



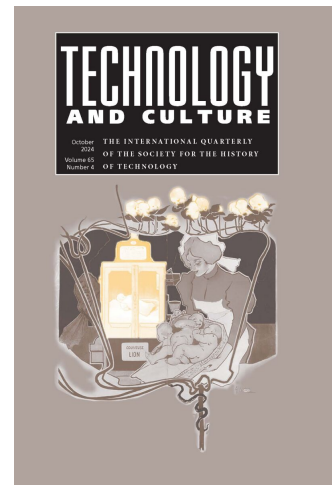
Automating Power: Cybernetics and Sovereignty in Cold War North Korea

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Automating Power: Cybernetics and Sovereignty in Cold War North Korea

BENOIT BERTHELIER

ABSTRACT: This study challenges the conventional Cold War narrative that portrays cybernetics as inherently opposed to communist authoritarianism and the perception of cybernetic control as a mechanism of liberal governmentality. It analyzes the introduction of cybernetics into the Democratic People's Republic of Korea (DPRK) during the Cold War. Previous studies about cybernetics in the socialist world have described how the discipline's emphasis on objectivity and decentralization clashed with orthodox political economists and Stalinist science and led to liberal reforms. Yet in the DPRK, the introduction of cybernetics was followed by an increase in authoritarianism.

KEYWORDS: North Korea; cybernetics; socialist economics; governmentality; sovereignty

Introduction

Shortly after the Korean War (1950–53), the Democratic People's Republic of Korea (DPRK) transitioned to a fully planned economy and began incorporating automation technologies along with new theories of management and economics inspired by Soviet cybernetics. This shift led to the widespread use of statistics and quantitative methods. The professionals involved in this shift—statistical workers, economic planners, and engineers—often relied on basic tools such as pen, paper, and an abacus, as a scene in Yun Sejung's *Yongkwangno nŭn sum shwinda* (The furnace is breathing), a novel about life in a large North Korean factory in the late 1950s, vividly depicts:

“Comrade, is it really so hard to compile statistics?” the Hwanghae factory's accountant asked the statistical worker who had just brought him a large spreadsheet. After spending the night and many nights before reading charts and sliding the beads on his abacus, the newly appointed

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statistical worker—a former factory worker with no mathematical background—simply bowed his head and uttered an exhausted “yes.”¹

The limitations of traditional computational methods led North Korea to venture into computing, culminating in the creation of its first general-purpose digital computer in 1961. Calculating machines, it was hoped, would provide the computing power needed to rationalize and optimize production, marking a first step toward full automation of industrial processes and economic planning. It was a vision that the DPRK would continue to pursue throughout the Cold War and has continued to pursue to this day. In 1991, as the USSR neared dissolution, Kim Jong Il, future heir to Supreme Leader Kim Il Sung, praised the achievements of “cybernetic economics” and “mathematical economics,” while reaffirming his commitment to the computerization of the country’s socialist economic management system.²

North Korea is often described today as a reclusive, “hermit” nation cut off from the rest of the world, but in the early years of the Cold War, it actively participated in the global scientific trend of cybernetics, importing research from and seeking scientific exchange with many other countries. From the late 1940s to the 1960s, the “cybernetic moment” saw the emergence of a global scientific movement based on Norbert Wiener’s work on automation and control and Claude Shannon’s information theory.³ Early cyberneticists sought to establish a unitary, systematic science of computational communication and control. In practice, cybernetics developed in many different fields—from economics and mathematics to psychology and biology—that were scattered around the world and yet united by common methodological interests in computation, feedback mechanisms, and self-regulation (homeostasis).

Recent work on the history of cybernetics has emphasized the disunity and geographical diversity of the discipline.⁴ Chen-Pang Yeang, for example, has shown how debates in modern Chinese linguistics influenced the early development of cybernetics, while Andrew Pickering has explored the influential role of British thinkers.⁵ In the 1950s and 1960s, cybernetics received considerable academic attention in Europe, Latin America, Israel, India, and Japan.⁶ Cybernetics also proved influential in the socialist world, particularly

1. Yun, *Yongkwangno nŭn sum shwinda*, 208–9. Following East Asian convention, the names of Northeast Asian origin are given by their family name first unless a particular name is commonly rendered in Western order with the given name first.

2. Kim, “Chuchê ūi sahoejuŭi kyŏngje kwalli riron ūro t’ŭnt’ŭnhi mujang haja.”

3. Kline, *The Cybernetics Moment*; Triclot, *Le moment cybernétique*.

4. Kline, “How Disunity Matters to the History of Cybernetics in the Human Sciences in the United States,” 13–16.

5. Yeang, “From Modernizing the Chinese Language to Information Science”; Pickering, *The Cybernetic Brain*.

6. Krell, “What Is the ‘Cybernetic’ in the ‘History of Cybernetics?’”; Burbano and Reyes, “Capsaicin and Cybernetics”; Larrain, Mariátegui, and de los Reyes, “Back and

in the USSR, where it transformed economic and political understandings of socialism.

Following Slava Gerovitch's pioneering work on the rise of cybernetics under Khrushchev, there has been a surge in scholarship analyzing the discipline's lasting impact on Soviet science. Gerovitch has shown how cybernetics in the USSR was closely intertwined with the political liberalization of the thaw. The incorporation of cybernetic methods played a crucial role in legitimizing and implementing comparatively liberal reforms in the scientific, economic, and political fields.⁷ With its focus on quantification and formalization, it offered an objective, alternative language to the parochialism and ideological dogmatism that had pervaded every scientific discipline under Stalin. Other studies have also emphasized the liberal influence of cybernetics on the USSR. According to Benjamin Peters, in its heyday, the new discipline promised structural reform and "a new kind of self-governance in the wake of Stalin's bloody rule."⁸ Adam Leeds traces the genealogy of post-Soviet Russian liberalism to early cybernetic economists and shows how their work provided the matrix for a "liberal socialism" in which the economy operated outside the realm of the state.⁹ And Eglė Rindzevičiūtė argues that, contrary to the expectations of the Soviet government, cybernetic-based techniques of governance ended up undermining authoritarian notions of control in the USSR and opening up the Cold War world through increased international scientific cooperation.¹⁰ Outside the USSR, but still in the socialist realm, Chilean and British technologists working on Chile's Cybersyn project sought to infuse democratic socialism into their technological design, unaware that such attempts could inadvertently lead to other, potentially totalitarian power dynamics, as Eden Medina shows.¹¹

In contrast, the adoption of cybernetics in North Korean scientific circles in the early 1960s neither was motivated by nor led to a desire for reform or a shift toward less authoritarian politics. On the contrary, this period saw an unprecedented consolidation of power in the hands of the then chairman of the Korean Workers' Party, Kim Il Sung. A first wave of purges from 1956 to 1960, which solidified the DPRK's anti-revisionist stance, and a second wave in the mid-1960s eliminated pluralism within the party and established a

Forth"; Kline, *Cybernetics Moment*, 104, 38; Greg Adamson, "Norbert Wiener and Prasanta Chandra Mahalanobis," paper presented at the 2012 IEEE Conference on Technology and Society in Asia, October 27–29; Furuhashi, "Architecture as Atmospheric Media."

7. Gerovitch, *From Newspeak to Cyberspeak*, 161–63, 275–76. "Liberal" reforms aimed at reducing state control in various sectors, contrasting with Stalinist policies. But, as Igor Kobylin suggests, they could still be seen as "conservative" (Kobylin, "'Bide Time and Maneuver,'" 79).

8. Peters, *How Not to Network a Nation*, 33.

9. Leeds, "Dreams in Cybernetic Fugue"; Leeds, "Spectral Liberalism."

10. Rindzevičiūtė, *The Power of Systems*.

11. Medina, *Cybernetic Revolutionaries*, 8.

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“monolithic ideological system” under Kim’s sole leadership.¹² This did not, however, lead to the suppression of cybernetic research. While cybernetics in the USSR catalyzed a clash between dogma-driven ideologues and proponents of an objective, scientific approach to governance, there was no similar clash in the DPRK, where new quantitative methods were hailed as a “technological revolution” that would help strengthen party power. Moreover, while the interest in cybernetics among North Korean scientists did lead to some international engagement—evidenced by the DPRK’s initiatives to send scientists to the USSR and Europe for training and to buy computers—these relationships were largely one-sided. Even visiting Soviet scientific delegations were kept in the dark about the actual progress and status of North Korean research.¹³

My goal in making this comparison is not to establish a simple dichotomy between a liberal West or liberalizing USSR and a closed, authoritarian DPRK, nor is it to reduce the reception of cybernetics to a binary of scientists either resisting or conforming to the state. Rather, I explore how the DPRK interpreted cybernetics in ways that were seen as strengthening state sovereignty, while in the West it increasingly symbolized a move away from state control, and in the USSR it was often seen as challenging party authority.

