Computing the Long Range: Inventing and Marketing the Future in the British Telecommunications System, 1966-1981

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ABSTRACT: This article is a history of computerized futures in the British telecommunication system's Long Range Planning Department from 1966 to 1981. This department, later known as the Business Planning and Strategy Department, played an important role in the telecommunications system's transition from public corporation and monopoly in the late 1960s to competitive, denationalized industry in the early 1980s. Computers occupied much of the department's concerns, from their use as simulations to generate business plans, to their presence in futuristic visions. In the late 1960s and early 1970s, the department used computer models to reinforce policy and purchasing decisions, while also distancing the business from worrying visions of computerized state control. With both these matters, the department aimed to 'invent' futures that would preserve the telecommunication system's state monopoly. By the early 1980s, however, the department instead used models to educate managers about market dynamics, and computers stood as icons of a Thatcherist, small government future. Computers thus performed two functions central to the shifting political-economic status of the British telephone system. Technologically, they moved from simulating purchasing decisions to market dynamics, and symbolically, they moved from representing the over-reaching state to aiding its contraction.

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Introduction

In 1969, J. S. Whyte, the Head of the British Post Office's Long Range Planning Department, warned of the 'bleak mechanistic prospect' posed by futures of computerized state control.[1] Meanwhile, Whyte was also developing a computer model to plan the replacement of exchanges in the British telecommunications network, which the Post Office had run since 1912 as a state-owned monopoly. Whyte's computer model, which supported the Post Office board's 1970 decision to purchase exchanges manufactured by American-owned STC over British firms GEC and Plessey, made *The Financial Times* as at the center of a row between these corporations and the government over the Post Office's 'giant computer model'.[2] This raises the question: how had Whyte reconciled his alarming futures of computer control with his computer-simulated futures for the Post Office board?

The subsequent history of the Long Range Planning Department (also known as the Long Range Studies Division, but which for brevity's sake I shall call the LRPD) raises further questions. By the end of the 1970s, the LRPD used computer models not to inform purchasing decisions, but rather to educate managers about market dynamics. This change arose from Margaret Thatcher's Conservative government splitting the telecommunications system in 1981 into a new corporation, British Telecom (BT), and ending BT's monopoly. Preparing for these changes, David Probert, the department's Head of Strategic Modelling, announced that 'competition and diversity are ideas of the future', and at a Long Range Strategy Seminar that the department organized to prepare for competition, BT's senior managers and board members speculated about how computers could promote free market futures and 'small government'.[3]

[1] 'LRSR 19: City in the Year 2000', 1969, TCC 252/19, BT Archives (hereafter cited as BTA).
[2] 'Post Office Equipment Row Brought into the Open', *The Financial Times*, 2 February 1972, 13.
[3] Probert, 'The Development of a Long-Range Planning Model for the British Telecommunications Business', 697; 'Into the 21st Century', 1980, TCC 75/1, BTA, 24.

How had the computer changed from a technology of monopoly and state control around 1970 to one of competition and small government by 1980? How was this change implicated in the British telecommunications system's turn from state monopoly to Thatcherist liberalization? I argue in this paper that the computer's changes, as a modelling technology and as a symbol of British state power, cannot be understood as separate from one another.

This article thus studies the computer, as technology and symbol, from the LRPD's founding in 1966 to its participation in BT's creation and liberalization in 1981. The department's founding mission was 'to invent the future, not to predict it', and so this paper's first task is to investigate the computer's role in the shift from the Post Office monopoly's 'invented' futures in the late 1960s, through Whyte's model and mechanistic dystopia, to BT's free market futures in the early 1980s.[4] This shift resulted from organizational change and from the computer shifting symbolically from a technology of potential state control to one that could promote the free market and shrink government.

In making this argument, I combine approaches from the history of computing with themes from sociological and historical approaches to the future. In recent years, two parallel histories of futurity, science, and technology have emerged. First, histories of intangible futures – imaginaries, visions, expectations – that are embedded within technoscientific practices and politics, and second, histories of futures materialized through forecasting and futurology.[5] The first draws attention to how tacitly-accepted collective futures shape not just technological and scientific order, but social and political order also, while the second has focused on planning, forecasting, and futurology as powerful sites for governmental, economic, and business action,

[4] Harris, *Automatic Switching in the UK*, 16.

[5] For the first type, see Jasanoff and Kim, 'Containing the Atom'; Borup et al., 'The Sociology of Expectations in Science and Technology'; Marcus, *Technoscientific Imaginaries*; also see examples of 'promises' and 'visions' in Fortun, *Promising Genomics*; Fjaestad, 'Fast Breeder Reactors in Sweden'. For the second type, see Vieille Blanchard, 'Modelling the Future'; Andersson, 'The Great Future Debate and the Struggle for the World'; Mitchell, 'Economentality'; Andersson and Rindzevičiūtė, *The Struggle for the Long-Term in Transnational Science and Politics*.

particularly after World War II. Lisa Messeri and Janet Vertesi have shown how these types can overlap by demonstrating how material practices of projection, such as budgeting documents and forecasting timelines, can cohere social groups by realizing imaginary, intangible futures.[6] Such analyses can explain the relationships between technological, social, and political change by studying the imagined futures that guide change and the futurological practices that fuel it. In this article, the computer serves as a site for both categories, as a symbol of dystopian and utopian futures, and as a tool for modelling those futures.

Historians of computing have also analyzed the computer as both tool and symbol.[7] Paul Edwards has shown the computer's crucial role in US Cold War politics and culture, for example, acting as a tool of 'closed world' systems such as the Strategic Defense Initiative, and as a metaphor supporting the rise of Command, Control, Communications and Information in the US military. Edwards also shows how modelling and simulation underpinned Cold War discourses, acting as metaphorical 'closed worlds' and supplying quantitative information that supported Cold War defense policy. Fred Turner has shown how the computer acted as a networking tool and metaphor for open world discourses in 1960s and 1970s counterculture, laying the foundation for counterculture's influence on networked utopian 'cyberculture' and the high-tech New Economy. Philip Mirowski investigates linear programming, an important tool for post-war neoclassical economists, as an example of how computing provided a symbolic foundation for neoclassical, informational theories of market organization. Jon Agar's history of British governmental computing shows how expert mechanizers gradually computerized the Civil Service while carefully negotiating the problematic metaphor of government as a 'machine'. This produced a tradition which Agar calls 'discreet modernism', where expert mechanizers cloaked government computing projects by displacing computers as

[6] Messeri and Vertesi, 'The Greatest Missions Never Flown'.
[7] Edwards, *The Closed World*; Turner, *From Counterculture to Cyberculture*; Mirowski, *Machine Dreams*; Agar, *The Government Machine*.

objects of trust. Agar's analysis helps this article, as Civil Service mechanizers also entered and influenced the LRPD. All these histories treat the computer as both material tool and imaginary symbol, and so provide a parallel starting point for this article's goal of analyzing both imagined and material futures in the Post Office and BT. The second central task of this paper is thus linking histories of the computer as tool and metaphor with histories of imagined and material futures.

