The Failure of Fax: When a Vision Is Not Enough

Jonathan Coopersmith
Texas A&M University

In the last decade, fax machines have revolutionized communications. We have become used to and dependent upon instantaneous information. Many people cannot conceive how they worked without a fax machine. The question, however, arises: If the concept is so good, why did nearly a century and a half elapse from the first patent in 1843 until rapid commercial diffusion in the 1980s?

In actuality, attempts to commercialize facsimile technology extend back to the 1860s [5]. Its promoters spanned the spectrum from individual inventors, such as Thomas Edison and Arthur Korn, to massive corporations, such as Xerox and AT&T. Their most common feature until the mid-1980s was failure. The few successes occurred not in general communications but in dedicated niche markets and, even here, failures flourished. Perhaps the question should be: In view of the dismal history of failures, why did so many people and companies press ahead? What motivated individuals and firms to commit resources to create new markets and technology, given the daunting history that lay behind them?

Failure, the lack of technical and commercial success for a product in the marketplace, is endemic to innovative technologies. Failure is worthy of study if only to better understand success. Historians of business and technology accept this, but tend to focus more on success. This lack of coverage distorts our knowledge of the business process because failure is an integral, if not dominant, theme in the existence of companies. Much scholarly writing about failure concerns how entrepreneurs overcame obstacles -- whether technical, economic, social, or political -- to succeed. The roads not taken or only partially traveled rarely are explored in depth [39]. Often a strong Whiggish whiff of technological or economic determinism can be detected.

When looking at failure, the range of potential causes is so wide that any easy answers should be suspect. Failures occur for a multitude of reasons, including the product, its institutional framework, the market, or factors beyond immediate control, such as monetary policy or war. Failure for one product or technology does not necessarily imply success for another, but competition is probably the most important single factor to consider. Competition includes the battle for resources, usually inside a firm or consortium, to develop and bring a product to market, as well as among products for the same market.

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Equally important is the comparison between the reality and the expectations of entrepreneurs, customers, and other interested parties. New technologies are often greeted and promoted with great enthusiasm. This enthusiasm can become the prevailing wisdom, which can be quite misplaced. One reason for such enthusiasm is the need to create a network of involved and committed supporters. Creating such a successful, durable network is extremely difficult [4; 19].

Lack of supporters can kill an innovation, but the opposite problem, too much unqualified support, can produce technological or institutional "inertia," wherein a technology or group remains basically unaffected by forces external to its institutional setting. This inertia may enure the short-term existence of the technology or group, but its blindness to changes may ultimately degrade or destroy it [24].

The numerous unsuccessful attempts to develop and diffuse fax technology over several decades provide an opportunity to study the shaping and reshaping of a technology whose potential, until recently, always exceeded its promise. This paper will examine four episodes in the history of facsimile technology: public picture telegraphy service in Great Britain in the 1920s-30s, the radio-broadcast facsimile newspaper of the 1930s-40s, Western Union projects from the 1930s through the 1980s, and Federal Express' Zapmail in the 1980s. These are advanced failures, cases where the sponsors considered the technology sufficiently developed to take to market.

Picture Telegraphy

Spurred by wartime advances in electronics, the 1920s marked a flowering of attempts to transmit photographs by wire and wireless. Led by France and Germany, the major European PTTs (Post, Telegraph and Telephone administrations) established picture telegraphy services starting in the mid-1920s. The British Post Office, with some reluctance, started its service in 1930.

The forces favoring picture telegraphy included the companies promoting their wirephoto equipment, the PTTs using the equipment which needed a network of compatible systems to increase the attractiveness of their investment, the actual users, and post office employees enthusiastic about its potential.

The engineering department saw in fax a possible future means of transmitting regular telegrams. Institutional and national pride also played a role. Failure to provide such service would have opened the path for a private firm, "a course which seemed open to several objections, one being that the agency most active in the matter was under American control." The most visible advocates were the newspapers, which envisioned and realized competitive advantages in their battles for circulation [3, 3888 and 2553].

