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Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende's Chile*

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Abstract. This article presents a history of 'Project Cybersyn', an early computer network developed in Chile during the socialist presidency of Salvador Allende (1970–1973) to regulate the growing social property area and manage the transition of Chile's economy from capitalism to socialism. Under the guidance of British cybernetician Stafford Beer, often lauded as the 'father of management cybernetics', an interdisciplinary Chilean team designed cybernetic models of factories within the nationalised sector and created a network for the rapid transmission of economic data between the government and the factory floor. The article describes the construction of this unorthodox system, examines how its structure reflected the socialist ideology of the Allende government, and documents the contributions of this technology to the Allende administration.

On 12 November 1971 British cybernetician Stafford Beer met Chilean President Salvador Allende to discuss constructing an unprecedented tool for economic management. For Beer the meeting was of the utmost importance; the project required the president's support. During the previous ten days Beer and a small Chilean team had worked frantically to develop a plan for a new technological system capable of regulating Chile's economic transition in a manner consistent with the socialist principles of Allende's presidency. The project, later referred to as 'Cybersyn' in English and

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'Synco' in Spanish,[1] would network every firm in the expanding nationalised sector of the economy to a central computer in Santiago, enabling the government to grasp the status of production quickly and respond to economic crises in real time. Although Allende had been briefed on the project ahead of time, Beer was charged with the task of explaining the system to the President and convincing him that the project warranted government support.

Accompanied only by his translator, a former Chilean Navy officer named Roberto Cañete, Beer walked to the presidential palace in La Moneda while the rest of his team waited anxiously at a hotel bar across the street. 'A cynic could declare that I was left to sink or swim,' Beer later remarked. 'I received this arrangement as one of the greatest gestures of confidence that I ever received; because it was open to me to say anything at all.'[2] The meeting went quite well. Once they were sitting face to face (with Cañete in the middle, discreetly whispering translations in each man's ear), Beer began to explain his work in 'management cybernetics,' a field he founded in the early 1950s and cultivated in his subsequent publications.[3] At the heart of Beer's work stood the 'viable system model', a five-tier structure based on the human nervous system, which Beer believed existed in all stable organisations – biological, mechanical and social. Allende, having trained previously as a pathologist, immediately grasped the biological inspiration behind Beer's cybernetic model and knowingly nodded throughout the explanation. This reaction left quite an impression on the cybernetician. 'I explained the whole damned plan and the whole viable system model in one single sitting … and I've never worked with anybody at the high level who understood a thing I was saying.'[4]

Beer acknowledged the difficulties of achieving real-time economic control, but emphasised that a system based on a firm understanding of cybernetic principles could accomplish technical feats deemed impossible in the developed world, even with Chile's limited technological resources. Once Allende gained a familiarity with the mechanics of Beer's model, he began to reinforce the political aspects of the project and insisted that the system behave in a 'decentralising, worker-participative, and anti-bureaucratic manner'.[5] When Beer finally reached the top level of his systematic hierarchy, the place in the model Beer had reserved for Allende himself,

[1] 'Cybersyn' comes from a synthesis of the two concepts driving the project, 'cybernetics' and 'synergy'. The abbreviation 'Synco' conveyed the objective of the project, namely 'Sistema de Información y Control'. The project name has also appeared as 'Sinco' or 'Cinco'.

[2] Stafford Beer, *Brain of the Firm* (New York, 1974), p. 257.

[3] Wiener himself christened Beer the 'father of management cybernetics'.

[4] Stafford Beer, interview by author, Toronto, Canada, 15–16 March 2001.

[5] Beer, *Brain of the Firm*, p. 257.

the president leaned back in his chair and said, 'At last, *el pueblo*.'[6] With this succinct utterance, Allende reframed the project to reflect his ideological convictions and view of the presidential office, which often equated his political leadership with the rule of the people. By the end of the conversation, Beer had secured Allende's blessing to continue the project.

At face value, a meeting between a British cybernetician and a Chilean president, particularly one as controversial as Allende, seems most unusual.[7] The brief presidency of the Unidad Popular (UP) has arguably inspired more historical scholarship than any other moment in Chilean history. Despite this wealth of literature, little is known about the Chilean government's experiment with cybernetics during this period and less about its contribution to the UP's experiment in democratic socialism.[8] The nature of the meeting between Beer and Allende suggests that writing technology into one of the most widely studied periods of Latin American history will bring to light an unstudied facet of the Chilean revolution and, in the process, demonstrate the value of this framework for analysis. In part, documenting the construction of this system provides information on the extent of Chile's technological capabilities during the early 1970s. More importantly however, the project provides a window for viewing new tensions within the UP coalition, Chile, and the international community at large. The impressions

[6] *Ibid.*, p. 258. The meeting between Allende and Beer constitutes one of the most popularly printed anecdotes of the Cybersyn project, always constructed from Beer's account. Here I have retold the story drawing from Beer's account in *Brain of the Firm*, an interview with Beer, and an interview with Roberto Cañete, Viña del Mar, Chile, 16 Jan. 2003.

[7] The biography of Salvador Allende Gossens is well known, but it warrants a brief synopsis here. Although he had run as the presidential candidate for the left in the previous two presidential elections, he first attracted worldwide attention in 1970 after he defeated his opponent, the rightist candidate Jorge Alessandri, by a slim 1.3% margin of the popular vote. His election marked the arrival of Chile's first democratically-elected socialist leader and the first to attempt socialist transformation through peaceful means. A socialist since the age of twenty-four, Allende entered politics fighting for his cousin Marmaduke Grove Vallejo, the Air Force Commander who became Chile's first socialist president for a short-lived twelve days in 1932. After establishing a branch of the socialist party in his hometown of Valparaíso, Allende quickly rose through the ranks of the party and was elected to Congress in 1937. Always in favour of socialist reform through existing democratic practices, unlike many of his more radical contemporaries, Allende consistently pushed for a leftist agenda from the senate and later from the presidential palace.

[8] This should not imply that the project has not been documented. Beer published his account of the project in the last five chapters of *Brain of the Firm*, as well as in the last chapter of *Platform for Change* (New York, 1975). Other references include Armand Mattelart and Hector Schmucler, *Communication & Information Technologies: Freedom of Choice for Latin America* (Norwood, 1985). Project participants, such as Raúl Espejo, Herman Schwember and Roberto Cañete have also published their accounts of Cybersyn in international cybernetics journals. Discussions of the project have similarly appeared in publications such as *New Scientist*, *Datamation* and *Data Systems*. These, however, are all publications dedicated to science and technology and not to the documentation Chilean history during the Allende period.

and aspirations expressed by various project participants furthermore reveal an alternative history of the UP era grounded in technological optimism and the merging of science and politics to bring about social and economic change. This article argues that the UP experiment with cybernetics and computation constitutes another innovative, yet unexplored, feature of Chile's democratic road to socialism. For this reason, examining this technological project promises to enrich our understanding of this complex moment in Chilean history.

Knowledge of this technological undertaking moreover contributes to the literature in the history of science and technology, particularly with respect to studies of cybernetics and the history of computing. The meeting between Beer and Allende suggests that cybernetics, an interdisciplinary science encompassing 'the entire field of communication theory, whether in the machine or in the animal', achieved a level of importance in Chile during this period, and that Allende's Chilean revolution was open to these cybernetic ideas and their application.[9] However, most discussions of cybernetics to date focus on the evolution of these ideas and their application within the USA and the European contexts and do not address how they migrated to other parts of the world such as Latin America. Chilean history provides a clear of example of how alternative geographical and political settings gave rise to new articulations of cybernetic ideas and innovative uses of computer technology, ultimately illustrating the importance of including Latin American experiences in these bodies of scholarship.[10] This article will first present an explanation of how cybernetics entered Chilean consciousness, attracted the attention of the nation's president, and guided the construction of this singular technological system.

From a different angle, the meeting between Beer and Allende also illustrates the importance of both technological soundness and political ideology in Cybersyn's construction. Although the project was technically ambitious, from the outset it could not be characterised as simply a technical endeavour to regulate the economy. From the perspective of project team members, it could help make Allende's socialist revolution a reality – 'revolutionary computing' in the truest sense. Moreover, the system had to accomplish this goal in a manner ideologically congruent with Allende's politics. As this article will demonstrate, the tensions surrounding Cybersyn's design and construction mirrored the struggle between centralisation and

[9] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge, 1948), p. 11.

[10] Although little attention has been paid to cybernetics in Latin America, scholars have addressed the development of cybernetic ideas in the Soviet Union, most notably Vyacheslav Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, 2002).

decentralisation that plagued Allende's dream of democratic socialism. Throughout Allende's presidency, Chile's political polarisation strongly influenced the perception of the project and its role in Chilean society. The interplay of cybernetic ideas, Marxist ideology and computer technology found in the project illustrates how science and technology contributed to Chilean ideas of governance during the early 1970s and altered the possibilities for socialist transformation. Explicating this multi-faceted relationship constitutes the final focus of this article and demonstrates that studies of technology can expand our knowledge of historical and political processes within the Latin American region.

Chilean Cybernetics

The origin of cybernetics has been well documented elsewhere.[11] Previous scholarship has shown that cybernetics grew out of a WWII project to create anti-aircraft servomechanisms capable of accurately aiming weapons at the future position of an enemy aircraft. This problem led Norbert Wiener, Julian Bigelow, and Arturo Rosenblueth to develop a theory of feedback control capable of making predictive calculations from an incomplete set of information, which later evolved into a theory for self-corrective control that many believed could be applied in both machines and organisms. Attempts to bridge the mechanical and the biological appeared as early as 1943 when Rosenblueth et al. wrote, 'a uniform behaviouristic analysis is applicable to both machines and living organisms, regardless of the complexity of the behaviour.'[12] This conviction laid the foundation for cybernetics, a new interdisciplinary science that strove to apply concepts from mathematics and engineering – such as statistical modelling, information theory, and the feedback loop – to a myriad of systems, including those outside the mechanical and biological domains.

Humberto Maturana and Francisco Varela provided one of the initial links between Chile and the cybernetics community, although Maturana never identified himself as a cybernetician.[13] Born in Chile in 1928, Maturana

[11] For a more in-depth treatment of the origin of cybernetics, see Paul Edwards, *The Closed World* (Cambridge, 1996) and Steve Heims, *The Cybernetics Group* (Cambridge, 1991). An alternative reading of the field's evolution is presented in David Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore, 2002). It is also worth noting that the British cybernetics community, of which Beer was part, placed a greater emphasis on applying their cybernetic ideas outside the laboratory than their American counterparts. See Andrew Pickering, 'Cybernetics and the Mangle: Ashby, Beer, and Pask,' *Social Studies of Science*, vol. 32, no. 3 (2002), pp. 413–37.

