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A BRIEF HISTORY OF INFORMATION SOURCES IN THE LATE 20TH AND EARLY 21ST CENTURIES (A SIMULATION)

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Introduction (*or the first part of several subsequent ordered parts*)

1 For hundreds of earth years prior to the end of the 20th century, people used a rudimentary and primitive technology as the dominant means to create, store, disseminate, and access information. Toward the end of that century and at the beginning of the next, new open-ended and flexible technologies emerged, which expanded options and thus challenged the status quo. That change contributed to diverse social, cultural, economic, and political developments, which were greeted by many of our ancestors with enthusiasm, but also with ambivalence, confusion, and, occasionally, reactionary objections and turmoil. The new technologies, applications, and forms developed at that time were the precursors to the vast array of informational resources immediately and freely available to 22nd-century citizens today, resources that provide a firm foundation for protecting the democratic ideals on which our society rests. Thus, this earlier time is more than an interesting period of history, for it represents an important turning point between two eras that helps us understand our informational roots and gain a new appreciation for our present circumstances.

    2 Here we provide a brief introduction to that period. To do so, we simulate, for the sake of illustration, the forms and conventions for presenting information that were used almost exclusively from the late 15th century through the end of the 20th century. Taking that tack allows us to illustrate the limitations of informational sources that dominated until the momentous technological developments of the early 21st century. Our intent, however, is not just to illustrate the limitations of these primitive forms, but also to help develop understanding of and appreciation

for the technological transformation that laid the foundation for the rich informational sources available to us now in the 22nd century. That is not to say that the long-outdated modes of information simulated here did not have their charms. In fact, they are still enjoyed today by a few connoisseurs and collectors. We hope that those with such a nostalgic or historical interest in these primitive forms will appreciate our efforts. In many ways, this simulation modeling the characteristics of obsolete informational sources is similar to the approach of scholars who have built primitive sailing vessels to better understand the challenges and ways of ancient seafarers. Similarly, we hope that this simulation will afford an understanding of the mindset and challenges of those who shared information and ideas during an earlier naïve and technologically unsophisticated era of information.

3 We ask the indulgence of understandably impatient wreadactors[1], many of whom will likely find this form not only unfamiliar and archaic, but also frustratingly inefficient and restrictive. For example, the dominant informational sources of the time, which we simulate here, assumed that only those who possessed the necessary knowledge and skills to enable understanding could access a particular informational source, and they felt no compulsion to assist anyone not possessing that knowledge and skill. In fact, individual information sources available until the end of the 20th century were often categorized on the basis of their estimated difficulty and thus their appropriateness for the narrow audiences at which they were often aimed. There were even mathematical formulas for determining level of difficulty on the basis of algorithms that included word frequency, sentence length, and other quantifiable factors. The concept that any informational resource could be designed to accommodate users with diverse levels of knowledge and skill was foreign to our ancestors, and it is a good example of how the limitations of earlier technologies dictated conceptions of informational sources. Yet the technological advances achieved during this period also laid the groundwork for our present circumstances, where a combination of automatic monitors and user-controlled options adjust information to the needs of individual wreadactors regardless of their level of knowledge or sophistication.

4 Others will no doubt note immediately the necessary linearity of this outdated form and our quaint concessions here to a sequential approach for conceptualizing and presenting information and ideas. We will address these issues *in more detail later and below,* with the latter phrase being a case in point highlighted *momentarily* in this linear simulation. That is, in the late 20th century, many relevant details were not made readily available when they might be most useful, especially if they interrupted the linear flow of a particular source. To do so was considered inappropriate and distracting and a mark of an amateur lacking the discipline to mold divergent thinking and resources into a single well-crafted and clearly circumscribed entity of information presented in a strict order, both chronologically and spatially. Information sources were conceptualized as having a beginning, middle, and end and were constructed around a central thesis, point,

idea, concept, and so forth. As noted *above,* to accommodate this convention, metaphors of time and space were often employed (*earlier, later, above, below*), signaling a link to information presented elsewhere in a distinct and linearly constructed presentation of ideas and information.

5 It is also already obvious that, consistent with late 20th-century sources of information, the presentation here uses none of the basic symbol systems on which today's information sources are founded. There is no audio, no dynamic movement within and across sources, and no video or animation. Nor are there any of the common features of information sources that we take for granted today, such as the virtual sensorium that allows wreadactors to enter informational worlds as an avatar or to interact with a variety of physical objects related to topos[2] of interest.

