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The Crisis of Communication: Videotext, the Internet and Innovation in France and the United States

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ABSTRACT *This article compares videotext in France and the United States, the two advanced industrialized countries where videotext was the most and least successful, respectively, in order to demonstrate how videotext as a techno-political project foreshadows the explosive growth of the Internet as the dominant global communications platform. It draws upon the theory of network effects, in combination with a comparative analysis of both the institutional settings for research and development and political discourse, to explain how the interaction between state, market, and culture shaped network development and policy outcomes. Data are drawn primarily from official policy documents and trade journals from the era.*

Keywords: videotext, Internet, France, United States, policy, networks.

Introduction

Innovation in large-scale technical systems such as national communications networks emerges from the interplay between culture, markets, and policy choices within specific historical contexts. To develop this argument, this article analyses the evolution of videotext in France and the United States.[1] During the 1970s and 1980s, many Western European states experimented with videotext—a pre-Internet platform for networked communication that linked a dedicated (and rudimentary) computer terminal to either the telephone network or the broadcast system. Broadly defined, videotext 'is a generic term for a computer-based, interactive system to access and selectively view text and graphics on a terminal screen. The content is usually organized into tree structures of pages that are selected from a hierarchical menu'.[2] Videotext's success varied widely across Europe, with outcomes influenced by both technical and political choices. All of the European systems began as state-led and publicly funded strategies to promote technological competitiveness, introduce citizens to the emerging information society, and facilitate electronic commerce. However, only the French system (Télétel) achieved real success as measured by household adoption and the amount of traffic generated by the network.[3] The United States, too, had a brief

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videotext era, though it receives substantially less attention in scholarly fields such as information systems, public policy, and the history of technology. Nevertheless, there was a short but important period in the American telecommunications sector in the mid-1980s when the privately-owned regional Bell operating companies (RBOCs), as well as various media-related corporations, tried to promote household videotext to consumers. This article compares videotext in France and the United States, the two advanced industrialized countries where videotext was the most and least successful, respectively, in order to demonstrate how videotext as a techno-political project foreshadows the explosive growth of the Internet as the dominant global communications platform. It draws upon the theory of network effects, in combination with a comparative analysis of both the institutional settings for research and development and political discourse, to explain how the interaction between state, market, and culture shaped network development and policy outcomes. (Data are drawn primarily from official policy documents and trade journals from the era.)

Mobilizing a Security Crisis: Videotext as French System and Symbol

Louis XI set up the French postal monopoly in the 1470s, justifying extensive state control under the banner of national security—logic extended to the telegraph in 1837. Continuing the pattern, France subsumed the telephone within the Post and Telegraph Administration by 1879 and fully monopolized the national network by 1889. A. N. Holcombe notes that French authorities prior to 1879 allowed a period of private franchises, both because the laissez-faire school was in vogue in France and, more importantly, because public revenues had been severely depleted by war with Prussia (1870–71) and the State was not willing to finance development of an unproven technology. However, after the first experimental long-distance messages were successfully completed, 'the decade of skepticism and indecision in the French telegraph administration was terminated by a sharp spasm of alarm. It was then seen what a mistake it would have been to have allowed the telephone industry to have escaped altogether from the control of the telegraph authorities'.[4] By the early twentieth century, the Postal, Telephone, and Telegraph (PTT) Administration had full control over telecommunications in France. Such a centralized institutional framework was common throughout Western Europe by the early twentieth century, where 'in each country, an administrative department equipped with a legal monopoly guarantees public telephone service to users without discrimination'.[5]

In France, the PTT focused its expertise and resources primarily on the postal system until the early 1970s. Though the Government implicitly had the prerogative to upgrade the telephone network at will, it did not actively exercise this authority and concentrated instead on promoting increased efficiencies in postal delivery. In *Le Colbertisme High Tech* (1992), French scholar Elie Cohen attributes the stagnation in the French telephone network to the Government's need to prioritize public projects following two world wars, and argues that consequently until 1974 the history of the French telephone is one of a 'permanent crisis'.[6] The same public tradition that made the French postal service one of the world's most modern and efficient, however, held that the *essential* infrastructure of the country should be equally available to all citizens. Though the French government largely ignored the telephone network until the mid-1970s, the network's inclusion within the postal ministry meant that the PTT always had the

latent institutional power to pursue a 'great leap forward' in network modernization. What was necessary was to reframe the role of communications technology in French culture and French national security, and then to link this new political discourse to a coherent plan for rejuvenating the network.