[12] Arturo Rosenblueth, Norbert Wiener and Julian Bigelow, 'Behavior, Purpose, and Teleology,' *Philosophy of Science*, vol. 10 (1943), pp. 18–24.

[13] Humberto Maturana, interview by author, Santiago de Chile, 8 September 2003.

studied medicine at the University of Chile and later pursued his graduate studies in the Biology Department of Harvard University. In 1959, he co-authored the important paper 'What the frog's eye tells the frog's brain' along with Warren McCulloch, Jerome Lettvin, and Walter Pitts, all of whom were important figures in the cybernetics field.[14] After the completion of his PhD Maturana returned to Chile and assumed a position in the biology department of the University of Chile, the most respected public university in the country. Here, he continued his work on the optic nerve, but more broadly tried to uncover the organisational structure of living organisms. Varela began his studies under Maturana's tutelage at the University of Chile and followed his mentor's footsteps to the doctoral program in biology at Harvard University. Like Maturana, he accepted a faculty position at the University of Chile upon his return to Santiago. The title of their first co-authored book, *De máquinas y seres vivos* (On Machines and Living Beings), illustrates the continued presence of cybernetic ideas in their biological studies.[15] Here, the authors presented their groundbreaking theory of self-organising systems, known as *autopoiesis*.

However, their contribution to Chilean cybernetics during the 1960s and early 1970s did not extend beyond the laboratory. On occasion, Maturana would later advise Beer on the theoretical aspects of the system – having travelled in the same circles, Beer knew of Maturana's work before Allende came to power and the two were able to strengthen their ties during Beer's time in Chile. Maturana and Varela later delivered several lectures to the core members of the Cybersyn team, but they always did so in an unofficial capacity.[16] Although these biologists provided one of the first bridges between Chile and the international cybernetics community, they did not contribute to the Chilean government's familiarity and application of cybernetics during Allende's presidency. Beer himself would unwittingly provide this connection.

The scope of this article does not permit a full biography of Beer, but a brief sketch will enable the reader to appreciate the unorthodox nature of his character in both business and cybernetic circles. Unlike many of his contemporaries in the cybernetics community, Beer himself never received a formal degree; his undergraduate studies in philosophy were cut short by military service in the British army during World War II. Following the war, Beer entered the steel industry and ascended rapidly to the management

[14] Jerome Lettvin et al., 'What the Frog's Eye Tells the Frog's Brain,' *Proceedings of the Institute of Radio Engineers*, vol. 47, no. 11 (1959), pp. 1940–51.

[15] Humberto R. Maturana and Francisco J. Varela, *De máquinas y seres vivos: una caracterización de la organización biológica* (Santiago, 1973). This book was later translated into English as *Autopoiesis and Cognition: The Realization of the Living* (Boston, 1980) with an introduction by Stafford Beer.

[16] Beer, interview.

level. In 1950 a friend serendipitously handed Beer a copy of Norbert Wiener's groundbreaking publication, *Cybernetics*. Reading the book changed Beer's life and spurred him to write an enthusiastic letter to the famous MIT mathematician detailing his application of cybernetic principles to the steel industry. Wiener, unfamiliar with the business world and intrigued by this new application of his work, invited Beer to visit him at MIT. Beer eventually became an informal student of MIT biologist Warren McCulloch and a friend to Wiener and University of Illinois electrical engineer Heinz Von Foerster. An independent thinker, Beer once gave a paper entitled 'The Irrelevance of Automation' at an international automation conference, an occasion that reportedly convinced Von Foerster that the British did indeed possess a sense of humour.[17] In line with his beliefs as an 'old-fashioned leftist', Beer tried using his understanding of cybernetic principles to bring about social change, as evidenced by a series of lectures he gave between 1969 and 1973 that he later published as the volume *Platform for Change*.[18] Known for his long beard, the ever-present drink in his hand, and his habit of smoking 30 cigars a day, Beer cultivated an image that, in one journalist's words, resembled a 'cross between Orson Welles and Socrates'.[19]

After serving for a number of years as the director of cybernetics and operations research at United Steel, the largest steel company in the United Kingdom, Beer left to assume the helm of Science in General Management (SIGMA), a French-owned consulting company that applied operations research (OR) techniques to business problems. Beer recalled that he was trying to use OR 'to change industry and government in the same way that the army, navy, and air force had been changed [during WWII] by making mathematical models'.[20] This was quite an ambitious goal considering the numerous contributions OR techniques had made to the Allied anti-aircraft and U-boat efforts during the war.[21]

SIGMA's reputation grew, and gradually the company began to attract an international clientele. In 1962 the director of Chile's steel industry requested SIGMA's services. Beer refused to go himself – he had never been to South America and his hectic schedule made the lengthy transit time seem unreasonable – but he put together a team of English and Spanish employees to travel to Chile in his place. SIGMA's work in the steel industry gradually expanded to include the railways. Due to the large amount of work, the Chilean SIGMA team often employed students to pick up the

[17] *Ibid.* [18] Beer, *Platform for Change*, and Beer, interview.
[19] Michael Becket, 'Beer: The Hope of Chile,' *The Daily Telegraph Magazine*, 10 August 1973, p. 7. [20] Beer, interview.
[21] See for example Agatha C. Hughes and Thomas Parke Hughes, *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge, 2000).

slack, and among these was Fernando Flores, a young Chilean who was studying industrial engineering at the Catholic University in Santiago.

A workaholic by nature, Flores devoted himself to mastering the principles of cybernetics and operations research practiced at SIGMA and became familiar with Beer's work after reading Beer's book *Decision and Control* and later *Cybernetics and Management*.[22] His knowledge of operations research led to a teaching position at the Catholic University and by his twenty-seventh birthday he had become the Acting Dean of the Department of Engineering Science. Like many of his contemporaries, Flores was active in academic and political circles. In 1969 a group of young intellectuals at the Catholic University, which included Flores, broke from the Christian Democratic party and established the Movement of Popular Unitary Action (MAPU), a political party of young intellectuals who were critical of the Christian Democrats and aligned with the Communists and Socialists of the UP coalition. The addition of the MAPU to the UP, combined with the inability of the right and the Christian Democrats to form a winning coalition, played a major role in Allende's narrow victory in the 1970 presidential election. As an acknowledgement of his political loyalty and technical competency, the Allende government appointed the then twenty-eight-year-old Flores as General Technical Manager of the Corporación de Fomento de la Producción (CORFO), the state development agency that Allende had charged with nationalising Chilean industry. It was the third highest position within CORFO, the highest position within the state development agency held by a member of the MAPU, and the management position most directly linked to the daily regulation of the nationalised factories.[23]

Allende believed the nationalisation of major industries deserved the utmost priority and later referred to the task as 'the first step toward the making of structural changes'.[24] The nationalisation effort would not only restore foreign-owned and privately-owned industries to the Chilean people, it would 'abolish the pillars propping up that minority that has always condemned our country to underdevelopment' – a statement Allende made in reference to the industrial 'monopolies' controlled by a handful of Chilean families.[25] The majority of the UP coalition believed that by changing Chile's

[22] Stafford Beer, *Decision and Control* (New York, 1966); Stafford Beer, *Cybernetics and Management* (London, 1967).

[23] Fernando Flores, interview by author, Viña del Mar, Chile, 30 July 2003; Oscar Guillermo Garretón, interview by author, Santiago de Chile, 4 August 2003.

[24] Régis Debray, *Conversations with Allende: Socialism in Chile* (London, 1971), p. 85.

[25] Salvador Allende, 'The Purpose of Our Victory: Inaugural address in the National Stadium, 5 November 1970,' in Richard Gott (ed.), *Chile's Road to Socialism* (Baltimore, 1973), p. 59.

economic base, they would subsequently be able to bring about institutional and ideological change within the boundaries of Chile's pre-existing legal framework, a facet that set Chile's path to socialism apart from that of other socialist nations.[26]

After Allende's inauguration in November 1970, the government used the first few months to implement policies grounded in structuralist economics and Keynesian 'pump priming', whereby economic growth would be achieved through increased purchasing power and higher employment rates in order to pull the Chilean economy out of the recession that the Allende administration had inherited. Land reform programmes and the inception of government-sponsored assistance to rural workers augmented the purchasing power of individuals in the impoverished agrarian sector, while workers in Chilean factories enjoyed a 30 per cent average increase in real wages during Allende's first year in office.[27] Initially, these initiatives to redistribute income succeeded in creating a growing segment of the population with money to spend, stimulating the economy, increasing demand, raising production and expanding the popular base of support for the UP coalition. In the government's first year GDP grew by 7.7 per cent, production increased by 13.7 per cent and consumption levels rose by 11.6 per cent.[28] These economic policies, however, would quickly return to haunt the UP government in the form of inflation and massive consumer shortages.

On the production front the government wasted no time expanding the existing nationalised sector and pushing it to a new level. By the end of 1971 the government had transferred all major mining firms and 68 other private companies from the private to the public sector.[29] The rapid pace of the government's nationalisation programme, coupled with its lack of a clear, consistent structure and delimitation, exacerbated the fears and insecurities expressed by owners of small- and medium-sized Chilean businesses. Promises of social change, moreover, helped provoke a revolution from below where workers sometimes seized control of their factories against the explicit wishes of their *compañero presidente*. Less than a quarter of the firms expropriated during Allende's first year had been on the government's list for incorporation into the public sector.[30]

Foreign investors in Chilean copper mines and telecommunications companies (for example, ITT) further complicated the situation by opposing nationalisation without sufficient monetary compensation.[31] In July 1971

[26] Sergio Bitar, *Chile: Experiment in Democracy* (Philadelphia, 1986).
[27] Peter Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism* (New York, 1986), p. 142.
[28] Bitar, *Chile: Experiment in Democracy*, p. 52.
[29] *Ibid.*, p. 45.
[30] Winn, *Weavers of Revolution*, p. 228.
[31] Nathaniel Davis, *The Last Two Years of Salvador Allende* (Ithaca, NY, 1985), pp. 23–6, 67–71.

the alienated Christian Democrats accused the government of abusing legislative loopholes to acquire desirable industries and proposed an amendment that would require congressional approval for all acts of expropriation. They claimed that the government had invoked a law written during the Great Depression to prevent layoffs and plant closures as a means of nationalising factories once workers aligned with the left had gone on strike and interrupted production. They proposed an amendment that would curb the pace of nationalisation by requiring Congress to pass a law authorising every new factory acquisition, a legislative manoeuvre that would have considerably weakened Allende's executive power if the president had not contested its legality.