North Korea’s distinctive approach to cybernetics lay in its explicit refusal to strip away the political dimensions of cybernetic control, refusing to see it as fundamentally separate from sovereign control. This stance challenges the tendency to see such an interpretation as merely a tactic by North Korean scientists to evade censorship or to conform to an authoritarian regime. Instead, it reveals an aspect of cybernetics that has been either overlooked or obscured elsewhere: that the use of cybernetics to automate decision-making and optimization processes does not strip the state of its authority to determine “what constitutes the public interest or the interest of the state” or to define optimality.¹⁴

In arguing that North Korean scientists rejected the depoliticization of cybernetics, I suggest that they rejected the notion that cybernetics could render politics obsolete by replacing human decision-making with automated self-regulation and rational optimization.¹⁵ This concept was prevalent not only in the West but also in the USSR, where reform-minded economists envisioned the economy as a self-regulating, decentralized system. They

12. Szalontai, “The Evolution of the North Korean Socio-Political System, 1945–1994,” 30.

13. Otchet o nauchno-tekhicheskom sotrudnichestve mezhdru SSSR i KNDR za 1968 god [Report on USSR-DPRK scientific and technical cooperation for 1968], *fond* (hereafter *f.*) 9480, *opis* (o.) 9, *delo* (d.) 1207, RGAE; Otchet o nauchno-tekhicheskom sotrudnichestve mezhdru SSSR i KNDR za 1974 god [Report on USSR-DPRK scientific and technical cooperation for 1974], *f.* 9480, o. 9, d. 2260, RGAE.

14. Schmitt, *Political Theology*, 6.

15. Tiqqun, “L’hypothèse cybernétique,” 232–34; Guilhot, “Automatic Leviathan,” 137.

envisioned an economy that operated with minimal party intervention, functioning through the free interaction of its components.¹⁶ In this view, the state's role was seen as that of a rational, information-processing entity, gathering subjective data to make objective decisions. Some went further, suggesting that economic planning should evolve from a feedback mechanism directly reflecting consumer preferences, rather than conforming to the party's determinations of optimality.¹⁷ Other economists even suggested that economic planning could directly reflect consumer preferences rather than party directives.¹⁸

Soviet cybernetics did not consistently adhere to this model. Leonid Kantorovich's early work left the determination of optimality in the hands of the party, positioning mathematical economists as the "humble servants" of the Stalinist state.¹⁹ Similarly, in the mid-1980s, the field moved away from the idea of cybernetic self-regulation to better align itself with the traditional, arbitrary control excised by the party.²⁰ Despite these concessions, the surge in cybernetic thinking legitimized the idea that "the economic governance of the Soviet Union in principle could be, and in reality should be fully automated," thereby challenging the centralized control traditionally exercised by the party.²¹

Throughout the Cold War, militaries on both sides of the Iron Curtain, emblematic of national sovereignty, embraced cybernetics research. This may seem to contradict the claim that states around the globe sought to separate cybernetics from politics. Yet it was precisely the perception of cybernetic control as a form of depoliticized rationality that sparked the interest—and also concern—of the military.²² Even critics who saw cybernetics as a totalitarian technology—like Dominique Dubarle, with his idea of the *machine à gouverner*—accepted the premise of cybernetic control operating autonomously, free from external manipulation: what Dubarle feared was the overwhelming power of an optimal, perfectly informed machine, not the arbitrary control of a sovereign ruler.²³ Despite their differences, scientists,

16. Pias, *Cybernetics*, 22–24.

17. According to Leeds in "Spectral Liberalism," military control systems and economists' market-like systems were both shaped by cybernetics and ultimately delegated decision-making to an ideal, rational entity that optimized outcomes mathematically. Also: Feygin, "Reforming the Cold War State," 91.

18. Sutela, *Economic Thought and Economic Reform in the Soviet Union*, 31–32.

19. Sutela, *Economic Thought*, 30.

20. According to Nikita Moiseev, while traditional economic planning should be replaced by cybernetic control systems, they also needed the oversight by a powerful, authoritative state figure (Moiseev, *Lyudi i kibernetika*, 119–20). Also: Gerovitch, "Striving for 'Optimal Control,'" 246.

21. Rindzevičiūtė, "Purification and Hybridisation of Soviet Cybernetics," 304.

22. Rindzevičiūtė, *Power of Systems*, 208; Gerovitch, *From Newspeak to Cyberspeak*, 267–77; Erickson et al., *How Reason Almost Lost Its Mind*.

23. Dominique Dubarle, "Vers la machine à gouverner," *Le Monde*, December 28, 1948.

governments, and critics agreed at the time that cybernetic technology was distinct from political decision-making and could be a substitute for it.²⁴

In North Korea, however, cybernetics was not described or understood as apolitical. This was not because North Korean intellectuals were uneducated. They were aware of apolitical conceptions of cybernetic control and criticized them. And while these critiques were ideologically motivated, they may have been more than empty rhetoric. As Daniel Bessner and Nicolas Guilhot have argued, the supposed neutrality of autonomous cybernetic control—where decisions are framed as objective outcomes of optimization processes—did not so much displace sovereign decision-making as obscure it: the depoliticization of cybernetics merely made decision-makers less visible and accountable.²⁵ Scholars in the DPRK recognized this phenomenon, emphasizing that cybernetic control was as political as traditional sovereign control.

Drawing on archival materials and primary sources from the DPRK, this article enriches the historiography of cybernetics in relation to political power in the twentieth century. It traces the adoption and adaptation of cybernetic methods in a state that has remained off the map of the global histories of cybernetics. The study explains why cybernetics did not inspire reform in North Korea as it did in the USSR and shows how North Korean scientists reinterpreted cybernetic methods and promises through the lens of the party's sovereigntist ideology. After documenting the rise of mathematical methods and computing in economic management from the post-Korean War era through the 1960s, it discusses how North Korean cyberneticists and intellectuals conceptualized the notion of control in ways that allowed these methods to be adopted and institutionalized without provoking conflict with the state.

From Statistical Planning to Mathematical Economics

Soon after the liberation of the Korean Peninsula from the Japanese Empire in 1945, the government of the North Korean People's Committee began to implement economic planning in key industrial sectors. North Korean economists took steps to quantify economic aggregates and systematize data reporting, but their work was constrained by the country's pressing need to restart the stalled economy after years of war and a rapid decolonization process.²⁶ As a result, economists were primarily concerned with quantifying resources and increasing production rather than forecasting

24. Diverse Cold War ideologies shared this view (Schmitt, *Political Theology*, 65).

25. Bessner and Guilhot, "Who Decides?," 17.

26. The DPRK's first economic plan in 1947 was designed with the help of economists from the former Japanese Empire (Armstrong, *The North Korean Revolution, 1945–1950*, 158).

or rationalizing economic processes. The planning that did occur was uncoordinated and often haphazard. Each government organization was responsible for compiling its data at the regional level, which limited the ability of central planners to accurately aggregate information so as to make forecasts.²⁷

Quantitative methods became the main tool of economic management toward the end of the Korean War (1950–53) with the establishment of the Central Bureau of Statistics in 1952 and the transition to a fully planned economy in the mid-1950s.²⁸ The North Korean government's first five-year plan in 1956 called for a “technological revolution” that would build a modern, developed infrastructure by drawing on foreign innovations, such as the mechanization of production processes and new methods of economic planning and labor management based on statistics and quantitative performance indicators, to manage an increasingly complex economy. Trained in Soviet textbooks and influenced by the works of planners and economists like Stanislav Strumilin, Aleksandr Kronrod, and Pavel Mstislavskii, North Korean economists now debated the various ways of calculating prices, economic balances (*pallanssü*), and the rate of turnover of liquid assets in state factories (*ryudong chagüm hoechölyul*).²⁹

The establishment of capital management bureaus under the Ministry of Finance and the complete centralization of banking under the Korean Central Bank in the late 1950s contributed to the development of finance and accounting and their respective calculation methods.³⁰ These changes also had a direct impact on the way work was done in factories and collective farms, where accountants and statisticians now had to compile the data needed for central planning and track progress toward the plan's goals. This general quantification of the economy went hand in hand with a rationalization of labor that made it possible to turn human activities into divisible, fungible units of computation. Labor management had already undergone a process of rationalization during the colonial period, but the country's postwar industrial infrastructure, rebuilt by “fraternal” socialist nations, was specifically designed for division of labor and assembly-line production. Japanese industrialists introduced Taylorism and Fordism throughout the empire, rationalizing production within a modern capitalist framework that emphasized individual utility.³¹ By the mid-1950s a local movement of

27. T'onggyehak e taehan ch'amgosö [Reference documents on statistics], 1948, item 67, Box 123, SA-2007-1, NARA; Chöng, “Chungang chipkwönjejök kukka t'onggye chëje üi kailchüng üi kanghwa nün sahöējuüi kónsöl üi chungyo chokön,” 13.

