Chapter 2

Four Rules of Forecasting

The changing technologies in chapter one describe a future of upward-sloping curves: faster, cheaper, more interactive, more compact, more global, a digital convergence that connects everything. But this is not the entire truth: the package of changes will make a qualitative difference. The world will move into a third era.

The history of communication technology is a movement from:

1.) an era of traditional communications (one-to-one) to

2.) an era of mass communications (one-to-many), This has included mass circulation newspapers, radio, motion pictures, and television. These mass media were often oriented to a domestic audience. And they were so expensive that they were usually owned wealthy individuals or institutions.[1] Now the world is entering:

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[1] For ease of exposition I have grouped three earlier stages as traditional - i.e., the development of speech from chimpanzee-level communication; the development of writing (possibly with distinct sub-stages of pictographs and phonetic writing); and the development of printing. Older technologies are layered in each new era: writing did not replace speech, radio did not replace print, television did not replace radio, etc. Melvin L. DeFleur and Sandra Ball-Rokeach, *Theories of Mass Communication*, Fifth ed. (White Plains, NY: Longman Inc., 1989) 3-45. However, their character may change: poetry in a preliterate society is different than poetry in a

3.) an era of abundant user-controlled global capacity (any-to-any). There will be affordable, high-capacity, and interactive capability, with video. The options are expanding exponentially - now 500+ million people (if you know their email addresses and/or they know the URL of your organization). Soon, video links can be established from, to, and among the 500+ million for whatever purposes they (and not wealthy corporations) chose.

Four Rules

This chapter discusses four rules that can help us to see the social processes, alongside the changes of technology, that will shape the road ahead:

1.) S curves of change;

2.) market forces (that accelerate progress, produce boom and bust cycles, and also limit options and overcharge consumers until there is more competition);

3.) the key role of visionaries and organizers, for both market and public initiatives;

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print-based society; for a wider discussion see: Jack Goody, *The Interface between the Written and the Oral* (New York: Cambridge University Press, 1987).
Jack Goody, *The Power of the Written Tradition*, ed. William L. Merrill and Ivan Karp, *Smithsonian Series in Ethnographic Inquiry* (Washington, DC: Smithsonian Institution Press, 2000).
ErocA. Havelock, *The Muse Learns to Write: Reflections on Orality and Literacy from Antiquity to the Present* (New Haven, CT: Yale University Press, 1986).

4.) the special character of the new technologies as technologies of freedom.

Rule 1.) S curves of change: Their Shape and Speed

> The status of the Internet is shifting from being the dazzling new thing to being a purposeful tool that Americans use to help them with some of life's important tasks. As Internet users gain experience online, they increasingly turn to the Internet to perform work-related tasks, to make purchases and do other financial transactions, to write emails with weighty and urgent content, and to seek information that is important to their everyday lives.
>
> - Pew Internet Project (2001)[2]

The history of progress is a story of three kinds of human attitudes. At first, a small group of pioneers envisions a new future and says: Me first! Later, after the tracks have been laid and trains begin to leave the station, a larger mass prepares to board (Me too!). And there is a final group of holdouts whose attitude toward change is Do we have to? and they take a very long time to change. For example:

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[2] Survey of March 2001: John B. Horrigan and Lee Rainie, *Getting Serious Online: As Americans Gain Experience, They Use the Web More at Work, Write Emails with More Significant Content, Perform More Online Transactions, and Pursue More Serious Activities*, *Pew Internet and American Life Report* (Washington, DC: Pew Foundation, 2002).

- Television was invented in the 1920s and began slowly; then in eight years, from 1947 to 1955, the first 63% of American households bought a television set; and then it required another 30 years to achieve 98%.[3]

- In 1970, only 6.7% of households with television had subscribed to cable. By the end of the next decade only 20% had signed-up. Then a large number of people suddenly decided that it was time: between 1980 and 1985 there was a jump to 42.8%. The growth continued at a slowing rate (to a total of 56.4% in 1990 and 62.4% in 1995.)[4] Then growth slowed again: between 1995 and 2002 cable subscribers grew to only 68% of households with televisions.[5]

- The first hobbyist microcomputer was the Altair 8800, featured in the January 1975 cover story of Popular Electronics that a Harvard undergraduate, Bill Gates, purchased in Harvard Square. In 1977 the Apple II, the first popular home computer, was introduced and 24,000 home computers were sold. In 1980, 52,000 home computers were sold. Suddenly, in August of 1981 IBM introduced the PC and the curve began to move: seven million households bought computers by 1984, almost

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[3] Julia Angwin, "Has Growth of the Net Flattened?," *Wall Street Journal*, July 16 2001, B1.

[4] U. S. Census Bureau, *Statistical Abstract of the United States: 2001*, 121 ed. (Austin, TX: Hoover's Business Press, 2002) 705.

[5] John W. Wright, ed., *The New York Times Almanac 2002* (New York: Penguin, 2001) 397.

14 million by 1989.[6] Household ownership moved to 31 million in 1995, and then has grown at 4 - 5 million/year, to 55 million households (53%) in 2000.[7]

In scientific language, the adoption of any new technology usually follows the shape of a laid-forward S. It begins slowly. Then, it takes-off into exponential growth. Finally, a boom-era begins to slow and another long period elapses before the innovation reaches its full market saturation.[8]

Figure 2.1 illustrates the process in recent decades:

[Figure 2.1 about here]

[6] Lee Sproull, "Computers in US Households since 1977," in *A Nation Transformed by Information: How Information Has Shaped the United States from the Colonial Time to the Present*, ed. Alfred D. Chandler Jr. and James W. Cortada (New York: Oxford University Press, 2000), 261.

[7] Wright, ed., *The New York Times Almanac 2002* 798.

[8] Everett M. Rogers, *Diffusion of Innovations*, Fourth ed. (New York: Free Press, 1995).