The most serious argument against a picture telegraphy service was the competing technology of air mail, which offered a less rapid but still quick transmission of photographs. Inside the Post Office, picture telegraphy had to contend with tight finances and the fear that it would harm the profits of ordinary telegrams. The concept itself proved awkward at times. As a decade of operations demonstrated, few people and businesses needed very rapid transmission at a very high price when alternative forms of communication

offered relatively quick service at less cost. A phototelegram to Germany cost from one to three pounds: An airmail letter cost four pence an ounce, or twice the cost per word in a telegram.

The Post Office decided in summer 1929 to open a public picture telegraphy service and purchase a Siemens-Karolus set. The Treasury approved the 6000 pound purchase but warned that establishment of a permanent service would depend on its remunerativeness. Service officially began on January 7, 1930. From transmission only with Berlin, the service quickly expanded to nine countries [3, 2874A, 3444 and 4639].

Transmitting a 3 x 5 inch photograph only took twenty minutes; however, the total time from acceptance to delivery averaged two hours. The difference included preparation, waiting for an open line, and ensuring a connection. Unpredictable transmission delays continually frustrated users. Fax needed higher quality circuits than voice for accurate transmission, so pictures often had to wait until a suitable trunk circuit became available.

The new service quickly ran into the all too common problem of overestimating demand and underestimating expenses. Traffic over the decade averaged one to two transmissions daily compared with the six needed to cover costs. The service usually recouped only a sixth of its expenditures, leaving the Post Office to swallow most of the 3000-3500 pound annual costs as well as the original cost of the equipment. Nonetheless, postal officials strongly recommended that the Treasury continue to subsidize picture telegraphy due "to the scientific importance of the system and its vogue abroad" as well as its "important future possibilities." The Treasury did [3, 3888].

Despite efforts to promote other uses, picture telegraphy's overwhelming market was newspaper pictures. Of the 157 picture telegrams transmitted from Britain in 1931-32, press agencies and newspapers sent 142 or 90% of all the photos [3, 5441]. Ironically, those papers that had campaigned in the late 1920s for a postal picture telegraphy service had, by late 1930, purchased their own machines. The major users decided that their volume justified owning their own machines, which permitted direct transmission into their photographic departments. In 1936, British newspapers owned 27 Siemens-Karolus and 10 Belin picture telegraphy sets compared to the one set owned by the Post Office [3, 3888 and 4877; 17].

Improved airmail service from the continent to Britain further limited the potential market for the expensive picture telegraphy. Postal surveys of potential users found that "cheaper and sufficiently rapid Air Mail Services" and newspaper ownership of fax machines had destroyed most of their potential clients [3, 3405 and 3888].

The total number of transmitted photographs, both private and public, grew from 387 in 1931-32 to 796 in 1938-39, and averaged nearly 600 photographs annually. For special occasions, such as a Royal wedding or the 1936 Olympic games, the PTTs arranged for extra equipment and close international coordination to minimize delays [3, 3888 and 5211]. Engulfed by World War II, public picture telegraphy died almost without notice. The Post Office suspended public service in May, 1940, owing to a lack of countries with which to correspond.

For the Post Office, picture telegraphy was a financial failure. Technically and politically, the system worked and maintained British standing among European PTTs. Neither a large market nor the replacement of ordinary telegrams emerged. Yet a market did evolve in newspaper photographs; however, the major customers, the newspapers, decided to cut out the middleman and transmit directly among themselves. A similar evolution occurred in the United States where AT&T, after several years of operating its picture telegraphy service, sold the service to Associated Press in 1933 to create AP Wirephoto. Although the Post Office knew its picture telegraphy operated at a large loss, it made no effort to shut the service. The reasons for continuing stem from the realization that Britain was participating in an international system of PTTs and that it would lessen its reputation by withdrawing and lose a say in shaping what promised to be an important technology of the future.