28. *Kyöngje chisik*, 18.

29. Ri and Kim, “Kach'i e chöpkünhan kagyök kyesan üi sido”; Petrov, *Kyöngje t'onggyehak kyojöng*; Sukharev and Barngolts, *Kongöp kiöpsö saöp üi kyöngjejök punsök*.

30. Their publications, such as *Chaejöng kwa kümyung*, promoted standard accounting practices.

31. Tsutsui, *Manufacturing Ideology*; Leaf, “Indigenous Algorithms, Organizations, and Rationality.” The use of the term “rationalization” here refers to a specific context

scientific management was developing in academia and industry, fueled by a steady stream of textbook imports and translations from the USSR, where the new field of cybernetics had revived interest in Taylorism as a precursor to the discipline.³²

The introduction of Soviet arithmetic planning methods and aggregate statistics marked the beginning of the digitalization of the North Korean economy. One consequence of the transformation of its analog processes, objects, and agents into discrete numerical and symbolic units that could be used for computation was that academic mathematicians became increasingly involved in economics as a discipline and in the practical economic affairs of the country. In the mid-1950s, the Laboratory of Mathematics and Physics of the DPRK Academy of Sciences translated Soviet statisticians' works on statistical inference for planning and developed statistical methods for quality control.³³ In 1959, the laboratory established a research group to study the use of semiconductors to develop electronic components for industrial automation, a group to study digital computing with a view to building a computer that could help improve planning, and a group focused on numerical mathematics and mathematical modeling of economic problems.

These three research groups would prove key to the introduction and dissemination of mathematical economics and cybernetics in the DPRK.³⁴ Drawing on the work of Soviet (Kantorovich, Andrey Kolmogorov), Chinese (Qian Xuesen), and American (Wiener, Lofti Zadeh) cyberneticists, the groups produced research on optimization theory, computing, and control theory. They emphasized the importance of mathematical methods (*suhak-chök pangpöp*) for planning and management and introduced operations research to the DPRK, which they called "mathematical management science" (*suri unyönggak*), a field that included "linear, nonlinear, and dynamic programming, extended reproduction analysis, game theory, queueing theory, and search theory."³⁵ If the first wave of mathematization after the Korean War had allowed planning to move from productivist slogans and arbitrary targets to basic formalizations of economic processes and the widespread use of averages and rates to predict supply and demand, the work of the

and doesn't negate the rationality of traditional methods like the communal *ture* or *kye*.

32. Choi, "Rationalizing the Guerilla State," 57; Gerovitch, *From Newspeak to Cyberspeak*, 285. On the implementation of labor rationalization methods: Kim, *Heroes and Toilers*, 59–69.

33. Sirazhdinov and Khasonovich, "Suri t'onggyehak kwa kongöp saengsan kwalli"; Ri, "Taeryang saengsan e issösö üi t'onggyejök p'umjil kwalli"; "Mulli Suhak Yönguso esö 1956-yöndo yöngu säöp ül chöngghwa."

34. The term "cybernetics" (*chojonghak*) was generally translated as "control science." The term *kkiberünetchikka* (from Russian) was less common, as the DPRK favored the use of native neologisms over foreign loanwords. The terms *chojong riron* and *chojongnon* (control theory) were generally used to refer to control theory specifically but at times encompassed cybernetics as a whole.

35. Kim, "Hyöndae kyesan suhak palchön üi myöt kaji t'ükching."

laboratory's mathematicians introduced even more advanced methods of optimization.

The laboratory's mathematicians wanted these new methods to be used beyond the confines of the Academy, and so in early 1961 they called for a "mass movement" that would introduce linear programming and operations research into "all areas of the people's economy."³⁶ They developed sample applications that reflected common problems in production facilities, such as where to place a communal compost pile to minimize transportation costs (see figure 1) and how to optimize the purchase of different types of pig feed given certain constraints (budget, protein requirements, size of purchase units, and so on).³⁷ Linear programming techniques made it possible to model these low-dimensional problems as systems of inequalities that could be easily solved using tables and basic arithmetic. To support the movement, the Academy published 20,000 copies of a guide to operations research that year, aimed at anyone with a middle school education, and a more advanced, theoretical version the following year, aimed at "mathematicians, economists, planners, and managers responsible for the management and administration of production."³⁸

Automation and Computation

Automation may have seemed an unlikely concern for North Korean engineers at the end of the Korean War. The country's entire manufacturing infrastructure had been destroyed. Coal production was less than 20 percent of prewar levels, and the country struggled to find energy to power its economy.³⁹ There was nothing left to automate and little to automate with.⁴⁰ But the pace of postwar reconstruction and foreign aid quickly increased the amount of machinery and energy available, allowing the first automated industrial processes to be introduced. For example, the Hŭngnam ammonium nitrate factory, built with Soviet technical assistance and opened in 1958, featured "state of the art automation devices" and conveyor belts, and by the early 1960s more than twenty major production facilities had partially automated their production processes.⁴¹ To further advance scientists'

36. "Suri unyŏnghak ŭi che pangbŏp ŭl inmin kyŏngjekka punya e nŏlli chŏgyong haja."

37. Kim, "Sŏnhŏng kyehoekpŏp iran muŏsin'ga?"; Chŏng, "Kyŏngje saŏp chido esŏ suri unyŏnghak ŭi riyong"; Ri, "Kyŏngni ŭyŏng esŏi hamnijŏk in kyesan pangbŏp," 32.

38. By comparison, statistics manuals by the Central Bureau of Statistics averaged a circulation of 5,000, while popular literature typically reached around 10,000 copies. "Kŭngan tosŏ sogae"; "Sŏjŏk annae"; Kwahakchŏk saŏp chojik pangbŏp ŭrosŏ ŭi suri unyŏnghak.

39. Chung, *The North Korean Economy*, 86.

40. Kim, "Kigye kongŏp ŭi palchŏn ŭn 5-kaenyŏn kyehoeŭi sŏngkwa chŏk suhaeng ŭl wihan yŏlsoe ida," 164.

41. Chŏllima chagŏppan undong, 82; "Saengsan kongjŏng ŭi chadonghwa," 30–31; Kim, "Hŭngnam chiran kongjang choŏpsik esŏhan kyŏngnyŏsa," 203.

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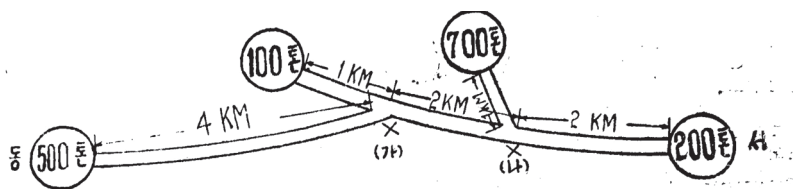


FIG. 1. How to optimize the collective farm. Illustration of an optimization problem on a collective farm. Given four fields at various distances producing different amounts of compostable materials, the question arises, where should the compost pile be located to minimize transportation to and from the pile? Starting in the early 1960s, economists sought to educate the masses on simple and concrete applications of operations research through popular magazines. (Source: Chõng, "Kyõngje saõp chido esõ," 39.)

knowledge, the Academy also purchased current foreign academic journals and supported the translation of Soviet reference materials that could provide further insight.⁴²

Although technology transfer had played a crucial role in bringing automation to the DPRK, the Academy of Sciences also supported the development of domestic research by establishing laboratories devoted to the subject. Scientists were most interested in recent advances in electronics and communications technologies, particularly analog computing devices. The research of Lev Gutenmaher and Soviet computing pioneers made them realize that computers could provide the tools to handle the complex equations of industrial control systems.⁴³ Scientists from the Korean diaspora in Japan also played a key role in the development of analog control engineering, as the country's first paper on analog computing was published by a Korean living in Japan, Rim Kapsun.⁴⁴ Analog computing research, however, focused on single-purpose machines, and the limitations of such devices were well understood. In 1956, mathematician Kim Hongsöp had published an article contrasting the narrow range of applications of analog computers with the much broader potential of digital computers. Analog computers could automate various specific industrial processes, but digital computers could orchestrate the automation of a variety of different, more complex processes, drastically reducing the need for human labor and creating "the prospect of infinite development." Kim predicted that computers would soon be able to model "high-level neural functions" and automate complex human intellectual activities.⁴⁵

Three years later, in 1959, the Academy's new Digital Computing Research Group began studying the architecture of the BESM and STRELA series of Soviet digital computers.⁴⁶ By September 1961, they had produced their own all-purpose electronic computer, called the 9.11, which was unveiled at the Fourth Congress of the Korean Workers' Party (see figure 2).⁴⁷ The 9.11 was adapted from the design of the Soviet M-3 computer and built with locally

42. Kang, *Pukhan kwahak kisul hyöngsöngsa*, 328; K'üllementchibü, *Chadonghwa mit wöngyök chojak*, 6.

43. Ri, "Chönja mulli üi üngyong e taehayö"; Son, "Ssoryön Kwahagwön Chadonghwa Mit Wöngyök Chojak Yönguso üi saeroun chönjagwan sik sangsa kyesan'gi."

