2 PLANNING THE DIGITAL FUTURE: MODELS AND MARKETS

In 1966, the Post Office founded the Long Range Systems Planning Unit to expand on its vision of a national digital infrastructure and to develop plans that would turn this vision into reality.[1] One of the key figures in this unit was Roy Harris, who had worked for Tommy Flowers on the Highgate Wood project and had reported and lectured on cybernetics and information theory for the Post Office. In keeping with the Post Office's ambitions for long-range planning, Harris's mission statement declared that the "prime purpose of planning was to invent the future, not to predict it."[2] Long-range planning, however, was not characterized purely by limitless techno-optimism for this digital future, and planners also pondered the problems of a self-governing, computer-controlled national infrastructure. In 1969, J. S. Whyte, the head of long-range planning, warned about the "bleak mechanistic prospect" of computerized telecom infrastructure, arguing that planners should mind the risk that such an infrastructure could erode dignity and privacy.[3]

By 1980, long-range planning looked very different. Preparing for the end of monopoly, BT renamed the unit the Business Planning and Strategy Department. Rather than "inventing" the future, the department made extensive use of computer models that would "scan" the future, while "competition and diversity" were proclaimed as "ideas of the future."[4] Computers would help realize this future too, as planners and executives discussed how the digital convergence of computing and communication could aid "small government."[5] Moreover, what Whyte had labeled bleak prospects for computer-controlled infrastructure in 1969 had turned into opportunities by 1980. At a long-range planning seminar with BT's senior management,

planners and executives anticipated how predictive computer control could allow autonomous infrastructure to anticipate users' information habits.[6] Combining this with information filtering, they speculated, could enable BT to "mould society." Several changes had thus happened to the Post Office's plans for a national digital infrastructure between 1966 and 1980. They had turned from inventive planning to predictive modeling, from warning about privacy to eroding it, and from emphasizing public monopoly to promoting small government and corporate surveillance.

This chapter continues the focus on the Post Office's visions and expectations for Britain's digital infrastructure. As chapter 1 explored how state ownership was central to the birth of this vision, so this chapter explores how that vision grew during national ownership, and how privatization and liberalization changed it. But it moves beyond a history of visions and expectations to explore the powerful role of explicit future-making practices like planning, forecasting, and futurology. The history of planning is central to understanding British political economy in the 1960s, when planning's appeal surged because it offered several opportunities. Planning could maintain the government's popularity with a public that increasingly perceived government's role as securing faster economic growth. It also offered a way to keep inflation and unemployment low and a solution to the demands of Britain's growing population on the welfare state. Finally, it tapped into the broader technocratic mood of the time. Britain's plans included macroeconomic, public expenditure, healthcare, and regional and housing planning. Ultimately, however, these plans overpromised and underdelivered, creating public disillusionment in the short term and, in the long term, paving the way for neoliberal politics that rejected both planning and state intervention.[7]

It would be a mistake, however, to see the Post Office's creation of a long-range planning unit as a last gasp of Britain's planning moment. Britain's 1960s planning vogue had roots in statistical forecasting and industrial interventionism from the interwar period, and while much of this activity focused on the state's capacity to create "long-term" plans, "long-range planning" was instead part of a technocratic response to planning's failures in the 1960s.[8] Long-range planning and other futurological fields were political "prediction technologies" intended not to forecast statistical, economic futures but instead to promote freedom of choice over optimal futures, embedding liberal politics in futurology. Yet, technocratic planners often remained as gatekeepers to these prediction technologies and their futures.

This was a controversial temporal extension of technocracy, particularly as many of these techniques emerged from the US defense think tank RAND. Public figures from Hannah Arendt to Lewis Mumford thus protested prediction's emergence as a technocratic Cold War conquest of the future.[9] This chapter thus maintains focus on the technocrats at the heart of Post Office telecom engineering who developed and modified their prediction techniques in dialogue with Britain's shifting political economy.

Futurology and futures research also paved the way for neoliberal imaginaries.[10] In this period, prediction turned from societal choices about world futures to paid, managerial consultancy work on policy and corporate decision-making. Focusing only on this end point, however, would miss that these prediction technologies were not born neoliberal, but instead developed through the influence of the US state-military-industrial complex, as well as French dirigiste planning circles. Prediction technology could thus "bridge statist and corporate rationalities and bring management methods taken from the large corporation to bear on governmental ways of 'seeing the future.'"[11] This chapter explores prediction technologies within British state institutions, the Post Office and BT, as they developed alternative modes of technocratic future-making in response to planning's failures, the corporatization of the Post Office, and the creation of BT. Studying these material prediction practices, whether they were complex computer models or simple timelines and budgeting documents, is vital. They materialized specific futures, visions, and expectations and sustained the communities and technologies invested and embedded in those futures.[12] The Post Office and BT mobilized these prediction technologies, which mainly took shape as computer modeling and simulation, to defend the digital vision through the 1970s and 1980s. Long-range planners found digital tools that would help them plan and implement a digital infrastructure, tools that both contested and adapted to the market turn and, in doing so, transformed the Post Office's plans for Britain's digital infrastructure from monopoly to market, from discreet to invasive, from public to private.

INVENTING THE FUTURE

In 1966, James Merriman set up the Long Range Systems Planning Unit to advise telecom R&D.[13] Its creation came after the McKinsey review of the Post Office, which had suggested that the Post Office needed more effective

long-term direction of R&D through "commercially sound" and "technologically complete" plans over a thirty-year timescale.[14] The Highgate Wood failure, for which the Post Office had attracted criticism in the *Sunday Times* and from the Select Committee on Nationalised Industries, also influenced the department's creation. The Post Office's director-general, Ronald German, answered the Select Committee's critiques of Highgate Wood's failure by pointing out that a new group, the Long Range Systems Planning Unit, had been formed to look at the "broad brush" of technological development.[15] Roy Harris, formerly of the Highgate Wood team, joined the Long Range Systems Planning Unit, and in this position, he penned two documents that formalized the Post Office's vision of a universal, integrated digital network. These two reports were "Telecommunications System of the Future," the department's founding document, and its sequel, "Telecommunications Systems of the 1980s."[16]

In "Telecommunications System of the Future," Harris advocated an "inventive" approach to the future. His report outlined a series of technologies, from videophones to remote computing, for which the department would coordinate both research and provision. Long-range planning would "exploit" these possibilities while also allowing for unexpected demands from telephone service users. Harris's sentiment—that "the prime purpose of planning was to invent the future, not to predict it"—captured his assumptions about R&D's limitless inventive capacity.[17] This turn of phrase echoed Hungarian-British electrical engineer Dennis Gabor's expression that "the future cannot be predicted, but futures can be invented," which appeared in his 1963 popular science book, *Inventing the Future*.[18] Harris may have borrowed this phrase after a personal encounter, as both Harris and Gabor attended information theory symposia at Imperial College, London, and Gabor later collaborated with Post Office researchers on computer simulation of speech compression.[19]