Western Union

Western Union offers the interesting example of a company that successfully integrated fax technology into its existing system of telegraphy but failed to conceive of facsimile as an independent form of communication. Consequently, facsimile's leading developer and user from the 1930s-60s vanished almost completely from the evolving fax market in the 1970-80s.

Western Union saw significant long-term potential from facsimile. The major perceived benefit was the exact reproduction of a telegraphic message, thus avoiding transmission errors, cause of the company's expensive "Accuracy First" program. Other advantages were lower labor costs by eliminating operators because of more automated operations, faster message handling, and expanding service [23; 26].

Western Union did not begin to expend significant resources on facsimile technology until 1935. Its researchers developed two major lines of automatic equipment. The least visible was long distance trunk circuits, where the equipment operated in Western Union offices. The second line transmitted telegrams from a local Western Union office directly to large users, eliminating courier operations.

The latter consisted of Telefax and postwar Deskfax services. For faster service to its larger customers, Western Union installed tie-lines to connect them directly via telephones, teleprinters, and, after 1937, Telefax. By December, 1941, Western Union had 200 Telefax circuits in operation in New York, Chicago, Atlanta, and San Francisco. The technology evolved, always in the direction of more automated operations, increasing the speed of operations and reducing the amount of human involvement needed [23].

After the war, Western Union developed and introduced Deskfax, a smaller version of Telefax, that extended the ability to directly send telegrams from an office desk. Messages sent from a Deskfax or public machine arrived at a central office for transcription into telegraphic code. Designed for inexpensive production and minimum maintenance and adjustment, important considerations for automatic equipment, Deskfax became the most widespread application of facsimile technology until eclipsed by telephone-based fax machines in the mid-1970s. Deskfax installations peaked at 45,000 units before

production stopped in 1960. In 1971, when only 20,000 fax machines existed in the US, businesses still operated 37,000 Deskfaxes [15; 33; 38].

From the 1950s until the early 1960s, Western Union created variations of Deskfax and Telefax for a wide variety of niche markets. The development of automatic switchboards allowed the creation of private fax networks where subscribers could directly transmit to other patrons or via a central operator to non-subscribers. Services included WeatherFax, BrokerFax, IntraFax, LetterFax, and Wirefax. In 1958, fax services accounted for $42 million of Western Union's $255 million in revenues [28]. Desktop machines, growing niche markets, dedicated communication networks, profitable service -- Western Union appeared to have the basis for widespread fax operations in the early 1960s. Two decade later, market surveys discussed Western Union in the past tense. The company faced three problems: competition, technology, and management. Western Union faced growing competition from new fax machines operating on the public telephone network and specialized fax message firms. Western Union had offered Wirefax, a public fax service, in five major cities in 1959 but had not expanded the system by 1970. In contrast, the Independent Postal System of America offered one-hour message pick-up and delivery from one thousand franchised locations nationwide [38].

From the mid-1960s, Western Union stopped promoting and modernizing its fax equipment, a dangerous lag in a period of rapidly changing technology, while exploring new ventures. The company failed to capitalize on its existing base of users and machines while venturing into areas where it faced powerful telecommunications competitors. In the 1960s, Western Union did experiment with several forms of fax service. Most impressive was the Broadband Exchange Service which offered a switched, duplex service among 50 US cities and connections with international carriers. Western Union tried other services in the 1970s-80s as traditional telegraphy withered under the onslaught of new electronic technologies and express delivery services. One of the more interesting efforts was EasyLink, part of a competitive trend towards integrating separate communications services into one system. EasyLink allowed a user to send a message from a telex or personal computer via Western Union and the postal service. Like the British Post Office had feared with picture telegraphy, EasyLink's e-mail system cut sharply into Western Union's mainline telex base without adding substantive new revenues. EasyLink lost $24 million in 1984, further worsening the company's shaky finances [25, 32].