Moreover, the rapid growth of the nationalised sector quickly created an unwieldy monster. The combined increase in the number of industries under state control and the number of employees within each industry presented the government with the difficult task of managing a sector of the economy that became harder to monitor with each passing day. In accordance with a decree passed in 1932, the government sent 'interventors' to replace previous management and to govern activities within these newly nationalised industries.[32] These representatives, however, often created new problems. Although many were competent and dedicated to their jobs, some were completely unqualified for the positions and others were corrupt. The problem of effective management of the new 'social property area' (APS – Area de Propiedad Social) was exacerbated by the decision to distribute appointments equally among the political parties regardless of the level of competence found in their respective talent pools. Even parties within the UP coalition criticised Allende's choice of the interventors. For example, members of the Communist Party argued that some interventors merely served as replacements for the managers who had preceded them, occupying similar houses and driving similar cars.[33] From the Communists' perspective, not only did these representatives fail to provide an adequate means of bringing production under the control of the people, but they also helped veil the social reality of a continuing status quo. Daily operations within the factories suffered further from the political strife caused by interventors who saw themselves as representatives of their party. At times, workers in some enterprises refused to listen to managers from political parties other than their own; this in turn gave rise to a frustrating process of party meetings and negotiations.[34]

[32] Allende's administration used the word 'interventor' to refer to the politically appointed officials who replaced the previous factory managers and literally intervened in factory production practices by bringing each newly nationalised factory under the control of state.

[33] Arturo Valenzuela, *The Breakdown of Democratic Regimes, Chile* (Baltimore, 1978), p. 66.

[34] *Ibid.*, p. 62.

As the bliss of the honeymoon period began to fade, the long-term instability of Allende's approach became apparent. Politically motivated reforms, such as the income redistribution championed by the UP, emphasised long-term structural transformation over short-term economic management. Consumption started to outstrip production, inflation began to skyrocket and government deficit spending continued to grow, all of which were exacerbated by shrinking foreign reserves and the denial of foreign credits. By July 1971 inflation had climbed by 45.9 per cent, and it would continue to rise to unprecedented levels throughout Allende's presidency.[35] From a production standpoint, the UP programme of industrial expansion through massive hiring initially helped factories to increase their output and attain full productive capacity, but once that installed capacity was reached the number of employees began to exceed the amount of work available and productivity began to fall. Valenzuela's retrospective observation that the 'economic crisis during the Allende period clearly became the government's chief unsolvable problem' succinctly characterises the magnitude of Chile's economic decline.[36]

However, at the time the government viewed the economic situation as far from 'unsolvable'. On 13 July 1971 Beer received a letter from Flores stating that he was familiar with Beer's work and was 'now in a position from which it is possible to implement on a national scale – at which cybernetic thinking becomes a necessity – scientific views on management and organization'.[37] He asked for Beer's advice on applying cybernetic principles to the management of the nationalised sector. Beer's response was enthusiastic:

> I simply must ask you whether I could play some part, although I do not know what to suggest … Believe me, I would surrender any of my retainer contracts I now have for the chance of working on this. That is because I believe your country is really going to do it.[38]

One month later, Flores flew to England to meet the man whose work he studied during his years working for SIGMA. The two met at Beer's club in London, the Athenaeum. Flores did not speak much English and Beer did not speak any Spanish, but the two men managed to communicate in a mixture of French, English and Latin. Flores informed Beer that he had assembled a small government team and asked the cybernetician to travel to Chile and direct their efforts to apply cybernetic principles to the nationalisation effort. In November 1971 Beer arrived in Santiago.

[35] *Ibid.*, p. 55.

[36] *Ibid.*, p. 61.

[37] Letter from Fernando Flores to Stafford Beer, 13 July 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University.

[38] Letter from Stafford Beer to Fernando Flores, 29 July 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University.

Constructing Cybersyn

Beer landed in Chile on the day Allende celebrated the first anniversary of his election. Before a packed audience at the National Stadium, the president informed the crowd that now 'more than ever one has to be aware of what Chilean life is and of the path that is authentically ours, which is the path of pluralism, democracy, and freedom, the path that opens the doors of socialism'.[39] It was a speech of celebration, promise and national pride that electrified the nation. Shortly thereafter, the minister of finance announced that Chile's annual borrowing had topped $100 million, far exceeding the predicted $67 million inflow for the year.[40]

During his initial ten-day visit Beer met various influential people in the Chilean government, including Pedro Vuskovic, the economics minister, and Allende himself. Flores assembled a handpicked Chilean team to begin work with Beer that included representatives from various academic disciplines.[41] This set the tone for the interdisciplinary collaboration the Cybersyn Project would require. Most of these early team members were friends of Flores. 'It was very informal at the beginning', Flores noted, 'like most things are. You look for support among your friends.'[42] Given his position as the general technical manager of CORFO, one of the largest government agencies of the time, Flores controlled a wealth of resources. Operating through CORFO, Flores was able to put together the funding needed to pay Beer's considerable fee of $500 a day as well as secure the other material and personnel resources that the project demanded. Moreover, the CORFO connection gave Flores the power to recruit individuals who possessed expertise not found in his network of friendships. Crediting his leadership abilities, Flores boasted, 'I didn't need to convince people. I had a lot of power to do so … given the amount of resources I managed in all aspects of the economy. We [CORFO] were so immense compared with [the Cybersyn Project] … it was a very small amount of money compared with who we were and what the stakes were.'[43] Former Cybersyn team members also highlighted the importance of Flores' personality in getting the project off the ground, describing him as a 'smooth operator' and a 'wheeler dealer'.

While Beer learned about Chilean economics and politics, each member of his team read the manuscript version of his book *Brain of the Firm*

[39] Salvador Allende, 'First Anniversary of the Popular Government, National Stadium, Santiago, November 4, 1971', in James D. Cockcroft (ed.), *The Salvador Allende Reader* (New York, 2000), pp. 123–4. [40] Bitar, Chile: *Experiment in Democracy*, p. 65.

[41] Roberto Cañete, 'The Brain of the Government: An Application of Cybernetic Principles to the Management of a National Industrial Economy,' *22nd Annual North American Meeting, Avoiding Social Catastrophes and Maximizing Social Opportunities: The General Systems Challenge* (Washington, DC, February 1978), pp. 516–25. [42] Flores, interview. [43] *Ibid.*

and made the language of Beer's management cybernetics their lingua franca.[44] The book outlined the 'viable system model', a system that Beer believed could describe the stability found in biological, mechanical, social, and political organisations. Cybersyn's design cannot be understood without a basic grasp of this model, which played a pivotal role in merging the politics of the Allende government with the design of this technological system.

The viable system model that first appeared in *Brain of the Firm* (1972) still stands as one of the guiding concepts behind Beer's work.[45] It is defined as 'a system that survives. It coheres; it is integral … but it has none the less mechanisms and opportunities to grow and learn, to evolve and to adapt.'[46] The value of the system 'variables' (inputs) determined the system's resultant 'state'; Beer referred to the number of possible states as the system's 'variety', a direct reference to Ross Ashby's important 'Law of Requisite Variety'.[47] A system able to maintain all critical variables within the limits of systemic equilibrium achieved 'homeostasis', a quality desired by all viable systems. From these principles, Beer constructed a five-tier model for viable systems, which he based on the human neurosystem. In spite of the model's biological origins, Beer maintained that the abstract structure could be applied in numerous contexts, including the firm, the economic enterprise, the body and the state.

In its most basic form the viable system model resembles a simple flow chart connecting the five levels of the system hierarchy. In his writings, however, Beer switches freely among metaphors drawn from machines, organisations and organisms when describing the purpose and functionality of each level. Given the purpose of this article, the viable system model will be explained here only as it applies to the Chilean industrial sector, focusing specifically on the five-tier cybernetic mapping of Chilean enterprises within the social property area (shown in Figure 1). It is perhaps easiest to understand the model at this level, though it should be borne in mind that the Cybersyn prototype operated initially within CORFO's management structure, a higher level of the hierarchy than the model of the individual enterprise discussed here. Although Beer hoped one day to restructure enterprise management to reflect this model, the

[44] Beer, *Brain of the Firm*, p. 249.

[45] 'Ten Pints of Beer: The Rationale of Stafford Beer's Cybernetic Books (1959–94), Discussion with Stafford Beer', *Kybernetes*, vol. 29, no. 5/6 (2000), pp. 558–69.

[46] Beer, *The Brain of the Firm*, p. 239. This statement illustrates a reoccurring characteristic of Beer's work, namely the synthesis of metaphors drawn from biology and engineering characteristic of work in the field of cybernetics.

[47] This law holds that the variety in the control system must match the variety in the system to be controlled. See W. Ross Ashby, *An Introduction to Cybernetics* (London, 1956).

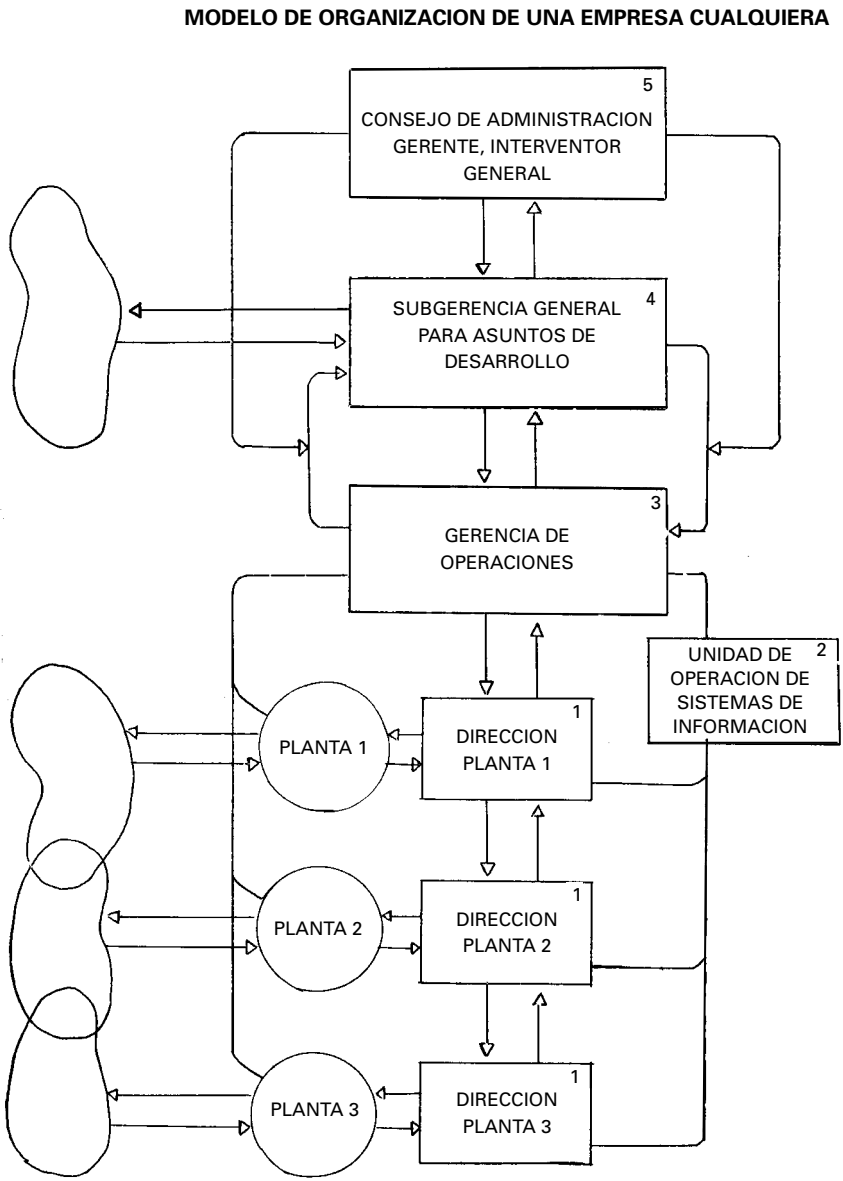

Fig. 1. *The Chilean State Enterprise drawn as a five-tier viable system.* Source: *CORFO,* Proyecto Synco conceptos y práctica del control; una experiencia concreta: la dirección industrial en Chile (*Santiago, 1973*). *Image used with permission from the Corporación de Fomento de la Producción, Santiago.*