6 We have also adopted other stylistic features that were common in the late 20th century and that persisted well into the 21st century, even though much more powerful technologies were by then becoming available. For example, we have adopted what today would be considered an authoritatively arrogant posture in presenting information. We write as "authorities," a word that has taken on a much more negative connotation than it had during the period we are simulating. However, such a stance was natural in an age when relatively few people were considered worthy of sharing information widely and when the means for allowing others to dispute one's ideas or challenge the veracity of the information presented were difficult and cumbersome. In fact, those whose presentation of information and ideas were deemed worthy of wide dissemination were called *authors,* with its obvious connection to the word "authority."

7 Such a posture is difficult to accept and understand today because democratic access and open sharing are central tenets of informationcare[3], the impetus for which can be dated to April 18, 2013, and the launch of the Digital Public Library of America. Nonetheless, this authoritative stance was logical until the late 20th century, although the information and communication technologies that appeared at that time chipped away at it steadily. For example, those who created informational sources became more accessible through open forums, accessible to a wide audience, that allowed consumers (another metaphor of the time) of information to question the traditional authorities/authors. Sanctioned authors of information also began to invite responses from users, often through a prototypical form of contact called *electronic mail,* or *email* for short. This shift had obvious political consequences, although we will not delve into those issues in this brief simulation. Suffice it to say that it was much more difficult for those in power to control information in order to maintain their status or to promote a particular ideology, which is a function of the informationcare that we take for granted today.

8 Most who encounter our attempt to mimic this outdated form are also likely to note its discursiveness, which is excessive by today's standards, although not

as excessive as had been the verbose circumlocution of the century prior to the one we overview here, perhaps reflecting a continual maturity of purpose that laid the groundwork for today's flexibility in pursuing topics to whatever depth one chooses. In part, the then dominant informational technology required this discursiveness because of the paucity of its available symbol systems, lacking even audio and animation.

9 However, the explanation likely runs deeper. The alphanumeric code had for centuries been privileged over other media and was thus considered a higher form with greater cultural capital. Less noticeable, though notable, are redundancies of core ideas and themes, internally within an individually separate source and externally across diverse sources available at the time. The tone, also, is serious, perhaps at times even pedantic and self-important by today's standards, which was consistent with the authoritative stance mentioned *earlier and above*. The use of creative forms employing, for example, humor, satire, irony, or farce were rarely employed to convey information, because it was considered unbefitting the dignity and importance ascribed to information sources of that day. Instead, with a few exceptions, diligent conformance to a few standard types of sources and genres, with their predictable forms and conventions, was expected.

10 Thus, qualities that today we would judge to be excessively discursive, redundant, serious, self-absorbed, overly confident, and sometimes purposefully obscure to suggest erudition were not only considered appropriate in information sources until the late 20th century, they were often considered desirable and even virtuous. One prescient author of that period addressed this issue explicitly as he attempted to characterize the profound implications of technological advances in information sources that were then in their infancy (Lanham, 1993)[4]. He argued that older conventional forms of information used a *rhetoric* (being strategically persuasive or argumentative) that was primarily abstract and philosophical with a visual representation designed to be transparent. He poetically stated that letters and words, which dominated the visual presentation, were like the crystal goblet that contained the wine of meaning. The rhetoric of the new forms that were emerging, on the other hand, was primarily visual and structurally associative (non-linear) and was centered on looking at, not through, the visual representation.

11 However, before quickly judging this crude framing of information from our more advantaged historical position, it should be kept in mind that these characteristics were logical byproducts of the technologies available at the time, and they were thus not consciously noted nor of any particular concern among those living before the end of the 20th century. As is often the case with those who are prisoners of available technologies, people were mostly oblivious to the limitations of their informational technologies and could imagine none better—that is until the late 20th and early 21st centuries. A new dawn for creating, organizing, disseminating, accessing, and storing information was rapidly approaching, and our ancestors began to awake from

a long slumber induced by the familiarity and pervasiveness of the unexam-
ined forms and conventions of a *typographic era* as they began to move to a
post-typographic era.