I undertake this investigation in two parts. In the first section, I explore the early history of the LRPD, the origin of its inventive agenda, and how this related to J. S. Whyte's computer model and 'mechanistic prospect'. I link the controversy over Whyte's model and his warnings about computer control to Agar's 'discreet modernism'. In the second section, I explore how the department began to look toward new technological and symbolic uses of the computer, through its attention to Jay Forrester's system dynamics and Daniel Bell's theory of post-industrial society. I then explore how these uses of the computer were centrally involved in the creation of BT and Thatcherist futures of small government.

Inventing the Future

The LRPD's 1966 creation as the 'Long Range Systems Planning Unit' was tied to the Post Office's reorganization into a nationally-owned corporation. The Post Office, to this point, had been part of the Civil Service, but through the late 1950s and 1960s the Post Office Board increasingly pressured government for greater freedom from financial control, so that the Post Office could be run more along the lines of a business. Tony Benn, the young technocrat appointed Postmaster General in 1964 upon the election victory of Harold Wilson's Labour

government, contributed a supporting voice from within government.[8] Benn added impetus to the drive to recreate the Post Office as a national corporation, and, as part of this drive, Ronald German, the Post Office's Director General, contracted the American management consultants, McKinsey, to review the Post Office in 1965. One of McKinsey's chief recommendations was that the Post Office's telecommunications business should establish a Long Range Planning Department to provide more 'technologically complete' plans for six to fifteen years out, and undertake studies for thirty years out.[9] The Post Office thus established the Long Range Systems Planning Unit in 1966 to devise these plans and, in 1969, when the Post Office was corporatized, it was renamed the Long Range Planning Department.

The department's founding came during a 1960s British planning vogue. In 1962, the Conservative government created a National Economic Development Council for economic planning, and in 1964, the new Labour government created the Department of Economic Affairs to provide long-term planning to complement the Treasury's supposed short-termism. This bipartisan interest was a reaction to British sterling crises, and came after a prior interest in economic planning during the high unemployment of the 1920s and 1930s.[10] In the 1960s, concerns focused on Britain's long-term planning. The economist Andrew Shonfield, in his influential 1965 work *Modern Capitalism,* lamented Britain's short-termism, particularly compared to France's centralized Commissariat Général du Plan.[11] I would suggest, however, that Shonfield's concerns instead highlight the 1960s British enthusiasm for long-range planning. David Edgerton has shown that similar claims of British scientific and technological

[8] Pitt, *The Telecommunications Function in the British Post Office*, 137–56; Campbell-Smith, *Masters of the Post*, 438–76.
[9] 'McKinsey and Company: Progress Review with Postmaster General, 23 February 1967, POST 72/906', British Postal Museum and Archive.
[10] O'Hara, *From Dreams to Disillusionment: Economic and Social Planning in 1960s Britain*, 1–8; Ritschel, *The Politics of Planning: The Debate on Economic Planning in Britain in the 1930s*.
[11] Shonfield, *Modern Capitalism*, 157.

decline in the 1950s and 1960s emerged from a culture that prized science and technology.[12] The broader context suggests that long-range planning too was prized, at least by government, as shown by the 1964 creation of the Department of Economic Affairs, its support for the 1966 founding of the Society of Long Range Planners (whose journal, *Long Range Planning*, still circulates), and now also the founding of the LRPD in one of the largest branches of the Civil Service.[13]

The department's founding also came during a growing American influence over long range planning.[14] 'Long range planning' was popularized by a 1964 report, 'Report on a Long-Range Forecasting Study', from the US military-industrial think-tank, RAND. The report outlined a novel forecasting methodology, 'Delphi', in which scientific and technological experts were surveyed across a range of areas to generate timelines for the future.[15] The journal *Long Range Planning* was subsequently founded in 1967 and various futurological techniques were taken up by industry. General Electric used Delphi during the 1970s, while Royal Dutch Shell famously used another technique, scenario planning, created by RAND alumnus Herman Kahn, in the early 1970s to map out strategic responses to oil scarcity, which Shell purportedly used to anticipate the 1973 OPEC oil embargo.[16]

Visions of Monopoly

The LRPD's goals were outlined in its 1967 founding document, *Telecommunications System of the Future*, by Roy Harris, the Post Office's chief systems designer. Harris was the son of a

[12] Edgerton, 'CP Snow as Anti-Historian of British Science'.
[13] 'Long Range Planning Society', 1966, EW 25/349, The National Archives, Kew (hereafter cited as TNA).
[14] Andersson, 'The Great Future Debate and the Struggle for the World'.
[15] Gordon and Helmer, 'Report on a Long-Range Forecasting Study'.
[16] Ringland, *Scenario Planning: Managing for the Future*, 16–21; Bradfield et al., 'The Origins and Evolution of Scenario Techniques in Long Range Business Planning', 799–800.

former Post Office Engineer-in-Chief, Lionel Harris, and the successor to Tommy Flowers. Flowers, best known as the designer of the World War II codebreaking machine Colossus, had led telephone exchange development after the war, using an analogue approach, while Harris, working under him, favored digital techniques. After the high-profile failure of the Post Office's prototype analogue electronic telephone exchange, Highgate Wood, Flowers departed the Post Office and Harris took over switching development.[17]

In *Telecommunications System of the Future*, Harris advocated an 'inventive' approach to the future, and outlined a series of technologies, from videophones to remote computing, for which the department would co-ordinate both research and provision. Long range planning would 'exploit' these possibilities, while also allowing for unexpected demands from users.[18] 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.[19] His turn of phrase echoed the Hungarian-British electrical engineer Dennis Gabor's expression 'the future cannot be predicted, but futures can be invented', which appeared in his 1963 popular science book, *Inventing the Future*. Harris may have borrowed this phrase after a personal encounter, as both Harris and Gabor attended an information theory symposium at Imperial College, London, in 1952, and Gabor later collaborated with the Post Office's Research Department on computer simulation of speech compression.[20]

The Post Office's monopoly status and the threat of new developments in telecommunications both explain Harris's inventive attitude. James Merriman, the Post Office's Engineer-in-Chief, had expressed concerns from at least 1967 about the development

[17] Harris, *Automatic Switching in the UK*, 11.
[18] 'Telecommunications System of the Future', 1967, TCB 662/1, BTA.
[19] Harris, *Automatic Switching in the UK*, 16.
[20] Gabor, *Inventing the Future*; 'Notes on a Symposium on Communication Theory Arranged by Imperial College', December 1952, TCB 226/2227, BTA; 'Computer Simulation of Professor Gabor's Speech Compression System', December 1966, TCB 422/21230, BTA.

of packet-switched data networks. Packet-switched networks, developed by Donald Davies at Britain's National Physical Laboratory, could have competed with the Post Office's plans to transmit data over customers' telephone lines, and so packet-switching threatened its monopoly. For Merriman, the key to combatting this threat was 'integrating' the network, through computerization and digitalization, so that a computerized network could transmit and route data, voice, and video.[21] He placed Harris in charge of devising this strategy at the Long Range Systems Planning Unit, and so *Telecommunications System of the Future* outlined the general principles of integration, digitalization, and computerization for the new network.