For Harris, this inventive approach to the future revolved around plans for the integrated digital network in two ways. First, it meant reinforcing expectations about social and technological change that demanded an integrated network, and second, it meant picking the systems that would support that network. "Telecommunications System of the Future" and "Telecommunications Systems of the 1980s" therefore both made broad claims about the future relationship between information technology and society and outlined the general principles of integration, digitalization, and computerization for the

universal digital network. In "Telecommunications System of the Future," Harris anticipated growing demand not just for telephone services but for a whole range of information services, including TV and radio broadcast, Viewphone facilities, fax transmission, remote computing, information retrieval, and data processing services. And, as Merriman had declared in 1966, the key to the Post Office's future was integrating telecommunications through computerization and digitalization so that the network could deliver all these services. Harris outlined the "total system concepts" that would allow the Post Office to meet all these demands, the first of which were "integration" and "information concepts." Harris spoke about how it was "essential to adopt an integrated approach whereby an increasing variety of telecommunication services is provided by the same general-purpose telecommunications network." He emphasized again how information theory lent the general concepts and techniques necessary to run these diverse services across a single general-purpose network. Harris then discussed the importance of "general-purpose control," in which, if the Post Office were to run a digital network providing integrated information services, applying computerization to network management would be essential.

In "Telecommunications Systems of the 1980s," Harris expanded on these points and made recommendations that dictated some of the Post Office's largest projects in the 1970s. Again, Harris repeated the Systems Planning Unit's expectations that the society of the 1980s would demand more information services and depend more on them. Integration was the ideal solution, and Harris referred to the integrated network field trials happening in new towns such as Washington and Milton Keynes. Harris then made a series of recommendations for Post Office engineering, all of which the Post Office followed. He recommended a forecast of the future distribution of different types of telephone exchange, which was one of long-range planning's most important projects and would later become a national controversy. Harris also recommended a broad, long-term review of the Post Office's long-distance network and how it could best transmit information services. This was another important project for long-range planning that (as discussed in chapter 4) fueled both the development of integrated digital standards and another high-profile technological failure in the Post Office. He emphasized the importance of studying local users' needs and when they would need various information services, such as video calling, which became another focus for long-range planning through the 1970s. Finally, Harris

recommended that the Post Office undertake a six-month feasibility study with industry on computerized telephone exchanges and follow that study with a five-year R&D program.

This final recommendation ended Harris's tenure at long-range planning. In the summer of 1967, Harris moved to become head of telephone exchange development and chair of the Advisory Group on Systems Definition, set up with industry to establish the technical feasibility and specifications for the digitalization and computerization of telephone exchanges.[20] As part of the Post Office's corporatization and reorganization, the Long Range Systems Planning Unit also underwent several changes. Long-range planning changed from a unit advising R&D to a fully-fledged division advising the telecom side of the Post Office. In doing so, the newly named Long Range Studies Division also gained a new head. In 1969, J. S. Whyte returned to the Post Office from secondment to a familiar destination, the Treasury's O&M department. As Merriman had done ten years earlier, Whyte had spent most of his time working on state computing projects and had helped restructure the British computing industry into ICL, a new flagship manufacturer that the Labour government hoped would be internationally competitive.[21] Whyte's return to the Post Office as department head for long-range planning, reporting directly to Merriman, the new senior director for engineering and another Treasury O&M alumnus, perhaps suggests that Merriman was stacking senior positions with like-minded engineers. Whyte committed to Harris and Merriman's inventive futures of integrated digital networks and spread bureaucratic computerization throughout long-range planning. Unlike the discreet mechanizers in central government, however, Whyte would take a more visible role in reaffirming the Post Office's role as the steward of national communications.

COMPUTER MODELS AND MECHANISTIC PROSPECTS

Under Whyte, long-range planners remained committed to inventing digital futures. This commitment is perhaps most evident with Viewphone, a videophone terminal that appeared in Harris's reports, Post Office promotional films, and further plans for the integrated digital network.[22] Viewphone was a desktop terminal with a seven-by-five-and-a-half-inch screen and a loudspeaker-equipped telephone for two-way speech and vision. A long-range planning report on Viewphone declared that, with rising income,

growing business advantages, and the "continuing advance in technological capability," it was "virtually certain that demand for a viewphone service will arise in the future."[23] AT&T's Picturephone, launched in 1964 to great fanfare but ultimately a commercial failure, heavily influenced these plans. Long-range planners concluded that Picturephone failed only because the public was not ready for video telephony and advised that the development of a British videophone should proceed because of the inevitable demand for the Post Office's integrated information network. Internal trials started in 1972, linking Telecommunications headquarters in central London with the Post Office's research station at Dollis Hill, northwest London.

Viewphone ultimately failed, but in doing so, it demonstrated long-range planning's success. A 1976 report on the Viewphone trials revealed little enthusiasm, as users found that many calls were blurry and that visual contact did not improve communication.[24] Users also mainly employed Viewphone to transmit written material, neglecting video telephony itself. Although BT still showcased Viewphone throughout the 1980s (a 1988 *BT Journal* article described it as an "important new service"), there was no commercial development until 1993, when BT launched Relate 2000, its first videophone.[25] This history echoes AT&T's Picturephone, which, despite its failure, was "a rather successful piece of the technological imagination that guided innovators by helping to establish a basic paradigm for information services and technology."[26] Even after unsuccessful trials, Viewphone's continuing presence demonstrates the Post Office's commitment to a single national network for voice, data, and vision.

The department also began using computer modeling for two of Harris's recommendations from "Telecommunications Systems of the 1980s." The first use was to forecast the long-term development of Britain's long-distance transmission network, and the second was to forecast the rollout of new telephone exchanges. The first project came together through the creation of a new group, the UK Trunk Task Force, within long-range planning. This group's task was to recommend a strategy for trunk network development up to 1985, with looser recommendations until 2000. The task force modeled traffic across the entire network for telephony, data, and, of course, Viewphone. The model simulated this traffic's cost, quantity, and quality based on whether transmission, signaling, and switching were analogue or digital. The model also simulated different network layouts to find the best arrangement of switching centers for the network's "backbone."[27] The model found that

digitalization would halve equipment costs and predicted that telephone connections would double by the decade's end, nearly quadruple by 2000, and that total traffic would almost quintuple.[28] The UKTTF's report, completed in 1971, thus recommended the digitalization of the entire network and was endorsed by the Managing Director's Committee for Telecommunications in 1972.[29]

The task force's model was not a neutral calculation, and it contained several assumptions that betrayed its human inputs. The model assumed a future of widespread videophone use, meaning that the network would need to carry video, in addition to voice and data, and assumed this would culminate with Viewphone's transformation into a "concept that included facsimile and visual access to data banks."[30] The head of the task force, Denis Breary, admitted that "a certain amount of forecasting of a sociological nature was necessary to establish a likely pattern of demand in the latter decades of this century."[31] The model was thus working from the task force's assumptions, which included expectations that, by 1980, Viewphone and teleconferencing systems would be widespread and that, by 2001, digital transmission between local users and telephone exchanges would need to carry both telephony and Viewphone signals.[32] These assumptions were all based on the Post Office's goal to build an integrated digital network and the expectation that the society of the 1980s would require voice, video, and data services. These predictions were not outputs of the task force's model but rather inputs, suggesting that senior Post Office management endorsed the task force's report not because of the strength of its findings, but because it reinforced their existing visions and expectations for the future.