44. Rim, "Sangsa hyöng chönja kyesan'gi üi yönsan och'a rül kat'un kyesangi rossö kyesan hanün pangpöp," 43–45.

45. Kim Hongsöp, "Kwahak kwa kisul üi palchön e issösö kyesan'gi üi yökhäl" [The role of calculating machines in the development of science and technology], *Taehak sinmun*, September 7, 1956.

46. "Uri nara chayön kwahak pumun üi kwahak palchön changgi chönmang kye-hoek," 16.

47. Hō, "Hyöndae kosokdo mannüing chadong chönja kyesan'gi wa kü yönyöng"; Hō Tongch'an, "Mannüing chönja kyesan'gi rül chejak" [Production of an all-purpose electronic computer], *Rodong sinmun*, September 7, 1961.

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produced components. The USSR had shared the blueprints of the M-3 with several COMECON members. The model was also the basis for Hungary and China's first computers. Like the M-3, the North Korean 9.11 used a ferrite magnetic core and a 31-bit architecture with two memory address operand instructions. The electronic components were provided by the Academy's Semiconductor Research Group.⁴⁸

The Academy laboratory where the 9.11 computer was built was also home to mathematical economists, who quickly turned their attention to the machine's potential uses in modeling and planning. Until then, planners had relied on large numbers of human computational workers, like the statistician in Yun Sejung's novel, who worked with abaci or, in rare cases, mechanical calculators. Computers could dramatically increase the speed and accuracy of calculations, reduce administrative overhead, and help implement more sophisticated economic models. As one of the Academy's experts put it, "If we get help of an electronic computer to implement the various methods of operations research then the organization of production will be managed in the most rational way, without any ledgers or complex exchange of documents, and with very little administrative staff."⁴⁹

In 1962, the Academy extended its mass movement to popularize mathematical economics by launching a campaign to promote the use of computers. The Mathematics and Physics Laboratory organized a cycle of summer conferences where audiences of academics, university staff, applied linguists, and technicians from the country's major factories were given hands-on programming experience with the 9.11 computer. Over the next few years, the academics would continue to work with factories, collective farms, and construction workers, helping them write programs that could solve "commonly occurring real problems," from bridge design to logistics optimization.⁵⁰

At the same time that the Academy focused on ad hoc, local use cases, it also envisioned the creation of larger communication networks that would feed information from production sites to computers. For example, in a 1965 article summarizing the progress of cybernetics and control theory in the DPRK and abroad, North Korean cyberneticist Ri Hyŏngwŏn emphasized the need to move toward a "global system theory" (*taeyŏk chŏgye riron*) of automation that would use computers to mathematically optimize "not only production processes, but the elaboration of the production plan, the

48. "Chŏllima Suhak Yŏngusil"; "M-3 Computer," Russian Virtual Computer Museum, <http://www.computer-museum.ru/english/m3.htm>; Zhōu, "Zhōngguó Kēxuéyuàn Jìsuàn Jìshù Yánjiū Suǒ kēyán gōngzuò sānshí nián," 2; "Kerŭmanyum pandoch'e soja ŭi chejak," 15.

49. "Suri unyŏnghak," 5.

50. "Chŏnja kyesan'gi ŭi sayongpŏp e taehan kangsŭphoe chinhaeng."



FIG. 2. North Korea's first digital computer creators. This image showcases North Korea's computing pioneers. The creation of the first digital computer sparked optimism for a future of economic planning and daily management, with the anticipation that these processes could be significantly enhanced and streamlined through computer automation. (Source: Hö Tongch'an, "Mannŭng chŏnja kyesan'gi rŭl chejak" [Production of an all-purpose electronic computer], *Rodong sinmun*, September 7, 1961.)

transportation of materials, and all accounting calculations.”⁵¹ Ri and his students then turned their attention to using nonlinear systems to model and optimize a wider variety of economic problems in the hope of creating a larger automated system.

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A Cybernetic Revolution?

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Within a decade, cybernetics transformed North Korean science and society. By the 1970s control engineering, mathematical economics, nonlinear systems, and digital computing had become major areas of research for Academy scientists. In economics, cybernetics popularized the concept of optimization (*ch'öeryanghwa*) and gave rise to new fields of study, such as operations research and cybernetic economics (*kyöngje chojonghak*), both of which are classified as applied branches of the larger discipline of economics. Working with mathematicians at the Academy, planners integrated linear programming methods into their methodology, particularly for problems of logistics, inventory control, and local production scheduling. Their methods now took account of stochasticity, allowing their forecasts to be based on probabilities rather than arbitrary targets and moving averages. A view of the economy as a complex organic system of interrelated parts that could be organized to approximate an optimal desired outcome replaced the deterministic model in which outputs were a linear function of basic inputs that could be increased by mobilizing labor and accumulating capital. Concepts borrowed from information theory led to a reconceptualization of management, planning, and labor as matters of information processing. Labor ceased to be a unified, amorphous factor of production; rationalization transformed it into a series of distinct processes with quantifiable inputs and outputs, while cybernetics framed workers as producers of information—about the condition of machines, the efficiency of work processes, and so forth—and integrated them into the feedback loops of factory management. Other fields besides economics were influenced by cybernetics. Linguists, for example, explored the question of automated translation and intermediary languages between humans and machines, while geographers worked on dividing national territory into discrete units of resources and production that could be used in optimization models.⁵²

Yet the transformations brought about by the introduction of cybernetics generated little overt conflict with, or even skepticism from, the DPRK

51. Ri, “Hyöndae t'onggye chadong chojonghak üi palchön ch'use wa koch'a ch'öeryang chochongniron e taehayö,” 143.

52. Kim, “Pönyök kwajöng üi kigyehwa mit chadonghwa e taehayö”; Nam, “Usuhan kyosu pangpöp üi ch'angio hago ilbanhwa haja!” A quantitative economic geography (*kyöngje chiri*) in the DPRK likely stemmed from its development within the USSR's cybernetic economics (West, “Cybernetics for the Command Economy,” 40–42).

government. This is all the more surprising when compared to the USSR, where cybernetics had caused major upheavals in scientific and political institutions only a few years earlier. Under Khrushchev, cybernetic economics had been an “ideological monster,” part of a struggle to replace the ideologically charged and overly subjective political economy that had dominated the Stalinist era, whose discursive vagueness could be used to arbitrarily justify any action, with a scientific, objective approach to economics through algorithms and statistics.⁵³

But the rise of mathematical economics in the DPRK did not seem to threaten traditional political economy. The country’s major economics journals, while still mostly oriented toward political economy, also published articles on mathematical economics and cybernetics. And party members were required to study all areas of economics.⁵⁴ This is not to say that there were no debates on economic issues; there were, but they were focused elsewhere, as in 1956, when several of the Academy’s economists, who were subsequently purged, suggested that colonial Korea had been feudal rather than capitalist, a claim that was seen as contradicting the historical and economic assumptions that the party used to justify its policies.⁵⁵ Thus, the conflict was not between political economy and mathematical economics but between a faction of political economists and the party. The purge of these economists points to other key differences between the political climates of the liberalizing USSR and the authoritarian DPRK, with censorship being rampant in the latter, despite the similar scientific pursuits of the two countries. Soon after Khrushchev’s de-Stalinization campaigns began, the North Korean leadership denounced the thaw as a revisionist move and purged over a hundred of its cadres with ties to the USSR. But while political relations between the two countries deteriorated, the DPRK continued to engage with Soviet intellectual and scientific trends. At the height of tensions between the two countries in the early 1960s, the DPRK Academy of Sciences was still sending its scientists to Moscow to study topics such as “electronic computation,” telematics, cybernetics, and automation while requesting that Soviet experts visit to educate its members in “large electronic counting machines.”⁵⁶

53. Gerovitch, *From Newspeak to Cyberspeak*, 150.

54. Chông, “Tangwôn tül ün kwahak kwa kisul ūl soyu hayöya handa.”

55. The purge included Song Yejong, Im Hae, Chông Illyong, and the “new configuration” economists (“Haebang hu 15-yôn kan ūi kyöngje hakkye ūi palchôn,” 6).