An inventive approach to the future thus meant planning systems that would preserve the Post Office's telecommunications monopoly. This counters Agar's assessment of the Post Office as 'ossified' for apparently ignoring packet-switching.[22] Instead, Merriman decided to explore alternatives to packet-switching that would make full use of the existing telephone network and preserve the Post Office's monopoly. Research into integrated networks ended up informing the 'Integrated Services Digital Network' (ISDN), a technical standard developed by the International Telecommunications Union's (ITU) Consultative Committee on International Telephony and Telegraphy from the mid-1970s. ISDN's monopoly origins also derive from the broad support it enjoyed from European national telephone agencies, and, as Janet Abbate has noted in the case of the X.25 packet switching protocol, fits into a broader pattern of international standard setting in telecommunications during the 1970s and 1980s, when European agencies developed standards that were modelled on their monopoly status.[23]

[21] Merriman, 'Men, Circuits and Systems in Telecommunications'; 'Interactions Between Data Processing and Telecommunications', June 1971, TCC 55/3/76, BTA. Packet switching had also been independently developed at RAND by Paul Baran: Abbate, *Inventing the Internet*, 8.
[22] Agar, *The Government Machine*, 381.
[23] Rutkowski, *Integrated Services Digital Networks*; Noam, *Telecommunications in Europe*, 360; Abbate, *Inventing the Internet*, 152–58.

The LRPD's inventive approach is also evident with Viewphone, a video phone terminal that appeared in *Telecommunications System of the Future*, Post Office promotional films, and further plans for the integrated digital network.[24] Viewphone was a desk-top terminal with a 7" x 5½" screen and loud-speaking telephone for two-way speech and vision, and an LRPD 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'.[25] AT&T's Picturephone, launched in 1964 with much fanfare, but which was ultimately a commercial failure, heavily influenced these plans. The LRPD's reports concluded that Picturephone had failed only because the public were not ready for video telephony, and so advised that development of a British videophone – Viewphone – should proceed because of the inevitable demand for the Post Office's integrated information network. In 1972, an internal trial started, 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 showed the success of the LRPD. A 1976 report on the Viewphone trial had discovered little enthusiasm. Users found that visual contact had not improved communication, and that many calls were out of focus.[26] Furthermore, users had mainly used it to transmit written material, which turned attention away from video telephony and towards document transmission. Subsequently, there seems to have been no further commercial development of Viewphone, although it was still used as a show piece throughout the 1980s (a 1988 article in *BT Journal* described it as an 'important new

[24] *Telecommunication Services for the 1990s*; 'Telecommunications System of the Future', 1967, TCB 662/1, BTA; 'Telecommunications Systems of the 1980s', 1967, TCB 662/2, BTA; 'A Presentation of the Work of the United Kingdom Trunk Task Force', 1969, TCC 145/1, BTA; 'UK Trunk Task Force Final Report, Volume 1', 1971, TCC 145/7, BTA.
[25] 'LRSR 8: A Marketing and Technical Appreciation of Viewphone', 1969, TCC 252/8, BTA.
[26] 'The Viewphone Trial - Questionnaire Results', 1976, TCC 23/563, BTA.

service'), until 1993, when BT launched Relate 2000, its first videophone.[27] There is a parallel here with Picturephone, which Kenneth Lipartito has argued that, 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', and I would suggest the same for Viewphone.[28] Viewphone's continuing presence as a showpiece, even after unsuccessful trials, shows the Post Office's commitment to the invented future of a monopoly integrated network for voice, data, and vision that Harris had planned in *Telecommunications System of the Future*. This echoes Messeri and Vertesi's insight that documents that plan and codify certain futures can sustain communities and technologies, even through persistent non-use.[29]

The 'Giant Computer Model' and The 'Bleak Mechanistic Prospect'

The department's inventive approach also appeared in computerized futures. In 1969, J. S. Whyte joined the Post Office from the Treasury's Organisation and Methods (O&M) department, where he had been involved in restructuring the British computer industry into ICL, a new flagship manufacturer that the Labour government and Tony Benn (by this point the Minister of Technology) hoped would be internationally competitive.[30] He took over the LRPD after Harris moved to lead a joint Post Office-industry group, the Advisory Group on Systems Definition (AGSD), which established the technical requirements for the integrated network. One of Whyte's first projects simulated the optimal rates of depreciation and replacement of outdated electromechanical telephone exchanges with new electronic versions

[27] 'Bill's a Winner, Says Juke-Box "Jury"', *BT Journal*, June 1988, 88-89; Nuttall, 'Well, Hello, How Nice to See You', *The Times*, 26 March 1993, 31.
[28] Lipartito, 'Picturephone and the Information Age', 77.
[29] Messeri and Vertesi, 'The Greatest Missions Never Flown'.
[30] For more on ICL, see Campbell-Kelly, *ICL: A Business and Technical History*.

over a thirty-year period.[31] Every simulation strategy found that replacing electromechanical exchanges with a hypothetical new electronic exchange would be cost-effective, and faster strategies were favored. Unfortunately, little detail about the technical composition of Whyte's model remains. From surviving records, the model was called 'A Local Exchange Model' (ALEM), a version of ALEM ran on a Honeywell computer hosted by the Post Office's Management Services Department, and it used discounted cash flow analysis to calculate the year-on-year costs of exchange replacement.[32] Finally, and crucially, the model assumed that the hypothetical replacement electronic exchanges used in these simulations had the exact same cost and traffic capacity as had been quoted to the Post Office by the American-owned manufacturer, STC, for its new TXE4 series of electronic exchanges.

In January 1971, 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.[33] Whyte handed the model over to the Operational Programming Department (OPD) and liaised with OPD to plan the TXE4 modernization strategy. Later that year, Whyte became OPD's Director. Whyte and his model had made it to the highest levels of the Post Office and contributed to

[31] 'LRSR 16: A Review of Premature Obsolescence and Depreciation Policy - Part 1', 1970, TCC 252/16, BTA; 'LRSR 17: A Review of Premature Obsolescence and Depreciation Policy - Part 2', 1970, TCC 252/17, BTA; 'LRSR 18: A Review of Premature Obsolescence and Depreciation Policy - Part 3', 1970, TCC 252/18, BTA; 'LRSR 25: A Review of Premature Obsolescence and Depreciation Policy - Part 4', 1970, TCC 252/25, BTA.

[32] 'Economic Appraisal of Exchange Equipment Strategies by Computer Model', 1972, FV 87/2, TNA; 'PO Model for Evaluating Alternative Equipment Strategies', 7 November 1972, FV 87/6, TNA; 'LRSR 18: A Review of Premature Obsolescence and Depreciation Policy - Part 3', 1970, TCC 252/18, BTA.

[33] 'Managing Director's Committee: Telecommunications', 8 January 1971, TCC 55/3/11, BTA; 'Post Office Board Meeting', 26 April 1971, TCC 15/4, BTA.

what would become one of the corporation's most controversial procurement decisions of the 1970s.