The French sense of national/economic crisis that followed the oil shocks of the early 1970s provided a rationale for the Government to focus on the telephone network. Just as the mass production crisis and the emergence of Japan as a serious economic competitor (which almost destroyed the American automotive and consumer electronics industries in the 1970s) created widespread interest in flexible, computer-driven production techniques throughout North America and Europe, so too were most industrialized countries beginning to move away from a reliance on manufacturing towards high technology and services as a more reliable strategy for economic growth. The OECD, for example, issued a series of reports in the early 1970s on the way in which computers and telecommunications technology were reconfiguring entire industries, work patterns and social organizations. It concluded that 'of all the new technologies which have burst upon society in recent years-rocketry, nuclear energy, radically new medical technologies— ... the technology of communication is the most important. The others altered the physical environment; but telecommunications can directly alter mankind's knowledge, values, prejudices and cultural pattern'.[7] Among the leading industrial powers, however, France was in arguably the riskiest position due to the risible state of its telecommunications network. In 1970, for instance, 87% of American homes had a telephone, compared to only 15% of French households.[8] Such a situation—arguably tolerable in a recovering economy based on mass production and primary commodities/exports such as agriculture—would be disastrous in a knowledge-based economy where inventory, production, and investment information needs to move rapidly to actors at all levels.

President Valéry Giscard d'Estaing recognized the economic crisis facing France, and linked it to a comparative 'backwardness' in the development, deployment and use of advanced telecommunications systems. The 'grand projet' of telephone modernization required billions of French francs and a sustained effort by the public authority during the late 1970s. By 1983, French telephones per 100 population had reached 35.6 compared to 37.7 in the United States.[9] France achieved high rates of diffusion in this compressed amount of time because the state now had the will, and hence could claim the resources, to push rapid network development. According to Dr Christian Stoffaes, Head of Strategic Studies at Electricité de France, the French concept of public service refers to 'an activity which the sovereign state decides to conduct by itself, or at least, where its duty is to intervene strongly in order to correct deficiencies of private initiatives'.[10] Thus, once the telephone network became part of the essential infrastructure of the country, the French public service tradition required the monopoly to enhance user access.

The French Government also identified a strategic advantage in waiting to develop the communications infrastructure: it could link telephone modernization to a deliberate public strategy for creating an online services industry (Télétel). Public versus private ownership of the means of communication does not sufficiently explain the differences between the French and American cases-other countries using a state-led and public ownership approach in this timeframe (such as Britain and Germany) did not pursue videotext as aggressively or successfully as France. In addition, as both V. Schneider (1993) and T. Vedel (1991) find in

analyses of technological decision-making, technical choices regarding whether videotext would be linked to the telecommunications or to the broadcast/television network influenced the success of the 'videotex experiment' in Germany, Britain, and France.[11] However, while not a sufficient condition, the French state-led model was a *necessary* condition both for the types of strategies and discourses that French authorities could legitimately mobilize to justify the creation of a widespread online services network, and the speed with which the shift in technological paradigms could be realized throughout society.

The Computerization of Society

In December 1976, President d'Estaing commissioned Simon Nora, Inspecteur Général des Finances, to develop a theoretical and cultural foundation for 'information society' policy strategies. The resulting document, *L'informatisation de la societé* (in translation, *The Computerization of Society*, co-authored with Alain Minc), extended and rationalized within a French context the emerging global emphasis on information as both the motor and the main output of modern economies. It also raised the spectre of American dominance in high-technology, thus linking the network modernization project to a deeply resonant French aversion to perceived American hegemony in the fields of communications, computers, and mass media. Nora and Minc coined the term 'télématique', which refers to the merger of telecommunications and computer technology. In a French context, however, the word is more expansive than this, referring also to the broader modernization of French society and French economy that was the real point of technological investment and innovation. In his letter of 20 December 1976 requesting the report, the President noted that Simon Nora could draw on assistance from 'all relevant ministries', though he emphasizes the role of the Ministry of Industry and Research, and the Ministry of Economics and Finance. The identification of these two ministries, plus the assertion that 'the applications of the computer have developed to such an extent that the economic and social organization of our society and our way of life may well be transformed as a result', suggest the sense of crisis with which policy elites approached the emerging information economy.[12]