Most important, however, was the reluctance of top management to view facsimile as a means of communication in itself as opposed to an integral part of the telegraph. According to company facsimile engineer Garvice H. Ridings, top management in the 1960s and 1970s had neither the interest nor comprehension to pursue the possibilities of true facsimile communications. Instead of creating a unified network of their existing machines, Western Union ignored its existing potential [11, 34].

The successful integration of fax technology into its telegraphic services definitely benefitted the company for a quarter-century. Its failure, however, to see the fax as anything but an adjunct to the telegraph message ultimately relegated Western Union to a minor player in the telecommunications world. This was a case of managerial narrow-vision or institutional inertia, even while

the company built the largest customer pool for facsimile in the United States until the mid-1970s.

Fax Broadcasting

Between 1935 and 1950, newspapers, radio stations, and fax promoters cooperated to create the "newspaper of the future," a newspaper that still awaits its audience. This failure stemmed less from technological inadequacies than from poor economics and misconceptions about the demand for news and the popularity of television.

The concept of fax broadcasting was simple: Instead of broadcasting sound from a studio, a radio station would scan a specially prepared newspaper and transmit it over the airwaves. At home, a recorder would print the newspaper. To use the contemporary analogy, the facsimile scanner was similar to the microphone and the receiver to the loudspeaker.

Newspapers were the focal point for blending these broadcast and narrowcast technologies into a new product. Media interest in fax broadcasting grew from opportunity and fear. The opportunity was a profitable synergy between newspapers and the radio stations that many of them owned. The fear was being "caught napping" by a new communications medium, as had happened with radio broadcasting in the 1920s [16; 37].

As with any emerging technology, visions and expectations greatly outpaced the technological capability. Proponents envisioned several financial advantages for the radiofaxed newspaper: A short-term supplement to the existing newspaper, someday it might replace the elaborate -- and strike-prone -- printing and distribution process with direct transmission to homes [45].

The television-radio-newspaper struggle greatly shaped the evolution and ultimate demise of fax broadcasting. From the fax broadcasting perspective, the problem was twofold: the fast growth of television and the slow growth of FM radio. The development and expansion of television took attention, FCC frequency allocations, advertising, and resources from the emerging FM radio, which did not meet its proponents' promises until the mid-1950s.

"Facsimilists" perceived television not as a competitor but as an expensive "personalized delivery of motion pictures" that offered only "fleeting, moving images on a screen, whereas fax provides a recorded duplicate of each transmitted page." Advocates of television viewed fax broadcasting as a potential supplement for television, printing programs and synopses [9; 21; 26].

The prewar fax broadcasting boom began when the McClatchy Broadcasting Company applied in October, 1936 to the FCC for permission for early morning fax broadcasting for two stations. By December, 1937, the FCC had granted eleven experimental licenses, over twenty stations by mid-1938, and forty by December, 1939. Ten thousand receivers had been sold by Pearl Harbor. Despite these advances, commercial enthusiasm had faded by 1941, when only four stations continued to transmit [1, 1941; 7; 22; 31; 41]. The loss of interest came from technical and commercial considerations. The equipment was very sensitive and slow. Nor did the nighttime broadcasts did provide a useful service. A morning newspaper provided more news at far less cost [14; 29].

After World War II, fax broadcasting experienced a rebirth based on FM transmission, which offered significantly better broadcasting quality and faster printing than AM. From a commercial standpoint, however, the FM spectrum was largely unplumbed, meaning that, unlike AM, FM did not have a large base of stations and receivers -- or potential customers [2; 46]. Despite this handicap, FM fax broadcasting advanced rapidly after 1944. Paralleling technical progress, promoters created an institutional framework to promote standards and public acceptance. The two strongest newspaper supporters were the *Miami Herald*, a Knight newspaper, and the *Philadelphia Inquirer*.