hypothetical chain of management presented in the following paragraphs does not reflect the documented management practices of the nationalised enterprises.

The model drew a distinction between the bottom three levels of the hierarchy that governed daily operations (systems 1, 2 and 3) and the upper two levels of management (systems 4 and 5), which determined the future development and the overall direction of the enterprise. At the bottom of the hierarchy, individual plants within each enterprise interacted with the outside environment (represented by the cloud-like figure on the left-hand side of the drawing) and through these flows of material inputs and outputs generated low-level, system 1 production indices. Factors such as energy needed, raw materials used, or even employee attendance could constitute such an index. Each plant behaved in an 'essentially autonomous' manner, restricted only the operational limits needed to ensure the stability of the entire enterprise. System 2, which Beer equated to a cybernetic spinal cord, transmitted these production indices to the various plants and upward toward the director of operations (system 3). By assuming responsibility for the normal functioning of the plants within the enterprise, these lower three levels prevented upper management from being overwhelmed with the nuances of daily production activity. However, in the case of a serious production anomaly, one which could threaten the stability of the enterprise and that after a given period of time could not be resolved by the director of operations, or system 3, the next level of management was alerted and asked to provide assistance.

Systems 4 and 5 only intervened in production under these circumstances. Unlike the other levels of management outlined in Beer's hierarchy, system 4 required the creation of a new level of management dedicated to development and future planning that would provide a space for discussion and decision-making. This level did not exist within the vast majority of Chile's state enterprises nor, as Beer noted, in the management configuration of most firms in operation during the 1970s. In the drawing it appears as the sub-directorate for development. System 4 also provided the vital link between volitional and automatic control or, in the case of industrial management, between centralised or decentralised regulation. Under normal circumstances, it allowed the lower levels to behave autonomously, but could trigger intervention from upper management if necessary. Securing this balance between individual freedom and centralised control proved vital when attempting to align the Cybersyn project with the political ideals promoted by the UP coalition, a theme that this article will discuss at greater length below. The final level of the model, system 5, represented the 'chief executive' position held by the appointed interventor, who determined the overall direction of the enterprise and the requisite levels of production.

In Beer's mind, this five-tier system not only provided the characteristic skeleton for all viable systems; it also existed recursively in each of the five levels. Beer writes: 'the whole is always encapsulated in each part … this is

a lesson learned from biology where we find the genetic blue-print of the whole organism in every cell.'[48] The state, the firm, the worker and the cell all exhibited the same series of structural relationships. Applying his organisational vision to Chile, Beer wrote, 'Recursively speaking, the Chilean nation is embedded in the world of nations, and the government is embedded in the nation … all these are supposedly viable systems.'[49] This property allowed the team to design a system of management that theoretically could function anywhere from the factory floor to the presidential palace.

Once armed with Beer's model for cybernetic control and convinced of its utility to Chile's economic transition, the team examined their available resources. By 1968 three US companies – NCR, Burroughs and IBM – had fewer than 50 computers installed in Chile, the largest being an IBM 360 mainframe.[50] According to the trade publication *Datamation*, Chile had fewer computers than Brazil, Argentina, Colombia and Venezuela.[51] The previous Christian Democratic government had encouraged US investment and business with US companies, but high import duties combined with the already high price tag made computer technology a less attractive option to Chilean industries than to their North American counterparts. The National Enterprise for Computers and Informatics (ECOM), a centralised government agency established in the 1960s to oversee the purchase of Chilean computing technology and offer data processing services on state owned mainframes, moreover tried to maintain its monopoly on computing machines by frequently denying requests from universities and private firms who wished to acquire additional computing resources.[52] The government owned few mainframe computers and could allocate time on only one machine to the Cybersyn project.[53] The project leaders originally secured time on the top-performing IBM 360/50, but later transferred the project to a less heavily used Burroughs 3500 mainframe when processing delays on the 360/50 exceeded forty-eight hours.[54]

The team simultaneously searched for a way to enable communications among factories, state enterprises, sector committees, CORFO management, and the central mainframe housed in CORFO headquarters. Eventually,

[48] Beer, *Brain of the Firm*, p. 156.

[49] *Ibid.*, p. 249.

[50] Aaron Finerman, 'Computing Capabilities at Argentine and Chilean Universities,' *Communications of the ACM*, vol. 12, no.8 (August 1969), p. 427.

[51] Barry Boehm, 'Computing in South America', *Datamation*, vol. 16, no. 5 (May 1970), p. 98.

[52] Raimundo Beca, interview by author, Santiago de Chile, 9 September 2003.

[53] ECOM owned three IBM mainframes (two 360/40 models and one 360/50) and one Burroughs 3500 mainframe. Notes on available ECOM computing resources, 11 Nov. 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University.

[54] A 48-hour processing delay on the IBM machine prohibited real-time analysis and caused much frustration among the Cybersyn team members.

they settled on an existing telex network previously used to track satellites. Unlike the heterogeneous networked computer systems in use today, telex networks mandate the use of specific terminals and can only transmit ASCII characters. However, like the Internet of today, this early network of telex machines was driven by the idea of creating a high-speed web of information exchange. The telex network would later prove more valuable to the government than the processing might of the mainframe, reaffirming a belief shared by both Flores and Beer that 'information without action is waste.'[55]

Having identified the existing hardware options, the team worked frantically to design a feasible schema for the entire system with a finish date optimistically set for October 1972.[56] The eventual design consisted of four sub-projects: Cybernet, Cyberstride, Checo, and Opsroom. Work on each of these projects would span from 1971–1973, during which time Beer would make 11 trips to Chile, each lasting approximately two weeks.[57] When Beer arrived in Chile for the second time in March 1972 the onset of shortages and rising inflation rates had transformed the problem of economic control into a strong political issue. Although Flores' small team remained marginal within the overall structure of CORFO, Flores was able to rouse sufficient interest among his web of government contacts to obtain the resources he needed and continue work on the project. It was at this time that the team first applied the name 'Cybersyn' to describe the entire scope of the system. A synthesis of 'cybernetics' and 'synergy', the project name firmly illustrated the team's belief that the whole system exceeded the sum of its parts.

The first component of the system, Cybernet, expanded the existing telex network to include every firm in nationalised sector, thereby helping to create a national network of communication throughout Chile's three-thousand-mile-long territory. Cybersyn team members occasionally used the promise of free telex installation to cajole factory managers into lending their support to the project.[58] Stafford Beer's early reports describe the system as a tool for real-time economic control, but in actuality each firm could only transmit data once per day.[59] This centralised design may appear to run counter to the UP commitment to individual freedom, but coincides with Allende's

[55] Flores, interview.

[56] Beer entitled one of the earlier project schedules, 'Project Cybersyn, Programme Beat-the-Clock'.

[57] Beer, interview.

[58] Cañete, interview. Cañete also noted that he received several inquiries from private factory owners of who wished to join the Cybersyn project in return for free access to telex technology.

[59] Reminding factory managers to send data on a daily basis proved to be a great source of frustration for the project team. Isaquino Benadof, interview by author, Santiago de Chile, 10 April 2002.

statement: 'We are and always shall be in favour of a centralised economy, and companies will have to conform to the Government's planning.'[60]

Cyberstride, the second component of the Cybersyn system, encompassed the suite of computer programmes written to collect, process, and distribute data to and from each of the state enterprises. Members of the Cyberstride team created 'quantitative flow charts of activities within each enterprise that would highlight all important activities', including a parameter for 'social unease', measured by the proportion of employees absent on a given day of work in comparison to the number of employees on the factory payroll.[61] Cyberstride performed statistical filtration on the 'pure numbers' output from the factory models, discarding the data that fell within the acceptable system parameters and directing the information deemed important upward to the next level of management. Equally important, the software used statistical methods to detect production trends based on historical data, theoretically allowing CORFO to prevent problems before they began. If a particular variable fell outside of the range specified by Cyberstride, the system emitted a warning, known as an 'algedonic signal' in Beer's cybernetic vocabulary. Only the interventor from the affected enterprise would receive the algedonic warning initially and would have the freedom, within a given time frame, to deal with the problem as he saw fit. However, if the enterprise failed to correct the irregularity within this timeframe, members of the Cyberstride team alerted the next level management, the CORFO sector committee (e.g., Comité Textil). Beer argued that this system of operation granted Chilean enterprises almost complete control over their operations, while still permitting outside intervention in the case of more serious problems. He further believed this balance between centralised and decentralised control could be optimised if one selected the correct period of recovery time given to each enterprise before alerting higher management, ensuring maximum autonomy within the overall viable system.