Modernization of the telephone network was thus an important, but only incremental, step towards realizing French success in the knowledge economy. Significant social and technical innovation required bringing online information services into French households and businesses, and encouraging online commerce and communication. The public obligations imposed on the telecommunications monopoly required that access be facilitated in a consumer context and encouraged the use of public funds to accomplish this goal. French scientists working at the Centre National d'Etudes des Télécommunications (CNET) developed packet-switching technology that enabled the French 'online kiosk' approach. Content providers (from the private sector) would post services on their own computers, which the individual could then access via a dedicated terminal attached to their telephone connection. France Telecom, the publicly owned (and monopolistic) national telephone operator, served as the conduit for this access. It billed customers monthly for their time online (wrapping the costs into the regular telephone bill) and transferred the revenues back to the content providers, less its common carrier fee. In addition, based on the assumption that the serious revenues accruing to the information age would be realized through information services, the Ministry initially provided free Minitels to French households, and

only charged a nominal rental fee for later, more advanced models. As Schneider argues, this centralized, supply-side strategy was a deliberate attempt by the French Government to 'create an initial stimulus for self-sustained system growth of telematic technology. A large terminal park would generate new communication traffic, new information services and consumer demand, which would [theoretically] pay back the investments in a relatively short amount of time'.[13]

The kiosk system had both practical and normative implications. On the one hand, it was both efficient and anonymous—online service costs were absorbed into the phone bill and the services were noted by only a general number that referred to the category of service. At a more normative level, incorporating online service fees into the monthly France Telecom bill reinforced the idea that all forms of information technology and service were now essentially the same. There was no clear regulatory demarcation in France, compared to the United States during this time period, between telecommunications, telematics, and broadcasting, and their attendant regulatory models. All were managed by the French Government within the institutional parameters of the state-led model, and via the relevant ministries. Access to the network would be non-discriminatory and rates would be evenly assessed according to the type of service selected. By 1995, France Telecom estimated that Minitel was available in 25% of French households, and that approximately 36% of the adult population in France had routine access to the terminals either at home or work.[14] Among the industrialized countries, only France at this juncture could claim access to a stable online services industry that had not only reached critical mass within the domestic population (with approximately 12,000 services available), but had already sorted out the social and legal problems posed by initial consumer interest in online access to unrestricted pornography and online sex chats. (Much of the initial interest in Minitel during the period 1983–87 revolved around public appreciation for the notorious *messageries rose* available through the 3615 access code. After the media focused extensive coverage on the explicit sexual services available through Minitel, France Telecom raised the 3615 access fees considerably in order to avoid the charge of using public money to subsidize smut and illegal activity. Businesses also had to develop means of regulating 3615 calls by employees, foreshadowing a similar problem with the explosion of 'Internet porn'.)[15]

However, in retrospect, 1995 also represents the year in which French videotext peaked and the Internet began to emerge as the network of choice in terms of media coverage, consumer purchases, and progressive worldwide adoption. In order to understand how and why French videotext did not successfully transition to the early twenty-first century, it is important also to examine the dynamics of research and development in the American political context.

An Industry Without a Market: Videotext in the United States

The regulatory debate about all forms of communications has always been more contentious in the United States than in France. In the early twentieth century, the Post Office Department actively lobbied the US Senate to be given regulatory jurisdiction over new communications technologies, based on its interpretation of Article I (Section 8, clause 7) of the Constitution. The provision gives Congress sole and exclusive authority 'to establish post offices and post roads' and the Post Office argued that the framers intended all forms of communication to be regulated by the federal government. Postmaster General Timothy O. Howe had summarized

the prevailing Post Office view in its 1882 annual report, stating that 'the telegraph was not known when the Constitution was adopted. Neither was the railway. I cannot doubt that the power to employ one is as clear as the power to employ the other'.[16] Yet despite the reams of evidence presented by the Post Office which showed that public ownership of the telegraph and the telephone was the regulatory norm in Europe, the United States Congress made an explicit choice not to organize electronic technologies within the postal framework. This policy choice shaped all further developments in this sector.