One reason for the Knight newspapers' strong backing was their admitted lag in adopting new technologies like color printing. Here was the opportunity for Lee Hill, already an innovator, to lead in introducing "'tomorrow's newspaper.'" Less heralded were delaying an expensive expansion of the printing facilities and the possibility of circumventing the typesetters union, Local 430 of International Typographical Union, AFL, which did strike starting in December, 1948 for four years. Another reason was the prevailing postwar attitude of technological enthusiasm. Australian Consolidated Press editor-in-chief E. W. McAlpine declared, "The atomic bomb and facsimile, being demonstrated by The Miami Herald, are symbols of the new age [12; 36; 40; 42]."

Emboldened by the interest in pubic demonstrations in 1947, *The Philadelphia Inquirer*, *The New York Times* and *The Miami Herald* began daily operations in expectation of forthcoming FCC approval of commercial operations. On December 30, 1947, the *Inquirer* began regular broadcasts. By March, 1948, the paper broadcast five daily editions to thirty-one receivers. Unlike the paper's ultimate goal of home broadcasts, receivers went to hotels, banks, restaurants, and other businesses which could attract large audiences [14, 41].

In March, 1948, the FCC authorized commercial fax broadcasting. Advocates thought that fax broadcasting had sufficiently matured technologically to make a profit while providing a public service. Radio Invention's Lee Crooks predicted that a year after FCC authorization, the nation would have one hundred fax publications [14]. One year later, the dream of commercial fax broadcasting was dead. By 1952, FM fax broadcasting had nearly vanished. Only six stations had FCC authorization to transmit, and five were part of the New York Rural Radio Network. In 1954, even that activity ceased [1, 1952, 1954].

What had happened? Audiences had flocked to public demonstrations, but refused to follow with their money. Economics as well as a technology still being tweaked destroyed the feasibility of fax. The problem was twofold: expensive receivers and paper. The initial FM receivers, designed to generate public interest and elite acceptance, cost $800-900, with estimates of large-scale production reducing that to $50 or even $100 [14].

The *Inquirer* polled 945 people who viewed its public demonstrations. Although 74% expressed interest in a home receiver, their commitment faded rapidly with price. Sixty-four percent would pay $100, 31% would pay $200, but only 6% would pay $500, still far below the actual price of a receiver. In a chicken-and-egg situation, the mass production needed to establish a market never occurred because the market did not exist [14]. As intractable was the cost

of paper. Even the most optimistic predictions priced a four-page faxpaper several times higher than a normal 40-page paper. Contrary to expectations, news proved a fungible and cost-sensitive commodity. AM radio and newspapers fulfilled the needs of most people.

ZapMail

The most spectacular failure in the history of fax was ZapMail. Unsurprisingly, its promoter was Federal Express, one of the most innovative and fast-growing firms of the 1970s-80s. Federal Express conceived ZapMail as a means of expanding from the physical to electronic delivery of data, thus further sharpening the company's competitive edge. The ultimate goal of ZapMail was a seamless system of Federal Express satellites handling communications among 50,000 rooftop dishes [13].

Federal Express' interest in ZapMail was not technology for technology's sake. The company was engaged in intense competition with other express delivery services. DHL Worldwide Courier Express, for example, offered its International NetExpress, a similar system but better situated because it offered rapid delivery to large international customers [10; 25]. The company launched ZapMail in July, 1984 with two tiers of service. For low-volume customers, standard delivery and pickup would continue but the documents would be transmitted from one Federal Express office to another for delivery within two hours. Like Western Union's Telefax, high-volume users would have their own Federal Express ZapMailer on their premises. The technologically advanced ZapMailer was deliberately incompatible with other facsimile equipment beginning to enter the commercial sector. The company hoped to establish a fax monopoly equivalent to AT&T's hold on telephone service.