The model's assumption that TXE4 would replace electromechanical exchanges shows a continuing commitment to 'invented' futures. Whyte's model did not predict the future, but instead supported decisions to roll out TXE4, and so supported a future where the Post Office board purchased electronic exchanges from STC. There are parallels here with Viewphone, as in both cases, the LRPD selected a technology, studied different ways to develop and roll out that technology, and then informed decisions about that technology, thus inventing futures rather than predicting them. Whyte chose TXE4 because he viewed it as the only viable electronic telephone exchange which could replace electromechanical exchanges, and so inadvertently triggered a conflict with GEC and Plessey, the British electronics manufacturers and long-time Post Office suppliers, who believed that their new jointly-developed electromechanical exchange, Crossbar 5005, had been overlooked.[34]

GEC and Plessey first became aware of these plans in September 1971, when the Post Office released its TXE4 modernization strategy.[35] Arnold Weinstock, GEC's Chairman, complained that 'computer simulation alone should not be a basis for major investment decisions', to which Whyte retorted that the model 'cannot of itself come to conclusions or take decisions'.[36] The row between the Post Office, GEC, and Plessey made *The Economist*, *The Daily Telegraph*, and *The Financial Times*, which, as I noted in the introduction, identified the Post Office's 'giant computer model', from which Plessey and GEC 'claim to have been

[34] 'LRSR 18: A Review of Premature Obsolescence and Depreciation Policy - Part 3', 1970, TCC 252/18, BTA.
[35] 'Telephone Exchange Switching: Modernization Strategy', 1971, TCC 387/THQ ICU 45(a), BTA.
[36] 'Post Office Switching Policy: Meeting between the Post Office, GEC and Plessey', 12 January 1972, FV 87/1, TNA; 'Economic Appraisal of Exchange Equipment Strategies by Computer Model', 1972, FV 87/2, TNA.

excluded', as central to the row.[37] The controversy reached the point that Prime Minister Ted Heath asked John Eden, the Minister for Posts and Telecommunications, to ensure that the model and the Post Office's proposals were properly scrutinized.[38] A series of government reviews took place, alongside an independent review commissioned by Plessey. A prime example of Agar's 'discreet modernism', Whyte's management of these reviews, which ensured that his model's authority became conflated with the Post Office's authority, allowed the computer to fade into the background.

Whyte achieved this by denying reviewers the opportunity to use and test the model, and instead only provided reports on how the model worked. The Plessey review concluded that the model could be 'substantially improved', to which Whyte replied that 'the author broadly endorses what has been done, although on many items he would not have realised this when preparing the Report … by and large it gives strong support to what we have in fact done, albeit in some cases unknown to the author'.[39] A review by the Cabinet Office's Central Policy Review Staff (CPRS) concluded that the Post Office's model seemed 'basically sound', and attributed GEC and Plessey's anger to the Post Office's previous opacity about modelling. The CPRS also argued that the Post Office should continue to have ultimate design and planning authority over TXE4 and all future exchanges.[40] The Treasury's review examined whether the model could have been more effective had it utilized linear programming, but crucially, Whyte's shielding of the model led to the Treasury's approval: 'Unless we have been seriously misled it seems as if the simulation model has achieved what was required of it and that

[37] 'Ryland's Row', *The Economist*, 5 February 1972, 45; 'The Fight for the New Telephone System', *The Financial Times*, 28 January 1972, 16; 'Post Office at Grips with Suppliers', *The Daily Telegraph*, 10 February 1972, 19; 'Post Office Equipment Row Brought into the Open', *The Financial Times*, 2 February 1972, 13.

[38] Eden to Heath, 'Report on Morton's Complaint', 14 June 1972, FV 87/2, TNA.

[39] 'Report to Plessey on Post Office Long-Term Investment Study by T.S. Barker, University of Cambridge', December 1972, FV 87/6, TNA; 'P.O. Commentary on Barker Report', 6 February 1973, FV 87/6, TNA.

[40] 'CPRS Summary of the Post Office's Modernisation Plan', August 1972, FV 87/5, TNA.

therefore there would be no substantial advantage in reformulating the model in programming terms'.[41]

Whyte's shielding transformed these reviews into endorsements of Post Office decision-making. He recast Plessey's criticisms as an unknowing endorsement, while the CPRS, in the absence of the Post Office's model, chose to endorse the Post Office's authority over its suppliers instead. Most revealingly, the Treasury's admission that 'unless we have been misled' emphasizes the trusted opacity of Whyte's model. This strategy reflects Whyte's background in Treasury O&M, which Agar has highlighted as a key site of discreet modernism and computer modelling within British government.[42] Agar particularly draws attention to Merriman, the Post Office's Engineer-in-Chief, who had been an expert mechanizer within O&M from 1955 to 1959, teaching simulation and gaming techniques to executive civil servants. Between Whyte and Merriman, the Treasury O&M tradition of computer simulation and discreet modernism had successfully arrived in the Post Office and LRPD. John Eden's full appraisal of the controversy supported the Post Office's TXE4 plan, citing the various reviews that had endorsed the Post Office and, by extension, Whyte's model.[43] The controversy caused by publicizing the simulation, and its closure through returning the model to an opaque state, underscores the successful tradition of discreet modernism in British state computing projects.

The dystopian warning that opens this article, Whyte's 'bleak mechanistic prospect', also shows the meeting of discreet modernism and invented, computerized futures. Whyte voiced concerns about the dangers of machine control posed by rapid technological

[41] Christie to Manzie, 'Treasury Comments on the Post Office's Model', 27 December 1972, FV 87/6, TNA.
[42] Agar, *The Government Machine*, 293–342.
[43] 'Modernisation of Telephone Exchanges: Memorandum by the Minister of Posts and Telecommunications for the Cabinet Ministerial Committee on Economic Policy', 9 April 1973, FV 87/4, TNA.

development in many publications and events, arguing that 'machines must not be permitted to erode the dignity of man', warning about the 'serious questions of the invasion of privacy', and titling one paper *Telecommunications in the Service of Man* – inviting the question of what the alternative might be.[44] He most forcefully articulated these concerns at a 1969 conference, *City in the Year 2000*, which included eminent speakers such as Ray Pahl, sociologist of post-industrial 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 co-author (with Eric Laithwaite, the creator of maglev transportation) of the 1977 popular science book *How to Invent*.[45] 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-fulfilment … 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.[46]

[44] 'LRSR 19: City in the Year 2000', 1969, TCC 252/19, BTA; 'A Panorama of Telecommunications in the Year 2000', 1970, TCC 274/2, BTA; 'Changing Characteristics of Telecommunications and Their Influence Upon Society', 1970, TCC 274/3, BTA; Whyte, 'Telecommunications', *The Guardian*, 17 September 1970, 13; 'Telecommunications in the Service of Man', 1971, TCC 274/4, BTA.

[45] Thring and Laithwaite, *How to Invent*.

[46] 'LRSR 19: City in the Year 2000', 1969, TCC 252/19, BTA.