The American regulatory approach, in contrast to the French tradition, draws upon the ideas of theorists such as John Locke and Thomas Jefferson, who assert a link between political freedom and private property rights. With the exception of the original postal monopoly-and in cases where the stated purpose of the technology is to enhance national security as defined in military terms-the United States relies on private industry and competitive forces to drive innovation. The same issues that arose in 1914 had been raised by the Post Office in the mid-1800s with regards to the telegraph. Yet, as Abramson, Arterton and Omen note in *The Electronic Commonwealth*, 'the precedent of private ownership had been firmly established. Western Union became the model upon which future media systems would build . . . From the very beginning the two media were viewed as similar services, though natural competitors. Similar treatment in public policy was a logical extension'.[17] Private ownership of media systems and the bias towards deregulation converge in a culture that sees government intervention in the marketplace as usurpation of freedom—whether of the information consumer or information provider. The United States prefers the market-led to the state-led model for network dissemination because this approach institutionalizes consumer choice and industry flexibility as the main drivers of social and economic outputs. As in the French case, ideas and institutions combined in the United States in the nineteenth century to shape the telecommunications regime in a way that would affect the types of networks that emerged in the late twentieth century.

After the expiration of the initial patents held by Alexander Graham Bell in the late nineteenth century-and a subsequent period of rapacious competitiveness wherein the growing Bell system crushed upstart rural and independent competitors-the United States Congress was faced with a common dilemma of the industrial era: how to encourage the price and innovation incentives of competition in a sector subject to 'natural monopoly', while not allowing an essential infrastructure to fall under the private control of one company. Against the backdrop of Roosevelt's New Deal, an activist Congress passed the *Communications Act of 1934*, thereby institutionalizing a regulated private monopoly approach. This legislation gave a newly-created Federal Communications Commission (FCC) regulatory authority over 'all interstate and foreign communications by wire or radio and all interstate and foreign transmission of energy by radio, which originates and/or is received within the United States'. (Regulation of intrastate communication remained the prerogative of state regulatory commissions.)

The Act also introduced the term 'universal service' in Section 1 of the legislation—a regulatory term both more specific and more contested than the previously discussed French concept of 'public service'. Tyler and Bednarcyck note that while the 'general concept of "universal service" is itself more or less universal, its translations into practical policies vary very widely'.[18] Once France accepted a public service obligation to provide network access, it became a public resource provided to all and policy was consistent across different political regimes. As Cats-

Baril and Jelassi note in reference to French videotext, 'on a political level, the will to see this project through was maintained through at least three administrations of different political persuasions and several secretaries of the PTT'.[19] By contrast, because the United States is both a pluralist and legalistic system that encourages interest groups and organizations to compete within and across sectors, the term universal service has no consistently accepted meaning. It tends to fluctuate across time and technologies, depending upon the ideological positions of the current commissioners and the zeal with which they are willing (and instructed by the Executive branch) to pursue infractions of the regulatory rules.

Pluralism also meant that the regulated private monopoly compromise would be assaulted almost immediately by organized business interests seeking a part of the now lucrative telecommunications industry. By 1949, the Justice Department filed suit against AT&T, arguing that the inclusion of a manufacturing arm (Western Electric) violated the 1890 Sherman Antitrust Act. AT&T agreed to a consent decree that ended the Justice Department's lawsuit in 1956. The Justice Department again filed suit against AT&T in 1974, charging the company with conspiracy to monopolize the telecommunications industry. It also charged all 22 Bell operating companies as co-conspirators.[20] The suit was settled by the 1982 consent decree (also referred to as the MFJ, or modification of final judgment), which mandated the separation of AT&T's long-distance division from the local Bell companies. Unlike most of the European monopolies, in which one national operator still controlled both local and long-distance service, the American long-distance industry was now opened to competition. The local operating companies were reorganized into seven regional units, each of which constituted a 'mini-monopoly' regulated by state public utilities commissions.

How Could Giants like Times Mirror and Knight-Ridder Have Been So Wrong?[21]

The RBOCs spent most of the 1980s petitioning the courts for relief from the MFJ's three major lines of business restrictions: manufacturing telecommunications products, providing inter-LATA (long-distance) service, and entering the information services industry. Though by July 1991 the RBOCs finally won a reversal of the decision to prevent their entry in the information services market, the regulatory hurdles of the 1980s partially explain the US lag in developing videotext when compared to Europe. France, the country that achieved the greatest success with videotext, developed and promoted the technology within a state-led framework that stressed universal access and a public obligation to promote dissemination. In the United States, however, attempts to promote competition via legal rule-making after the break-up of AT&T stifled the development of a comparable system in the United States. Since 'the RBOCs represent approximately three-quarters of US telecommunications assets, defining the limits of [their] business ventures has the effect of directing policy for the entire industry'.[22] It is also important to stress, however, given that the Internet and World Wide Web are now so ubiquitous that they appear inevitable, that many American telecommunications and information companies in the 1980s *were* interested in videotext, and particularly in the French experience with household online services. For instance, *Time* magazine (December 1986) quoted France Telecom's Francois de Valence in a story on videotext-and why America didn't have a similar system—to the effect that 'to find oneself at a Minitel screen able to converse freely with four or five people is new—there is no equivalent. It's like an electronic café'.[23] Media stories about this 'French miracle'