Computer modeling also forecast the rollout of new telephone exchanges. One of Whyte's first projects as head of long-range planning was to simulate the optimal depreciation and replacement rates for outdated electromechanical telephone exchanges over thirty years.[33] Every simulation strategy found that installing a hypothetical new electronic exchange would be cost-effective, and faster strategies were better than slower ones. Unfortunately, few details remain about this model's technical composition. Surviving records show that the model was called A Local Exchange Model (ALEM), a version of it ran on a Honeywell computer hosted by the Post Office's Management Services Department, and that it used discounted cash flow analysis to calculate the year-on-year costs of exchange replacement.[34] Finally, and crucially, the model assumed that the hypothetical replacement electronic

exchanges in these simulations had the exact same cost and traffic capacity as quoted to the Post Office by the US-owned manufacturer, STC, for its new TXE4 series of electronic exchanges. In January 1971, as it would do the following year with the UKTTF report, the Managing Director's Committee for Telecommunications endorsed the simulations' conclusions. In April, the Post Office board followed suit and "thanked Mr. Whyte for his clear and comprehensive presentation of the telecommunications business proposals for exchange equipment," approving the purchase of STC's TXE4 based on these simulations.[35] Whyte handed the model over to the Operational Programming Department and liaised further to plan the TXE4 modernization strategy. Later that year, Whyte left long-range planning to become the director of operational programming.

The model's assumption that TXE4 would replace electromechanical exchanges shows a continuing commitment to invented futures. Whyte's model did not offer a new future but upheld a decision to roll out TXE4, thus supporting a future where the Post Office board purchased electronic exchanges from STC. There are parallels here with Viewphone and the trunk task force model. In all these cases, long-range planners picked a winner and then studied different ways to develop and roll it out. The department thus invented rather than predicted futures. As the next two chapters will show, however, this strategy could backfire. Using TXE4 as the basis for the ALEM model would contribute to one of the Post Office's most controversial procurement decisions of the 1970s. The trunk task force's model and its expectations about Britain's need for a high-bandwidth telecommunications infrastructure also guided investment in the waveguide, an experimental transmission technology that ended up as a high-profile and costly failure. For now, however, this chapter will remain with the Long Range Studies Division and how it maintained and transformed the Post Office's visions and expectations.

One new area that Whyte focused on while head of long-range planning was public concerns about computing and digitalization. In various publications and events, he conceded that rapid technological development risked machine control over society. He argued that "machines must not be permitted to erode the dignity of man," warning about the "serious questions of the invasion of privacy" and titled one paper "Telecommunications in the Service of Man," inviting the question of what the alternative might be.[36] Whyte most forcefully articulated these concerns at a 1969 conference, "City

in the Year 2000." The conference included eminent speakers such as Ray Pahl, the sociologist of suburban and postindustrial communities; Alexander Macara, the future chair of the British Medical Association; John Dennis Carthy, a prominent BBC science communicator; and Meredith Thring, fuel scientist, mechanical engineer, and future coauthor (with Eric Laithwaite, who created maglev transportation) of the 1977 popular science book *How to Invent*.[37] Whyte described how automated, computerized communication networks could degrade humankind:

> There seems to be no reason in principle why we should not envisage the fully automated situation in which the individual need rarely leave his home but merely manipulates the knobs and dials and screens around him in order to obtain his education, conduct his business, do his shopping and get his entertainment. This bleak mechanistic prospect is unacceptable because it pays no regard to the fundamental nature of man, and his indispensable need to interact with other men and seek self-fulfillment. . . . If men are to have any hope of controlling their own destiny, they must attempt to reduce the gap between our explosively growing technological capability and our lack of understanding of its social consequences.[38]

In warning about this "bleak mechanistic prospect," Whyte responded to public concerns about the dehumanizing intrusion of computers and communications into personal life. In 1967, Alan Westin, Professor of Law at Columbia University, had published his influential book *Privacy and Freedom*. This book drew attention to new, often technological, ways of invading privacy, such as the informational surveillance made possible by computerized data banks. The Younger Committee, Britain's first large-scale official study of privacy, thus invited him to present evidence, and its 1972 report underlined the threats of mass communication and computerized record-keeping systems.[39] This could be seen in the public hostility to the 1971 census and the uncertainty around public data protection, which led to the highest-ever proportion of the public refusing to complete the census. Three years later, Harold Wilson's new Labour government published two white papers, *Computers and Privacy* and *Computers: Safeguards for Privacy*. In this climate, British government computing projects had become interpreted as a new threat posed by the centralized, computerized state to the individual citizen.[40]

Whyte and Merriman came from a British governmental tradition of "discreet modernism," where expert mechanizers obscured their extensive automation and computerization of the British state. Whyte's visible warnings

appear to defy this tradition, as well as undermine the Post Office's plans for digitalizing and computerizing Britain's telecom infrastructure. As head of long-range planning, however, Whyte no longer worked as an expert government mechanizer in Whitehall. Instead, he was part of a public monopoly that, as Harris and Merriman established in 1967, invented futures of computerized, integrated networks for telephony, data, and Viewphone. Discretion may have sufficed for Treasury O&Ms' expert mechanizers, but in the national telephone system, at a time of rising privacy concerns about computerization and telecommunications, Whyte could not be discreet. He thus mollified public concerns about computers and privacy by affirming the Post Office's awareness of the potential dystopian consequences of its plans, as well as its commitment to avoiding those consequences. This was also an important sign that, for senior Post Office engineers, a nationalized political economy for digital infrastructure was no longer infallible. They could not assume that nationalized control over communications was uncontroversial, and instead had to directly address the political dimensions of their project. At this point, under national ownership, computer control and surveillance were a threat to address. Throughout the 1970s and 1980s, however, as the telecommunications monopoly ended, and computer simulation became further entrenched within long-range planning, computerized control and surveillance would begin to look less dystopian to telecom engineers and managers.

SYSTEM DYNAMICS AND POSTINDUSTRIAL SOCIETY

In the 1970s, long-range planners began to study new uses and visions for computing inside and outside telecommunications. These studies emerged from several influences that changed long-range planning in the Post Office. The Post Office restructured the telecom business, moving long-range planning to a new department, Telecommunications System Strategy, and renaming long-range planning as the Long Range Intelligence Division. The new Telecommunications System Strategy Department, headed by Roy Harris, was created to oversee the development of the general-purpose network, particularly System X, Britain's first fully computerized telephone exchange. Although this move might seem to shrink long-range planning's responsibilities, relocation gave long-range planning a new focus on broader social and economic futures. Whyte, who left long-range planning in 1971, was

replaced by Alex Reid, former director of University College London's Communications Studies Group, where he had directed research into the social impact of computers and communications under contract for the Post Office and the Civil Service.[41] Under Reid's tenure, long-range planning began social forecasting and hired researchers from across a wider range of fields, including information scientists, statisticians, sociologists, and psychologists.[42] The department's relocation and instigation of economic and social forecasting, along with Reid's appointment and new hiring strategy, suggest that Merriman and Harris felt that long-range planning needed a new direction, oriented more toward the telecommunication system's social and economic environment.