56. “Perepiska s Posol’stvom SSSR v Koreiskoi Narodno-Demokraticeskoi Respublike, ministerstvami i drugimi tsentral’nymi uchrezhdeniiami i organizatsiiami o kul’turnykh svyaziakh SSSR i Koreiskoi Narodno-Demokraticeskoi Respubliki” [Correspondence with the Soviet Embassy in the Democratic People’s Republic of Korea, ministries, and other Soviet central institutions and organizations on cultural relations between the USSR and the Democratic People’s Republic of Korea], 1959–1967, f. P9518, o. 1, d. 118–23, 893–94, GARF.

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In the USSR, new scientific discourses and methods arising from the spread of cybernetics were used to “subvert and even displace official philosophy,” but in the DPRK the party used them to reinforce its rule and dogmas.⁵⁷ Domestic technological artifacts like the 9.11 computer and semiconductors were promoted as symbols of the success of Kim Il Sung’s doctrine of national self-reliance, and mathematical economic management methods were seen as providing scientific legitimacy to the party’s economic policies. The Soviet economic cyberneticists’ ideal of decentralized economic planning and management provided the scientific justification for Khrushchev’s plan to decentralize economic decision-making power from Moscow to regional economic centers.⁵⁸ In North Korea, on the other hand, the technological need for computers and mathematicians to implement optimal economic planning methods served to justify limiting the power of the People’s Committees (*inmin wiwŏnhoe*), local governance structures that had previously enjoyed a degree of autonomy and legislative power.⁵⁹ By arguing that its electric calculators and later the electronic computer could be used more efficiently if all of the country’s important calculations and decisions were made in one place, where qualified experts were also concentrated, the Central Bureau of Statistics was able to wrest economic decision-making power from the People’s Committees.⁶⁰ While cybernetic economics required a degree of decentralization for information—feedback—to circulate between central authorities and regional production sites, the design of such communication systems and their rules for data collection and standardization remained the prerogative of the Central Planning Bureau.

It could be argued that the DPRK’s involvement with cybernetics was too underdeveloped and limited to have the same impact as in the USSR. Indeed, in the early 1960s Korea had only a handful of cyberneticists and a single computer for the entire country. Despite mentions in the scientific press of a nationwide automated planning system, nothing on the scale of the Soviet OGAS—an attempt at a statewide automatic control system—materialized in the DPRK, and the numerous but disparate applications of cybernetics never reached the organic totality that cyberneticists such as Ri Hyŏngwŏn had envisioned. Nevertheless, the scientists were well integrated into the party’s apparatus and demonstrated the ability to get their work accepted outside the Academy. Moreover, knowledge of cybernetics continued to advance throughout the 1970s, a period during which the country underwent an authoritarian cultural revolution that established the autarkic nationalist doctrine of *juche* as the sole official ideology. To accelerate the digitization

57. Gerovitch, *From Newspeak to Cyberspeak*, 191.

58. Gerovitch, *From Newspeak to Cyberspeak*, 274–77.

59. Kang, “Inmin Wiwŏnhoe ūi kiwŏn kwa pyŏnchŏn chugwŏn kigwan kwa haengjŏng kigwan ūi kwangye ro pon Pukhan chŏngch’isa,” 61–62.

60. Chŏng, “Chungang chipkwŏnjejŏk kukka t’onggye,” 20.

and automation of economic planning, both the Academy of Sciences and the Kim Ch'aek University of Engineering produced new domestic computers, while trading companies sought to purchase turnkey computer factories from France and Japan and imported computers from both sides of the Iron Curtain.⁶¹ These initiatives were fully supported by Supreme Leader Kim Il Sung, who pushed for further mathematization of economic management and lamented the country's inability to develop a local computer industry, and by his son and successor, Kim Jong Il.⁶² And while one can find examples of what James Scott calls "unobtrusive resistance" in the historical archive, such as the reporting of false figures and a reluctance on the part of workers to accept rational or optimal solutions as such, there was no overt opposition.⁶³

Cybernetics finally came under criticism in the 1980s. In 1988, for example, the journal *Philosophical Research* published several critical articles.⁶⁴ In one, the psychologist Nam Sŭngil attacked the discipline for its misguided belief that the human mind could be mathematically modeled. In another, the philosopher Kim Ch'angnyŏl more directly attacked the idea, attributed to Wiener, of a cybernetic "government machine" that would be able to autonomously make "political decisions after calculating which has the highest probability within some system of social statistics."⁶⁵ However, Nam's concern was not with how cybernetics was being applied within the DPRK but with how it was being used by various "bourgeois" intellectual movements in the West, while Kim criticized a specific "reactionary" interpretation of cybernetics, not the field as a whole. On the contrary, he saw its rise and the technologies that relied on it ("computers, robots, translators") as a positive development and proof of "humanity's special place as owner and reformer of the world."⁶⁶

Self-Regulation, Control, and Governmentality

Kim's and Nam's arguments are strongly reminiscent of early Soviet critiques of cybernetics in the late Stalin era and may seem unoriginal. Both mobilize the same "bourgeois" and "reactionary" qualifiers that were applied to cybernetics when the discipline first entered the Soviet intellectual world

61. "Nitchō bōeki gōi-sho-an no yōshi [Summary of trade agreement between North Korea and Japan]," *Asahi Shinbun*, January 22, 1972; Yves Loge, correspondance intérieure Honeywell-Bull, consultation de "Korean Jei Equipment Import Corporation" pour l'implantation d'une manufacture d'ordinateurs en Corée du Nord, 1974, 2012 007 461, ANMT.

62. Kim, "Minjok kanbu yangsŏng saŏp ūl tōuk kaesŏn kanghwa hal te taehayŏ," 472–73; Kim, "Chuch'è ūi sahoejuūi kyŏngje," 374.

63. Scott, *Domination and the Arts of Resistance*, 192.

64. Kim, "Sin in'gan kigyeron ūi pandongjŏk ponjil"; Nam, "Purŭjyoa simnihak e taehan pip'an."

65. Kim, "Sin in'gan kigyeron," 46.

66. Kim, "Sin in'gan kigyeron," 44.

after World War II to dismiss it as an American imperialist science. Even the venue, a philosophy journal, and the focus of Nam's article on psychology seem, three decades later, to echo the campaign of attacks against cybernetics waged by Soviet philosophers and psychologists in 1952 and 1953.⁶⁷ But they differ in one crucial respect: instead of rejecting cybernetics as a whole, they identify different possible ways of understanding and applying it. This difference sheds light on why and how cybernetics was adopted without the same political consequences as in the USSR, as well as how North Koreans understood the affinities between cybernetic control and a centralized state.

Kim Ch'angnyŏl argued that a computer model of human action will always fail to account for creativity (*ch'angjo*), the act by which "humans conquer nature and reform society." While a computer can help humans achieve a goal, it can never replace the human subjects who set those goals in the first place. The idea of a self-regulating political or legal system, or even a communications network, is "reactionary" to him since such an idea merely serves to conceal the dominant position of the system's hidden administrators and the inequalities that benefit them, whether it be monopolistic private ownership of capital and class struggle in the realm of automated economic management or Anglo-centric linguistic domination in the context of "so-called universal communication systems."⁶⁸ In contrast, a "progressive" use of cybernetics recognizes that systems are designed by humans and therefore ultimately under their control. Cybernetics does not dissolve the sovereign in automation, but merely transforms his mode of exercising power from establishing a decision point to establishing a decision space in which to search for a local optimum.

Kim's anthropocentric language and references to the conquest of nature echo the central tenet of *juche*, the monolithic ideology of the Korean Workers' Party, according to which, as Kim Il Sung put it, "man is the master of all things and decides everything," locating the critique in the tradition of Stalinist high modernism.⁶⁹ But I am less interested here in tracing the genealogy of official DPRK ideology than in showing how its development in conjunction with cybernetics led North Korean cyberneticists to emphasize the role and importance of sovereign decisions in determining the purpose of cybernetic systems at a time when practitioners of the discipline in both the Soviet Union and the West sought to ignore this role.