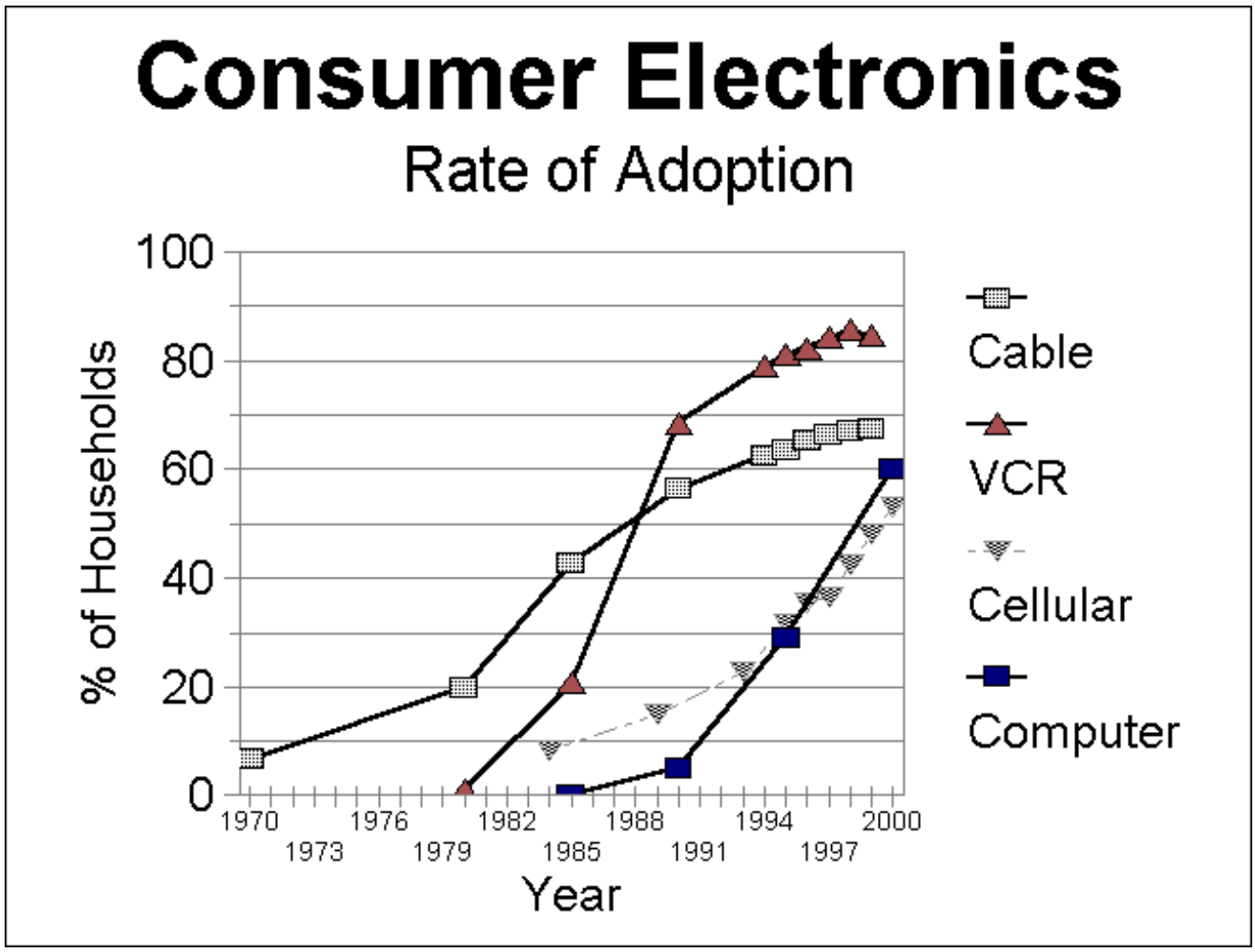

Figure 2.1

Most Americans have lived the beginning of this process many times. Everybody has heard, across several decades:

- Why do I need a computer?

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- Why do I need a fax machine?

- Why do I need cable?

- Why do I need a color (or a larger) monitor?

- Why do I need a faster computer?

- Why do I need a cellular telephone?

- Why do we need a Web site?

- And next: Who do we need broadband?

The skepticism is perennial. (Henry David Thoreau wrote in 1854: We are in great haste to construct a magnetic telegraph from Maine to Texas; but Maine and Texas, it may be, have nothing to communicate.)[9] And then, of course, skepticism can become adoption.

The S curve is not a guarantee. Many innovations fail. The S curve only describes the path of successful innovations, looking backwards. Even innovations that start to succeed can be overtaken: in early America, a generation of canal-building schemes (3,700 miles had been completed by 1850) ended just as the technology started to take off, surpassed by the invention of the railroad.[10]

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[9] Brian Winston, *Media Technology and Society. A History: From the Telegraph to the Internet* (New York, NY: Routledge, 1998) 245.

[10] Canals vastly multiplied the efficiency of a team of mules. They dropped the cost of long distance transportation from 30 cents

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Investors inspired by Alfred Ely Beach, an inventor and publisher of Scientific American, were ready to back a new technology of pneumatic tubes to transmit messages in office buildings and throughout America s central cities, but they were overtaken by the telephone.[11]

But at least one lesson for every planner or potential innovator holds true: The world s initial response to a good idea will be: No and skeptical inertia. The world s first reaction is an untrustworthy guide: there is a sociological process that the world also must move through.

The same truth will hold, again, for ideas in this book: for broadband, for the capacity to transmit Internet television and to linkup worldwide. People will ask, again, whether they need the capacity. Most institutions - at first - will say No. However, the fact that the world is *initially* uncertain about bold innovations does *not*

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per ton-mile for overland transportation to less than one cent per ton-mile by the 1860s. Rail charges were higher (three cents per ton-mile) but it offered superior speed and reliability (canals froze during the winter; rivers could be unnavigable during floods or low water.) The canal construction took-off after New York built the Erie Canal from Albany on the Hudson River to Buffalo, providing a direct low-cost trade route from New York City to the Northwest. James M. McPherson, *Battle Cry of Freedom: The Civil War Era*, ed. C. Vann Woodward, vol. VI, *Oxford History of the United States* (New York: Oxford University Press, 1988) 11-12.

[11]Encyclopedia Britannica, *Beach, Alfred Ely* (Online) (<http://www.britannica.com/eb/article?eu=14084&tocid=0&query=pneumatic%20tube>, 2002 [cited April 7 2002]).

necessarily mean that the future is uncertain. The right answer is to persevere until the S curve s exponential growth kicks-in. (For commercial startups, the trick is often timing, and to have enough capital to take a large initial market share and, then, survive until exponential growth arrives.)