These influences, alongside the Post Office's strained economic environment in the 1970s, manifested in the quantity and quality of reports that long-range planners wrote from 1974, when the department relocated to Telecommunications System Strategy. Of the thirty-seven reports written before 1974, thirty-two addressed technological change in telecommunications, while five addressed societal futures.[43] Of these five, three profiled long-range planning in British government; one reported on the conference "City in the Year 2000," where Whyte had warned about the "bleak mechanistic prospect"; and the last, a 1971 study titled *Britain 2001 AD*, projected Britain's economic environment to the year 2001.[44] This last report was also the first recommendation for comprehensive economic forecasting in the Long Range Intelligence Division, citing the pressures of Britain's turbulent economic environment. In 1974, the department thus began two new series, Long Range Economic Forecasts and Long Range Social Forecasts. From this point, approximately 40 percent of long-range planning reports were economic or social forecasts, 25 percent were telecommunications forecasts, and 35 percent were "interactions" forecasts, synthesizing research on telecommunications futures with social and economic forecasts.[45]

These economic and social forecasts provided avenues for new uses and visions of computers in telecom infrastructure. The first Long Range Economic Forecast, "The Economic Consequences of Energy Scarcity," introduced the Post Office to a new type of computer modeling, system dynamics.[46] The report responded to Britain's 1973–1974 energy crisis, caused by a National Union of Mineworkers strike that slowed down domestic production of coal, and the 1973 oil embargo by OAPEC, the consortium of oil-exporting Arab nations. Prime Minister Edward Heath thus introduced a three-day workweek

in December 1973 to conserve energy. The combined energy and economic crises caused telephone growth to drop by 50 percent, and so the board initiated a Telecommunication Energy Conservation Program, while long-range planners ambitiously studied the potential for telephone exchanges powered by on-site nuclear reactors.[47] The energy scarcity report surveyed and synthesized a range of forecasts from think tanks and policy units, such as the University of Sussex's Science Policy Research Unit and appraised the likelihood of future energy crises.

The report highlighted system dynamics' use in *Limits to Growth*, an influential 1972 report published by the Club of Rome, an intellectual network formed in 1968 to draw attention to issues requiring global action.[48] The *Limits* report used Jay Forrester's system dynamics, originally known as "industrial dynamics," which Forrester developed while at MIT's School of Industrial Management as a heuristic tool to model industrial systems and help managers better understand the systems they managed.[49] Industrial dynamics expanded into system dynamics, which, for the *Limits* study, became "world dynamics." Using world dynamics, *Limits* projected an "overshoot and collapse" of society based on the interaction of five variables: world population, industrialization, pollution, food production, and resource use. Post Office long-range planners dismissed this gloomy prediction but nevertheless concluded that a long-term energy problem was likely. They thus emphasized that, to weather future crises, business and government needed "more sophisticated" long-term planning.[50] Forrester's system dynamics would become a key part of the department's "more sophisticated" long-term planning.

Meanwhile, the department's social forecasts offered new ideas about computers' role in society. Joan Glover, the department's newly hired sociologist, undertook and analyzed customer interviews and questionnaires to forecast changes in labor structure, home working, and telecommuting. Glover concluded that networked computing would facilitate home working for professional, managerial, and clerical workers and transform work from the type where "people and machines were coordinated to produce goods" into the "co-ordination of people and machines to produce knowledge."[51] Expansive and academic, Glover's social forecasts cited Max Weber, Michael Young, Anthony Giddens, Peter Hall, Georges Friedmann, and Peter Berger on the nature of work, family, leisure, cities, and alienation. They also showed the continuing influence of US futurology, citing reports from the Institute for the Future, a RAND spin-off, and *The Year 2000: A*

Framework for Speculation on the Next Thirty Years, the highly influential futurological text by Herman Kahn and Anthony Wiener.[52] Perhaps the strongest influence, however, was Daniel Bell's *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, published in 1973.[53]

Bell's *The Coming of Post-Industrial Society* combined computers and futurity in two ways. First, Bell predicted a future society in which information, rather than matter, would be the primary resource for economic growth. Computers were central to Bell's predictions, rendering work informational rather than material, and so Glover's futures of informational, computerized work, in contrast to pasts of material production, echoed Bell's postindustrial society. *The Coming of Post-Industrial Society* was a turning point for understanding how computers would change the future, and postindustrialism proved a popular concept to explain the 1970s zeitgeist that "computers soon seemed *everywhere*."[54] Second, *The Coming of Post-Industrial Society* was not only about capitalism's future but was also a plea for more extensive use of social forecasting techniques.[55] Bell argued that industrial society's linear forecasting could not understand postindustrial society, so society needed new predictive techniques to judge the various trends, indicators, and technologies that would shape the future. Computers, as "intellectual technologies," were again crucial. Using techniques such as simulation and model construction, these intellectual technologies would forecast and solve the problems of postindustrial society. Bell thus argued that computers, as an intellectual technology, would play a double role, both forecasting society's postindustrial future and, within that future, making society postindustrial by rendering work informational rather than material. This double role of the computer played a similar role in long-range planning as in Bell's postindustrial society. While long-range planners did not extensively reference Bell's work, his strong influence in Glover's social forecasts on postindustrial society suggest that Bell's arguments about computers as intellectual and prediction technologies affected long-range planners.

This influence is suggested by long-range planners' growing use of system dynamics simulations, one of futurology's archetypal intellectual technologies. The department first used system dynamics to respond to the potential reorganization of the Post Office's telecommunications monopoly. The economic constraints imposed on the Post Office during the first half of the 1970s had reignited a public debate about whether it was wise to have one corporation run two very different public services. A review group, the Carter

Committee, began in 1975 and, in 1977, recommended that the Post Office separate into two corporations, one for Post and one for Telecom. In 1976, the department thus commissioned a model of the Post Office corporation to gain a holistic understanding of the telecommunications business, as it became increasingly likely that the telecom business would detach from the Post Office.[56] The department engaged David Probert, a researcher at Cambridge University's Department of Control and Management Systems, to develop a system dynamics–based model of the telecommunications side. As a student, Probert had interned at the Post Office's research station, Dollis Hill, for the summer of 1970, working on a statistical analysis of signals and noise in digital communication systems. From 1973 to 1976, Probert completed his PhD research on stochastic machine learning at Cambridge and then transitioned directly into working for the Post Office on a system dynamics model of the telecom business.[57]

The Long Range Planning Model (LRPM), delivered in 1977, thus explored "alternative corporate futures."[58] Written in FORTRAN and run on an IBM 3033 time-sharing system, the model grouped the business into four conceptual modules: marketing, personnel, finance, and technology. Planners simulated corporate futures by altering a cluster of up to ten parameters and tracking the effects across 180 variables, showing the company's future finances, equipment needs, total workforce, and more across a thirty-year time horizon. As these outputs referred to the entire telecommunications business, not individual departments, operational departments mainly used the model to analyze the impact of strategic choices on the whole business. In this sense, system dynamics' first use, simulating holistic corporate futures, united the telecommunications business into an independent whole, separate from the Post Office.