Whyte's warnings responded to wider concerns about the dehumanizing intrusion of computers and communications into personal life. Alan Westin's influential 1967 book *Privacy and Freedom* drew attention to the new, and often technological, ways in which privacy could be invaded.[47] Westin particularly highlighted new techniques of informational surveillance made possible by computerized data banks, and as a result, the Younger Committee, Britain's first large-scale official study of privacy, invited him to present evidence.[48] The Younger Committee's 1972 report highlighted the threats of mass communication and computerized record-keeping systems. Agar shows that British government computing projects then became interpreted as a new threat posed by the centralized, computerized state to the individual citizen, and so concludes that 'by the early 1970s the computer had become cast as a threat to privacy'.[49]

Whyte's warnings reflect these trends but appear to conflict with the LRPD and Post Office's computerization projects. The 'bleak mechanistic prospect', however, can be thought of as an updated counterpart of discreet modernism, when transparent warnings joined opaque state computing. In the LRPD, Whyte was no longer an expert government mechanizer, but instead part of a highly-visible monopoly that, as Harris and Merriman established in 1967, invented futures of computerized, integrated networks for telephony, data, and Viewphone to defend its monopoly from packet-switched data networks. Discreet modernism may have sufficed for Treasury O&M's expert mechanizers, but in the national telephone system, at a time of rising concerns about computerization and telecommunications, Whyte needed to join the discreet modernist strategies used for his 'giant computer model' with explicit warnings about computerized communications as a symbol of state control. This would change, however, with new uses for the computer and with the end of the state's telecommunications monopoly.

[47] Westin, *Privacy and Freedom*.
[48] *Report of the Committee on Privacy*.
[49] Agar, *The Government Machine*, 360.

Marketing the Future

In the early 1970s, three factors caused the LRPD to change: internal restructuring, economic crises, and the appointment of a new head. The LRPD was relocated so that, rather than reporting directly to Merriman, it sat within the Telecommunications System Strategy Department, which Harris headed, and which had been created to oversee the development of System X, Britain's first fully-computerized telephone exchange. While this at first seems a shrinkage of the LRPD's responsibilities, relocation instead provided a new remit to explore broader social and economic futures about computers and communications. In 1974, the department began economic forecasting, which started in the wake of anti-inflation price restraints that the government had placed on the Post Office in 1972, causing the corporation to enter the red for several years.[50] Whyte, who left the LRPD to head Operational Programming in 1971, was replaced by Alex Reid, who had directed University College London's Communications Studies Group.[51] At the Communications Studies Group, Reid had directed research into the social impact of computers and communications under contract for the Post Office and the Civil Service, and under Reid's tenure, the LRPD also began social forecasting in 1974. The department's relocation and instigation of economic and social forecasting, along with Reid's appointment, suggest that Merriman and Harris felt a new direction was needed for Long Range Planning, one more oriented toward the telecommunication system's social and economic environment.

This change is borne by the number of new reports undertaken in the LRPD. Of the thirty-seven reports produced prior to 1974, thirty-two addressed technological change in

[50] 'Post Office Report and Accounts', 1971, TCC 11/2, BTA; 'Post Office Report and Accounts', 1972, TCC 11/3, BTA.
[51] 'New Chief', *Post Office Telecommunications Journal*, Autumn 1972, 29.

telecommunications, while five addressed broader futures.[52] Three of these reports were a series profiling long-range planning in British government, one was a report on the conference *City in the Year 2000*, and one, a 1971 study entitled *Britain 2001 AD*, was a projection of Britain's economic environment to the year 2001.[53] This last report was also the first recommendation for comprehensive economic forecasting in the LRPD, citing the pressures of Britain's turbulent economic environment. In 1974, the department thus began Long Range Economic Forecasts and Long Range Social Forecasts. From this point, approximately forty percent of the LRPD's reviews were economic or social forecasts, twenty-five percent were telecommunications forecasts, and just under thirty-five percent were 'interactions' forecasts, synthesizing research on telecommunications futures with social and economic forecasts.[54]

It is unclear how influential the new LRPD's forecasting activities were on Post Office policy and decision-making. Nevertheless, this period of change is still significant because these economic and social forecasts provided channels for new simulated and symbolic computer futures to enter the LRPD, which would become relevant at the highest levels as Margaret Thatcher created British Telecom and ended its monopoly.

Limits to Growth and Post-Industrial Society

[52] 'Long Range Studies Reports', 1968-1973, TCC 252, BTA; 'Long Range Studies Memoranda', 1969-1970, TCC 273, BTA; 'Long Range Studies Division Reference Papers', 1969-1975, TCC 274, BTA'; 'Long Range Studies by Research Contracts', 1971-1973, TCC 272, BTA.
[53] 'LRSR 10: Long Term Profile Part 1, Long Term Planning in the UK', 1969, TCC 252/10, BTA; 'LRSR 12: Long Term Profile Part 2, General Financial, Industrial, and Commercial Survey', 1969, TCC 252/12, BTA; 'LRSR 13: Long Term Profile Part 3, Further Studies of Manufacturing, Industry, and Commerce', 1969, TCC 252/13, BTA; 'LRSR 19: City in the Year 2000', 1969, TCC 252/19, BTA; 'LRSR 1000: Britain 2001 AD', 1971, TCC 272/1000, BTA.
[54] 'Long Range Intelligence Bulletins, 1974-1978', TCC 90/1, BT Archives; 'Long Range Research Reports', 1975-1977, TCC 92, BT Archives.

The LRPD's attention to a new type of computer modelling came in its first Long Range Economic Forecast, 'The Economic Consequences of Energy Scarcity', which addressed the impact of energy and fuel shortages on the telecommunications business.[55] A severe energy crisis affected the UK from 1973-74, caused by a National Union of Mineworkers strike, which slowed domestic production of coal, and an oil embargo by OPEC, the consortium of oil exporting nations, in October 1973. Ted Heath thus introduced a three-day work week in December 1973 to conserve energy. From the combined energy and economic crises, telephone growth dropped by fifty percent, and so the board initiated a Telecommunication Energy Conservation Program, while the LRPD ambitiously studied the potential for telephone exchanges powered by on-site nuclear reactors.[56]

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, to appraise the likelihood of future energy crisis, and in doing so, also highlighted a new type of computer modelling. This came via *The Limits to Growth*, an influential 1972 report published by the Club of Rome, a think tank formed in 1968 to draw attention to issues requiring global action.[57] *Limits*' report had used modelling adapted from Jay Forrester's system dynamics, originally known as 'industrial dynamics'. So that managers could better understand the systems they managed, Forrester developed industrial dynamics while at MIT's School of Industrial Management as a heuristic tool that modelled industrial systems as inputs and

[55] 'LRIB 1: Long Range Economic Forecasts: The Economic Consequences of Energy Scarcity', 1974, TCC 90/1, BTA.

[56] 'Post Office Report and Accounts', 1974, TCC 11/5, BTA; 'Post Office Report and Accounts', 1979, TCC 11/10, BTA; 'Long Term Economic and Technological Trends', 1974, TCC 55/6/33, BTA.