The S curve s shape does not tell us whether an adoption cycle will be completed within a few years, or several decades. Several factors will affect how quickly different applications change the world.[12]

A.) The Advantages and Cost of Changing Old Technologies

Moore s Law is a good, basic guide to change. However, new technologies replace old technologies: a key question is whether the old technology still does a good job, and the price of changing.

For example, one the reasons that the telephone was slow to catch-on in England was the superb, low-cost (penny post) mail and telegraphy service. City dwellers had two or three mail deliveries daily, with the first post always arriving before breakfast; mail deposited in London letter boxes before 8 PM was delivered anywhere in the city or suburbs by 8 AM the next day. Large commercial firms had their own telegraph links. Telegraph lines also linked branch post offices in most neighborhoods with messenger

[12] In consumer electronics, another factor affecting the shape of the S curve is that innovators price down their demand curves, beginning at a very high price to capture large profits from a relatively small number of technophiles or other users with a strong financial benefit from the new product.

boys to assure prompt delivery.[13]

Another reason that S curves can move slowly is that entire institutions are designed for old technology. The adoption of the telephone was slowed because companies and merchants traditionally located themselves into districts - a financial district, a garment district, a market district. They did so to be close to others with whom they did business. Communications could occur over lunch at a local pub, by sending an office boy or runner with a note, or by a short walk. The telephone s S curve began to move only after businesses began to locate different parts of their operation in different places, and after a critical mass of their customers began to acquire and use the telephone.[14]

Similarly, although Edison had invented the central electricity generating station in 1881, by 1910 only 25% of American industry was electrified. The economic and practical reason was that to realize the full potential of electricity involved reengineering an entire factory. Existing steam engines were located in the center, with power transmitted by overhead shafts and belts. Electric motors had their full economic justification only after the old plants were depreciated and new plants were built using decentralized electric motors for each machine, which could be located

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[13] Sally Mitchell, *Daily Life in Victorian England* (Westport, CT: Greenwood Press, 1996) 82-83.

[14] Ithiel de Sola Pool, "Foresight and Hindsight: The Case of the Telephone (1977)," in *Politics in Wired Nations: Selected Writings of Ithiel de Sola Pool*, ed. Lloyd S. Etheredge (New Brunswick, NJ: Transaction Publishers, 1998).

anywhere.[15] For plants sited along rivers and that used water power, the full economic advantages of electricity could be realized only as the company could incur new debt and take advantage of the opportunity to rebuild itself, literally, in different physical locations.

B. Complementary technologies

New applications require a package of technologies, not just one technology. The speed at which S curves move depends upon rates of change in each part of the package. Before printing could become a mass phenomenon, several technologies needed to improve. When printing with moveable type was invented by Johann Gutenberg in Germany (circa 1450), his Bibles were expensive: his parchment Bibles required the hides of 50-75 goats; paper was less costly, but each sheet was created individually by craftsmen relying upon scarce supplies of waste rag or scrap from garment manufacturers. Only 400 years later, in the mid-19th century, were machines invented to produce wood pulp paper in continuous rolls (the price of newsprint dropped by a factor of 10 between the 1860s and the 1890s, and *then* everything began to take off.) It was only earlier in the 19th century that steam power, faster cylindrical designs (to replace the flat reciprocating printing bed), the casting of lines of type (linotype) rather than the setting of individual characters, and other improvements, also combined to make affordable printed materials available to the general public.[16] (For example, the New

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[15] William Easterly, *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics* (Cambridge, MA: MIT Press, 2001) 179-80.

[16] James R. Beninger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, MA: Harvard University Press, 1986) 359.

York Sun began production as a new, penny newspaper in 1833; earlier, a good circulation would have been five thousand copies, but it reached twenty-seven thousand in two years; its immediate successor, The Herald, grew to a circulation of forty-thousand by 1836.)[17] Between 1820 and 1860 the new technologies increased the productivity of printing by a factor of one hundred.[18]

C. Learning new technology

> The single potentially revolutionary element of the colonial information infrastructure was the widespread, institutionalized Protestant belief in the importance of literacy for individual piety, conversion, and salvation. . . . Although the inhabitants of the southern colonies lagged those of the north, and although female literacy rates trailed male rates everywhere, colonial literacy after 1760 exceeded 75 percent. In New England overall literacy approached 90 percent on the eve of independence . . This broad-based literacy supplied a human social and cultural infrastructure of people who were technically and psychologically prepared to move beyond the

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Scott D. N. Cook, "Technological Revolutions and the Gutenberg Myth," in *Internet Dreams: Archetypes, Myths, and Metaphors*, ed. Mark Stefik (Cambridge, MA: MIT Press, 1996), 71-72, 74-76.

[17] Ithiel de Sola Pool, *Technologies of Freedom* (Cambridge, MA: Belknap Press, 1983) 18-29. For the confluence of factors producing the penny press: Michael Schudson, *Discovering the News: A Social History of American Newspapers* (New York: Basic Books, 1978) 12-60.

[18] Steven Lubar, *Infoculture: The Smithsonian Book of Information Age Inventions* (New York: Houghton Mifflin, 1993) 24.

> informational status quo of colonial society.
>
> - Richard D. Brown[19]

And, too, mass market printing was delayed until people learned to read. By 1650, two centuries after Gutenberg, only 20% of Europeans had become literate; it required four centuries, until the 19th century, for the new Industrial Revolution and new political commitments to free (and - soon - compulsory) public elementary education to produce widespread literacy across leading countries.[20] (As Brown notes, above, America - and especially New England - were substantially ahead of Europe and the rest of the world.)

For the next upgrade in the global Internet, the actual technical learning by most users will be modest. Many undergraduates already find it easy to digitize and use audio and video on desktop PCs in their dorm rooms. And their fiber optic links and the super-speed Internet2 may be a generation ahead of technology in many

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[19] Richard D. Brown, "Early American Origins of the Information Age," in *A National Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*, ed. Alfred D. Chandler Jr. and James W. Cortada (New York: Oxford University Press, 2000), 45-46.. More broadly: Alfred D. Chandler Jr. and James W. Cortada, "Bibliographic Essay on the Role of Information in the Transformation of the United State," in *A National Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*, ed. Alfred D. Chandler Jr. and James W. Cortada (New York: Oxford University Press, 2000).