The LRPM took a new, pluralistic approach to futurity. Probert described how the model did not predict a singular corporate future, but generated a range of alternative futures for management to "expand our own 'mental models.'"[59] The model simulated different futures: the "uncontrollable future," a predetermined future for which the model would identify the resources needed to execute short-term plans; the "designed future," which simulated "considerable freedom in controlling the corporate destiny"; the "self-fulfilling future," which assumed that a designed future would achieve "full implementation"; and finally, the "future as a game," which blended the above types to convey to management that the future would result

from conflict among various corporations, each attempting to effect their designed futures and each influenced by the inertia of history.[60] This pluralistic approach shows how simulation began to change the telecom business's approach to futurity. Simulation put possible futures in dialogue with the present to aid decision-making. Long-range planning had thus changed from envisioning one digital future, as it had been under Merriman, Harris, and Whyte, to anticipating alternative futures. But in all cases, anticipation was also normative, conjuring futures of an independent telecom business.

The model's delivery in 1977 was timely, as the Carter Committee review also finished that year, recommending that the government separate post and telecommunications so that the telecommunications business could reinvest its profits, rather than support the loss-making postal business.[61] This recommendation didn't just vindicate the senior management's desire for the split but also reinforced a shift in thinking about telecom from a public service to a commercial enterprise. This enabled an understanding of the telecom business as something that could either reinvest profits or support a loss-making postal business. To the Post Office board's ire, however, the Labour government instead delayed separation for an ill-fated experiment in industrial democracy. This experiment increased the Post Office board from seven management members to nineteen, adding seven trade union members and five external members from industry.[62] The former postmaster general, Tony Benn, had advocated industrial democracy since taking over the Department of Trade and Industry in 1974. By 1977, James Callaghan had replaced Harold Wilson as prime minister, and Benn successfully secured Callaghan's approval for the industrial democracy experiment. The experiment started that year, and so in 1978, the Callaghan government vetoed the Post Office split to continue the industrial democracy experiment.[63]

The opinions on industrial democracy were mixed. Initially, the press reported it as a pioneering experiment, but soon suggested that Post Office management was undermining it, tired of industrial relations dominating the board's time.[64] Britain's interest in industrial democracy in the late 1970s, which the government only ever notably implemented in the Post Office and British Steel, has been cast as a flirtation that went as far as it did only because of underlying economic issues and the failure to find lasting solutions to those issues.[65] An academic report on the experiment by the University of Warwick's Industrial Relations Research Unit found that difficulties had stemmed from the sheer size of the Post Office organization

and had been exacerbated by the conflicting expectations and interests of management and union members:

> Management members in particular claimed to take into account the interests of the various groups involved in and with the Corporation. The best means of doing so was often seen by managers to be to ensure that those interests had no direct representation at key management decision-making points.[66]

The management board members discounted the Warwick report as overly academic and "essentially anthropological" but agreed that they had lacked united purpose during the experiment.[67] Industrial democracy thus seems another episode in Post Office history that showcases the friction between the government wielding the Post Office as an instrument of economic and industrial policy and Post Office management's ambitions for greater independence from state control.

The Conservatives' election in May 1979 not only meant the end of industrial democracy but also foreshadowed telecom liberalization, which had further effects on modeling in long-range planning. James Prior, Margaret Thatcher's employment secretary, had first been reluctant to end industrial democracy, wary of upsetting the Trades Union Congress. In 1979, however, Keith Joseph, the secretary of state for industry, ended industrial democracy after receiving resignation threats from the Post Office chairman, William Barlow, who had been appointed in 1977 on the presumption that he would oversee the split and run the new telecom corporation.[68] Furthermore, Joseph also announced that the postal and telecom businesses would split and noted that this split would be part of a broader review of the telecom monopoly, setting the stage for its future liberalization.[69]

This political change highlighted a key deficiency in long-range planning's first model, the LRPM, which had modeled only the corporation and not its wider environment. Probert thus added politics and economics into long-range planning's simulations, and by 1979 he had developed a strategic control unit (SCU) for the Long Range Planning Model. The strategic control unit was a bolt-on program that enabled the Long Range Planning Model to simulate various future crises, from "economic recession" to "severe constraints on tariff increases," and the business's ability to recover from such crises.[70] Given that economic instability had also provoked long-range planners to widen their forecasting horizons earlier in the 1970s, it appears that the turbulence of industrial democracy, further fiscal constraints from the 1976 IMF bailout, and the looming threat of liberalization also influenced

the SCU's development. The unit allowed users to set objectives for corporate performance parameters, and when the model initiated a crisis by "spiking" certain variables, the unit would try to normalize chosen parameters. This meant that long-range planners could map the viability of different paths from crisis to recovery, and, tellingly, Probert envisioned the SCU as guiding management decisions within real-life crises.[71] In effect, the SCU took a normative turn by turning the LRPM from a model that described various futures into a model that prescribed specific futures. This idea that predictive computing could prescribe the future would transform telecom managers' visions for a digital network as they confronted liberalization.

FROM 1980 TO *NINETEEN EIGHTY-FOUR*

Computing and prediction helped BT's senior management negotiate the transformation of their visions for digital infrastructure through liberalization and privatization, which first concretely appeared on the policy agenda in 1979. After Keith Joseph announced in 1979 that the new Conservative government would review the Post Office's telecom monopoly, he commissioned a report into telecom liberalization by Michael Beesley, professor of economics at the London Graduate School of Business Studies. Beesley had previously served as chief economic adviser to the Ministry of Transport in the 1960s and had undertaken cost-benefit analyses of the M1 motorway and the London Underground's Victoria Line.[72] In the 1980s and 1990s, Beesley, along with the economist Stephen Littlechild, came to the fore as the two published together and separately on market reform, liberalization, and privatization, becoming two of the most prominent economists advising the Thatcher governments on liberalization and privatization policies.[73] Beesley's report on telecommunications first targeted value-added network services (VANS), services in which a third party would lease lines from the telecom business to provide non-voice services, such as data transmission, between clients. Beesley then expanded the report to look at leasing lines to resale voice telephony to customers, creating further competition. Finally, Beesley also looked at expanding competition into transmission and switching networks, effectively liberalizing telecom infrastructure completely so that competitors could build alternative networks.

