of the evolution of ICT from the telegraph to the present day, I have provided the necessary background to comprehend the social context of these technologies and their effects. It is not ironic that studying the history of the evolution of information and communication technology is inherently humanistic. Stories about the development of telegraphy, telephony, television, and the Internet are fundamentally about human creativity, altruism, greed, and ambition. This historical background is presented as needed in a non-linear fashion that you are likely familiar with in locating information online.

Rhetorical Literacy

The third type of digital literacy referenced by Selber is **rhetorical literacy.** In this context digital technologies are conduits for "hypertextual media" and individuals are viewed as "producers of technology." This viewpoint describes the world of what is termed Web 2.0 today and Web 3.0 of the near future. We take the power of hypertext and hypermedia for granted in a world where they are found in all online environments. The ability to seamlessly and easily link related content online has transformed the human processing and distribution of information.

   The concept of linking information and building webs of knowledge was espoused by Belgian bibliographer Paul Otlet and integrated into his Mundaneum project in Brussels in the early 20th century.[6] Additional detail is provided about Otlet and his ideas in Chapter 6; however, an introduction is appropriate in the context of rhetorical literacy. Otlet's vision was to create a massive catalog of all human knowledge and creative work and then provide access to it using electrical communication. An inquiry from a user on any topic would be directed to the Mundaneum in Brussels by telegraph or telephone, where the staff would access millions of index cards (much like a library card catalog of that era) to locate the answer. The return response to the requester was communicated by telegraph or telephone. Otlet's dream in the 1930s was to use a then-new technology known as television to

relay the information (with related visuals) back to the requester. His visionary scheme exists online today in the form of Wikipedia, Google, and the Web.

Vannevar Bush in 1945 expanded on Otlet's Mundaneum concept with an idea for an electromechanical system for linking information (both textual and visual) in his Memex.[7] The Memex would have recorded and stored information on the then-new medium of microfilm, but the unique concept in Bush's device was a system of switches that would record information about the linkages made between various forms of related content. He termed these linkages "associative trails," and the concept was a harbinger of what is known today as online hypertext. The flaw in Bush's concept was the lack of a universal cataloging system similar to Otlet's that would allow random access to the information sought. Bush's "As We May Think" article in *Atlantic Monthly* and *Life* magazines was very influential in shaping the information-access dreams of a generation of computer scientists in the mid-20th century.[8]

Among them was information scientist Ted Nelson, who coined the term "hypertext" in the 1960s as a means of describing "branching and responding" textual links between related information.[9] As part of his Project Xanadu[10] to make all human information accessible to all on Earth, he also described "hypermedia," which is related content not constrained to be text, or what we know at present as "multimedia." In the early 1990s Tim Berners-Lee used the fundamental concepts of hypertext and hypermedia to construct his "Mesh" system of linked documents that evolved into the World Wide Web.[11]

In the era of Web 2.0, citizens of the digital universe are not just passive downloaders of digital online media, but increasingly are active producers of new content. This video, text, music, art, and sound content may be digitized and uploaded to the Web as linked hypermedia. The creation and communication of user-generated content (UGC) online has transformed a digital universe dominated by computer scientists and highly specialized Web developers into a global society where anyone can publish anything – that governments will allow.

Cybernetics

Another key aspect of digital literacy is deciphering the source of key terms related to information and communication technology. The archaic meaning of "communication" was to literally hand a message from person

to person, as would a messenger in ancient Greece. One might think that "broadcasting" applies only to radio and television, when its etymology is derived from an agrarian term meaning "to sow." Before the invention of mechanical planting machines, farmers would walk through their fields and "broadcast" the seeds for a new crop by scattering them by hand. Today electronic messages are "scattered" through society through the air by phone, radio, and television and via fiber-optic cables on land and under the sea.

A key term for the digitally literate is "cybernetic." It is derived from the Greek term "kybernetes," meaning a pilot, steersman, or governor.[12] The modern derivation is that cybernetics involves feedback mechanisms providing command-and-control functions in closed systems. Cybernetic perspectives assist in understanding complex systems that include circular causal chains that make up feedback loops that regulate the functioning of a system. The study of cybernetics applies to many diverse disciplines, but the focus in this text is on its relevance to information and communication systems.