Some additional conventions explained

12 To minimize confusion, we explain here a few additional conventions that
were used in informational sources during this period and that we have adopted
in this simulation. For example, the small, raised numerals we have inserted on
four occasions in the previous part *earlier and above* and on two occasions in the
subsequent parts *later and below,* were called *endnotes* or *footnotes,* depending on
their placement at the extreme end of an information source or at the end of
an intermediary unit that we will describe *later and below.* This convention was
another way to avoid adding detail that was considered potentially distracting to
the linear flow of the presentation in a particular informational source and to its
topical unity (see Footnote 2). (Another convention that often signaled a milder
interruption to the flow of a presentation was the use of parentheses, which are
the marks inserted at the beginning and end of this statement.) Footnotes and
endnotes are analogous to today's pathways through the virtual sensorium. Such
supplementary or ancillary information also took an intermediary form, called
a *link,* that was used in early electronic digital forms that emerged during this
period and that are discussed *later and below.*

 13 Footnotes and endnotes also seemed associated primarily with formal,
scholarly sources of information and were obligatory to legitimize one's mem-
bership in that community. In scholarly writing, footnotes or endnotes also ref-
erenced other informational sources, although until the end of the 20th century,
accessing these sources required much time and effort, typically including locating
and physically entering an edifice called a *library* (see Figure 1.1)[5] that housed vari-
ous information sources and had workers who assisted in finding other sources
beyond its enclosing walls. The latter service was important, because even the
largest libraries contained only a small fraction of the relevant information avail-
able, and libraries were the only option for serious informational searches until
approximately the final decade of the 20th century.

14 However, the scholarly community was subdivided, it seems, with some using another approach that inserted between parentheses the name of an individual or group of individuals who had constructed a particular informational source and the year of its construction as follows: (*name or names, year*). We adopt that convention here, particularly to reference individuals who were trying to understand and interpret the changes taking place during this period. A related convention is a listing at or near the end of an information source; the *references* was a list that provided details about the related but independent sources mentioned in that source. This list was in *alphabetical order,* which means the constituent items were listed in the order of the traditional alphabet, in this case by the producers' last names. Beginning with the technological advances and emerging forms of information sources just on the horizon at the end of the 20th century, the use of these lists, and indeed ordering anything alphabetically, had nearly disappeared by the second decade of the 21st century, as voice recognition and random access became standard.

15 Several additional conventions used then, and thus here, were designed to help structure and organize that linearity and topic–centeredness. A *title* at the outset of an informational source provided in a few words a clue to the overarching topic. Then *headings* were used to sub-divide the topic into smaller topics and to signal topical shifts in the linear presentation. Headings were like signposts on a straight road indicating that one had crossed into new but related territory. Some of these headings, although often optional, were standard, especially in longer or more formal sources and included the following: *abstract, forward, preface, prologue, introduction, chapters, afterward,* and *postscript*.

16 A smaller organizational unit was called a *paragraph*. It was signaled by an indentation from the left side, the *margin,* of a *page* (an often sequentially numbered physical unit used as a navigational tool). It was composed of several sentences usually having a unifying implicit or explicit topic, although the division of an informational source into paragraphs was sometimes arbitrary and made simply to break the visual monotony of the word strings. In the present example, we have added the convention of numbering each paragraph, which was not common, although this convention gained some momentum from the technological changes of this historical period that initiated more non-linear reading.

17 There was one notable exception that existed for centuries before this period: the Christian Bible. Interestingly, it was an informational source, albeit a religious and moral one, that was not constructed nor typically read linearly. Not typically noted by those living before or during this period is the fact that this most ancient of informational sources was actually constructed and used in a way that presaged the revolutionary changes that began during this period. That simply numbering paragraphs as an aid to navigation and as a concession to non-linear access was not typical illustrates how deeply engrained the separateness and linearity of informational sources was in this earlier era of information. Non-linear reading of informational sources was resisted, it seems, long after the need for it had nearly disappeared.

Conventional technologies and their use

18 Under this heading we introduce and explain the material technologies of informational sources of the time and how they were constructed and used. The terms and meanings we introduce are mostly alien to our time, but they were so transparent during this period that they were considered timeless and immutable until they were challenged by the new technologies that emerged in the late 20th century.