Beesley's conclusions were unabashedly pro-competition and proved too much, too soon, for the Thatcher government. Beesley concluded that

there should be no restrictions on VANS provisions, that BT should lease circuits to competitors, and that competitors should build alternative telecom infrastructures.[74] These suggestions brought strong opposition from BT, the unions, and even some business users, who preferred liberalization to focus on VANS provision and private circuits rather than competing systems for residential customers.[75] The government chose a compromise, inviting proposals for a single alternative network, which formed in 1981 as Mercury Communications, funded by a consortium of Barclays Merchant Bank, BP, and the telecommunications company Cable & Wireless. Mercury gained its initial license in 1982 to supply leased private circuits and then became a full alternative system in 1984, gaining a license as a public telecommunications operator.

Meanwhile, preparation for the split went ahead. The government renamed the telecom business British Telecom, which reorganized itself into a market-oriented structure to prepare for liberalization.[76] The board created a new directorial position, Organisation and Business Systems Development, which combined long-range planning with the Management Services Department. Showing the business's greater focus on market opportunities, BT renamed management services as business systems, and long-range planning merged with business planning to become the Business Planning and Strategy Department (BPSD).[77] Alex Reid, the head of long-range planning, became director of business systems, while Probert won a full-time position within the BPSD as director of strategic modeling.

With this new market focus came a new market-oriented model. After the government announced that the telecom monopoly would end, Probert developed the Integrated Communications Demand Model (ICDM) to simulate BT's competition and market share.[78] This model's simulations tracked 150 indicators across a thirty-year time horizon, but differed from the Long Range Planning Model in that it grouped indicators into three areas of market demand—terminals, connections, and services—varyingly allocated to BT or its competitors throughout the simulation. When Probert completed the model in 1981, he emphasized how this model showed long-range planning's commitment to this new marketized future by declaring that "competition and diversity are ideas of the future."[79] Probert used the ICDM to school BT staff in these so-called ideas of the future, describing that demonstrating the model to a manager "can be a valuable stimulus to more flexible thinking on the questions of market demand."[80] Probert wrote articles about

the model for company magazines and journals, produced brochures, and arranged presentations, seminars, and drop-in meetings, using the model to educate managers about the market. He also emphasized the model's color interface, a new addition, as instrumental for its pedagogical usage, explaining that the new interface would allow the presentation of simulations "in a neat and compact manner which is acceptable to management."[81] Probert described how he could use colored curves, bar charts, and numerical values to facilitate a management-friendly output of the model's analyses, concluding that "the extent to which managers are prepared to entertain model-based approaches is significantly affected by the 'friendliness' of the interface."[82]

The reorientation of simulation from decision-making input to training tool responded to staff resistance to liberalization and privatization. The board favored liberalization, as it would mean greater freedom from state economic controls, and this continued with the board's support of privatization, which freed BT from public-sector borrowing restrictions. Many staff, however, were not so compliant. The Post Office Engineering Union began anti-privatization action on several fronts: working-to-rule on international traffic; refusing to interconnect to BT's new competitor, Mercury; and refusing to maintain equipment used by Mercury and its owners, Cable & Wireless, BP, and Barclays.[83] The board held a crisis meeting in April 1983 with the POEU, in which union leaders emphasized their grievances that the government had unexpectedly liberalized international telecommunications alongside domestic, allowing Mercury to enter international telephony. While this decision also vexed BT's board, which had assumed that BT would remain the sole carrier of international traffic from the UK, the board could not persuade the POEU to cease action.[84] Industrial action thus continued, and, by October 1983, BT had suspended two thousand engineers.

The Integrated Communications Demand Model formed part of several tactics, supported by computerized systems, that BT's senior management used to convince staff that liberalization and privatization were positive changes.[85] These tactics included letters posted to staff's homes and discounts on employee shareholding. For example, BT gave access to its first computerized central employee database, PRISM, to Hill Samuel Registrars, BT's employee share scheme administrator, to build a register for direct mailing about employee share ownership.[86] This strategy even extended to holding senior staff meetings with Patrick Jenkin, Keith Joseph's successor as minister

for trade and industry, who explained to staff the necessity of privatizing BT. The board circulated Jenkin's message to all managers to communicate these explanations to their staff and "calm any exaggerated fears."[87] Communiques in this style continued in the run-up to privatization, with staff informed that competition would positively stimulate BT and reminded that, with the Conservative victory in the 1983 general election, any industrial action against privatization would be seen as defying the will of the electorate.[88]

Computer simulation's shift from planning to pedagogy reveals its importance to British Telecom. Organizational simulations become truly productive once they turn from representations into managerial tools.[89] This change happened with system dynamics in BT, which Probert developed from the Long Range Planning Model, a corporate representation, to the Integrated Communications Demand Model, a training tool, as part of a broader strategy by British Telecom's management to marketize staff. Probert often emphasized his "marketing" of the ICDM, from its drop-in clinics to its colorful, manager-friendly interface, but this marketing extended beyond the simplistic sense of advertising its use to staff.[90] System dynamics in British Telecom was also "marketed" through the progressive incorporation of free-market principles into its code and "marketized" staff by teaching free-market views. The ICDM's usage also further highlights how long-range planners' attitude to the future had changed. This model extended the SCU's prescriptive approach, overtly displacing the norms of monopoly with the future of a competitive, marketized network. The ICDM taught managers to displace the norm of public ownership with norms of free markets and competition. This predictive, pedagogical power was reinforced by the notion that these computer models "scanned" the future.[91] A powerful symbol of this predictive authority appeared in the logo given to BT's new Business Planning and Strategy Department, an all-seeing eye that gazed into the future (figure 2.1).[92] This inverted Harris's view of long-range planning from the department's founding, where the goal was explicitly to "invent the future, not to predict it." Where the department's early activities and models served to uphold the Post Office's vision of a universal digital infrastructure for Britain, by 1981, BT's prediction technologies instead surveilled the future for both threats and opportunities posed by the market.

Long-range planning at BT also forged this new relationship between computing and futurity through computers' symbolic role in new visions for Britain's telecom infrastructure. In November 1980, the BPSD organized

FIGURE 2.1
The Business Planning and Strategy Department's new logo. Source: TCC 75/2, BT Archives. Courtesy of BT Group Archives.

a weekend retreat, "Into the 21st Century," for senior management and board members to prepare for liberalization.[93] This seminar, taking place over two days and attended by twenty-eight figures from BT's board and management, became a venue for BT's most senior managers to articulate new visions of societal, organizational and technological change, visions that stood in stark contrast to those articulated by Merriman and Harris thirteen years earlier. Indeed, Peter Benton, BT's managing director, introduced the seminar as a challenge to both embrace the future and discard the past, explaining that it was an "attempt to appraise the forces which will affect our destiny; and perhaps identify the forces which we ourselves will need to exert to ensure a prosperous future" and that to do so, it was

necessary "to ensure that we were not blinkered by our traditions and preconceptions."[94]

Much discussion at the retreat concerned the power of computing to transform the economy and the state. Alex Reid, the director of business systems, long-range planning's parent division, spoke of how networked computing would give successful enterprise "a vision of the total scope of the market" and the "freedom to perform any function in any country."[95] A group discussion explored the potential for portable computing to facilitate a diverse and competitive market and render the labor force more mobile.[96] In another echo of Bell's postindustrial society, Richard Greensmith, head of the Telecommunications Industrial Relations and Safety Department, spoke about how the "electronic office" and other computerized systems would "automate sole [*sic*] destroying jobs."[97] The discussants extended this vision further to suggest that intelligent machines could abolish the need for human labor altogether, asking, "Couldn't an intelligent machine program itself well enough?"[98] Another discussion concerned the future place of information as "the basic commodity of service industries" and the difficulties in evaluating the "output" of information compared to the solid material output of "iron bars or bushels of wheat." The discussion concluded that in monitoring and allocating the information commodity, "governments should . . . take the lead; or market forces should be allowed to work unfettered; but it is illogical to argue for both simultaneously."[99] Here, BT's senior management saw postindustrial computerization as presenting Britain with a binary choice between government control or liberalized markets and private ownership. Privatization and liberalization seemed, to BT's senior management, two sides of the same coin, and the idea of competing as a publicly owned enterprise was never entertained.