Customer demand never reached Federal Express's expectations. As well as "normal" technical teething troubles, a major problem was the high initial charge of $35 for five pages, a rate that contrasted unfavorably with $14 for Federal Express overnight delivery. Reducing the charge to $25 did not help greatly, nor did sharply slashing rental fees for the NEC equipment. Federal Express was leasing hundreds of ZapMailers monthly, but purchasing thousands from NEC [25; 27].

Two additional miscalculations of business behavior further hurt ZapMail. Companies needed many fewer same-day deliveries outside their firm than expected. Overnight mail worked as well and cost less. The three-hour difference between the east and west coasts, coupled with the delivery time from mailrooms, restricted the utility of transcontinental transmissions to a few hours a day. Financially, ZapMail's costs and losses escalated. When the company finally pulled the plug on ZapMail in October, 1986, it had lost $317 million [35].

The fundamental flaw of ZapMail was the emphasis on centralized mailroom to mailroom delivery at a time when the trend was towards decentralized desktop to desktop delivery. Compounding this error was the equipment's incompatibility with any other fax system, barring ZapMail from the rest of the fax community.

Conclusion

The advance of facsimile technology was neither uncontested nor simple, as these examples have shown. Failure, conspicuously displayed in harsh accounting terms, was a close companion. Competition from other technologies and other demands for resources played a significant role. Other forms of communication, whether the newspaper, the airplane, or the overnight package, satisfied users at significantly less cost or effort than the fax technologies. Other demands for resources existed in all cases and played a significant role in fax broadcasting but were decisive only in Western Union. In no case did the technology actually fail to perform. The problems encountered were the usual teething troubles encountered when deploying or adapting a new system. Rare is the technology or product that succeeds the first time. Reshaping, remarketing, and "tweaking" the product to remedy newly perceived shortcomings are common themes in the histories of many products and technologies [18, 44]. Usually, supporters and skeptics realize the need to reshape some aspect of the product. Only an extremely poor and irredeemable showing, as in the case of fax broadcasting, will immediately kill a project.

The lack of success derived not from the component technologies, but from the gap between the proponents' visions and the reality of specific markets. What the equipment did not do was deliver significant and economically obvious benefits to a sufficiently large customer base. Only in picture telegraphy was a niche market created which provided a protective environment for the technology to succeed commercially -- and that happened outside the Post Office.

Networks of cooperating supporters existed in all four cases. The projects could not have lasted as long as they did without internal and external support. The nature and depth of this support varied significantly. Western Union and the Post Office were both monopolies that introduced fax technology for different reasons. Western Union sought specific economic benefits by reducing labor costs and extending existing operations. Until the decline of telegraphy, Western Union's deployment of facsimile was a success. The British Post Office inherited an outside technology and deployed it in step with its European counterparts. Once obligated, however, the Post Office did not think of stopping service.

In contrast, ZapMail and fax broadcasting had more innovative corporate sponsors buoyed by the concept of technological progress. Federal Express had a reputation as a radical company, expanding the frontiers of the possible, as demonstrated by its original concept of overnight delivery. ZapMail promised to be a similar leap over its rivals. In this case, the concept overlooked ZapMail's fundamental discontinuity with Federal Express's desk-to-desk delivery. Perhaps a more conservative corporation might have focused more on this aspect. Fax broadcasting was also radical, a jump in the dark, but a jump based on the past success of radio and the future promise of television.

Three of the four cases involved major miscalculations about the market for their product. Only the Post Office launched its picture telegraphy service with low expectations. Fax broadcasting stand out because informed students of the airwaves assumed that, like television, fax broadcasting would become an integral part of the exploitation of the airwaves.

Joseph J. Corn has identified three fallacies about new technologies leading to such overconfidence: the fallacies of total revolution, social continuity, and the technological fix [6]. Enthusiasm is needed to create the enormous effort to develop and market new products. An accurate balance sheet before such an effort would probably scare most supporters away. The greater the excitement, however, the greater the potential for a gap between reality and expectations. As this paper has demonstrated, the process of commercial innovation is far harder and slower than many successes has indicated.

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