19 Until the late 20th century, informational sources were constructed through a process called *writing*[1]. Writing was considered to be, fundamentally, a solitary activity engaged in by a *writer*. Although it was not unusual for two or more individuals to write collaboratively, they typically did not write simultaneously. The product of this process was a *text*, which as noted *earlier and above* was a linear unit of information with a distinct beginning, middle, and end and with certain other features that enabled and reinforced that linearity. Essentially, an informational source at that time was one of many texts, each of which was like an island in a large sea of information. Although there were other types of texts constructed for other purposes, such as for entertainment, aesthetic enjoyment, or personal use, most of these, too, were considered to be distinctly separate units and often followed the general linear constraints of sources aimed strictly at communicating information.

20 Those who accessed these informational texts were called *readers*, because *reading* was required to access the information stored in a text. Reading, even more than writing, was a solitary activity. To successfully read informational texts, readers needed much specialized knowledge. Most basically, they needed the ability to decode alphanumeric symbols, because until the late 20th century information sources were comprised almost entirely of such symbols, and in any event those symbols were virtually always the center of attention. Further, no audio pronunciation of texts was possible, at least before advances in synthesized speech. Once decoding was mastered, however, many other skills and strategic knowledge were required. For example, readers needed to master all of the conventions discussed here *earlier and above* as well as to be strategic in using them in varied genres.

21 From our current vantage point and knowing of the technological advances that were on the horizon at that time, we might well be sympathetic to those who needed to access information prior to the end of the 20th century. There were only a few crude options for assistance when a reader faced difficulty with a particular text. For example, there existed other texts called *reference works* that might be consulted, if they were available. One was called a *dictionary* (see Figure 1.2), which might be consulted if a reader encountered an unfamiliar word. Another common but much longer reference source was called an *encyclopedia*, which might be consulted for more detailed information. At that time, there was no immediate access during reading to sources of information about unfamiliar concepts—no audio or video and certainly not the retinal and facial monitoring

or the customizable Information Avatar Agents (IAAs) to which our genera-
tion has become accustomed. However, technological changes during this period
quickly made these older sources obsolete.
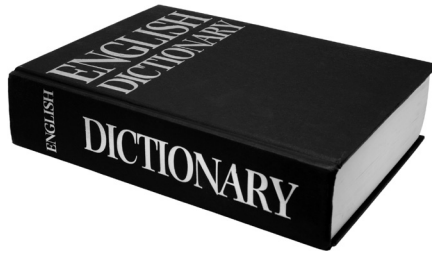
22 The fundamental technology of reading and writing during this period, but
also a cause of its limited possibilities, was a special material called *paper.* Paper was
usually made from a mush of ground up trees that was pressed into thin sheets and
dried. The sheets were then cut into different-sized, usually white, rectangles. A
variety of common tools were used to write symbols and pictures on these sheets.
Although it was limited to a small set of symbols, one tool that was common in
businesses and homes during much of the 20th century was the *typewriter.* With
a typewriter, a writer could insert sheets of paper one at a time onto a revolving
roller. Then mechanical *keys,* each with a different symbol, were struck with the
fingers of both hands. A hand lever, or later a push button in models that used a
power source called *electricity,* advanced the paper in the roller. The keys struck a
ribbon wound onto a reel and coated with a material that left an imprint on the
paper when struck by the keys. Interestingly, in early versions of this machine,
rapid *typing,* as using this machine was called, jammed the keys. To offset this
problem the keys were arranged in a pattern aimed specifically at slowing down
the user. However, as is often the case, users eventually adapted, and quite rapid
typing was possible. A picture of a typewriter is shown in Figure 1.3. Further, this
figure illustrates the limited two-dimensional technology of paper and its inability
to incorporate sound, animation, or video, or to allow a wreadactor to actually
experience what it was like to use a typewriter in the virtual sensorium.

23 However, for written material that was considered particularly important
or useful, a liquid material called *ink* was used to put symbols on paper by a much
larger machine called a *press.* The process of putting the ink on paper was called
printing, and when printed the information was called *published,* from a Greek word
that meant "making public." Ink was made from poisonous chemicals combined to
make various colors, although black was by far the most common. The production
of paper also used materials and processes that were unkind to the environment,
which was an issue noted by some information sources at the time, but it was not a
major contributing factor in the changes that were about to ensue.

24 The most important writing or most useful information, usually decided upon by people who owned the presses or by specialized employees called *editors* or *reviewers,* was printed on many sheets of paper that were stitched or glued together on the left side and put between two thicker and harder materials usually made of another type of paper enhanced with dead organic material and called *cardboard*. These devices for preserving the information that was considered most important or useful and that allowed individual readers to read what had been written were called *books* (the dictionary shown in Figure 1.2 is in the form of a book), a term that survives today but with a much different meaning.