These views became even clearer as they further related digitalization to individualism and small government. J. J. Wheatley, BT's head economics adviser, imagined how computerization and telecommunications could liberate the state from big government. He suggested that microtechnology, which would generate high-value manufacturing and service-based industries, would revive the economy and combat inefficient, swelling bureaucracies:

> There could be a convergence of computing and communication technology, with "small government" aspirations:
>
> - Small is beautiful.
> - Small is cheaper.

- Large is unnecessary.
- Devolution gets government closer to people.
- Small is anti-bureaucratic.[100]

Wheatley's sentiments latched onto a broader vogue for technology and decentralization inspired by works such as the economist E. F. Schumacher's 1973 book *Small Is Beautiful*, although Schumacher's book focused more on "appropriate technology" and sustainable development.[101] Wheatley's focus on small, cheap government, however, was more typical of the British state's contraction under Thatcher and echoed digital libertarian ideologies that saw digitalization as an opportunity for small government and a flat, decentralized society.[102]

Normative futures of emancipatory individualism joined these political-economic aspirations. Richard Greensmith, for example, continued by explaining that the electronic office and personal networked computing would mean "a trend away from bigness and centralisation, . . . thus restoring the importance of the individual."[103] Charles May, BT's director of research, envisioned that mobile telephony would overcome "the tyranny of the local line":

> I am convinced that the next generation of businessmen—or perhaps the next but one—is going to want a truly universal pocket telephone. . . . This would completely release him from this "tyranny of the local line" and enable him to make and receive calls wherever he happened to be.[104]

This collision of information technology and individualism was part of a broader trend, both in Britain and abroad. Kenneth Baker, Thatcher's minister for information technology, argued that computerization under the Conservatives would provide greater personal freedom, contrasting this with computerization in the totalitarian hands of the "Electronic State."[105] On the left, Tony Benn suggested that, in the hands of the worker, information technology could give "people a sense of freedom," although he warned that the microchip, in the hands of the capitalist corporation, was "tyranny in the form of liberation."[106] These readings of digital technology again echo the digital ideologies that took hold among US politicians and technologists from the 1970s, who similarly interpreted personal, networked computing as facilitating personal freedom.[107]

These visions, however, focused not only on liberation but also on surveillance. BT's senior managers and engineers saw computers as powerful

predictive machines that surveilled not just the future, but also BT's users. Charles May explained that global computer tracking of users could enhance mobile telephony's emancipatory power:

> I believe there are about 6 thousand million people in the world. . . . I see no problem of keeping track of them all so that the international telephone system—already the most elaborate and complex thing man has ever created—can find and call anyone in the world wherever he may be.[108]

Charles May, BT CEO George Macfarlane, and Roy Harris also discussed the potential for a heuristic machine-controlled network that could shape users and predict their demands and desires:

> Although it is argued that technology is only justified if it serves people and that it should not be self-perpetuating, the increasing power and complexity of machines shapes people's demand and desires. Human desire for information is not random: the assembly and accessing of databases reflects users' interests and heuristic machines will judge what individual users are most likely to want to know.[109]

The discussion even envisioned that these predictive surveillance machines could gift BT the power to transform society itself. Participants concluded that using computers for "the selection and manipulation of that information" meant "there is potential for moulding society by selecting the contents of the databases."[110] By 1980, computers had not only changed long-range planning from inventing to predicting the future, but also appeared close to realizing the "bleak mechanistic prospect" that J. S. Whyte had warned about eleven years earlier.

BT's senior management recognized these visions' darker undertones. Replacing human labor with intelligent machines was a "heretical idea," while using predictive computer databases to mold society had "ethical problems."[111] Charles May argued that his global computer tracking system would be permissible so long as users could opt out, a "god-given right" that he, "as a technologist, would defend to the death," and in doing so, he explicitly distanced himself from a "big brother" approach.[112] Distancing their visions from science-fiction dystopias appears to have been a popular strategy among BT management. J. J. Wheatley also labeled dystopic interpretations of these computerized futures as the "politics of the pessimists," suggesting that the "dictatorship of technology" of H. G. Wells's *The Shape of Things to Come* and "the enslavement by the information society" of George Orwell's *Nineteen Eighty-Four* were lazy cultural references that bore no resemblance to BT's visions.[113]

The ways BT managers contrasted these science-fiction futures to their new digital vision of predictive computer control reveals much about the politics of this new vision. Wheatley invoked *The Shape of Things to Come* as a dictatorship of technology, but *The Shape of Things to Come* follows a Wellsian convention wherein societal collapse is a necessary precondition for the emergence of utopia, and this utopia emerges through the guidance of scientists and technocrats that command powerful technology.[114] In *The Shape of Things to Come*, these are the technocratic airmen who control aircraft. Referencing this book perhaps suggests that Wheatley saw this vision of small government and corporate technocracy, enabled by digital convergence and predictive computing, as acceptable so long as engineers and managers remained in control. May and Wheatley distanced BT's visions from Orwell's "big brother" future and the "politics of the pessimists."[115] The contrast is easier to see here. *Nineteen Eighty-Four* is often invoked to describe contemporary, high-tech, corporate surveillance, but Oceania is a violent society with a centralized state and quite visible, low-tech modes of surveillance, such as cameras and telescreens.[116] BT's management, however, read *Nineteen Eighty-Four*'s dystopia as irrelevant to the competitive marketplace and the private sector. In contrast, they proposed invisible, computerized modes of corporate surveillance that paradoxically would support their new vision of digitalized decentralization, individual freedom, and small government.

This paradox shows the political power of prediction technologies and the "hypersurveillant imaginary" that they offer. In the postwar era, futurology's prediction technologies, which included techniques like system dynamics, became the "core political technology of the present," a tool of technocracy that allowed direct intervention in the future.[117] By turning the long-range into a category of rational decision, long-range planners could manage plural futures, simultaneously affirming the future as a realm of liberal choice while also extending technocratic control into the future. Similar values are contained within the hypersurveillant imaginary, a particularly popular sociotechnical imaginary under late capitalism.[118] Whereas traditional surveillance monitors the present, hypersurveillance uses the predictive power of computing to put the future under surveillance, so that present action can preempt future change.