Cyberstride represented a joint effort between a team of Chilean engineers headed by Isaquino Benadof, one of Chile's leading computer experts and the head of research and development at ECOM, and a team of British consultants at Arthur Andersen in London. The British team, led by Alan Dunsmuir, designed and coded a temporary suite of programmes, which they gave to the Chilean team in March 1972 for final revisions. Meanwhile, Chilean operations research scientists and engineers from CORFO and the State Technological Institute (INTEC) visited plants throughout the country, met workers and managers, selected approximately five critical variables of

[60] Régis Debray, *The Chilean Revolution: Conversations With Allende* (New York, 1972), p. 111.
[61] Beer, *Brain of the Firm*, p. 253.

production, created flowchart models of factory operation, and translated these models into computer code that was read into the mainframe with punch cards.[62] They also determined the optimal amount of recovery time allotted to each firm before allowing an algedonic signal to percolate up the system hierarchy, a process Beer referred to as 'designing freedom'.[63] Project notes reveal that the team planned to have thirty enterprises on line by August 1972, a figure that would rise to include 26.7 per cent of all nationalised industries by May 1973 (more than 100 industries).[64]

CHECO (CHilean ECOnomy), the third part of the Cybersyn project, constituted an ambitious effort to model the Chilean economy and provide simulations of future economic behaviour. Appropriately, it was sometimes referred to as 'Futuro'. The simulator would serve as the 'government's experimental laboratory' – an instrumental equivalent to Allende's frequent likening of Chile to a 'social laboratory'. The bulk of the work on CHECO occurred in England, under the direction of electrical engineer and operations research scientist Ron Anderton. The simulation programme used the DYNAMO compiler developed by MIT professor Jay Forrester, a technology that was reportedly one of Anderton's areas of expertise. However, the Chilean team, headed by a chemical engineer Mario Grandi, kept close tabs on Anderton's model, laboriously checking his calculations, asking detailed questions about the model and the computer tools used in its implementation, and sending a young Chilean engineer to study with Anderton in London. The CHECO team initially used national statistics to test the accuracy of the simulation programme. When these results failed, Beer and his fellow team members faulted the time differential in the generation of statistical inputs, an observation that re-emphasised the perceived necessity for real-time data.

The last of the four components, Opsroom, created a new environment for decision making, one modelled after a British WWII war room (Figure 2).[65] It consisted of seven chairs arranged in an inward facing circle flanked by a series of projection screens, each displaying the data collected from the nationalised enterprises. In the Opsroom, all industries were

[62] CORFO created INTEC in September 1968 to promote technological research in Chile and study the development of new industrial products. In March 1971 the Allende government appointed Flores president of INTEC, a position Flores leveraged to secure resources for the Cybersyn Project.

[63] Stafford Beer, *Designing Freedom* (New York, 1974).

[64] *Mensaje Presidente Allende ante Congreso Pleno, 21/Mayo '73* (Santiago, 1973), pp. 412–13.

[65] The idea of war occurs frequently throughout the project notes, and certainly there is more to be said about this relationship than the scope of this article allows. Beer invoked the war room analogy as a means of conveying the importance of visual displays of information in rapid decision-making, but also as a means of reminding participants that they were fighting an economic war where time was of the essence.

Fig. 2. *The Cybersyn Operations Room.* Source: *Personal archive of Rodrigo Walker. Image used with permission from Rodrigo Walker.*

homogenised by a uniform system of iconic representation, meant to facilitate the maximum extraction of information by an individual with a minimal amount of scientific training. Beer recognised that the men sitting in the chairs would not possess skills as typists – an occupation typically performed by female secretaries. Therefore, in lieu of the traditional keyboard the Opsroom team designed a series of large 'big-hand' buttons as the input mechanism that one could 'thump' to emphasise a point. Beer felt this design decision would allow the technology to facilitate communication, eliminating 'the girl between themselves and the machinery'.[66] Beer made this last comment in reference to the traditional need for female typists. However, it also reveals the gendered assumptions built into the design of the system. Moreover, Beer claimed the big-hand design made the room appropriate for eventual use by workers' committees as opposed to a '*sanctum sanctorum* for a government elite'.[67] A prototype of the room was constructed in Santiago during 1972, using projection equipment primarily imported from the UK. Although it never became operational, it quickly captured the imagination of all who viewed it, including members of the military, and became the symbolic heart of the project.[68]

[66] Beer, *Platform for Change*, p. 449.

[67] Beer, *Brain of the Firm*, p. 270.

[68] General Carlos Prats, head of the Armed Forces and later Secretary of the Interior, expressed interest in the Cybersyn Operations Room for its potential military applications.

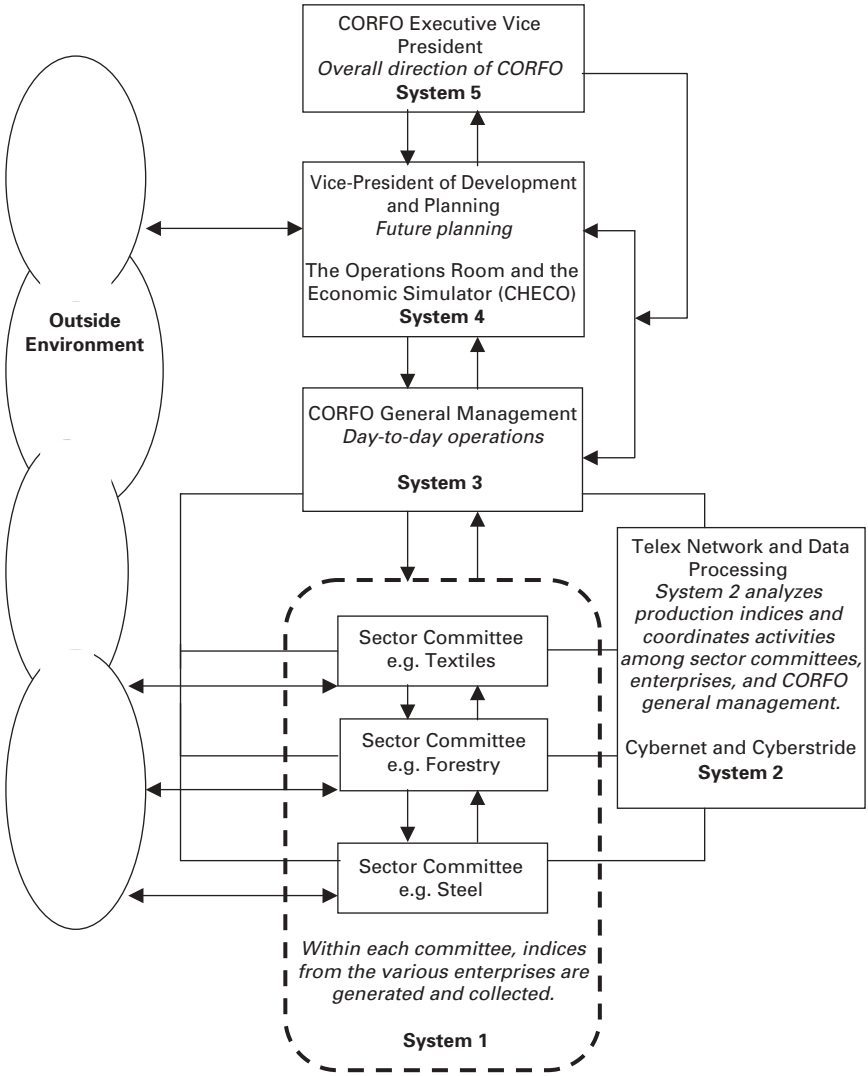

Fig. 3. *CORFO drawn as a Viable System*. Source: *Image drawn by the author*.

An idealised correlation of Cybersyn's intended architecture, the organisation of CORFO, and Beer's five-tier viable system model appears in Figure 3 – it should be noted that this diagram outlines Cybersyn's theoretical design, rather than its actual level of functionality and implementation. At this level of recursion, the sector committees collected and sent production data daily using the telex network, which relayed the information to a data processing centre located within ECOM (system 2). A staff of computer technicians processed the data using a single mainframe computer and

Cyberstride's specialised suite of computer programmes, which searched for trends and irregularities in production performance. If a sector committee (system 1) failed to resolve a production irregularity on its own, ECOM alerted members of CORFO general management (system 3). In the case of a particularly difficult or urgent problem, members of CORFO general management would convene with higher-ranking CORFO officials in the Operations Room (system 4) to discuss the problem and possibly reallocate resources or plan a new approach for managing the social property area. CHECO also operated at the system 4 level, and permitted CORFO management to test their ideas prior to implementation. If lower management still could not solve the problem, CORFO senior management (system 5) then used the data provided by the cybernetic toolbox to make an informed decision on how to intervene in production.

The original plans called for similar management hierarchies at the level of the individual plants, state enterprises, and the sector committees, although these ideas never came to fruition. Beer also began work on a series of training programmes aimed at presenting the system to workers' committees and training them to use these new management tools to increase and coordinate their participation in factory operations. Perhaps the ambitious scope of this 'work-in-progress' accounts for the discrepancies between the model of operations presented in the preceding paragraphs and the regular operational practices recounted by Chilean engineers involved with the project. For example, Benadof recalled that his office received information from the individual enterprises every afternoon and, after running the numbers through the mainframe computer, later transmitted the results to the telex control room at CORFO without notifying the individual interventors or passing through the algodonic process outlined by Beer.[69] This rift between theory and practice will receive further consideration in the following section.

In spite of these inconsistencies, work on each of the system components advanced rapidly. The pre-existing telex infrastructure contributed significantly to the early operation of the Cybernet network, the first and only Cybersyn component used regularly by the Allende government. The Cyberstride suite generated its first printout on 21 March 1972, at which time Beer sent an enthusiastic telex to Anderton: 'Cyberstride suite really works … The whole thing was impossible and we did it.'[70] Due to problems in locating a suitable space for construction, and delays in receiving equipment from the British company Electrosonic, the Opsroom prototype

[69] Benadof, interview.

[70] Telex from Stafford Beer to Ron Anderton, 21 March 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University.

did not reach completion until late December 1972 and even then had a very limited functionality.[71] The economic simulator never passed the experimental stage. Since work on the project was cut short, it is impossible to say how the finished system might have furthered Chile's revolutionary process.

However, Cybersyn proved instrumental to the UP even in its unfinished form. The new infrastructure for communication provided by Cybernet proved vital to the government during the opposition-led strike of October 1972 (*Paro de Octubre*).[72] In response to the strike, which threatened the government's survival, Flores created an emergency operations centre where members of the Cybersyn team and other high-ranking government officials monitored the two thousand telexes sent per day that covered activities from the northern to the southern ends of the country.[73] The rapid flow of messages over the telex lines enabled the government to react quickly to the strike activity and mobilise their limited resources in a way that lessened the potential damage caused by the *Gremialistas*. Gustavo Silva, executive secretary of energy in CORFO at the time of the strike, credited the network for coordinating the 200 trucks loyal to the government against the effects of 40,000 striking truck drivers.[74] Although the resolution of the October Strike had negative consequences for the UP government, among them the incorporation of three senior members of the military in Allende's cabinet, the government had survived. The value of the telex network during the October Strike helped to establish Flores as both a technical expert and a vital contributor to the survival of the UP. This, in Flores' opinion, motivated Allende to appoint him minister of the economy.[75] It also publicly demonstrated Cybersyn's utility to the government, particularly the telex network. Several weeks after the end of the strike, Cybersyn participant Herman Schwember remarked, 'The growth of our actual influence and power has exceeded our best imagination.'[76]

Following the strike, the telex network permitted a new form of economic mapping that enabled the government to collapse the data sent from all

[71] Letter from Stafford Beer to Robert Simpson of Electrosonic, 1 Oct. 1972, box 62, The Stafford Beer Collection, Liverpool John Moores University.