25 For centuries, including well into the late 20th and early 21st centuries, books represented the most majestic and highly regarded means of recording and disseminating information and ideas. Those who wrote books, interestingly often a single individual or small group of collaborators, were often ascribed high status, although by the late 20th century there was a surfeit of books and authors, lessening the status of each (Hamilton, 2000). For the most formal and respected books, writers and readers rarely met. In fact, it was often considered a special occasion for readers to meet or interact in any way with an author of a book, which reinforced authors' images as authorities and sometimes as celebrities.

A new era dawns

26 Radically new technologies and processes for creating, accessing, sharing, and refining useful information and ideas emerged during the final two decades of the 20th century. By the end of the first two decades of the 21st century, these new sources had substantially marginalized conventional information sources. If paper was the defining material technology of the previous forms, *electronic digital computing* was the defining technology of the new era. The seeds of this revolutionary transformation were planted in the mid-20th century when a device called a *computer* (see Figure 1.4) was invented to process numerical information electronically using a binary numerical system. The name comes from its earliest use, which was to rapidly process numerical information. Soon, however, it became apparent that digital processing of information opened up a limitless

range of possible applications that could potentially enhance almost every then-current technology while creating an equally limitless range of new applications. One author in the latter half of the century described a computer as a machine that could become a machine, thus highlighting its open-ended possibilities (Ellis, 1974). And for the first time in the history of written information, people could decide what they most valued in their information sources and could instantiate those values with the technology available (Reinking[6], 2009).


27 The speed and memory capacity of computers and their portability increased literally every earth month during this period, matched by an equally rapid decrease in cost. By the end of the first decade of the 21st century, at least in economically developed regions, it was rare that individuals did not have at least one personal computer

28 More importantly, new forms of communication emerged during that decade that enabled every computer user to be connected with every other user, first through small cables called *wires,* but these were quickly eliminated by wireless communication that did not require any physical connection between users. Eventually a variety of specialized, hybrid devices (e.g., a *smartphone;* see Figure 1.5) became available, often small enough to be carried by hand or in personal clothing or a utility bag. These devices enabled users to combine all the power of computers with other functions previously requiring separate devices such as a *telephone* (synchronous audio communication) and a *camera* (static or moving digital pictures with sound).

29 However, by far the most significant development that completely trans-
formed information sources was the *Internet,* a worldwide network that enabled
computer users to communicate and share information directly with each other.
It also allowed individuals, educational institutions, governmental agencies, vari-
ous organizations, and businesses to create informational *websites* accessed through
keyword searches using *search engines,* which quickly sifted through all of the
available information and recommended relevant sites. All of this information
was densely interconnected through active links that allowed any site of informa-
tion to be easily connected to any other.

30 Originating in a crude form called *Mosaic* in the mid-1990s, the Internet by
the end of the first decade of the 21st century was deeply embedded in every aspect
of society and culture. According to one source during this period, in 2012 there
were almost 700 million websites with a host name (http://www.internetlivestats.
com/total-number-of-websites/), and another source indicated that by 2014
there were almost 3 billion users of the Internet worldwide (http://www.inter-
netlivestats.com/internet-users/). Figure 1.6 displays three representative screens
that could appear on personal computers and later on smartphones: a popular search
engine, the results of a search, and a typical *webpage,* the latter term referring to
the dynamic interconnectivity of information that was newly available during this
period (*web*) and the older static informational technology it replaced (*page*). Any
segment of the visual display could be made active to link to other webpages,
which a user accomplished by *clicking* a *cursor* (a navigational pointer) or, with later
technology, by touching the relevant part of the display. At this time, paid advertis-
ing also dominated many of these pages. The increasing dominance of commercial
interests in relation to information storage and retrieval during this period was the
main factor leading to the development of informationcare.
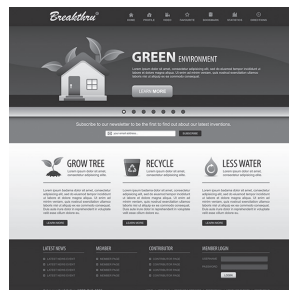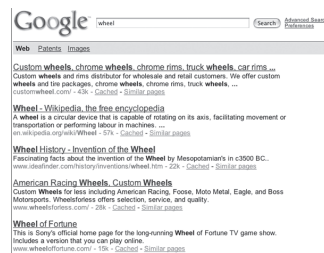
31 The Internet transformed virtually everything about the print-based information sources that had dominated until the late 20th century. Information sources were no longer bound by linear organizational structures and the conventions that served them. Instead, authors began to experiment with non-linear forms, first called *hypertexts* (Bolter, 1991; Purves, 1998), which allowed information to be organized as non-linear associations and led to the development of new genres, tools, and conventions for writing and reading. In fact, the concept of the solitary authoritative author or small authoring team slowly began to release its stranglehold on information sources. Instead, information sources were becoming truly collaborative, often created by development teams; in an early form of today's wreadaction called a *Wiki,* sources were continuously updated and monitored democratically, with only general guidelines and relatively loose controls on content, and depending, as today, on crowd-sourcing to manage veracity.