The root "cyber" has been embedded into many commonly used terms involving ICTs, such as "cyberspace" (e.g., the digital universe), "cyberpunk" as a style of postmodern literature, and "cyborg" to describe a bionic blend of human and machine. Cybernetics should not be construed as applying only to machine-based systems. All humans rely on cybernetic feedback loops in our bodies to manage vital functions such as respiration and blood circulation – and especially for communication with others.

We learn how to acquire new digital knowledge and skills through elaborate feedback loops with friends and family and with formal instruction. You try your hand at taking digital photos and then sharing them online with friends. You receive useful feedback about your photographs and modify your image acquisition and processing skills accordingly. In a Web 2.0 universe the feedback loops may be immediate and personal ("I don't like my picture taken at the party last weekend – please delete it") or it may be distant and more impersonal (bidding on a digital camera on eBay). These interactive mechanisms are at the heart of related Web 2.0 technologies such as Wikipedia. With social networking and other Web 2.0 tools you can expand your feedback options and use them to acquire new knowledge and skills, especially those concerned with new telecommunication technologies. This text provides the background needed to understand the evolution of these technologies and then encourages you to think critically about how they affect human life today and in the future.

Navigating this Text

This book is divided into five main sections:

Part I. Introduction and Framing – Chapters 1, 2, 3
Part II. Internet and Web History – Chapters 4, 5, 6
Part III. Telecommunication and Media Convergence – Chapters 7 and 8
Part IV. Internet Control, Cyberculture, and Dystopian Views – Chapters 9, 10, 11
Part V. New Communication Technologies and the Future – Chapters 12, 13, 14

As noted above, this text is written for non-linear access so chapters can be read in random order if desired. However, it is probably best to read the Moore's law and critical perspectives chapters (2 and 3) first, since key concepts introduced there are elaborated upon in subsequent chapters. Also, the history chapters (4–6) will be more coherent if read in sequential order.

Chapter 2 defines Moore's law and explains its centrality to technologies in the digital universe. Its implications for telecommunication, ubiquitous computing, and intelligent devices are examined in the context of their effects on daily life. The chapter concludes with thoughts on the sustainability of Moore's law in this century. Chapter 3 provides the critical analysis of the digital universe that was alluded to in Selber's literacy model. The perspectives of critics of technology such as Jacques Ellul and Neil Postman are examined in regard to their application to information and communication technologies. The pro-social and pathological effects of living in the age of information are discussed – with an emphasis on the role that speed and efficiency play in the adoption of new communication technologies.

Part II is focused on the creation of the Internet and the World Wide Web. Chapter 4 reviews the origins of the Internet in the Cold War and the influential role that computer scientist J. C. R. Licklider played in its development. The central role of the US Department of Defense in creating the Advanced Research Projects Agency (ARPA) and its ARPANET highlight the controversy over the motivation for developing the first nationwide data network. Chapter 5 analyzes the evolution of the ARPANET into the Internet between 1980 and 1990. The contributions of key innovators such as Vinton Cerf and Robert Kahn (developing TCP/IP and other key network protocols), Ted Nelson (the concept of hypertext as a linking tool), and Doug Engelbart (creating interface

technologies) are discussed in the context of the creation of the global Internet. Chapter 6 introduces Paul Otlet and his creation of the Mundaneum in Belgium between 1910 and 1934 – a precursor of the World Wide Web 60 years before its creation. The role of Tim Berners-Lee is examined in his conceptualization of the merger of hypertext, TCP/IP, and a domain name system into a universal document accession system he called "Mesh" (and the world now knows as the Web). The chapter concludes with an analysis of what we call Web 2.0 and how it might evolve in the coming decade into Web 3.0.

Part III begins with Chapter 7 and a review of the development of telegraphic communication systems in Europe and North America and their linkage via undersea cables. These quickly spanned the globe and led to the concept of a "wired world." As the wires were converted from copper to fiber-optic cables in the past 20 years, these often overlooked connections made possible the global Internet. The "flat world" described by Thomas Friedman is defined by these connections and how they facilitate the role of telecommunication in outsourcing digital work and in the creation of global teams by public and private organizations. Chapter 8 focuses on digital convergence in the shift from analog to digital media. The benefits of media convergence are examined, along with its negative effects on existing media such as newspapers and radio and television broadcasting.