[72] The *Gremialista* movement began in protest to government nationalisation efforts and gained considerable momentum in October 1972 after a 40,000-member independent trucking association tried to prevent the creation of a parallel state-owned equivalent. The October strike attempted to shut down the Chilean economy by mobilising truck drivers, shopkeepers, professional and economic associations, bank clerks, and even several student and campesino organisations.

[73] Flores, interview.

[74] Gustavo Silva, interview by author, Santiago de Chile, 5 Sept. 2003.

[75] Fernando Flores, 'Fernando Flores habla sobre el Proyecto Synco,' *The Clinic*, vol. 5, no. 108 (July 2003), p. 9.

[76] Letter from Herman Schwember to Stafford Beer, 6 Nov. 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University.

over the country into a single report, written daily at CORFO, and hand delivered to La Moneda. The detailed charts and graphs filling its pages provided the government with an overview of national production, transportation, and points of crisis in an easily understood format, using data generated several days earlier. The introduction of this form of reporting represented a considerable advance over the previous six-month lag required to collect statistics on the Chilean economy, and allowed the UP to track the dips and spikes of national production through to September 1973.[77]

Allende would continue to support Cybersyn's construction throughout his presidency. On 8 September 1973 – a mere three days before the military coup that would end his dream and his life – he sent a communication to the Cybersyn team asking that the Operations Room be moved to the presidential palace in La Moneda.

'*Revolutionary*' *Computing*

Flores' success with the *gremio* strike put him in a unique position as the newly appointed minister of the economy. Relatively unknown to the opposition, Flores believed he had a chance of increasing his support by 'building a different personal image' based upon 'a certain myth around [his] scientific qualifications'.[78] However, the new challenges he confronted as minister in a situation of extreme and growing economic dislocation convinced him that technology could only play a limited role in saving Chile from a political and economic breakdown. As Flores began to distance himself from the project to assume his new duties in Allende's cabinet, Beer remarked that their relationship, which 'was going great when [Flores] became undersecretary' had 'almost wholly collapsed'.[79]

Flores' reaction, however, should not imply that Cybersyn's designers had neglected the complexities of Chile's larger political context in the creation of this new technological system.[80] From its early stages the project operated under the joint leadership of a Scientific Director (Beer) and a Political Director (Flores). Beer, however, often stepped outside the bounds of his scientific duties and recognised the utility of combining Marxist rhetoric with

[77] Comando Operativo Central, 'Situación General del País', 3 Sept. 1973, private collection of Roberto Cañete.

[78] Letter from Herman Schwember to Stafford Beer, 12 Nov. 1972, box 64, The Stafford Beer Collection, Liverpool John Moores University.

[79] Letter from Stafford Beer to Herman Schwember, 21 Feb. 1973, box 66, The Stafford Beer Collection, Liverpool John Moores University.

[80] Although it does illustrate the increasing instability of Chile's economic and political situation, which by 1973 overshadowed the gains made by the Cybersyn system.

that of modernisation to create a 'powerful political instrument' able to garner outside support.[81] He often used phrases such as 'the people's science' to stress the anti-technocratic nature of the Cybersyn project. In his public speeches, Beer emphasised that Chile's best scientists were creating 'a new system of management' and refrained from mentioning the contributions of his British colleagues.[82] At Beer's request, the famous Chilean folksinger Angel Parra composed an original song entitled 'Litany for a Computer and a Baby About to Be Born' for use on the factory floor. The 'baby' in the title refers to the rebirth of Chilean people through socialist transformation. The chorus of the song similarly conveyed the political intentions of the project:

> Hay que parar al que no quiera
> que el pueblo gane esta pelea
> Hay que juntar toda la ciencia
> antes que acabe la paciencia.[83]
>
> (We must stop those who do not want
> the people to win this fight
> We must bring together all of science
> Before we run out of patience)

The song demonstrated the importance of technology in bringing about social change, and its potential for eliminating political corruption. Its lyrics issued a rallying cry as well as a prophetic warning.

The politics of the project extended beyond propaganda or rhetoric, shaping the very design of the system. Understanding the correlation between the design of Cybersyn and Allende's politics requires a closer examination of the President's plan to transform Chile into a socialist state.

Cybernetic Socialism

Allende's interpretation of Marx's writings emphasised the importance of respecting Chile's existing democratic processes in bringing about socialist reform, a possibility alluded to by Marx but never realised.[84] Unlike previous socialist revolutions, such as those in Cuba and in the Soviet Union, Chile's transition to socialism was to be democratic, including respect for election results, individual freedoms (such as the freedom of thought, speech, press,

[81] Stafford Beer, 'The Extension of Cybernetic Management Systems to the Enterprises: A Reconsideration of the Political Context', 14 Oct. 1972, box 57, The Stafford Beer Collection, Liverpool John Moores University.

[82] *Ibid.*

[83] Lyrics 'Letanía para una computadora y para un niño que va a nacer', box 64, The Stafford Beer Collection, Liverpool John Moores University.

[84] Karl Marx, 'The Possibility of Non-Violent Revolution,' in Robert C. Tucker (ed.), *The Marx-Engels Reader* (New York, 1978), pp. 522–4.

assembly and rule of law), and public participation in government decision-making through elected representatives. At one point, Allende promised that, 'we would not be revolutionaries if we were to limit ourselves to maintaining political freedom. The government of the Unidad Popular will extend political freedom'.[85] However, it is crucial to note that Allende's notion of individual or political freedoms did not coincide with individualism, which he associated with capitalist selfishness that detracted from the collective well being of the Chilean nation.[86] In contrast to the centralised planning found in the Soviet Union, Allende's articulation of socialism stressed a commitment to decentralised governance with worker participation in management, reinforcing his professed belief in individual freedoms. Yet, he also admitted that in the face of political plurality the government would favour the 'interest of those who made their living by their own work' and that revolution should be brought about from above using a 'firm guiding hand'.[87]

The tension inherent in Beer's model between individual autonomy and the welfare of the collective organism mirrors the struggle between competing ideologies found in Allende's democratic socialism. Both emphasise the importance of individual freedoms and the need for decentralisation, while recognising situations when 'the needs of one division must be sacrificed … explicitly to the needs of other divisions'.[88] Thus, the collective welfare of the state or the homeostasis of the system takes priority over the mechanisms devised to ensure autonomy, freedom, and liberty. According to Beer, this conflict of values can only be resolved at the top, a belief supported by Allende's determination that the Chilean government would favour policies protecting the rights and interests of the workers in spite of the legislative provisions that granted equal rights to the opposition.

However, the striking similarity between Allende's articulation of socialism and the cybernetic model guiding Cybersyn's construction should not come as a complete surprise. Cybersyn was intentionally designed to provide an instrumental embodiment of Chile's socialist politics. As Schwember wrote, 'The feasibility of any conceivable scheme of participation is strongly dependent on prevailing ideology.'[89] Marxism not only guided the design

[85] Salvador Allende, 'The Chilean Road to Socialism: First Annual Message to Congress, 21 May 1971,' in Richard Gott (ed.), *Chile's Road to Socialism* (Baltimore, 1973), p. 149.
[86] Debray, *The Chilean Revolution*, p. 87.
[87] Allende, 'The Chilean Road to Socialism,' p. 150; Winn, *Weavers of Revolution*, p. 185.
[88] Beer, *Brain of the Firm*, pp. 160–1.
[89] Herman Schwember, 'Cybernetics in Government: Experience with New Tools for Management in Chile 1971–1973,' in Hartmut Bossel (ed.), *Concepts and Tools of Computer-Assisted Policy Analysis, Vol. 1* (Basel, 1977), p. 136.

of the system, it provided the essential hegemonic force needed for Cybersyn's continued functionality.

The Marxist slant in Cybersyn's design appears clearly in two system diagrams later drawn by Schwember, both of which illustrate the centrality of worker participation to Cybersyn's operation (Figure 4). The first image depicts the nation, the central government, industry (CORFO), and the individual firms as nested viable systems, each one located recursively inside the other. The figure of a worker appears at the heart of these systems, reinforcing the perceived importance of workers to the Chilean nation. The second diagram shows a modified rendering of Beer's five-tier viable system model with the figure of a worker inserted into the structure of both system 1 and system 5. Here, the worker contributes both physically *and* mentally to the production process, an illustrated response to Marx's critique of alienated labour in capitalist societies, where the worker 'does not develop freely his mental and physical energies but is physically exhausted and mentally debased'.[90] The idea of alienated labour appeared frequently in Cybersyn team discussions and, in Beer's opinion, constituted one of Marx's most influential ideas.[91]

At a more concrete level the system's original design created new channels for worker participation, such as inviting workers to lend their expertise to the creation of factory models. Plans to place low-tech versions of the operations room in each of the nationalised factories similarly strove to augment worker participation. These simplified rooms, with blackboards instead of projection screens, would assist worker decision-making through facilitated communication and greater visualisation of factory operations, and would create a mechanism for entering the command chain of higher management. According to an interventor from MADEMSA, a maker of electric appliances, mapping the vital indices of production provided a source of motivation for employees who used the figures as a basis for bonuses and as a means of promoting collective production instead of individual output.[92]

The correlation between Allende's Marxism and Beer's cybernetics was intentional, but it would be wrong to classify cybernetics as a Marxist science, just as it would be wrong to call Cybersyn an inherently Marxist technology. According to Beer, cybernetics provided a scientific method for uncovering natural laws and remained neutral in its conclusions. 'Proper use of science', Beer wrote, 'is really the world's brightest hope for a

[90] *Ibid.*, pp. 86, 135; Karl Marx, *Economic and Philosophic Manuscripts of 1844* (New York, 1964), p. 125.

[91] Beer, interview.

[92] Beca, interview. Beca, who was both director of ECOM and interventor in MADEMSA during the government of the UP, noted that the use of the system depended strongly on interventor support. For example, MADEMSA discontinued all work on Cybersyn's implementation after Beca left the factory.