[20] Cook, "Technological Revolutions and the Gutenberg Myth,",, 70-78.

offices and homes. The principal barriers are psychological: To most people, the idea of creating a national or global television channel seems that it would be too complicated, too expensive, cosmic, and overwhelming. They do not know how to do it, nor do they know anyone who is doing it, or who to call.

However, international broadcasting is a known and well-established technology. The new desktop options can be learned quickly and, at most, will only be a momentary barrier once institutions observe a critical mass of other users beginning to use the technology.

D. Applications and Revenue

The speed of an S curve also depends upon the growth of revenue to support new applications and attract new users; and new applications that attract new users. Early in the 20th century, the sale of radios was limited by the number of radio stations and the scarcity of radio programs - and the building of new radio stations depended, in turn, upon the ownership of radios by a new listening audience. It was a jerky start until the revenues began to grow. From a slow beginning, the number of radio stations grew exponentially, from 30 in 1923 to 681 in 1927. Next, network programing (which awaited the organizing of national networks of local stations, of ad agencies, and of national advertising revenue) grew from four to sixteen hours/week between 1930 and 1935. With this change, average radio listening time/household rose from about 45 minutes/day to almost five hours/day.[21]

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[21] Beninger, *The Control Revolution: Technological and Economic Origins of the Information Society* 365. For a wider discussion, including the role of salesmanship in the speed of the S curve, see: Susan Smulyan, *Selling Radio: The Commercialization of*

For television, an early catalyst was the comedian Milton Berle and his show Texaco Star Theater. In 1947 there were 17 television stations in the United States and 136,000 sets. Berle s show became what, in a later computer term, would be called a killer app : by the end of 1948, 700,000 televisions had been sold (about 80% tuned, on Tuesday nights, to Milton Berle) and there were more than 50 television stations.[22]

Rule 2.) Market Forces Shape the Future: Two Cheers and a Warning.

> Recently I heard Bob Metcalfe [a pioneer in the development of computer networking] speak before an audience of telecommunications executives at an industry forum. He speaks like he writes, and he pulled no punches because of the particular audience on this occasion. More than 300 Web generations ago, the ARPA knights launched the Internet rebellion against the Imperial Telco Empire, he began. Soon he was describing the oppressive telecommunications regulatory regime and its pitiful telephone monopolies as the Imperial Empire from Star Wars.
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> As Metcalfe went through his condemnation of the industry, I watched the telecom executives. For people who were being likened to Darth Vader, they were remarkably genial. Laughter radiated throughout the

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American Broadcasting 1920-1934 (Washington, DC: Smithsonian Institution Press, 1994).

[22] Lawrence Van Gelder, "Milton Berle, TV's First Star as "Uncle Miltie" Dies at 93," *The New York Times*, March 28 2002, C13.

> room. Even the notion of imperial storm lawyers seemed to evoke only grins and nodding of heads in agreement. Yep, that's us, they seemed to be confirming. After the meeting, Metcalfe got the highest ratings of any speaker at the forum. [23]

For most of the 20th century, government policies and politics, not competitive markets, regulated new communications technologies. The telephone companies of the world were government-run (PTTs - Post, Telephone & Telegraph) or government-licensed monopolies (AT&T, in the United States). Today, deregulation has arrived in almost every country.[24] Market forces, and hundreds of billions of dollars of venture capital, are driving the future.

Thus, the second rule will seem obvious. However, it also alerts us that the past behavior of corporations has not always been in the best interest of consumers. A knowledge of history, even recent history, is important in an area of future-oriented journalism often driven by corporate press releases. There are pending battles between the cable industry and consumers over access to 2+ Mbps broadband. An understanding of market forces also will clarify a

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[23] Robert W. Lucky, "View from the Death Star," in *Internet Collapses and Other Infoworld Punditry*, ed. Bob Metcalfe (Foster City, CA: IDG Books, 2000), 242.

[24] National Science and Telecommunications Board, *Broadband: Bringing Home the Bits* (Washington, DC: National Research Council, 2002) 296-306.
Harvey Sapolsky and et al., *The Telecomunications Revolution: Past, Present, and Future* (New York, NY: Routledge, 1992).

typical history of boom-and-bust cycles that accompany the early S curve of technical progress, and that also tend to reduce competition.

A. Behavior that is Not in the Consumer s Best Interest

The competitive market is the greatest engine for change that has been invented. A great deal of the reporting about new technology is based on corporate press releases and emphasizes the exciting products and new services that companies will bring to the market. However for-profit companies also are an ally that needs careful watching: When there is not enough competition, for-profit companies have been known to overcharge customers and limit the freedom of choices.[25] For example:

- CD disks cost no more to produce than albums or tapes, but consumers typically are charged double the price for the CD format: in the US, about $15 billion of music is sold each year, 2/3 in CD format.[26] Roughly $5 billion/year of overcharging.[27] The same egregious overcharging of consumers occurs with DVD s (that cost

[25] For a broader discussion see the work of Herbert Schiller. A good introduction is: Frank Webster, *Theories of the Information Society*, ed. John Urry, *International Library of Sociology* (New York: Routledge, 1995) 74-100.

[26] Wright, ed., *The New York Times Almanac 2002* 394.

[27] To be sure, copyrights are important to repay creative artists for sales and use of their material - but copyright was not intended to give excess monopoly profits to middlemen who want to keep old (and inefficient) distribution technology.

$2 to produce) and VHS tapes (that cost $2.25).[28]

- The newest generation of direct broadcast satellite that carries DirecTV s current number of channels costs about $200 million and will last at least 10 years. The annual revenue in 2001 was $5.6 billion (counting subscription fees from 10.7 million households, advertising revenues, and fees earned from the producers of channels.)[29] While the satellite does not care if another 100 million households receive the signal - and every new subscription is pure profit - DirecTV still is likely to charge subscription fees to the next 100 million subscribers.