32 Likewise, the traditional gatekeeping exercised by editors, publishers, and reviewers was disabled by the ease of creating and disseminating information. An example was the creation of new genres of informational forms, including *blogs* (short for *weblogs*) and another form called *twitter* comprised of short *tweets*. Blogs were like a personal journal posted for all to see on the Internet, although *bloggers* encouraged those who *followed* them to add their own comments to the blog, and a free market of popularity meant that some blogs had thousands, even hundreds of thousands or more, followers, and many became respected sources of information and informed opinion, although many also became sites for likeminded people to share and reinforce biases and misinformation. The popularity of this form increased rapidly from its simple origins in the mid 1990s, until by 2010 one company tracking its use reported that there were 8 million blogs, with a new one appearing every 7.4 seconds and with an average of 2.75 million postings each day (http://technorati.com/state-of-the-blogosphere-2010/).

Within a few years, blogs moved far beyond a personal space for sharing information and perspectives. The genre became a tool for promoting commercial, corporate, and political interests, as noted in an entry found in an online source called Wikipedia (http://en.wikipedia.org/wiki/Blog). Wikipedia, too, represented a unique and innovative informational source that arose on the Internet. The information it contained was open to correction and revision by any user, although some control and restrictions eventually emerged to seek a balance between reliability and democratic revising and editing. As an open, non-commercial venture, it figured prominently in laying the foundation for the free and open access to information we enjoy today.

33 Needless to say, the dominance of the alphanumeric code was replaced by a veritable kaleidoscope of symbol systems available to informational sources on the Internet. Information sources made extensive use of audio and video, and no one presumed that written words were central or that other non-alphanumeric representations were of lesser importance, as they virtually always were in printed sources.

34 One of the most important transformations from the standpoint of learning was that digital information sources, most prominently on the early Internet,

were literally interactive. Theorists of printed forms had by the end of the 20th century considered reading to be an interaction between a textual presentation and a single reader's independent knowledge, but only in a figurative, theoretical sense. Digital information sources, on the hand, were literally interactive. Not only did those who accessed them have the option to instantly pursue relevant information that they did not possess, but informational sources were created that sensed difficulties, adapted accordingly, made recommendations to users, and so forth, much as they do today. Several theorists at the time began to consider such differences (for example, McEneaney, 2006; Reinking, 1997, 2009; Rose & Meyer, 2006; Rouet, Levonen, Dillon, & Spiro, 1996; Spiro, Feltovitch, Jacobson, & Coulson, 1992). The relative convenience and speed of the Internet transformed people's fundamental stance toward information. The desire for information in the normal course of daily life saw few of the limits that had existed when information was available only in printed form, because the technology of the typographic era could provide no practical or efficient means of locating diverse information on demand. In the emerging post-typographic era, any question or need for information could be addressed immediately at virtually any time or place.

35 Lee Raines, an observer at the time, cleverly summarized several key differences between conventional printed sources and sources on the Internet by using a series of words all beginning with the letter *V* (http://www.pewinternet.org/Presentations/2009/The–New–News–Mediascape.aspx):

Volume (of information)

Variety (of information, tools, sources, etc.)