continued to appear in other mainstream outlets such as *PC Week* and *American Journalism Review* until the mid-1990s.

Concurrently, videotext received substantial private investment by US companies during the 1980s and there were scattered experiments in upscale communities throughout the country. Larry Pryor, magazine editor for news (1982–86) for Times Mirror's Gateway Project, noted that even though this early experiment closed in 1986 with only 2,000 subscribers—despite offering news, entertainment, shopping, e-mail, and banking services—'those of us on the news side of the business lamented [Gateway's] passing because it was the fastest, most flexible news delivery system ever invented'.[24] Similarly, in a brief history of Viewtron (a joint venture of Knight-Ridder, AT&T, and minor partners), David E. Carlson notes that at the end of the first year (October 1984) only half of the predicted 5,000 subscribers had signed on in the initial launch area of South Florida, and that the venture finally folded in 1986 after losing an estimated $50 million.[25] The RBOCs also entered the videotext market, but were likewise unsuccessful in building consumer demand. For instance, by April 1989 Southwestern Bell's videotext service in Houston had only 10,000 subscribers and the telephone company discontinued the experiment. Though the installed base of videotext terminals in the United States reached a nominal high of 1.5 million in 1990 (compared to 5.8 million in France),[26] by 1992 the International Telecommunications Union no longer provided statistics on US videotext in its annual reference sources.

One group of scholars thus proved prescient when they referred to videotext in the United States as an 'industry in search of a market'.[27] In a case study of student use of Viewtron, Heeter *et al.*, concluded that it would be 'necessary to get people to try videotex extensively before the market potential could be realized'.[28] (Based on a limited sample of 36 students, the authors stressed that initial reluctance to use the service turned to enthusiasm, so long as repeated guidance on navigating the system was provided.) J. Hart noted in another scholarly article from the era that while Minitel suggested that online services could be commercially viable, 'the main lessons to be learned from the Minitel/Télétel experience concern the importance of reducing the entry costs for users and producers to mass consumer-oriented information services'.[29]

Overlapping Networks: From Videotext to Internet

The parallel development of the early Internet during the period 1969–95 suggests that the comparison between US and French videotext cannot be read as a straightforward story of the vagaries of private sector regulation versus the virtues of centralized state planning. Just as Minitel began in the labs of the French Government, the Internet began as a project within the Defense Advanced Research Projects Agency (DARPA).[30] Because the project was conducted primarily within a defence-related framework, initial government control and the use of taxpayer money could be justified even in the American market-led culture. Commercial spin-offs from the project might later be a bonus, just as the interstate highways facilitated the growth of roadside diners, hotels, and gas stations, but consumer access was not the essential goal during the Cold War.

Indeed, DARPA's influence over the development of large-scale technical systems in the United States provides further support for the argument that institutional settings for research and development exert a significant influence on

the way in which networks develop. DARPA is a public organization essentially unique to the American experience and cultural context. The Agency began in 1958 as an Eisenhower-era response to the Soviet launch of Sputnik, and its mission 'has been [and remains] to assure that the US maintains a lead in applying state-of-the-art technology for military capabilities and to prevent technological surprise from her adversaries'.[31] DARPA is a stand-alone research organization that receives major funding from the Department of Defense (DOD), but which has the autonomy to pursue high-risk, high-payoff technological projects. Because the Agency does not have to account financially for each 'failure' and 'dead-end' encountered in its highly experimental research, it can facilitate an astonishing level of creativity among its affiliated scholars, computer scientists, physicists, etc. (Senior DARPA staff rotate frequently in an attempt to avoid the pitfalls of vested interests and group-think within the organization.) Essentially, even within the highly hierarchical and centralized arena of the United States Defense establishment, American policy elites attempted to create through DARPA an organization that could leverage the perceived benefits of the private sector—unbridled creativity and innovation—while simultaneously capturing the public benefits of long-term research horizons and secure funding. DARPA also enables the military to shield radical, path-breaking, and/or bizarre research within an institutional structure that is paradoxically stable (operating since 1958) and flexible. This institutional arrangement was particularly important during the late Vietnam-war era, when research on distributed communications advanced to the forefront, as many of the most talented software engineers, linguists, and other scholars of communications-related fields were located in the universities (many of them graduate students with a pronounced aversion to the Vietnam War).[32]