- The Internet itself was created in opposition to computer companies. As a market leader, IBM wanted a closed architecture email system just for IBM computers, to force anybody who wanted to use email to buy IBM computers themselves; and other manufacturers had similar preferences to build closed Internets that could only communicate with their equipment.[30]

- Nor are telephone companies - that offer new DSL Internet service and will play a larger role - more virtuous and consumer-

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[28] Source: Geraldine Fabrikant, "Attack of the Disruptive Disk: Sales of DVD's Are Challenging the Business of Renting Movies," *The New York Times*, November 16 2001, C3.

[29] Alicia Mundy, "Charlie's Angel," *Cableworld*, April 1 2002, 15.

[30] For a broader history: Stewart Brand, "Wire Legends: Founding Father [Paul Baran]," *Wired* 2001.
Christos J. P. Moschovitis et al., *History of the Internet: A Chronology, 1843 to the Present* (Santa Barbara, CA: ABC-CLIO, Inc,., 1999).

friendly when they have monopoly positions. AT&T, when it held a monopoly position, fought doggedly to prevent any other company from operating services, or attaching devices, to its telephone system.[31] It required years of litigation and a ruling of the Supreme Court in 1977 (fought, every inch, by AT&T) to give consumers their right to buy and install their own telephones rather than being required to rent telephones from the telephone company for a monthly fee. It was not until the mid-1980s, by order of the FCC, that local telephone companies allowed people to select their own long-distance carriers (i.e., without having to dial a long string of additional numbers.)[32]

This history is important because, as we will see in the next section, part of the American communications industry is fighting to reduce competition and restore earlier monopoly or oligopoly control. Once, there were thousands of small Mom-and-Pop cable companies. Today, 5-6 control access to about 80% of the cable-subscribing American public. A major fight is on the horizon as many Americans will rely on their cable company for a limited broadband service to their homes. There are smart, aggressive, for-profit people on the other side of the bargaining table.[33] The

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[31] For a history of the deregulation battle for telephone: Peter Temin and Louis Galambos, *The Fall of the Bell System* (New York: Cambridge University Press, 1987). More broadly, see: Robert Britt Horwitz, *The Irony of Regulatory Reform: The Deregulation of American Telecommunications* (New York: Oxford University Press, 1989).

[32] Michael Totty, "Yesterday's Choices," *Wall Street Journal*, September 10 2001.

[33] National Science and Telecommunications Board, *Broadband:*

National Research Council warned recently:

> The risk in all of these possibilities is that the local government will not be equipped with the knowledge or skills to negotiate with a large private sector provider. If the town does not act carefully, there is risk of industry capture, an outcome in which a private sector provider manipulates the situation to the point where the town becomes dependent on it and thus loses any power to negotiate or foster competition. With some notable exceptions, local governments are less likely to be familiar with the technology and business side of networking that they are with more traditional government operations, which places them at a disadvantage.
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> - National Research Council (2002)[34]

Local cable companies are monopolies (or duopolies, if the telephone company offers DSL service.) They stopped the extraordinary build-up of 100 million miles of fiber optic capacity (chapter one) one-mile away from consumers - and for a business reason. Typically, cable companies divide the fiber capacity from a fiber optic node, via their coaxial cables, throughout a neighborhood (e.g., 250 homes). The coaxial cable provides a hundred or more television channels to a set-top box, available to consumers in different monthly subscription packages; there are dozens of pay-per-view movie channels competing with local video

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Bringing Home the Bits 207.

[34] Ibid.,, 214-15.

stores; and then there is a small residual broadband capacity for a faster Internet, that is divided among houses in a neighborhood, varies with their usage, and is enough to get Web pages to download faster, but not enough to do much else.

However, as we saw in chapter one, the key to freedom and competition is at least one reliable, two-way 2-6 Mbps. No consumer needs hundreds of preassigned channels arriving at a desktop box. The consumer just needs one, 2-6 Mbps channel that can be switched electronically to any channel. With 2-6 Mbps, American consumers can cut-free. They can subscribe to the Disney Channel, or the Discovery Channel directly without paying their cable company middlemen. (And Disney and Discovery, who also must pay the cable company, are free of these middlemen s charges, too.) A 2-6 Mbps connection also permits individuals to create their own Internet television channels. Households with several television sets and a computer might contract for 15 - 20 Mbps.

Cable companies estimate that the last mile construction to give direct fiber optic connections to each home might cost $1,000 - $1,500.[35] But this is a misleading number. As we saw in chapter one, improvement only requires small, less expensive, steps. If a fiber node is moved part-way (reducing the last mile problem to the last half mile problem) the cable s full capacity can be shared among half the number of users.[36]

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[35] Ibid.,, 154.

[36] For technical reasons, the capacity more than doubles: As nodes are divided and fiber is deployed closer to the customer, the total amount of usable bandwidth becomes greater; this makes it possible for every node division to more than double the available

C. Boom and Bust Cycles

The S curve of progress describes the future. But market forces produce cycles of boom and bust along the way. Both extremes are a misleading guide for long-term planning.

When pioneers are successful and a new technology starts to take off into exponential growth, many new companies jump-in. Many fail or are bought-out (in earlier days, forced-out) by larger companies seeking to build a monopoly position:

> -After the first transcontinental railroad was completed, joining the Central Pacific and the Union Pacific at Promontory, Utah on May 10, 1869, more investors jumped-in to build four additional cross-continent lines, and large quantities of track were laid throughout the country, a great deal more than was immediately justified by the current availability of customers; the country went from 46,844 miles of track in 1869 to 70,268 miles in four years (1873).[37] Eventually, about 60+ smaller railroad companies either failed or were bought-up by the major survivors. (The collapse of the railroad building bubble, and end of the building spree, was known as the Panic of

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data capacity while reducing the number of users who share it. Similarly, breaking a 500-home node into four parts, each passing an average of 125 homes, increases the available reverse and forward capacities significantly more than fourfold and provides more than four times the bandwidth per user. Ibid.,, 252-53..

[37] U. S. Bureau of the Census, *Historical Statistics of the United States, 1789-1945* (Washington, DC: Superintendent of Documents, 1949) 200.