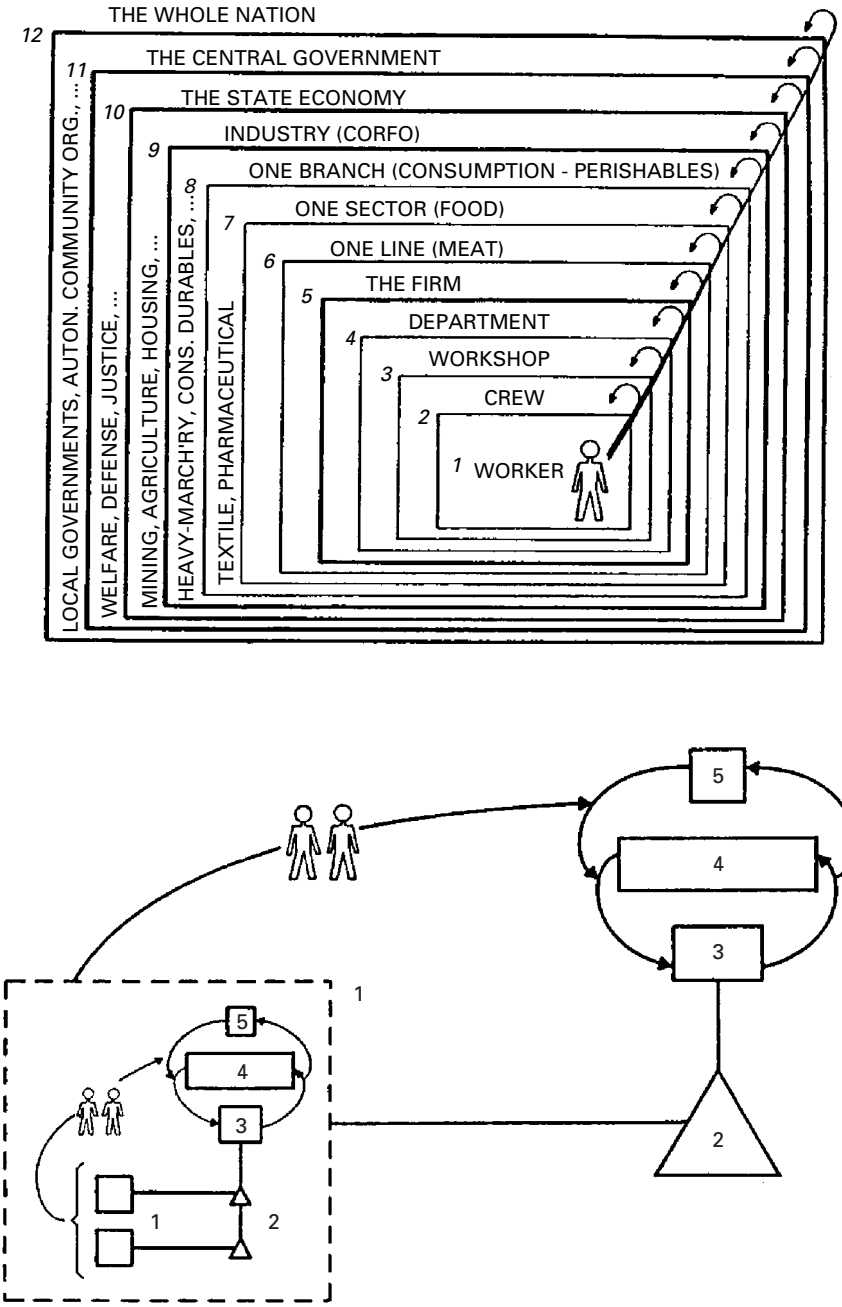

Fig. 4. *Worker participation drawn as a system diagram.* Source: *Herman Schwember, 'Cybernetics in Government: Experience with New Tools for Management in Chile 1971–1973', in Hartmut Bossel (ed.),* Concepts and Tools of Computer-Assisted Policy Analysis, Vol. 1 (*Basel, 1977*). *Images used with permission from Birkhäuser-Verlag.*

stable government … with cybernetics, we seek to lift the problems of organizational structure out of the ruck of prejudice – by studying them scientifically.'[93] The strength of cybernetics, therefore, is that it 'provides a language sufficiently rich and perceptive to make it possible to discuss the problem objectively, without heat'.[94] As a neutral language, cybernetics 'should not develop its own ideology; but it should attest to one'.[95] This is an important point – Beer recognised that his cybernetic toolbox could create a computer system capable of increasing capitalist wealth or enforcing fascist control, a moral dilemma that would later plague the project team. In Beer's opinion, cybernetics made Marxism more efficient through its ability to regulate social, political and economic structures. Marxism, in turn, gave cybernetics a purpose for regulating social action.

Regulating the Revolution

Beer and Allende both sought to change the Chilean system of economic governance. For Allende, transforming Chile from a capitalist to a socialist country necessitated structural transformation and a systematic dismantling of previous production practices. Beer's work similarly aimed to provide tools for transforming Chile's system of factory control by restructuring the industrial sector to adhere to his five-tier model, eliminating what he perceived as unnecessary bureaucracy, and granting factory workers a new means of participating in factory regulation. In one of his earlier reports dated October 1972, Beer wrote, 'The target is to transform the whole of industrial management, and to make Chilean industry fully effective in one year.'[96]

However, Beer's goal quickly transcended its initial objective of factory regulation and expanded to address numerous facets of the Chilean political system, including a project to install algedonic meters in a representative sample of Chilean homes that would allow Chilean citizens to transmit their pleasure or displeasure with televised political speeches to the government or television studio in real time.[97] Beer dubbed this undertaking 'The People's Project' and 'Project Cyberfolk' because he believed the meters would enable the government to respond rapidly to public demands, rather than repress opposing views.[98] Barely one month later, Beer wrote to

[93] Beer, *Platform for Change*, p. 425. [94] Beer, *Brain of the Firm*, p. 180. [95] *Ibid.*, p. 260.
[96] Stafford Beer, 'The Extension of Cybernetic Management Systems to the Enterprises,' p. 3.
[97] Beer did not elaborate much on how these signals would travel from Chilean homes to the Chilean government, but the effect seems similar to the current practice of monitoring focus group reactions to political speeches.
[98] Stafford Beer, 'Project Cyberfolk', March 1972, box 61, The Stafford Beer Collection, Liverpool John Moores University.

Cybersyn Project Director Raúl Espejo, 'We are only beginning the reformation of the whole process of government. I do not exaggerate to say that the total concept is of two orders of magnitude bigger than cybersynergy.'[99] By December 1972, two months after the October strike, Beer had completely revised the scope of the project, drawing two levels of recursion rather than the single viable system that initially characterised Cybersyn. The original technical project was now eclipsed by a new overarching project of state regulation that began with the Chilean people and ended with the ministry of the economy; in this schematic Cybersyn provided one input rather than a systematic whole.

Although Beer's ambitious ideas continued to command the respect of his Chilean teammates – they often referred to him as a genius – he frequently met resistance from those who claimed they were 'politically unrealistic'. This complaint resurfaced among members of his team, some of whom preferred constructing technical solutions to redefining government operations. In response to one of Beer's later reports, Espejo wrote, 'Within the government in the short term, I think the ideological problems are in a second place … we can do models for effective problems of the economy …. Through them we can dismantle the bureaucracy.'[100] Throughout 1973 Beer grew increasingly frustrated with Espejo's technocratic leanings; this passage suggests Espejo's affinity for technical problems rather than ideological ones.[101]

From 1971 to 1973 Beer expanded the project goal from one of economic regulation to one of political-structural transformation. However, the success of the project depended upon members of the industrial sector and the Chilean government accepting the system in its entirety. As Beer himself acknowledged, adopting individual components could prove disastrous and result in 'an old system of government with some new tools … For if the invention is dismantled, and the tools used are not the tools we made, they could become instruments of oppression.'[102] This having been said, observers from within Chile, around the world and even within the project team tended to view Cybersyn as a set of technological components rather than a synergistic whole – in effect separating the technology from the ideology behind its creation. According to Beer, members of Chilean opposition parties wrote congratulatory letters embracing Cybersyn's design – minus, of course, its emphasis on worker participation. The centrist

[99] Telex from Stafford Beer to Raúl Espejo, 6 Nov. 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University.

[100] Letter from Raúl Espejo to Stafford Beer, 22 May 1973, box 66, The Stafford Beer Collection, Liverpool John Moores University.

[101] Beer, interview.

[102] Stafford Beer, 'On Decybernation: A Contribution to Current Debates,' 27 April 1973, box 64, The Stafford Beer Collection, Liverpool John Moores University.

Chilean newsmagazine *Ercilla* separated the project from its socialist objectives in a different way, publishing an article in January 1973 entitled 'El "hermano mayor" de Mr. Beer' – an obvious allusion to the totalitarian world depicted in George Orwell's *1984*.[103] Equally sinister commentary appeared in the rightist magazine *Qué Pasa* under the headline, 'La UP nos controla por computación'.[104]

Internationally, similar perceptions provoked criticism from British publications *New Scientist* and *Science for People*, both of which accused the system of being overly centralised and abusive of the Chilean population.[105] Similar criticism came from the United States, particularly from mainframe computing guru Herb Grosch of the National Bureau of Standards, who refused to believe that 'Beer and his team could put together a major new model, in a strange and primitive hardware and software environment, in a few months'. In a scathing letter to the editor of *New Scientist* Grosch wrote, 'I call the whole concept beastly. It is a good thing for humanity, and for Chile in particular, that it is only a bad dream.'[106] Throughout 1973 Beer received invitations from the repressive governments in Brazil and South Africa to build comparable systems. Considering the political context of each of these nations during the early 1970s, it is easy to sympathise with Beer's lament, 'You can see what a false position I am in.'[107]

According to Beer, the success of the system hinged on its acceptance as a *system*, a network of people as well as machines, a revolution in behaviour as well as in instrumental capability. However, in practice quite the opposite occurred. Not only were the tools not accepted in the manner in which they were designed, but members of the Cybersyn team themselves failed to understand fully the cybernetic principles behind their development, and proved unable to convey the rationale behind the system to members of the industrial sector. From the perspective of many Chilean engineers involved

[103] 'El "hermano mayor" de Mr. Beer,' *Ercilla*, no. 1958 (23–30 Jan. 1973), p. 11.

[104] 'Plan Secreto "Cyberstride": La UP nos controla por computación,' *Qué Pasa* (15 Feb. 1973), p. 7.

[105] John Adams, 'Everything under Control,' *Science for People*, no. 21 (April–May 1973), pp. 4–6; Joseph Hanlon, 'Chile Leaps into Cybernetic Future,' *New Scientist*, vol. 57, no. 833 (15 February 15 1973), pp. 363–364.