[57] Meadows et al., *The Limits to Growth*; for an overview of the Club of Rome, *The Limits to Growth*, and its reception, see Vieille Blanchard, 'Modelling the Future'; Seefried, 'Towards The Limits to Growth?'

outputs.[58] 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. The LRPD's report dismissed *Limits*' gloomy predictions of a total collapse to society, but concluded that a long-term energy problem was nevertheless likely to occur, and so emphasized that, to weather future crises, business and government needed more sophisticated long-term planning.[59] Forrester's system dynamics would become a key part of the department's long-term crisis planning.

Meanwhile, the department's social forecasts provided a vehicle for the changing symbolic status of computers. In these social forecasts, Joan Glover, the LRPD's newly-hired sociologist, undertook and analyzed customer interviews and questionnaires to forecast changes in labor structure, home working, and telecommuting.[60] Glover concluded that networked computing would facilitate home working for professional, managerial, and clerical workers, and transform the nature of work from the type where 'people and machines were co-ordinated to produce goods' into the 'co-ordination of people and machines to produce knowledge'.[61] 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 American futures research, citing reports from the Institute of the Future, a RAND spin-off, and *The Year 2000: A Framework for Speculation on the Next Thirty Years*, the highly

[58] Forrester, 'Industrial Dynamics'; Thomas and Williams, 'The Epistemologies of Non-Forecasting Simulations, Part I'.
[59] 'LRIB 1: Long Range Economic Forecasts: The Economic Consequences of Energy Scarcity', 1974, TCC 90/1, BTA, 6.
[60] 'LRIB 2: Long Range Social Forecasts: Working from Home', 1974, TCC 90/2, BTA; 'LRIB 8: Long Range Social Forecasts: Attitudes to Work', 1975, TCC 90/8, BTA.
[61] 'LRIB 8: Long Range Social Forecasts: Attitudes to Work', 1975, TCC 90/8, BTA.

influential futurological text by Herman Kahn and Anthony Wiener.[62] Perhaps the greatest influence, however, was Daniel Bell's *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, published in 1973.[63] Bell predicted a future post-industrial society where, rather than matter, information would be the primary resource operated upon 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, contrasted to pasts of material production, echoed Bell's post-industrial society.

Bell's presence is indicative of a turning point in popular conceptions of computer futures. As Webster notes, Bell's post-industrial society provided an analytical construct with which to understand the perception in the 1970s that 'computers soon seemed *everywhere*'.[64] Turner argues that the symbolic role of the computer in post-industrial society, taken up by countercultural figures such as Stewart Brand, influenced advocates for telecommunications deregulation, exemplified in Esther Dyson, George Gilder, Alvin Toffler, and George Keyworth's 1994 'Magna Carta for the Knowledge Age'.[65] In this collision of Bell, the counterculture, and the New Economy of 1990s America, the computer represented information, knowledge, and the mind. Dyson and her co-authors thus perceived liberalizing computers and telecommunications as essential to emancipating the individual citizen for the knowledge economy. They also saw networked computing as central to this liberalized economy, ushering in new, electronic marketplaces. This heady mix of the market,

[62] 'LRIB 2: Long Range Social Forecasts: Working from Home', 1974, TCC 90/2, BTA; 'LRIB 8: Long Range Social Forecasts: Attitudes to Work', 1975, TCC 90/8, BTA; Kahn and Wiener, *The Year 2000*.

[63] Bell, *The Coming of Post-Industrial Society*.

[64] Webster, *Theories of the Information Society*, 38.

[65] Turner, *From Counterculture to Cyberculture*, 228–30; Dyson et al., 'Cyberspace and the American Dream: A Magna Carta for the Knowledge Age (August 22, 1994, Future Insight Release 1.2, Progress & Freedom Foundation)'.

individualism, and networked computing would serve a similar function during telecommunications liberalization in the UK.

'Competition and Diversity are Ideas of the Future'

The LRPD's first use of system dynamics responded to the potential reorganization of the Post Office's telecommunications monopoly. In 1976, the LRPD engaged David Probert, a researcher at Cambridge University's Department of Control and Management Systems, to develop a system dynamics-based model of the corporation, which suggests that Forrester's system dynamics, first noted in 'The Economic Consequences of Energy Scarcity', had remained influential. The LRPD commissioned the model to gain a holistic understanding of the telecommunications business, as it became increasingly likely that the business would be separated from the Post Office.[66] In 1975, the Labour government had initiated a new review into the Post Office's structure, which recommended separating the postal and telecommunications businesses so that the telecommunications business could reinvest its profits, rather than support the loss-making postal business.[67] To the Post Office board's ire, however, the Labour government delayed in favor of an ill-fated experiment in industrial democracy. Meanwhile, Margaret Thatcher became leader of the Conservative party in 1975, and the introduction of competition into national monopolies was a key part of the Conservatives' election-winning 1979 manifesto.[68] Upon their successful election, Keith Joseph, Thatcher's Minister for Trade and Industry, announced an end to industrial democracy, the separation of the postal and telecommunications businesses, and a review of the

[66] Probert, 'Systems Dynamics Modelling within the British Telecommunications Business', 69.
[67] *Report of the Post Office Review Committee*.
[68] 'Conservative General Election Manifesto', 1979.

telecommunications monopoly.[69] BT was formally created in 1981, at which point the telecommunications monopoly was liberalized and, three years later, BT was privatized.

Probert designed his first model, the Long Range Planning Model (LRPM), delivered in 1977, to explore 'alternative corporate futures' as the business faced independence from the Post Office.[70] Written in FORTRAN and run on an IBM 3033 time sharing system, the LRPM grouped the business into four conceptual modules – marketing, personnel, finance, and technology – and when a simulation was run, a cluster of up to ten parameters was altered and the effects tracked in up to one hundred and eighty different variables, giving a picture of the company's future finances, equipment needs, total manpower, and so on, over a thirty-year time horizon. As these outputs referred only to the whole corporation, and not individual departments, operational departments mainly used the model to analyze the effects of strategic choices on the business as a whole. In this sense, system dynamics' first uses in the LRPD cohered the telecommunications business into an independent whole, separate from the Post Office, by simulating holistic corporate futures.

Probert soon added the wider political-economic environment to the LRPM through the development of a 'Strategic Control Unit' (SCU) in 1979. The SCU was a 'bolt-on' program that would permit the LRPM to simulate various future crises, from 'economic recession' to 'severe constraints on tariff increases', and the business's ability to recover from such crises.[71] Given that economic instability had also provoked the LRPD to widen its forecasting horizons earlier in the 1970s, I would suggest that this turbulence influenced the development of the SCU as well. The SCU allowed users to set objectives for corporate performance parameters, and as the model initiated a crisis by 'spiking' certain variables, the SCU would prioritize

[69] Hamilton, 'Joseph to Split Post Office', *The Observer*, 9 September 1979, 21.
[70] Probert, 'Systems Dynamics Modelling within the British Telecommunications Business', 70–72; Probert, 'The Development of a Long-Range Planning Model for the British Telecommunications Business'; 'Strategic Modelling in British Telecom', 1982, TCD 278/PR 42, BTA.
[71] Allenstein and Probert, 'A Strategic Control Module for a Corporate Model of British Telecom'.

normalization of the selected parameters. This meant that the LRPD 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.[72] Simulation was no longer about 'inventing' technological futures, as with TXE4, but, in response to economic crises and organizational uncertainty, became oriented to broader political and economic change.