1873.) [38]

- When Henry Ford built the Model T, there were dozens of automobile manufacturers, with backers and products, who hoped to win. Within two decades, most had failed or were bought-out by the survivors. Between 1923 and 1932, more than 600 companies were founded to manufacture radio receivers; by 1933, most had failed and nine companies held about 75% of the market.[39]

- The cable industry began twenty years ago with thousands of tiny, family-operated companies: at the time this book goes to press six giants have bought-up their competitors and control access to 80% of the nation s subscribers;[40] a pending deal would leave three companies in control of almost two-thirds of the market.[41]

- When personal computers began to take off, there were more than 200 PC clones in 1981-1985. These became six major

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[38] Simon Romero, "Shrinking Future of Fiber Optics Loses Glimmer," *The New York Times*, June 18 2001.

[39] Lubar, *Infoculture: The Smithsonian Book of Information Age Inventions* 217.

[40] Bruce Orwall, Deborah Solomon, and Sally Beatty, "The Bigger Picture: Why the Possible Sale of at&T Broadband Spooks 'Content' Firms," *Wall Street Journal*, August 27 2001.

[41] Yochi J. Dreazen, Greg Ip, and Nicholas Kulish, "Why the Sudden Rise in the Urge to Merge and Form Oligopolies?," *The Wall Street Journal* 2002.

companies by 1994, and further consolidation is pending.[42]

Today, the boom and bust cycle also reflects the extraordinary sums of venture capital, and strategic planning to secure wealth via a quickly-inflated stock price in the boom phase.[43] In laying new fiber optic cable, for example, Gary Winnick, an entrepreneur and former associate of the investor Michael Milken, formed a company called Global Crossing in 1997 to take advantage of the breakthroughs in fiber optic cable technology (chapter one) and deregulation to build state-of-the-art networks linking the Americas with Asia and Europe. After raising $750 million and completing the first upgraded cable under the Atlantic, Mr. Winnick s company went public and its stock hit a high of $73+/share, valuing the company at nearly $30 billion, many times what its network had cost.[44]

Global Crossing intended to build so much capacity, so quickly, that it would discourage competitors. However, many other venture capitalists and companies jumped-in, with a result of vast overcapacity, falling prices, and reduced cash flows to handle debt payments until the anticipated global growth of demand arrived. The stock began to fall (by the fall of 2001, to less than $5/share) and by early 2002 Global Crossing had filed for bankruptcy.

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[42] Alfred D. Chandler Jr., *Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computer Industries* (New York: Free Press, 2001) 247.

[43] For an overview of business strategies and market dynamics: Lee McKnight, Paul N. Vaaler, and Raul L. Katz, eds., *Creative Destruction*, Reprint ed. (Cambridge, MA: MIT Press, 2002).

[44] Romero, "Shrinking Future of Fiber Optics Loses Glimmer,".

While the press treats the bust cycle as a catastrophe, the bankruptcies are a form of extraordinary gift from the original venture capitalists: a great stockpile of capacity is created and it will be acquired by successor companies and venture capitalists at a fraction of its original cost.[45] For example, Iridium, the first global LEO system with 66 satellites, failed, but after it defaulted on nearly $7 billion in debt, its assets were purchased for less than a half cent on the dollar; and Iridium continues life with a Department of Defense contract and is approaching profitability, its new owners being sufficiently free of debt that they can offer profitable global telephone service at rates (e.g., $1.50/minute) that are competitive with current international cellular telephone charges.[46]

Rule 3.) Visionaries and Organizers: He Who Organizes, Wins

> The spread of successful ideas is governed mainly by communications technology and politics
>
> - J. M. McNeil[47]

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[45] The apparent over-building also was economically rational. The major expense of fiber optic cable is the installation, which usually involves digging trenches (a fiercely expensive proposition in inner cities). Thus, if a trench is to be dug, makes good sense to look ahead an install a great deal of fiber optic capacity at the beginning. (Another trick is to install hollow plastic pipes through which more cables can be threaded in the future, without digging.)

[46] Michael Menduno, "Making Dead Birds 'the Deal of the Century'," *Wired*, August 2001.

[47] J. R. McNeil, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton,

Chapter 2

Forecasting the evolution of technology does not require a crystal ball. Instead, create an initial list by observing what scientists are trying to invent and what visionaries are trying to organize.[48] As a minimal rule: until somebody is trying to invent it, or somebody is trying to organize it, don t bet on it.

New technologies change the world when they are promoted by effective organizers and visionaries. A good example of this larger pattern is the development of the telephone system. At first, Alexander Graham Bell s invention only worked across short distances, with poor sound quality. But he had a vision, and he organized the financial supporters he needed to solve the problems and create a business of the most remunerative kind . . . that would also benefit the public in a way that has never been previously attempted. (Box 1). Bell was persuasive to his investors, in part because he was a capable and realistic engineer as well as a visionary. As he told his backers candidly, in words that every Internet visionary discussing the global broadband upgrade will appreciate: Such a plan as this, though impracticable at the present moment . . .

Box 1

Kensington, March 25, 1878

To the capitalists of the Electric Telephone Company:

2000) 326.

[48] For an appreciation of computer and Internet visionaries, see Howard Rheingold, *Tools for Thought: The History and Future of Mind-Expanding Technology*, Reprint ed. (Cambridge, MA: MIT Press, 2000).

Chapter 2

Gentlemen -

It has been suggested that at this, our first meeting, I should lay before you a few ideas, concerning the future of the electric telephone, together with any suggestions that occur to me in regard to the best mode of introducing the instrument to the public.

The telephone may be briefly described as an electrical contrivance for reproducing, in distant places, the tones and articulations of a speaker s voice, so that conversation can be carried on by word of mouth between persons in different rooms, in different streets, or in different towns.

The great advantage it possesses over every other form of electrical apparatus consists in the fact that it requires no skill to operate the instrument. All other telegraphic machines produce signals which require to be translated by experts, and such instruments are therefore extremely limited in their application, but the telephone actually speaks, and for this reason it can be utilized for nearly every purpose for which speech is employed.

At the present time we have a perfect network of gas pipes and water pipes throughout our large cities. We have main pipes laid under the streets communicating by side pipes with the various dwellings, enabling the members to draw their supplies of gas and water from a common source.