In comparison to the French case, then, research on and deployment of an advanced telecommunications network was never explicitly linked to an overt American 'crisis'. Instead, the project emerged via the ongoing interaction (in a Cold War context) between both military elites, who were interested in the broad question of whether a network could be made to withstand limited nuclear attack, and a variety of scholars, graduate students, and scientists interested in the basic research questions of how computers could be made to 'communicate', and/or how to increase the processing and computational capacity of existing computers. The 1969 prototype (Arpanet) for the technologies that later evolved into the Internet connected only four computers, but the implications of this research into packet-switching and distributed networks were profound. Defence contractors were among the first to use the new technology, followed by elite public and private universities. By the mid-1980s, however, Arpanet funding was exhausted. In 1987, a coalition of Michigan universities (MERIT) signed a cooperative agreement with the National Science Foundation (NSF) to set up and administer the emerging Internet backbone. Using the language and standards first developed for the military, the network consisted of several supercomputer sites and high-speed connections. It is at this critical juncture that private industry began to view the Internet with interest. As in the French case, the American government provided the initial supply push by financing the technology, and subsidizing its use through various public organizations. As first defence contractors, then academics, students, and nonprofits, went online, however, a pool of potential fee-paying customers emerged at approximately the point that the federal government (DARPA) was ready to divest Arpanet, and hand-off the technological know-how to the private sector.[33] The Internet gradually transitioned from the defence sector to the

educational sector then to the private sector, and by the mid-1990s discussion of videotext in both the American popular and the scholarly press essentially stopped. In his introduction to the English translation of Nora and Minc's report to the President on telematics (1979), Daniel Bell noted 'in the United States, where the scale of activities in this field is considerably larger than in France, there is as yet no national policy'.[34] Nor would there be; instead, the American challenge to French videotext emerged within the public sector and then transitioned to the private sector via incremental policy responses and broadly-defined research and security interests.

Conclusion

In a recent analysis of telegraphy and radio, P. McMahon argues 'one clear lesson is that substantial shifts in core technologies can play a fundamental role in the progress of nations and effect change in the basic structures of global development'.[35] This analysis of videotext, the Internet, and innovation provides further support for this insight. Somewhat ironically, given the fears of American hegemony and of technological obsolescence that spurred the French to develop Télétel in the 1970s, the eventual displacement of videotext by the Internet resuscitated the French sense of economic crisis. In June 1996, the French Government convened an Internet Interministerial Commission (IIC) to report on the current status of videotext in relation to the Internet. IIC concluded that while the Minitel experience provided France with certain first-mover advantages-particularly a populace already comfortable with electronic commerce-France needed to transition to an Internet-based communications platform as soon as possible. The IIC also suggested that while videotext was an important evolutionary step in the attempt to combine telecommunications and computers, the Internet was a more advanced and disruptive technology that would generate significant changes in global economic and social organization. In a (likely unconscious) echo of the Nora and Minc discourse from 18 years earlier, the IIC concluded 'these [Internet] services do not represent the development of a new technology alone; their success and their universal nature means they represent a new social space which justifies the elaboration of new behavioural rules'.[36]

Moreover, despite those enduring legends about all of the lucrative Silicon Valley careers begun in someone's garage, American capitalism is much more sophisticated than the modern mythology of the lone Internet entrepreneur suggests. The role of the government in promoting innovation, especially in communications, is crucial. In a comparison of French and German videotext, Schneider concludes 'the structures of these sociotechnical systems and the videotext strategies connected with them were ultimately influenced by the institutional structures of the telecommunications sector and the role of the state in the development of technology'.[37] This analysis of France and the United States provides additional support for the theory that innovation in large-scale technical systems is typically seeded by public sector funding and national policy goals. Both the United States and France used the state to accelerate the transition to the Information Age. The significant differences had to do with how each defined 'national security' (and thus justified the use of public funds), the institutional settings within which research and development played out, and how each approached crucial transition from the government lab to the household consumer.