Part IV begins with Chapter 9, on the battles over public and private control of the Internet. The role of e-commerce is studied in the context of this struggle for control over the past 20 years. In Chapter 10 we examine global cyberculture and the role of digital telecommunication in fostering this new culture. The perspectives of media critic Marshall McLuhan are examined in light of what he called the electronically connected "global village." Digital divide issues are studied in terms of disparities in access to these digital services in various parts of the world. The emergence of global social networks is an outgrowth of the bonds formed by early pioneers on the Internet that transcended space and time. However, there are attempts by some governments to limit free access to the Internet, and these are examined in the context of national priorities that promote censorship and the construction of intentional barriers to the free flow of information. Chapter 11 deals with the "dark side" of the Internet. It examines online privacy issues and the threats to personal privacy and data security posed by hackers, viruses, and Webbots. It concludes with an outline of several simple steps that we can take to protect our privacy online and shield personal information from unwanted disclosure.

The final section – Part V – is focused on the evolution of new telecommunication and digital technologies that will affect global societies in coming decades. Chapter 12 examines the blended universe of wired and wireless communication technologies. Television has morphed from a wireless broadcast technology to a wired one via cable services and with online content streamed over the Internet using IPTV. Telephones are now mobile television viewers with content streamed live from the Internet or wirelessly accessed from local broadcasters. Mobile phones provide the always on, always accessible means of staying in contact with family and friends. The mobility of these services means that there will be no "away" from ICTs, and the chapter analyzes the social ramifications of being continuously connected. Chapter 13 explores the creation of virtual worlds that humans can inhabit through participation in online games. Computer games have come of age in the past two decades and have achieved a remarkable level of realism that makes active participation compelling. The chapter will also examine new applications of immersive "augmented realities" that superimpose computer-generated images over related scenes in the material world.

The book concludes with Chapter 14, which provides several perspectives on the future of the digital universe. The immediate future is bright as Moore's law drives down the cost of digital tools while greatly improving their power and our access to them. As the digital divide shrinks, more humans will have access to these tools to connect and work with others. Some future ICT scenarios are utopian – that humans will co-evolve with technology and adopt the best aspects of machine intelligence and memory. Others are dystopian – that machine intelligence will eventually surpass that of humans and our role in the future may be that of maintenance staff for the cybernetic world. The reality will likely be somewhere between these polar visions. Why spend time thinking about these futures? Each of you will spend your lifetime living there, so giving some critical thought to these scenarios may be instructive. I hope you enjoy this journey through the digital universe as a virtual road map for connected life in the decades ahead.

Notes

1. By "we," I am referring to citizens of the planet Earth who use information and communication technologies. This would include most of the 90 percent of the world's population that will have mobile phone access (but not necessarily possess one) by 2020.
2. L. Mumford, *Technics and Civilization* (New York: Harcourt, 1934).

3. "Telematics" is another term used to describe information and communication technologies.

4. S. A. Selber, *Multiliteracies for a Digital Age* (Carbondale, IL: Southern Illinois University Press, 2004).

5. N. Postman, *Technopoly: The Surrender of Culture to Technology* (New York: Vintage, 1992). Neil Postman died in 2003 at the age of 72, a loss to his community at New York University and to all who value his perceptive contributions to education, the study of semantics, and critical views of technology.

6. P. Otlet, *International Organisation and Dissemination of Knowledge: Selected Essays of Paul Otlet*, ed. W. B. Rayward (London: Elsevier, 1990).

7. V. Bush, "As We May Think," *Atlantic Monthly* (July 1945), 101–8. "Memex" is a portmanteau of memory and index.

8. Ibid. The article was republished with illustrations in the September 10, 1945 issue of *Life* magazine.

9. T. H. Nelson, *Literary Machines: The Report on, and of, Project Xanadu Concerning Word Processing, Electronic Publishing, Hypertext, Thinkertoys, Tomorrow's Intellectual Revolution, and Certain Other Topics Including Knowledge, Education and Freedom* (Sausalito, CA: Mindful Press, 1981).

10. Ibid.

11. T. Berners-Lee, *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by its Inventor* (New York: HarperOne, 1999).

12. The Greek word *kybernan* is also the source of the English word "govern."