Velocity (speed at which information is disseminated and collated)

Venues (multiplicity of venues and times for accessing information)

Voices (democratic expression and multiple voices in dialogue)

Vibrancy (virtual worlds, mirror worlds, augmented reality)

Vigilance (attention can be truncated and elongated, and privacy)

Visibility (of personas and access to all)

Voting & **V**entilating (democratic participation and collective intelligence)

Valence (customized personal information, the "daily me" and "daily you")

Vivid (social networks and networked individualism)

Signs and issues

36 With the advent of digital sources of information, some changes occurred immediately and without much protest or angst. For example, the typewriter virtually disappeared in a few short years because of the obvious advantages of

a computer for constructing texts. Likewise, with the dawn of digital sources of information, the printed encyclopedia became an anachronism almost overnight. However, when changes threatened the deep affinity for traditional forms, especially when there was the risk of potential financial loss or loss of deeply rooted social structures, transformation was slow and sometimes deliberately retarded. For example, publishing printed texts was mostly a commercial enterprise, and its profitability depended on slow development, controlled distribution, and limited access. Digital forms undermined all of these qualities and, consequently, authors' and publishers' claims to own or control information.

37 Although it is difficult for us to understand from our present vantage point, authors and publishers used to claim ownership of the printed information sources they produced. If there was anything that kept the juggernaut of digital sources of information from more quickly reaching its full potential, it was the forces of commercial interests that stressed the widely accepted idea that information sources could be owned. Remarkably, that concept was engendered legally in complementary concepts referred to as *copyright* (an ironic term because it actually meant the denial of the right to copy information sources without fees or permissions) and *intellectual property* (a metaphor suggesting that products of the intellect could be owned as if they were tangible property). These commercial interests also exerted considerable influence on Internet-based information sources, where traditional business models were adapted or new ones conceived, most aimed at restricting access to information in order to retain profits.

38 A related social phenomenon shows the sometimes conflicted stance that the transformation of informational sources produced and that acted to slow development. For example, one might expect scholars and academicians whose work depends on ready access to information to have been in the vanguard of those taking advantage of the new digital possibilities and freedoms. Many were. However, academia as a whole clung to its traditional cultural roots that were embedded strongly in conventional printed publications, often in collaboration with commercial publishers (see Beach et al., 2007). Until the late 20th century, academics gained reputations and were promoted to higher positions on the basis of the number of printed texts they produced and the status of the outlets in which these texts appeared. Thus, by the late 20th century there was a glut of academic publications, many of which were considered of inferior quality even then. In fact, an interesting irony is that many academics increased their stature by publishing critiques highlighting the limitations of other publications and calling for even more publications of higher quality.

39 Education of the young, also firmly rooted in conventional printed forms throughout this period, was slow to adapt, which is perhaps not surprising given the historically conservative biases of formal education. Thus, although computers appeared early in formal education during this period, their use was typically mundane in service of the traditional curriculum (Cuban, 2001), with little recognition of the radical transformations of information sources that were occurring

outside the walls of schools (formal education at the time occurred in edifices constructed for that purpose). By 2009, most teachers charged with developing literacy acknowledged that new information and communication technologies should be integrated into their instruction, but their definition of integration was firmly grounded in conventional print-based instruction, and they identified many obstacles to integration (Hutchison & Reinking, 2011). Some scholars, meanwhile, issued strong calls for such integration and pointed out the substantial gap between forms of literacy being using in formal education and those practiced in daily life (Leu, 2006). It was becoming apparent that the skills, strategies, and dispositions needed to locate, evaluate, synthesize, and communicate information on the Internet shared little overlap with those that were appropriate for the printed sources of information that preceded the Internet. A different kind of education was needed.

40 But there were signs that the rock-solid dominance of the most culturally central printed forms was beginning to crack. Printed newspapers, a popular mainstay of superficial, often ideologically laden, daily information that had long thrived in the era of printed information, declined rapidly during this period (Pew Research Center for People and the Press, 2009). Surveys by a non-profit research agency in the United States revealed that the percentage of people who regularly got their daily news via digital sources increased fivefold between 2000 and 2006 (Pew Research Center for People and the Press, 2006) and that 58% of adult respondents indicated that they first consulted the Internet when they had a problem, which was the highest percent of all answer categories (Estabrook, Witt, & Raine, 2007). Only 13% indicated that they went to a public library, which was the lowest percent.