In the USSR, this perception of cybernetic control as autonomous and therefore free from external ideological influence was the crux of the conflict over cybernetics, as it challenged the party's position as ideological leader

67. Rindzevičiūtė, "Purification and Hybridisation," 297–98.

68. Kim, "Sin in'gan kigyeron," 44–45.

69. Kim, *On Some Problems of Our Party's Juche Idea and the Government of the Republic's Internal and External Politics*, 12; Scott, "Soviet Collectivization, Capitalist Dream," 193; Stites, *Revolutionary Dreams*, 145–46.

and economic sovereign and threatened to “extensively” limit its role.⁷⁰ Soviet military leaders, for instance, were skeptical of nationwide computerized planning because it eliminated “the leading role of the party,” while state organs such as the Planning Committee feared that computer models simulating market mechanisms would drastically reduce their sovereign decision-making capacity.⁷¹

In the West, Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow had already argued against a distinction between human and mechanical purpose in their 1943 article “Behavior, Purpose and Technology,” while in Rosenblueth and Wiener’s 1950 paper “Purposeful and Non-purposeful Behavior” they asserted that the purpose of their human designers was completely “irrelevant” to the study of cybernetic systems.⁷² The abandonment of functional analysis of the intrinsic design of agents—whether human or nonhuman—in favor of observing their behavior in terms of inputs and outputs effectively rendered the question of prior intentionality moot. According to Rosenblueth and Wiener, a designer’s intentions might influence an object’s system function, but they emphasized that only the object’s observed behavior, which might deviate from its intended function, was relevant. Later cybernetic research moved from the study of servomechanisms to the question of control in institutions such as corporations and governments, also minimizing the human decision factor.

In his 1966 book *Decision and Control*, for example, the British cyberneticist Stafford Beer states that once management cybernetics has been successfully implemented, “there is no managerial decision left to take.”⁷³ This cybernetic notion of control as autonomous self-regulation has often been contrasted by Beer and others with the irrational, arbitrary decisions of authoritarian rulers, a comparison that suggests that the very act of deciding to implement cybernetic control is a technical rather than a political decision.⁷⁴ But even as Beer speaks of the end of managerial decisions, he remains largely silent on the question of scientific decisions; he presents coercive control and cybernetic control as two radically different ways of achieving a set of goals, but he does not address the question of who exactly are “those who devise and produce” self-regulating systems, nor does he address the question of who makes the decision to adopt such a management system.⁷⁵ Beer was only one of many who took a similar position: the increasing

70. Katsenelinboigen, *Soviet Economic Thought and Political Power in the USSR*, 133–35.

71. Gerovitch, *From Newspeak to Cyberspeak*, 267.

72. Rosenblueth, Wiener, and Bigelow, “Behavior, Purpose and Teleology,” 22; Rosenblueth and Wiener, “Purposeful and Non-purposeful Behavior,” 318; Galison, “The Ontology of the Enemy,” 250–52.

73. Beer, *Decision and Control*, 67.

74. Medina, *Cybernetic Revolutionaries*, 28; Rindzevičiūtė, *Power of Systems*, 16–20.

75. Beer, *Decision and Control*, 354, 489.

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incorporation of cybernetics into governance and management methodologies in the West after World War II was made possible by the erasure of the Hobbesian question of *quis judicabit* in the promotion of self-regulation and optimality.⁷⁶ Borrowing further from Schmitt, we might say that cybernetics has erased both constituent power (the decision to implement a cybernetic control system) and constituted power (the decisions made by those in charge of these systems).⁷⁷

The case of the DPRK offers a good opportunity to further explore this congruence of cybernetic control and sovereignty, since North Korean cyberneticists did not present the two as antithetical, but rather took care to legitimize the implementation of cybernetic systems by referring to party policy and emphasizing how susceptible these systems were to external control by their designers and operators. The farmers in Kim Hongsöp's example of calculating the optimal position of a collective compost pile, which is intended to illustrate the use of linear programming (see figure 1), solve a system of equations that abstracts from the political connections, seniority, traditions, or other "irrational" factors that may have been invoked by the various farming units that wanted the pile located near them. While this may appear to be a rational, objective solution free of political considerations, the system still implicitly embeds a decision to collectivize compost, as opposed to, say, each unit keeping its own pile and competing or trading with each other. This, in turn, leads Kim to justify the methods in terms of the party directives that legitimize them.⁷⁸

Similarly, with the introduction of operations research, the locations of bus stops, hospitals, roads, and other infrastructure were now calculated rather than arbitrarily determined by local officials, but the decision to do so was still the product of a political will that ultimately found its justification in the constituting power of the party. It is worth noting, however, that the party was not entirely external to the scientific field, nor was it an omnipotent and omnipresent entity. Most scientists would have been party members themselves, and some would have had advisory roles through which they directly influenced policy decisions. The central party authorities in Pyongyang were also unlikely to interfere directly with the management of smaller production units, and the impetus for implementing cybernetic management was more likely to come from locally trained party members. The shift from a top-down form of control to a more rational one did not eliminate sovereign political decision-making, but it did change the structure of the party and give rise to a new class of experts and technicians.

76. Guilhot, "Automatic Leviathan," 135.

77. Constituent power refers to the ability to determine one's political form and existence, while constituted power is the exercise of authority within limits set by the constituting power (Schmitt, *Constitutional Theory*, 125–29).

78. Chông, "Kyôngje saõp chido esõ," 41.

Optimizing Sovereign Control

This newly constituted class presented itself as a transparent proxy for the constituting power of the party rather than as the makers of apolitical, automated decision-making systems. Kim Hongsöp, for example, one of the first mathematicians to call for the use of computers and decentralized, automated information processing in economic planning, emphasized that these methods were tools for—rather than challengers to—party authority. In a 1964 article introducing cybernetics and information theory to the public, he lists all the various administrations and industries that “in the near future” will be fully automated by “computers and the latest mathematical results” but warns that “this does not mean that the devices used in this process will have the same creative ability as humans.” Machines, he notes, are merely “faithful helpers” created by humans to “free themselves from mechanistic labor” and whose purpose is to “actively contribute to the tasks of the revolution” by informing and helping to fulfill the party’s goals.⁷⁹ Autonomous production systems can regulate themselves internally to achieve a goal, but they cannot decide what the goal should be. Mathematical methods can derive the optimal path to a goal based on a set of constraints, but the setting of the constraints and the goal itself, the definition of the problem space, is external to the system.

Determining what purpose the system should serve remained the prerogative of the party and the scientists working to implement its policies. In industry, one of the goals of a new management system (later called *taean*) developed in the early 1960s was to decentralize information processing so that workers and managers could participate in economic planning while establishing channels of communication within factories and between factories and the party.⁸⁰ As a result of these changes, workers participated through “mass discussion” that became part of feedback loops, whereas previously the decision-making flows of factory management had been strictly unidirectional. But the input gathered from the “working masses” was primarily intended to reduce the workload of the “handful of specialists” and planners who were unable to process all the “complex factors of production” for the calculations required by scientific planning.⁸¹ The goal was to delegate the collection and processing of information in order to “overcome subjectivism in economic management,” that is, the arbitrary decisions made by planners or managers because they lacked data or had invalid data. But it was still

79. Kim Hongsöp, “Chadonghwa wa hyöndae suhak,” 41.

80. Choi, “Rationalizing the Guerilla State,” 64–68; Chöe Hyöng-sik, “Taeon üi saöp chëgye rül töuk chölchöhi kwanchöl haja!”; Kim, “Taeon saöp chëgye üi simhwa palchön ül wihayö.”

81. Kim, *Modern Korea*, 128–30.

up to a group of engineers, experts, and party cadres to work out objective, optimal plans based on the data collected from the masses.

One could argue that these changes nevertheless constituted a form of inchoate or stunted liberal governmentality, hampered by authoritarian government, technological poverty, and a specific historical context. If we define liberalism broadly as a kind of calculation by which states self-limit the extent of their intervention, such an interpretation is indeed possible.⁸² The affinities between cybernetic self-regulation and the self-limitation of laissez-faire, liberal governmentality have often been noted, from the reinterpretation of the invisible hand as a feedback mechanism to the analysis of modern governmental systems in terms of communication, calculation, and control.⁸³ Extending these considerations to a socialist state may seem misguided in light of Foucault's explicit argument that "autonomous socialist governmentality" does not exist, but the reason it does not exist is precisely because socialism remains deeply connected to liberal governmentality, ideologically distinct but "governmentally similar."⁸⁴ We can thus read North Korea's engagement with cybernetics, in part, through the prism of this similarity as an attempt to shift the power of the sovereign away from direct economic intervention.

The introduction of mathematical methods into economics and administration empowered a class of technocrats that included not only a small, closed clique of highly educated elites but also a growing group of technicians, managers, and workers who sought further technical education. The Academy's movement to popularize operations research, for example, allowed the population to participate in the scientific management of the economy. Planning decisions were no longer strictly unilateral, but rather based on predictions and calculations made by multiple stakeholders. Reforms like the *taean* system also gave workers and managers more operational autonomy in the day-to-day management of production, favoring incentives over coercion. These examples illustrate a new way of exercising power: a form of governmentality that reduces the cognitive load of a centralized state in administrative matters by optimizing the efficiency of the exercise of power through relative delegation, decentralization, and automation.