[106] Herb Grosch, 'Chilean Economic Controls,' *New Scientist*, vol. 57, no. 837 (15 March 1973), pp. 626–7. Grosch himself is a rather interesting character within the history of computing circles, first for his self-coined 'Grosch's Law', which governed the mainframe computing industry during the 1960s and 1970s, and second for his notoriously cantankerous personality. While his harsh commentary in *New Scientist* may be attributed to the latter, it is also the case that Grosch had travelled to Santiago during the late 1960s to advise the government of Eduardo Frei Montalva on ways to improve Chile's computer capabilities.

[107] Telex from Stafford Beer to Raúl Espejo, 1 March 1973, box 66, The Stafford Beer Collection, Liverpool John Moores University.

with the project, mastering cybernetic theories took second place to seeking to order economic chaos or developing new technologies. Contrary to Beer's view of the project, a number of the engineers described their work as primarily technical, rather than political, and saw the end goal as creating a new tool for economic management. One of the members of the Chilean team, who was charged with creating factory models of the textile sector, poignantly summarised the situation:

> … the final objective, 'the revolution in management' is not accepted, nor even understood …. I haven't seen a single manager really motivated by the central concept, and what is worse … [of] the team that has developed the work only a very few present the concepts involved … Ultimately your work is accepted as long as it provides tools to achieve a more effective *traditional* management. It is not even a halfway revolution, it is a mixture, which if not adequately cared for might end up meaning a new increase in bureaucracy.[108]

To put it another way, these new technologies served to entrench further many of the management practices that had disempowered workers prior to Allende's presidency, rather than to bring about revolutionary change.

On the factory floor technocracy regularly eclipsed ideology. Although Cybersyn engineers received explicit instructions to work in conjunction with worker committees in developing quantifiable models detailing factory production capabilities, often the converse occurred and the engineer would treat the worker with an air of condescension rather than cooperation, or he would ignore the workers altogether and deal directly with management.[109] Moreover, they frequently hid or overlooked the political facets of the project in favour of emphasising its technological merits, thereby avoiding potential labour conflicts. Although the project team did draw up training programmes for educating workers on how to use these new management tools to increase levels of participation, these efforts were cut off before they could bear fruit. As a result, most workers remained unaware of the Cybersyn system and the management tools it offered.

Instead of promoting social transformation and augmenting worker participation at every level of government, a principle upheld on paper by Beer and CORFO, these interactions between Cybersyn engineers and workers in the nationalised sector reflected Chilean social and cultural hierarchies generally and reinforced the project's technocratic image. The new role created for the scientific expert was later summarised in a paper written by a member of the project team. According to the author, 'The individual [workers] should have effective organic feedback channels to all niveaus [sic]

[108] Letter from Tomás Kohn to Stafford Beer, 19 April 1973, box 63, The Stafford Beer Collection, Liverpool John Moores University.

[109] Tomás Kohn, interview by author, Santiago de Chile, 5 Sept. 2003.

of the system', but at the same time learn to accept expert advice and even demand it when necessary. This would help them 'avoid confusion of their role'.[110] The design of the Opsroom further confirmed that Cybersyn would maintain the existing power relations surrounding production instead of transforming them. By deciding to remove the keyboard and 'eliminate the girl' between the user and the machine, as well as by designing the system to reflect and encourage masculine forms of communication, the Cybersyn team demonstrated a complicit understanding that state power would remain largely in the hands of Chile's male population. This design choice similarly illustrates that 'worker' would continue to refer exclusively to those employed in factories and not expand to include those performing clerical tasks.

Cybersyn's success, as described by Beer, hinged on creating a new structure of economic management that fundamentally altered the relations between workers, managers, engineers and public sector employees. However, reaching a state of homeostasis, or stability, depended on controlling the number of variables central to Chile's economic transition. This premise created two immediate problems. First, making Beer's model a functional reality necessitated transforming the existing political, economic and social structure, a near impossible task in Chile's fractured political context. Revolution through democracy, rather than through violence, restricted the potential avenues for change and after much frustration caused Beer to wonder, 'Does it take more courage to be a cybernetician than to be a gunman?'[111] Second, although members of the project team designed the factory models with a degree of structural flexibility at the industry level, Cybersyn as a whole did not possess the capabilities needed to effect the transition of Chile's economy from capitalism to socialism or control the unforeseen events that marked Chile's unprecedented path toward revolution. Rather than regulating transformation, Cybersyn fell victim to the instability accompanying Allende's programme for socialist reform. Project engineers found themselves attempting the impossible: modelling an economic system that refused to remain constant using only a subset of the variables needed to understand the system. Production, as gauged by flows of raw materials and finished goods, constituted only one aspect of the Chilean economy – one that increasingly paled in comparison to the economic dislocations of inflation, consumer shortages, political infighting, US foreign policy, black-market hoarding, labour strikes and increased social

[110] Schwember, 'Cybernetics in Government,' p. 88. It is interesting to note that Beer diverged from this view as the project progressed and eventually drafted both a report and a letter to President Allende emphasising the importance of the workers learning to create the models themselves rather than looking to the advice of technocratic experts.

[111] Beer, 'On Decybernation', p. 6.

unrest. Labour, in particular, did not behave as just another factor of production, but rather as a corpus of self-conscious individuals able to criticise and resist state operations. In hindsight Beer wrote, 'The model we were using … could not adequately represent changes that had come about during Allende's term … because these were changes in economic management that had nothing to do with ownership in the legal sense.'[112] Rather than transforming Chile's economy through the massive social restructuring Beer envisaged, Cybersyn struggled merely to regulate the day-to-day operations, a task that became increasingly difficult by 1973.

However, this should not imply that the system was a complete failure, just as the ideological congruence between the system and Allende's plan for reform does not qualify it as a success. Regulation, like transformation, played an important role in keeping the Allende government afloat and, as Chile's socio-economic situation slid into chaos, the necessity for social and political regulation gradually eclipsed the earlier priority attributed to structural transformation. Although Beer maintained that the system would only function properly in its entirety, components from the prototype contributed significantly to the government's ability to counteract and manage strike activity as well as its capacity to map complex economic fluctuations using recently generated data. By May 1973 26.7 per cent of the nationalised industries, responsible for 50 per cent of the sector's revenue had been incorporated to some degree within the system.[113]

Following the strike of October 1972 CORFO founded a Directorate of Informatics charged with expanding the scope of the industries connected to the system and increasing the use Cybersyn data within state operations, a technical undertaking supported by CORFO president and former Minister of the Economy Pedro Vuskovic.[114] These regulatory contributions of the system assisted the day-to-day economic operations of the Allende government – if less skilfully managed, the October strike, or any number of Chile's other economic crises, could have shortened the life span of the UP and further restricted their political options. In one of his final reports on the project, Beer summarised his views on the importance of regulation to Chile's democratic road to socialism:

> [I] … envision our invention as an instrument of revolution. I mean that 'The Way of Production' is still a necessary feature of the Chilean revolution, but that 'The Way of Regulation' is an extra requirement of a complex world not experienced by Marx or Lenin.[115]

[112] Beer, *Brain of the Firm*, p. 323.
[113] *Mensaje Presidente Allende Ante Congreso Pleno, 21/Mayo '73*, pp. 412–13.
[114] Alberto Martínez, telephone conversation with the author, 7 October 2003. Martínez served as CORFO director of planning during Vuskovic's appointment as CORFO president.
[115] Beer, 'On Decybernation,' p. 5.

In the light of Beer's experience of the application of cybernetic principles to the Chilean political situation, his new interpretation of revolution is understandable. However, it seems more plausible that this newfound emphasis on regulation did not stem from a change in world complexity or from an oversight in Marx's philosophy. Rather it reflects how science and technology can influence and redefine our conceptualisations of political order and the tools available for orchestrating social change. The history of the Cybersyn system further illustrates that political ideologies not only articulate a worldview, but can also contribute to the design and application of new technologies that politicians, engineers and scientists subsequently use to create and maintain these new configurations of state power.

Cybersyn demonstrates how the study of technology can advance our understanding of historical events and processes within the Latin American region. Given that the creation of a technological system requires diverse assemblages of actors, in this case politicians, foreign experts, engineers and factory workers, a scholarly analysis of such a system can illustrate how members of each group articulated the challenges they faced and their place within the world they were creating. Disagreements over implementation (such as the level of worker involvement), contradictory readings of its potential for control, and the politics of everyday design decisions (such as whether to use a keyboard in the Operations Room), did not simply reflect ideas on technological feasibility and soundness. Instead, they revealed class resistance to economic and social change, the scope of Cold War ideology, and the limitations of the redistribution of power within Chile's socialist revolution. Furthermore, the system brings to light the as yet unstudied value attributed to science and technology during this period of Chilean history and provides a concrete articulation of the UP ideological programme for economic transformation.

The history presented here demonstrates, moreover, the singular nature of Chile's socialist experiment. Not only was this project unique in the manner in which it applied cybernetic science to economic regulation and state governance, but its emphasis on decentralised control also resulted in a technology that reflected the distinguishing features of the UP government. Although we may question the exact magnitude of the contribution made by this system in staving off Chile's mounting political, social and economic upheavals, its history does offer a new perspective on the Chilean experience. In contrast to the chaotic images of shortages, strikes, and protests that have come to characterise the era, Cybersyn presents an alternative history. Here we see members of CORFO, INTEC, ECOM and their British interlocutors struggling to realise a different dream of socialist modernity, technological capability and regulated order. It would be a dream some Cybersyn team members continued to pursue up until the day the military imposed a very

different form of order on the Chilean people and members of the project team fled CORFO headquarters with project documents tucked under their arms in order to preserve them for the future.[116]

On the morning of 11 September 1973 the Chilean military launched a coup against the Allende government. It began in the city of Valparaíso and continued to gather strength as the military travelled south toward Santiago. By 2 p.m. Allende was dead, his dream incinerated by the flames engulfing the presidential palace. Following the coup, the military made several attempts to understand the theoretical and technological aspects of the Cybersyn Project. When these efforts failed, they decided to dismantle the operations room.

Almost every Cybersyn participant who contributed to this study has claimed that the project changed his or her life. Most now hold high positions in either universities or tech-related industries, and have continued to use knowledge acquired from the project to this day. However, despite Cybersyn's contribution to Chile's technological history as well as to the political history of this well-studied period, until very recently it had all but vanished from wider Chilean memory. Like the many other casualties of the Pinochet dictatorship, Cybersyn disappeared.

[116] Guillermo Toro, email correspondence with author, 5 June 2004. Toro, who began working as the Cybersyn project coordinator in June 1973, vividly recalls risking his life by leaving CORFO headquarters with Project Director Raúl Espejo on the day of the coup with four packages of photocopied Cybersyn documents that Espejo still holds in his possession. In Toro's words, the documentation, 'debe ser salvado para contarlo'.