At the 1980 long-range strategy seminar, the discussions about using heuristic, predictive computing to anticipate and shape customers' data consumption matches the predictive corporate, consumer surveillance that

hypersurveillance describes. The appeal of both hypersurveillance and prediction technologies emerges from the political and commercial power they promise to their wielders, claiming that one can intervene in the present by picking futures. The history of long-range planning at BT is largely a history of political prediction technologies, from early models of exchange obsolescence and trunk digitalization to more sophisticated corporate system dynamics models. The 1980 long-range planning seminar, however, shows the emergence of the hypersurveillant imaginary, in which BT's managers, engineers, and long-range planners discussed the power that hypersurveillance would give them over consumer markets. By 1980, long-range planning at BT had collided prediction technologies with the hypersurveillant imaginary. Strategic modeling allowed BT to choose a future of "competition and diversity," in which digital convergence would facilitate small government, free markets, and individual freedom, and within that future, the hypersurveillant imaginary offered a way to continue to "mould society." In this new digital vision, BT could avoid concerns about privacy and totalitarianism altogether by using prediction technologies to rewrite the future, averting the path from 1980 to *Nineteen Eighty-Four*.

CONCLUSION

The history of long-range planning at the Post Office and BT shows how futurology served three roles. First, long-range planning sustained Merriman and Harris's vision of a universal digital network. After the failure of Britain's planning moment during the 1960s, attention turned to new ways that the state could know the future. Under the advice of McKinsey, the Post Office founded its Long Range Systems Planning Unit, and engineers such as Harris and Whyte made plans that reaffirmed the Post Office's commitment to an integrated digital network and showed their sensitivity, as operators of a nationalized infrastructure, to these new technologies' privacy risks. Underscoring the department's importance, many of its senior figures earned promotions after working on long-range planning. Roy Harris went on to head the Telecommunications System Strategy Department, responsible for the flagship switching and transmission projects (covered in chapters 3 and 4). J. S. Whyte was promoted to head the Operational Programming Department, where he negotiated a national controversy about Post Office computer modeling (explored in chapter 3) and, after that, succeeded Merriman

as the senior director for engineering. Alex Reid became director of business systems and (discussed in chapter 7) helped orient BT's digital network toward financial users from the City of London.

The department was an incubator not only for engineers, however, but also for technologies. Reflecting a national political economy that picked industrial and technological "winners," Post Office long-range planners too picked Viewphone as a technological winner, imitating AT&T's Picturephone. But Viewphone also emulated AT&T's Picturephone by successfully failing, never reaching the market, and yet standing as an icon of the Post Office's goal for an integrated digital network that transmitted voice, data, and video. Long-range planners also began to use computers models to pick winners, as the ALEM model "chose" TXE4 for the Post Office's next main telephone exchange, while the UKTTF model "chose" the waveguide as a high-bandwidth transmission technology for Britain's information highways. Chapters 3 and 4 follow, in part, TXE4 and the waveguide, showing these choices' consequences for the history of digital switching and transmission.

Futurology's second role was in giving an entry point for new computing ideas and techniques. As long-range planning became more expansive during the economic and energy crises of the early 1970s, planners studied new ideas about how computing and communications would transform society. While practical in their aims, undertaking surveys and writing reports on telecommuting and working from home, these studies also looked to the ideas of academics and futurologists on the relationship between technology and society. Foremost among these was Daniel Bell and his "post-industrial society," which reinforced planners' expectations of an information revolution and reaffirmed their use of computers as prediction technologies. In some ways, this was as an extension of Post Office engineers' first encounters with information theory and cybernetics, when they became enamored with the idea of a "second industrial revolution," wherein "human beings, used as sources of judgement, may also be replaced by machines."[119] Indeed, Bell himself pointed to cybernetics as a component of "the computer age," although he also criticized cybernetics as a mechanistic and closed vision of society.[120] Regardless, Post Office engineers and long-range planners paid attention to scholarly expectations about digitalization and used these expectations to bolster their plans for a universal digital network. During this period, the department looked to more sophisticated computer models for long-range planning, also influenced by computer simulations of energy and resource

scarcity such as *Limits to Growth*. System dynamics played a central role in long-range planning, first in helping cohere telecom into a corporate whole, separate from the postal service and, second, as a pedagogical tool used to inculcate free-market values in staff during liberalization. At first, long-range computing reinforced a singular corporate future of digital infrastructure monopoly, and then it embedded free-market values for a liberalized future.

Futurology's third role was as a chrysalis within which the Post Office's universal digital vision could transform from a vision of monopoly into a vision of markets. At the 1980 long-range planning seminar, BT planners, engineers, and executives anticipated a future in which predictive computers, embedded throughout Britain's telecom infrastructure, would give them a complete vision of the market and their customers. Allowing BT to monitor, predict, and filter customers' data usage, predictive computing would give BT the power to mold society itself. This new vision was so powerful because it offered a way to use digitalization to negotiate a new marketplace and track and tailor customer's individual needs in a world seemingly defined by individual choice and small government. Long-range planning was not just a venue through which managers and engineers articulated this new vision. Prediction technologies showed new ways to think about futurity that permitted managers and engineers to articulate these contradictory visions. How could BT's senior management simultaneously prize choice, competition, and small government while envisioning a future of predictive computer control and surveillance? Prediction technologies, pioneered within the telecom infrastructure by long-range planners, showed how computer control and surveillance of both customers and the future could preserve and optimize choice.

This chapter already begins to indicate the ways in which digitalization intersected with changing political economy. Long-range planning gave a venue for managers and engineers to develop and deploy digital tools and imaginaries that engaged with wider political economy. In the 1970s, engineers and planners imagined a nationalized digital network for information services, while acknowledging the risks of state-owned digital networks. They also used digital tools, in the form of computer simulations, that reinforced the Post Office's national monopsony over equipment procurement. In 1980, these engineers and managers instead imagined the commercial opportunities of predictive, commercialized computer control and surveillance in a privatized infrastructure, while their computer simulations turned away from

monopoly and monopsony and to competition and liberalization. Crucially, these visions and tools were not just reflections of the political economic environment. They co-constructed these changes to the political economy of telecommunications. Models reinforced monopoly, corporatization, and liberalization. Digital imaginaries about commercial surveillance helped senior management understand the opportunities that digitalization could offer them in a marketplace. Digitalization in long-range planning did not merely follow political economy but shaped it. This does not mean, however, that this is a history of ruptures alone. There was continuity alongside change. The Post Office's original digital vision placed computer control at the center, both as managerial tools and as control centers within Britain's future digital infrastructure. So, while BT executives' 1980 digital visions differed from the past and reflected the changes of the early 1980s, they also maintained the core value of computer control that was at the heart of Merriman's digital vision from the 1960s. The next chapter investigates how the Post Office and BT digitalized Britain's telephone exchanges, embedding this computer control into Britain's telecom infrastructure.

Visions of a Digital Nation

Market and Monopoly in British Telecommunications

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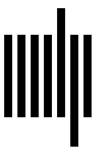

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