41 Even books, the cultural bastion of the print era, began to give way to digital forms. The National Endowment for the Arts in the U.S. (2004) reported and lamented a precipitous decline in what it called *literary reading,* while the Book Industry Study Group (http://www.bisg.org/) reported that between 2001 and 2006 the average number of books per American fell from 8.27 to 7.23. However, sales of books had initially increased, due in part, it seems, to the convenience of locating and buying them through Internet sites; these sites also monitored the purchases of individual readers and made suggestions that furthered sales. However, toward the end of the first decade of the 21st century *ebooks* appeared (sometimes distinguished from *treebooks,* referring to the conventional source of printed pages). These electronic devices allowed readers to download hundreds and eventually thousands of books wirelessly and to read them on a single portable device. Some of these devices displayed textual information using *electronic ink* composed of thousands of microscopic balls that could be rotated to display either black or white, depending on the desired image. In 2010, Amazon, a popular commercial firm for ordering books on the Internet, reported that its sales of ebooks had exceeded hardcover book sales (Miller, 2010). Books were still being written much as they always had,

but they were purchased and read in ways that increasingly tilted toward the affordances of the digital world.

Conclusion (*or final, ending part*)

42 As noted *earlier and above,* most information sources until the end of the 20th century had distinct ending points. Often, too, editors and publishers set strict limits for authors on the length of an information source, typically reflecting the form and organization of the information source (or its expense and other marketing considerations). In this simulation, we have nearly reached that point.

43 To draw an information source to a closing point, authors would often end with a concluding section that summarized what had preceded it (again consistent with linearity and redundancy) or that highlighted major points or conclusions, which explains the title of this section. Thus, in this simulation of an information source that became increasingly outmoded during the late 20th and early 21st century, we have provided a brief history of that period, overviewing conventional print technologies that dominated for hundreds of years until the transformational period occurred. We contrasted the fading technologies and forms of print with the rapidly emerging, open-ended, digital technologies and forms that began to dominate and that set the stage for our current ways of creating, storing, disseminating, and accessing information.

44 As in many other eras of rapid and fundamental technological change, this brief history suggests that our ancestors did not clearly see, interpret, or appreciate what was occurring at the time, nor could they have foreseen the advanced forms that the changes initiated during this period would ultimately achieve. We are indeed fortunate to live in an era freed from the restrictive chains that bound information until the late 20th century. For wreadactors interested in more details, this simulation will of course not begin to suffice. In that case we encourage you to enjoy fully the informational sources that are now at your disposal, but with greater knowledge about their roots in this interesting period.

Notes

1   The origin of the current terms *wreadact* and *wreadactor* has a relevant etymology. It is an epigram composed of common terms used in this period: *reader, writer, and redactor* (or *editor*) and *actor.* These terms previously were separated because they typically referred to distinct and separate roles. Producing, refining, and consuming information was generally performed by different individuals who had different tasks at different times. The role of actor, in this case one who chooses to act or be active, was a connotation added shortly after the historical period considered here as it became clearer that personal agency was central to engaging with information presented in the newer forms.

2   In this period, the word *topics* would have been used in place of the current word *topos.* We have retained the modern word here so as not to confuse wreadactors. A topic in the late 20th century was an abstract, elusive entity that was believed to unify an informational source or one of its constituent parts. On a macro-scale, a topic was sometimes

called a subject. Informational sources in the late 20th century were deeply topical and essentially driven by attempts to achieve this unifying state of consistency. The word was derived from the ancient Greek *topos,* meaning "a place"; thus today we have reclaimed the original meaning in that the raw material of informational sources is conceptually a place, not a metaphysical search for interconnected unity.

3   Informationcare, an established and accepted concept today, also has etymological roots in this period. In the late 20th century, universal health care was a major societal and political issue that was particularly controversial in the United States. Once that issue had been resolved, there was a realization that careful attention to the veracity, useful-ness, and openness of information was a vital aspect of social human wellbeing almost as much as was healthcare to physical wellbeing. Although opposed by commercial interests at the outset, informationcare became a movement that gained momentum and resulted in our current system of democratic access to and vetting of information.

4   See paragraph 14 for an explanation of the conventional notation used here. Thus, again, we see here the difficulty of being bound to linear arguments, in this case the necessity of introducing a concept before there is a logically opportune time to explain it within the overall organizational frame.

5   Figures were pictures or illustrations inserted physically near the alphanumeric texts to which they were related.

6   A distant ancestor of the *author* of this simulation.

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