At this juncture, the theory of 'network effects' provides a framework within which to extend these findings. The network effect refers broadly to 'the dynamic process by which a solution becomes useful or useless depending on whether it is adopted'.[38] The concept is a scholarly extension-inspired in particular by the telecommunications regulatory debates of the 1970s-of Harvey Leibenstein's general discussion of the 'bandwagon effect' in the 1950s.[39] Influential network analysts such as J. Rohlfs note that 'the utility that a subscriber derives from a communications service increases as others join the system'.[40] In France, the Government's decision to distribute Minitels for free throughout the country generated an important network effect within the domestic context. However, this centralized (and expensive) French strategy ended in stagnation. Once the system and the terminals were in place, there was very little 'value added' in terms of faster access and spin-off innovations. Each generation of Minitel terminal was slightly better than the last, but there was no French equivalent of Silicon Valley to exploit the innovative capacity of free-market competition after the initial supply-push strategy was exhausted.

The essential French character of Minitel also stifled videotext exports abroad and further decelerated the initially vibrant network effect. For instance, despite the creation of Minitel USA and intensive marketing efforts by France Telecom in selected major cities such as New York, the difficulty of making America's personal computers 'Minitel ready', combined with the fact that the majority of the content was initially available only in French, negated the possibility of succeeding in the American market. Because France Telecom never adjusted its centralized strategy, and because it neglected to consider the consequences of not translating French content immediately, French videotext could not develop a significant foothold in the American market prior to the downward spiral of technological obsolescence that intersected with the rise of the Internet. Moreover, unlike the Internet's TCP/IP, which quickly became adopted throughout the world as the preferred (and seamless) communications protocol, French videotext—even in its heyday—never 'translated' in other national or technical contexts. As P. McMahon argues, 'whatever the peculiarities of national development, the overall systemic advantages of specific technologies and associated systems eventually become clear, and those technologies and systems take on a transnational character that outweighs local variations'.[41]

Finally, the massive sunk costs of the system put French technocrats in an awkward position by the early 1990s, resulting initially in a collective resistance to market cues and a denial of the Internet's implications as a disruptive technology, with a concomitant emphasis on the Internet as yet another symbol of American 'hegemony'. As late as 1995, Alain Giraud (one of the primary architects of Minitel), argued in *PC Week* that 'with Minitel, we already have a network platform in place. Isn't this the experience that everyone is fumbling for?'[42] Approximately two years later, however, the French public monopoly model had been overhauled clearly in the direction of the Anglo-American market-led model, with shares in the newly privatized France Telecom offered on the New York Stock Exchange.

In the US, conversely, technology policy is most often a subset of military policy, and national security is defined and justified in terms of power politics. During the Cold War, only an organization such as ARPA would have had the resources and the legitimacy to sustain a long-term commitment to developing an innovative new communications network. However, while willing and able to use the military framework and rationale for technological research and development, the United States typically moves to the free market to promote consumer access to goods and

services, to stimulate incremental innovations and applications, and to generate the network effect within a consumer market where demand (unlike in the videotext case where American companies had no obvious platform from which to launch their new services) has been stoked via public investment.

In conclusion, it is critical, on the one hand, to recognize and document the significant role of the Government (and taxpayer money) in creating the Internet, particularly given the relentless media hype in the late 1990s (prior to the stock market 'tech-wreck') about turbo-capitalism and 21-year-old Internet billionaires. However, it is also crucial to recognize that private companies continue to develop many of the most important incremental innovations, particularly in e-commerce and data protection. This analysis of videotext, the Internet, and innovation ultimately demonstrates that successful innovation policy does not require a stark choice between state and market, but instead a flexible and careful calibration of the limits and possibilities of both.

Notes and References

1. 'Videotext' and 'videotex' are synonymous. The latter term is used more frequently in writings from the 1970s and 1980s.
2. W. L. Cats-Baril and T. Jelassi, 'The French videotex system Minitel: a successful implementation of a national information technology infrastructure', *MIS Quarterly*, 18, 1994, pp. 1–20.
3. The official name of the French videotext system as a whole is Télétel, while the small dedicated terminals used to access information services are known as Minitels. It is common in France to use 'Minitel' to refer to both the network and the terminals, and that colloquial practice will be followed here.
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