While Probert indicated that the LRPM and SCU were used to advise strategic decision-making and business plans across the telecommunications business, system dynamics' most intriguing use in the LRPD came with a new model: the Integrated Communications Demand Model (ICDM). The ICDM, which Probert developed in response to the government's 1980 announcement that the state's telecommunications monopoly would end in 1981, simulated competition and market share.[73] ICDM simulations tracked 150 indicators over a thirty-year time horizon, but differed from the LRPM in that these indicators were grouped into three areas of market demand – terminals, connections, and services – that were varyingly allocated to BT or its competitors over the course of the simulation. The ICDM's development also came during further reorganization for the LRPD, which, as part of BT's creation, was renamed Long Range and Strategic Studies and was subordinated to a new department, the Business Planning and Strategy Department (BPSD).[74] Probert was appointed Director of Strategic Modelling, and, when he completed the ICDM in 1981, linked it to this political, economic and organizational change by announcing that 'competition and diversity are ideas of the future'.[75]

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[72] Probert, 'Systems Dynamics Modelling within the British Telecommunications Business', 71–74.
[73] 'Strategic Modelling in British Telecom', 1982, TCD 278/PR 42, BTA; Doubleday and Probert, 'The Development of an Integrated Communications Demand Model for the British Telecommunications Business'.
[74] 'Business Planning and Strategy Department: Report', 1982, TCD 93, BTA.
[75] Probert, 'The Development of a Long-Range Planning Model for the British Telecommunications Business', 697. Probert was quoting the U.S. Democratic Senator for South Carolina, Ernest Hollings, who is best known for his campaigns against poverty, but it is not clear how Probert was familiar with Hollings.

Probert used the ICDM to school BT staff about these so-called 'ideas of the future', describing that 'using the model to demonstrate to a manager the implications of the high degree of uncertainty associated with, say, a demand elasticity for a new service can be a valuable stimulus to more flexible thinking on the questions of market demand'.[76] Probert wrote articles about the ICDM for company magazines and journals, produced brochures, and arranged presentations, seminars, and drop-in clinics to use the model to educate managers about the market.[77] Probert also emphasized the ICDM's color interface, a new addition to his models, 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'.[78] 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'.[79]

The re-orientation of simulation from decision-making input to training tool was part of several strategies used by BT's senior management to convince staff that liberalization and, later, privatization, were positive changes.[80] The board favored liberalization, as it would mean greater freedom for the business from the state economic controls that it had suffered in the 1970s, and this continued with the board's support of privatization, which freed BT from public sector borrowing restrictions. Many staff, however, were not so amenable. BT engineers refused to interconnect BT telephone lines with competitors', and various anti-liberalization

[76] Doubleday and Probert, 'The Development of an Integrated Communications Demand Model for the British Telecommunications Business', 1092.
[77] Doubleday and Probert, 'The Development of an Integrated Communications Demand Model for the British Telecommunications Business'.
[78] Doubleday and Probert, 1087.
[79] Doubleday and Probert, 1092.
[80] 'Telecommunications Board: Arrangements for Liberalisation', 25 November 1980, TCC 59/1, BT Archives.

and anti-privatization material were circulated amongst staff.[81] The ICDM formed part of a broader strategy, which included letters posted to staff's homes, discounts on employee share-holding, and meetings with government ministers, to explain the supposed necessity of these changes. In one meeting, Patrick Jenkin, Keith Joseph's successor as Minister for Trade and Industry, explained to staff that Britain 'cannot afford to keep BT trammelled by the mesh of bureaucratic controls at a time when technological and commercial developments really set this organisation at the centre of our electronic future'.[82] The board circulated Jenkin's message to all managers so that they could communicate these explanations to subordinates and 'calm any exaggerated fears'.[83]

The department's shifting use of system dynamics from planning to pedagogy reveals simulation's importance for BT. Mirowski argues that simulations become truly productive once they are turned from representations to managerial tools, exemplifying this with an air defense staffing simulation turned into recruit training protocol.[84] The same change happened with system dynamics, as Probert developed it from the LRPM, a corporate representation, to the ICDM, a training tool, used as part of a broader strategy by BT'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 took place beyond the simplistic sense of advertising its use to staff.[85] System dynamics in BT was also 'marketed' through the

[81] Tebbitt to Thatcher, 'POEU Action', 17 October 1983, PREM 19/1344, TNA; 'Save Buzby from the Vultures - BT Research Engineers', Buzby Collection, Computer Networking and Telecommunications Research Technology Collection, University of Salford.
[82] 'Extracts from a Speech, and Answers to Questions, given by the Secretary of State to Senior BT Managers', 29 July 1982, TCD 69/2/115, BTA.
[83] 'Privatisation', 13 October 1982, TCD 69/2/115, BTA; 'BT and Privatisation: A Situation Report for All Managers and Their Staff', October 1982, TCD 69/2/115, BTA.
[84] Mirowski, *Machine Dreams*, 532.
[85] Probert, 'The Development of a Long-Range Planning Model for the British Telecommunications Business', 703–5; Doubleday and Probert, 'The Development of an Integrated Communications Demand Model for the British Telecommunications Business', 1087–93.

progressive incorporation of free market principles into its code, and through its use in 'marketizing' staff by promoting free market views.

Alongside simulating the market, the computer also came to symbolize it. In November 1980, the BPSD organized a weekend retreat, called 'Into the 21st Century', for senior management and board members to prepare for liberalization and competition, and much discussion concerned the power of computing to transform the economy and the state.[86] Alex Reid, by then Director of Business Systems, the BPSD's parent division, spoke of how networked computing would give successful enterprise 'a vision of the total scope of the market' and 'freedom to perform any function in any country'.[87] A group discussion explored the potential for portable computing to facilitate a diverse and competitive market, and render the labor force more mobile.[88] In another echo of Bell's post-industrial 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', providing 'vast opportunities for wealth creation and individual self-realisation'.[89] Another discussion concerned the future place of information as 'the basic commodity of service industries' and the difficulties in evaluating the 'output' of information as compared to how the solid material output of 'iron bars or bushels of wheat' could be monitored. 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'.[90] Here, BT's senior management perceived computing and information as presenting Britain with a choice – either government control or 'unfettered' market forces.

[86] 'Into the 21st Century', 1980, TCC 75/1, BTA.
[87] 'Into the 21st Century', 1980, TCC 75/1, BTA, 77.
[88] 'Into the 21st Century', 1980, TCC 75/1, BTA, 108.
[89] 'Into the 21st Century', 1980, TCC 75/1, BTA, 60.
[90] 'Into the 21st Century', 1980, TCC 75/1, BTA, 58.