In a similar manner it is conceivable that cables of telephone wires could be laid under ground, or suspended overhead, communicating by branch wires with private dwellings, counting houses, shops, manufactories, etc., uniting them through the main cable with a central office where the wire could be connected as desired, establishing direct communication between any two places in the city. Such a plan as this, though impracticable at the present moment, will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe in the future wires will unite the head offices or telephone companies in different

cities, and a man in one part of the country may communicate by word of mouth with another in a distant place.

In regard to other present uses for the telephone, the instrument can be supplied so cheaply as to complete on favorable terms with speaking tubes, bells and annunciators, as a means of communication between different parts of the house. This seems to be a very favorable application of the telephone, not only on account of the large number of telephones that would be wanted, but because it would lead eventually to the plan of intercommunication referred to above. I would therefore recommend that special arrangements be made for the introduction of the telephone into hotels and private buildings in place of the speaking tubes and annunciators, at present employed. Telephones sold for this purpose could be stamped or numbered in such a way as to distinguish them from those employed for business purposes, and an agreement could be signed by the purchaser that the telephones should become forfeited to the company if used for other purposes than those specified in the agreement.

It is probable that such a use of the telephone would speedily become popular, and that as the public became accustomed to the telephone in their houses they would recognize the advantage of a system of intercommunication.

In conclusion, I would say that it seems to me that the telephone should immediately be brought prominently before the public, as a means of communication between bankers, merchants, manufacturers, wholesale and retail dealers, dock companies, water companies, police offices, fire stations, newspaper offices, hospitals and public buildings and for use in railway offices, in mines and other operations;

Although there is a great field for the telephone in the immediate present, I believe there is still greater in the future.

By bearing in mind the great object to be ultimately achieved, I

believe that the telephone company cannot only secure for itself a business of the most remunerative kind, but also benefit the public in a way that has never been previously attempted.

I am, gentlemen, your obedient servant,

Alexander Graham Bell[49]

A corollary to this rule implies a way to change the world: *If you can imagine a specific project for a better world that you would like to see underway, step forward with your vision, make a commitment, and keep your word - or find somebody who shares it, who can be effective, and support them.*

The same rule applies to the use of new technology by any institution. At a minimum, institutions will require someone to rethink what is possible, and this does not occur automatically. New technologies typically are introduced into existing organizations with their own structures, cultures, flows of work and relationships.[50] But a bureaucracy with email is still a bureaucracy.

As the media critic Marshall McLuhan noted, the world s first instinct is to use new technology simply to do, in a different form, what was done with the old technology. When they could read and write, people initially wrote-down their oral sagas (e.g., Homer).[51] It

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[49] Pool, "Foresight and Hindsight: The Case of the Telephone (1977),",, 187-88.

[50] John Seely Brown and Paul Duguid, *The Social Life of Information* (Cambridge, MA: Harvard Business School Press, 2000).

[51] For a review of issues related to the early Greek transition: Havelock, *The Muse Learns to Write: Reflections on Orality and*

took centuries for new literary forms (e.g., plays, novels) to be invented.[52] Similarly, at first, motion picture cameras were simply used to film a play on a stage.

In designing Internet applications, we still are at the stage of using the new motion picture camera to film a play on a stage. People search for, and read, Web pages as if in a reference library. E-business consists of putting mail-order catalogs on-line. News is putting the Reuters news wire or the print version of The New York Times on-line. During the Clinton Administration, the first idea of the US Dept. of State in the global digital age was to put the texts of official speeches and press briefings on-line. Advertising agencies still do mass market advertising over the Internet, rather than use its interactive capabilities to ask consumers what ads and offers they would be interested to see (e.g., current sales of children's clothing).

Increasing fast and low-cost global communications are likely to make it easier to capture imaginations and begin new movements (although there is no evidence that the Internet, or any other technology, can make a major difference unless there is a good idea to be promoted.) The historian J. R. McNeil suggests that we have already seen, in an era of mass communications, extraordinary changes by comparison with the baseline rates of earlier history. Marxism blazed across the skies, spreading more quickly than Buddhism or Christianity. And then was replaced. Fascism appeared and disappeared even more quickly. Nationalism and anti-

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Literacy from Antiquity to the Present.

[52] James. J. O'Donnell, *Avatars of the Word: From Papyrus to Cyberspace* (Cambridge, MA: Harvard University Press, 1998) 42, 54.

colonialism swept the underdeveloped world with political change in two decades. Environmentalism inched its way forward for almost a century until Rachel Carson s Silent Spring in 1960; and then, between 1970 and 1990 became an agenda-defining global movement. Civil rights for Blacks, and liberation for Women and Gays, and consumer and health foods movements in the United States suddenly advanced at an astonishing pace.[53]

We will see, in chapter three, that the evolving Internet - reducing costs, increasing range, adding video and interactive capacities - has the potential to accelerate almost everything, including political and social organizing and change. However, what will happen depends upon Rule 3: Who will step forward as a visionary and effective organizer, for what ends?

Rule 4.) Technologies of Freedom

The fourth rule for forecasting is that these new communication technologies will be technologies of freedom. They increase options for everybody. Instead of a forced-march into the future determined by one set of institutions (e.g., Wall Street), the effects of the new technologies will arise from many individuals and institutions (in a pluralist world) doing as they damned well please.

Ithiel de Sola Pool was the first social scientist to describe the technologies of our third era as technologies of freedom. Pool began his career with the study of mass communications, the second-era technologies that produced mass market advertising, Nazi and Communist propaganda, the control of the mass media in totalitarian societies, and the role of the mass media in the

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[53] McNeil, *Something New under the Sun: An Environmental History of the Twentieth-Century World*.

modernization of underdeveloped countries. Often, the few who controlled or owned the mass media (governments, advertisers) sought to manipulate behavior. Yet, when Pool studied early forecasts of the telephone, he found that forecasting the effects of the telephone was a different kind of problem: it did not become the tool of mass market advertisers, dictators, or governments with top-down objectives: in America, almost every household and business acquired a telephone, could initiate calls to anybody, and use it for their own purposes. (A Marxist analysis of the telephone as serving primarily the interest of corporate capitalists would have been absurd.)[54]

Did the telephone help criminals or the police? (Both: Gamblers upgraded from numbers-runners to calling their bookmakers. But, next, the police learned to wiretap.) Did the telephone create dense inner cities - permitting corporate offices to be centralized downtown while leaving manufacturing plants elsewhere? Or did the telephone build the suburbs permitting (with the automobile) people to live and conduct business at greater distances, and have more open space? Both. The telephone was used for what, on other grounds, people and institutions wanted to do.