In Western liberal governmentalities, such a process implies a "defunctionarization" of the state's economic intervention, the replacement of planning functionaries with firms whose free, informed actions in a competitive market will regulate the economy in a more efficient way.⁸⁵ In a state where virtually all workers are functionaries, the configuration will be different,

82. Foucault, *The Birth of Biopolitics*, 20.

83. "Kommunikation," 'Kalkulation' und 'Kontrolle', Seibel, *Cybernetic Government*, 120. Also: Hayek, "The Atavism of Social Justice," 407; Lemke, *The Government of Things*, 112–16.

84. Foucault, *Birth of Biopolitics*, 92; Prozorov, *The Biopolitics of Stalinism*, 43.

85. Foucault, *Birth of Biopolitics*, 175–76.

but the new technocrats were not simply ordinary economic planners. Their function was not so much to direct the economy and precisely quantify the expected inputs and outputs of productive agents, but rather to set up macro-structural systems that would “naturally” tend to increase output and reduce the amount of data collection and calculation required of planners. The rationale behind this emerging economic system, while grounded in socialist ideals of optimal state-directed behavior, mirrored liberal governmentality's principle that freedom requires shaping individuals into responsible agents.⁸⁶ The terms of this freedom were enforced by an ever-increasing number of legal institutions.⁸⁷ At the same time that this new form of governing was taking hold, numerous disciplinary apparatuses aimed at producing new autonomous socialist subjectivities emerged, such as the *chŏllima* Hero Campaign. Nevertheless, the similarities between the use of cybernetics in the West and that in the DPRK underscore the fact that there is nothing particularly unique about the DPRK state's attempt to limit the scope of its economic interventions and to focus on systemic regulation rather than the control of individuals (even if this attempt is significant in the history of the DPRK itself). This is a feature shared, to varying degrees, by all modern states, socialist or otherwise.

Whether the emergence of a new governmentality necessarily leads to a diminution of the sovereign power of the state or whether, as North Korean cyberneticists have argued, the former merely reinforces the latter, sometimes in covert ways, is an open question. In the Foucauldian tradition, liberal governmentality is opposed to sovereign power, but this opposition is based on a rejection of the role of the judiciary and the primacy of the economic.⁸⁸ For example, Foucault's analysis of West Germany as a paragon of liberal governmentality, a post-sovereign state born of market reforms in 1948, overlooks the fact that the institutional and monetary conditions that made such an economic system possible were unilaterally decided by a foreign military as part of its efforts to more effectively administer an occupied territory in a classic display of sovereign power.⁸⁹ By seeming to dissolve the need for sovereign politics through automation, cybernetic governance may also seem inherently liberal. But as Guilhot shows, far from replacing politics with technology, cybernetics “obfuscated the real logics of decision behind a facade of dynamic equilibriums resulting from the self-steering capacity of complex systems.”⁹⁰ In the DPRK, this link between decision and complex

86. Dean, *Governmentality*, 165.

87. Foucault, *Birth of Biopolitics*, 176.

88. Grenier and Orléan, “Michel Foucault, l'économie politique et le libéralisme,” 1180–81; Dean, *The Signature of Power*, 19–43.

89. Kindleberger and Ostrander, “The 1948 Monetary Reform in Western Germany,” 169–70; Leaman, “The Political Economy of Germany, 1918–49 and the Formation of the West German State,” 36.

90. Guilhot, “Automatic Leviathan,” 140.

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systems was instead made patent, criticized when it served the “wrong” ruler and praised when it was used by the “progressive” power of the party. Cybernetics represented a different way of exercising power, a way of automating its exercise, but automation was not autonomy. Even if decision-making could be delegated to machines or individuals, the delineation of the subspace in which these agents could operate was the product of a sovereign decision.

Conclusion

Shortly after the end of the Korean War, the DPRK began researching cybernetic methods (operations research, control theory, informatics, and so on) and applying them to economic planning, production management, and certain social sciences, following the global rise of cybernetics as a field of study and its growing popularity in the Soviet Union. However, despite the strong influence of the Soviet scientific field, North Korea’s engagement with cybernetics exhibited an important difference: while the adoption of cybernetics in the USSR led to fierce debates between political economists and cyberneticists, the discipline was uncontroversially accepted in the DPRK.

The absence of an ideological struggle over cybernetics in the DPRK can be explained by the fact that cybernetics was introduced there as a tool in the service of, rather than as a substitute for, political control. Western cyberneticists claimed that cybernetic systems would manage and govern themselves according to objective optimization processes without the interference of arbitrary human decisions. In the USSR, cybernetics was perceived as a potential encroachment on the party’s decision-making prerogative, while in North Korea it was seen as merely a layer of abstraction that provided a simple, efficient interface for the exercise of sovereignty. To use the vocabulary of North Korean cyberneticists, cybernetics allowed for the automation of the “mechanistic” aspects of the exercise of power—the way labor was organized, goods were allocated, or the economy was planned—which in turn allowed for a more efficient use of the “creative” sovereign decision-making capacity of the Korean Workers’ Party and its leadership.

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Bibliography

Archival Sources

Archives Nationales du Monde du Travail, Roubaix, France (ANMT)
National Archives and Records Administration, Washington, D.C., U.S.
(NARA)

Russian State Archive of the Economy, Moscow, Russia (RGAE)
 State Archive of the Russian Federation, Moscow, Russia (GARF)

Published Sources

- Armstrong, Charles K. *The North Korean Revolution, 1945–1950*. Ithaca: Cornell University Press, 2013.
- Beer, Stafford. *Decision and Control: The Meaning of Operational Research and Management Cybernetics*. New York: Wiley, 1966.
- Bessner, Daniel, and Nicolas Guilhot. “Who Decides?” In *The Decisionist Imagination*, edited by Daniel Bessner and Nicolas Guilhot, 1–26. New York: Berghahn, 2019.
- Burbano, Andrés, and Everardo Reyes. “Capsaicin and Cybernetics: Mexican Intellectual Networks in the Foundation of Cybernetics.” *AI and Society* 37, no. 3 (2022): 1013–25.
- Ch'oe, Hy'ong-sik. “Tae'an ūi sa'op ch'egy'e rŭl t'ouk ch'olch'ohi kwanch'ol haja!: Kyehoek ūl saengsanja taejung ūi k'ot ūro” [Let's implement the *tae'an* system even more thoroughly: Planning as belonging to the productive masses]. *Ch'ollima* 11 (1969): 55–65.
- Choi, Hyungsub. “Rationalizing the Guerilla State: North Korean Factory Management Reform, 1953–61.” *History and Technology* 20, no. 1 (2004): 53–74.
- Ch'ollima chag'oppan undong* [The Ch'ollima working team movement]. Pyongyang: Chig'op tongmaeng ch'ulp'ansa, 1960.
- “Ch'ollima Suhak Y'ongusil” [The Ch'ollima Math Laboratory]. *Kwahagw'ŏn t'ongbo* 6 (1962): 49–51.
- Ch'ong, Kiry'ŏn. “Tangw'ŏn t'ul ūn kwahak kwa kisul ūl soyu hay'oya handa” [Party members must possess knowledge of science and technology]. *K'ulloja* 11 (1961): 16–20.
- Ch'ong, My'ongsul. “Ky'ongje sa'op chido es'ŏ suri uny'onghak ūi riyong” [On the use of operations research in the guidance of economic matters]. *Ky'ongje chisik* 7 (1961): 38–44.
- Ch'ong, Y'ongsul. “Chungang chipkw'ŏnjej'ŏk kukka t'onggye ch'eye ūi kailch'ung ūi kanghwa n'ŭn sah'oeju'ui k'ons'ol ūi chungyo chok'ŏn” [Further strengthening the system of centralized national statistics is an important condition of building socialism]. *Ky'ongje y'ong'u* 2 (1960): 13–20.
- “Ch'ŏnja kyesan'gi ūi sayongp'ŏp e taehan kangs'uphoe chinhaeng” [Lectures on the way to use electronic computers]. *Kwahagw'ŏn t'ongbo* 2 (1962): 74–75.
- Chung, Joseph S. *The North Korean Economy: Structure and Development*. Stanford: Hoover Institution Press, 1974.
- Dean, Mitchell. *Governmentality: Power and Rule in Modern Society*. Los Angeles: Sage, 2010.
- Dean, Mitchell. *The Signature of Power: Sovereignty, Governmentality and Biopolitics*. London: Sage, 2013.