The opinions of BT's senior management became clear as they positioned the computer as a symbol of individuality and a small state. Greensmith went onto explain that personal networked computing would mean 'a trend away from bigness and centralisation … thus restoring the importance of the individual'.[91] J. J. Wheatley, BT's Head Economics Adviser, envisioned how computerization could enable small government:

> 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.[92]

These sentiments were typical of the computer's perceived political and economic importance in Thatcher's Britain. Kenneth Baker, Thatcher's Minister for Information Technology, in a 1982 speech to the British Association for the Advancement of Science, proclaimed the opportunities that computers and information technology in the 'post-industrial society' would provide for greater personal freedom, the retreat of the state, and privatization.[93] This speech came during IT-82, a national information technology year launched by Margaret Thatcher, which Ronald Kline has described as a globally significant moment in the popularization of the 'information age'.[94] Thatcher also linked computerization with

[91] 'Into the 21st Century', 1980, TCC 75/1, BTA, 60.
[92] 'Into the 21st Century', 1980, TCC 75/1, BTA, 24.
[93] Baker, 'Towards an Information Economy', 7 September 1982, T 471/45, TNA.
[94] Kline, *The Cybernetics Moment*, 104–12, 203.

liberalization, arguing in a December 1982 speech that IT required 'free enterprise' and 'competition'.[95] The computer here did not just symbolize the smaller state, but necessitated it. This symbolic status was deeply entangled with the termination of BT's monopoly. Patrick Jenkin had proposed BT's privatization in 1982 as 'the most lasting legacy of Information Technology Year', and a subsequent government white paper, *The Future of Telecommunications in Britain*, announced that the 'need to free BT from traditional forms of government control' would be achieved through IT regulations which would be 'the most liberal in the world'.[96]

The political importance of the computer came from the central role given to information technology in Conservative industrial policy for reviving the national economy, a commonplace policy in Western governments during the early 1980s.[97] The computer, however, was important beyond industrial policy, also serving as a symbol of the changing structure of the economy and the state. In the USA, countercultural ideas of computing's emancipatory potential mixed with neoliberal economic and industrial policy, resulting in a vision of computing as enabling individualism, creating free markets, and reducing the power of government.[98] Conservative politicians and BT's senior management attributed similar qualities to computing, and from the recurrent (if not necessarily knowing) allusions, Daniel Bell's post-industrial society appears particularly influential. In Britain, these ideas fused with the Thatcherist program of privatization, and so BT's privatization was perceived as essential to unleashing computing's power to transform the state, the economy, and the individual.

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[95] Thatcher, 'Speech Opening Conference on Information Technology'.

[96] Jenkin to Brittan, 'Future Policy on Telecommunications', 12 March 1982, PREM 19/875, TNA; *The Future of Telecommunications in Britain*.

[97] On the Conservative emphasis on information technology, see Lean, *Electronic Dreams*, 91–94, and Sumner, 'Defiance to Compliance', 326; for broader Western emphases, see Schiller, *Information and the Crisis Economy*, 1–6.

[98] Barbrook and Cameron, 'The Californian Ideology'; Turner, *From Counterculture to Cyberculture*.

In the BPSD, this political-economic promise of the computer, auguring liberalization and the retreat of state control to senior management, met with computer simulation's use in encouraging the adoption of free market sensibilities amongst staff. This differed significantly from the LRPD circa 1970, when modelling served as an instrument of state monopoly power over industry, and the computer symbolized dystopian futures of state control. The seeds for these changes had been planted in the mid-1970s, as system dynamics and Daniel Bell showed new roles for the computer. These roles' growth was shaped by Britain's changing political economy, and by organizational and regulatory change in telecommunications. As computing became a symbol of the Thatcherist state and market economy, so computer simulation became a way of 'marketing' the future for BT's liberalization. These dual understandings of the computer among BT's management were mutually reinforcing. As shown by the Long Range Strategy Seminar, understanding the computer was key to senior management's understanding of marketization and neoliberalism, and so understanding the ICDM computer simulation became part of winning staff's acceptance of liberalization. This relationship between liberalization and computerization also took on national importance in Margaret Thatcher's economic and industrial policy, which normalized the supposed mutual dependence of information technology and the market economy, particularly through BT's liberalization and privatization.

Conclusion

This article's first task was to uncover the computer's role in the shift from 'invented' futures and the 'bleak mechanistic prospect' to marketized simulations and 'competition and diversity'. The computer, as simulation and symbol, was central to both invented and marketized futures, and was implicated in the shift between the two. The LRPD and British

political economy both began to change in the mid-1970s in the wake of financial crises, and, for both, new theories of the computer and post-industrial society provided a frame for the neoliberal future. In BT, system dynamics was one of several strategies that midwifed that future.

Histories of computing have long recognized the computer's important role in the rise of neoliberalism, from cyberculture's influence on the New Economy to personal, networked computing as a template for the 'hollowed out' neoliberal state.[99] These histories, alongside others, recognize the computers' two-fold power as machine and imaginary. Computer simulation specifically has been highlighted by Edwards and Mirowski as exemplifying this power, where practical simulations symbolically stand in for reality – and sometimes completely displace it.

These histories, however, do not fully unpack simulation's power as a function of futurity. This power partly derives from its role as evidence of the future, come to transform the present. Thus simulation, as this article shows, was situated within broader futurological and institutional practices. Whyte's model was part of a range of strategies, including *Telecommunications System of the Future*, Viewphone reports and the 'bleak prospect', that invented futures of computerized monopolies. Probert's ICDM and J. J. Wheatley's 'small government aspirations' came alongside social and economic forecasting, and were part of various tactics for 'marketing' futures of liberalization to BT staff.

This political and institutional power of simulation as an instrument of futurity has come through in recent historical attention to simulation as part of a range of material practices of forecasting and prediction, from the post-war growth of futurology to histories of

[99] Agar, *The Government Machine*; Turner, *From Counterculture to Cyberculture*; Barbrook, *Imaginary Futures*; Edwards, *The Closed World*; Mirowski, *Machine Dreams*.

environmental forecasting.[100] Histories of futurology have shown greater attention to the range of futuristic practices in which computer modelling and simulation have been deployed, but have remained distinct from studies of imaginaries, expectations, and other intangible futures. Histories of computing, on the other hand, have forged a deeper understanding of computing as both material and symbolic practice, and so show that material and symbolic practices are not so easily separated.

I have shown in this article that it was the capacity for computing in the Post Office and BT to generate evidence of the future, and simultaneously symbolize those futures, which endowed it with such significance. In the late 1960s and early 1970s, the computer both forecasted and symbolized monopoly futures, supporting Post Office purchasing decisions and provoking the 'bleak mechanistic prospect', both of which, in different ways, reinforced futures of computerized state monopoly power. Through the rest of the 1970s and into the 1980s, a new system of ideas – market liberalization and the small state – arose in which the computer played a central role, symbolizing and simulating free market futures for BT's liberalization. With the increased prominence of histories of futurity, both through histories of futurological organizations and practices and through social studies of imaginaries and so on, there is a clear place for the history of technology to demonstrate technologies' prominent role in both forecasting and symbolizing the future.

[100] Andersson, 'Midwives of the Future: Futurism, Futures Studies and the Shaping of the Global Imagination'; Warde and Sörlin, 'Expertise for the Future: The Emergence of Environmental Prediction c. 1920-1970'; Turnbull, 'Simulating the Global Environment: The British Government's Response to Limits to Growth'.

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