The Internet, and related computing technologies, also - like the telephone - are technologies of freedom. They increase choices. They can (and will) be used by everybody for their own purposes.

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[54] Ithiel de Sola Pool, *Forecasting the Telephone: A Retrospective Technology Assessment of the Telephone* (Norwood, NJ: Ablex Publishing Co., 1983).
Ithiel de Sola Pool, ed., *The Social Impact of the Telephone* (Cambridge, MA: MIT Press, 1977).

However, Pool s descriptive idea also contains a political warning about the possibility of too-hasty public policy and unintended confusion and damage to freedom in the years ahead. The warning has two implications: about regulation by government; and as the legal theorist Lawrence Lessig has started to articulate, about de facto regulations created by computer code and technical design, which constitute the common law of cyberspace and shape the future of freedom and other interests in the world.

A. A Warning: Government Regulation of Technologies of Freedom

To explain Pool s warning:

Soon, all forms of communication will be found over the Internet. Everything will be traveling in digital form (speech, text, video) and to many different recipients for different purposes.

Pool argued that three different legal regimes have governed different types of communications technology:

1.) The freedoms of speech and press, that have been fundamental to the growth of political democracy and are the most strongly defended: In America, there may be no prior restraint, no taxation, no use of government power to restrict the free exercise of the rights.

2.) The law to govern common carriers, such as telephone companies. Governments have required universal access and standard (regulated) rates. They have taxed the use of the telephone, But there also have been strong guarantees for privacy: court orders (for example) must be obtained to learn the numbers that are called, or for wiretaps. And telephone companies cannot sell information about who is called.

3.) The era of mass communication added another, more intrusive, and more restrictive legal regime. Broadcast licenses were required to own and operate radio and television stations. The content of programming could be reviewed and be an acceptable basis for granting or denying a license. Owners of radio and televison stations were required to police the programming that they broadcast and even (at times) to comply with government-defined fairness doctrines in covering political campaigns. The official justification was partly correct - there was a bandwidth scarcity that restricted the number of channels, but there also may have been an underlying apprehension that any technology that could reach tens of millions of households might be powerful, and its use should be subject to government review.

Since the Internet will do everything, we cannot regulate it by the last two legal regimes (i.e., common carriers, or mass communications) without an invasion of privacy and violating freedoms of speech and press. When is it free speech, and when is it broadcast television? Pool felt strongly that all forms of communication over the Internet should receive the strongest protections, of speech and press. As the Internet grows, it will be even more important to assure that the Internet is the home of freedom, to assure that the world is the home of freedom.

However, just to provide an early warning: At the moment, do-it-yourself Internet television on a global scale is just becoming practical. When it arrives, and hate groups everywhere create Web sites to breath hostility at anybody who wants to log-on? And a pluralist world - with XXXX sites and gambling sites, etc. - is more fully present (live!) in cyberspace? Will the public, and democratic processes, have the forbearance and wisdom to keep freedom paramount?

B. Warning: Code and Other Laws of Cyberspace

As the Internet becomes used daily, and more important for both nine-to-five institutions and evenings worldwide, the technical choices that affect its design also become important - for freedoms they create, for freedoms they restrict, for the ease of one kind of activity versus another kind of activity. Lawrence Lessig's Code and Other Laws of Cyberspace: has started to raise such issues: the laws of cyberspace - set by engineers (or by Microsoft or AOL) can shape the uses of new freedom as much as formal laws enacted by governments.[55] The availability of market competition and alternatives can help - and forethought and vigilance also can help the cause of freedom.

We have already seen the example of restricting consumer freedom by restricting broadband options (above, pp. xx). The National Research Council also has raised the question of why direct fiber-to-the-home is not available: One question that the market has not yet explored is whether the consumer would make a significant capital investment, similar to the $1,000 to $2,000 that a computer costs today, as part of obtaining Internet service. For example, if there were . . . fiber running to the residence (making it a relatively future-proof investment) . . . [w]ould residents be willing to finance the capital costs of installing that fiber in the first place? [56] However the fact that a national overview in the early 21st century finds that the market has not yet explored . . . the option is a warning that local regulators and consumers who want more freedom must

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[55] Lawrence Lessig, *Code and Other Laws of Cyberspace* (New York: Basic Books, 1999).

[56] National Science and Telecommunications Board, *Broadband: Bringing Home the Bits* 158.

assure that freedom is part of the technical design.

Several further examples:

- Concerning control and freedom from unwanted advertising. The code for instant messaging technology, once it is written and included as a feature in browsers, also creates a technology for pop-up advertising. Will it be used for this? More broadly: will Microsoft or AOL include a feature that allows you to turn off all advertising - or will you be able to buy a browser with this feature? If it is not in the code, it is not a right.

- The operating code for the Internet s routing computers that read the addresses of each packet can be used to block Internet traffic from specified sites; or automatically copy all messages to a law enforcement agency. Each of these options might be beneficial in some cases. But Internet code is global, and options that are benign in Western democracies can be used by bad actors in many countries around the world. It might be wiser for the Internet s routing computers not to have these added features.

- There are features that might be added on behalf of freedom: Why not permit any two users to encrypt Internet and/or digital cellular telephone calls automatically by a near-unbreakable method known only to themselves? Or - now that chips are powerful enough to handle encryption and decryption in the background - why not write an automatic option to encrypt e-mail to selected users? When it is part of the code, it becomes a de facto right.

Summary

The four types of social, economic, and political processes that will combine with new technology to shape the future are

summarized in Table 2-1:

Table 2 - 1

Four Rules of Forecasting

- S curves of change: Their shape and speed
  - Advantages and costs of changing old technologies
  - Complementary technologies
  - Learning new technology
  - Applications and revenue

Market Forces Shape the Future
  - Behavior that is not in the consumer's best interest
  - Boom and bust cycles

Visionaries and Organizers: He Who Organizes, Wins

Technologies of Freedom
  - Government regulation of technologies of freedom
  - Code and other laws of cyberspace

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