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2024
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- Erickson, Paul, Judy L. Klein, Lorraine Daston, Rebecca M. Lemov, Thomas Sturm, and Michael D. Gordin. *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality*. Chicago: University of Chicago Press, 2013.
- Feygin, Yakov. "Reforming the Cold War State: Economic Thought, Internationalization, and the Politics of Soviet Reform, 1955–1985." Ph.D. diss., University of Pennsylvania, 2017.
- Foucault, Michel. *The Birth of Biopolitics: Lectures at the Collège de France, 1978–1979*. Edited by Michel Senellart. Houndmills: Palgrave Macmillan, 2008.
- Furuhata, Yuriko. "Architecture as Atmospheric Media: Tange Lab and Cybernetics." In *Media Theory in Japan*, edited by Marc Steinberg and Alexander Zahlten, 52–80. Durham: Duke University Press, 2017.
- Galison, Peter. "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision." *Critical Inquiry* 21, no. 1 (1994): 228–66.
- Gerovitch, Slava. *From Newspeak to Cyberspeak: A History of Soviet Cybernetics*. Cambridge, MA: MIT Press, 2002.
- Gerovitch, Slava. "Striving for 'Optimal Control': Soviet Cybernetics as a 'Science of Government'." In *Cultures of Control*, edited by Miriam R. Levin, 245–62. Amsterdam: Harwood, 2000.
- Grenier, Jean-Yves, and André Orléan. "Michel Foucault, l'économie politique et le libéralisme." *Annales: Histoire, Sciences Sociales* 62, no. 5 (2007): 1155–82.
- Guilhot, Nicolas. "Automatic Leviathan: Cybernetics and Politics in Carl Schmitt's Postwar Writings." *History of the Human Sciences* 33, no. 1 (2020): 128–46.
- "Haebang hu 15-yŏn kan ūi kyŏngje hakkye ūi palchŏn" [The development of the field of economics during the fifteen years after liberation]. *Kyŏngje yŏn'gu* 3 (1960): 1–11.
- Hayek, F. A. "The Atavism of Social Justice." In *Essays on Liberalism and the Economy*, edited by Paul Lewis, 401–12. Chicago: University of Chicago Press, 2022.
- Hö, Kōn. "Hyōndae kosokdo mannŭng chadong chŏnja kyesan'gi wa kŭ unyŏng" [The contemporary high-speed all-purpose automatic electronic computer and its management]. *Kwahagwŏn T'ongbo* 4 (1961): 32–39.
- Kang, Hoje. *Pukhan kwahak kisul hyŏngsŏngsa* [History of the formation of North Korean science and technology]. Seoul: Sŏnin, 2007.
- Kang, Ŭngchŏn. "Inmin Wiwŏnhoe ūi kiwŏn kwa pyŏnchŏn chugwŏn kigwan kwa haengjŏng kigwan ūi kwan'gye ro pon Pukhan chŏngch'isa" [The origin and transition of the People's Committee: The relationship between sovereign and administrative organs in North Korean political history]. *Hyŏndae Pukhan yŏn'gu* 23, no. 1 (2020): 39–74.
- Katsenelinboigen, Aron. *Soviet Economic Thought and Political Power in the USSR*. New York: Pergamon, 1980.

- “Kerümanyum pandochê soja üi chejak” [Making semiconductor devices from germanium]. *Kwahagwôn t'ongbo* 2 (1961): 14–15.
- Kim, Byong Sik. *Modern Korea*. Translated by Takeshi Haga. New York: International, 1970.
- Kim, Ch'angnyöl. “Sin in'gan kigyeron üi pandongjök ponjil” [The reactionary nature of new man-machine theories]. *Ch'örhak yöngu* 3 (1988): 44–48.
- Kim, Cheehyung Harrison. *Heroes and Toilers: Work as Life in Postwar North Korea, 1953–1961*. New York: Columbia University Press, 2018.
- Kim, Hongsöp. “Chadonghwa wa hyöndae suhak” [Automation and contemporary mathematics], *Ch'öllima* 5 (1964): 40–41.
- Kim, Hongsöp. “Hyöndae kyesan suhak palchön üi myöt kaji t'ükching” [Some particulars of the development of modern computational science]. *Kwahagwôn t'ongbo* 5 (1962): 4–10.
- Kim, Hongsöp. “Sönhöng kyehoekpöp iran muösing'a?” [What is linear programming?]. *Kwahagwôn t'ongbo* 3 (1961): 43–50.
- Kim, Hyöng-uk. “Taeon säp chëgye üi simhwa palchön üi wihayö” [Further developing the *taeon* system]. *Kyongje chisik* 8 (1964): 11–15.
- Kim, Il Sung. “Hüngnam chiran kongjang choöpsik esöhan kyöngnyösa” [Words of encouragement at the opening ceremony of the Hüngnam ammonium nitrate factory]. In *Kim Ilsöng chöjakchip* [Works of Kim Il Sung], 202–6. Pyongyang: Chosön rodongdang ch'ulp'ansa, 1979.
- Kim, Il Sung. “Kigye kongöp üi palchön ün 5-kaenyöN kyehoek üi söngkwa chök suhaeng üi wihan yölsoe ida” [The development of the machinery industry is key for the successful execution of the five-year plan]. In *Kim Ilsöng chöjakchip* [Works of Kim Il Sung], 144–83. Pyongyang: Chosön rodongdang ch'ulp'ansa, 1981.
- Kim, Il Sung. “Minjok kanbu yangsöng säp üi töuk kaesön kanghwa hal te taehayö” [On strengthening and improving the formation of national cadres]. In *Kim Ilsöng chöjakchip* [Works of Kim Il Sung], 146–62. Pyongyang: Chosön rodongdang ch'ulp'ansa, 1986.
- Kim, Il Sung. *On Some Problems of Our Party's Juche Idea and the Government of the Republic's Internal and External Politics*. Pyongyang: Foreign Languages Publishing House, 1972.
- Kim, Jong-Il. “Chuchê üi sahoejuüi kyöngje kwalli riron üro t'ünt'ünhi mujang haja” [Let's arm ourselves with *juchê* theories of socialist economic management]. In *Kim Jongil sönjip* [Selected works of Kim Jong Il], 349–78. Pyongyang: Chosön rodongdang ch'ulp'ansa, 1992.
- Kindleberger, Charles P., and F. Taylor Ostrander. “The 1948 Monetary Reform in Western Germany.” In *International Financial History in the Twentieth Century: System and Anarchy*, edited by Carl-Ludwig Holtfrerich, Harold James, and Marc Flandreau, 169–96. Cambridge: Cambridge University Press, 2003.

OCTOBER
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VOL. 65

- Kline, Ronald. "How Disunity Matters to the History of Cybernetics in the Human Sciences in the United States, 1940–80." *History of the Human Sciences* 33, no. 1 (2020): 12–35.
- Kline, Ronald R. *The Cybernetics Moment: Or Why We Call Our Age the Information Age*. Baltimore: Johns Hopkins University Press, 2015.
- Kobylin, Igor. "'Bide Time and Maneuver': A Conservative Style of Cybernetic Governmentality." *Stasis* 10, no. 2 (2021): 77–101.
- Krell, Jacob. "What Is the 'Cybernetic' in the 'History of Cybernetics'? A French Case, 1968 to the Present." *History of the Human Sciences* 33, no. 1 (2020): 188–211.
- Kŭkjong, Kim. "Pönyök kwajöng ŭi kigyehwa mit chadonghwa e taehayö" [On the automation and mechanization of the translation process]. *Chosön öhak* 2 (1960): 66–72.
- K'üllementchiyebü, Essü Te. *Chadonghwa mit wöngyök chojak* [Automation and remote control]. Pyöngyang: Kungnip kongöp kisul sojök ch'ulp'ansa, 1957.
- "Kün'gan tosö sogae" [Presentation of new publications]. *Kisul Kwahak* 3 (1961): 60.
- Kwahakchök saöp chojik pangpöp ŭrosö ŭi suri unyönghak* [Operations research as a scientific method of work organization]. Pyongyang: Kwa-hagwön Ch'ulp'ansa, 1961.
- Kyöngje chisik* [Economic knowledge]. Pyongyang: Kungnip Ch'ulpansa, 1957.
- Leaf, Murray. "Indigenous Algorithms, Organizations, and Rationality." *Structure and Dynamics* 3, no. 2 (2008).
- Leaman, Jeremy. "The Political Economy of Germany, 1918–49 and the Formation of the West German State." In *The Political Economy of West Germany, 1945–85: An Introduction*, edited by Jeremy Leaman, 9–47. London: Palgrave Macmillan, 1988.
- Leeds, Adam E. "Dreams in Cybernetic Fugue: Cold War Technoscience, the Intelligentsia, and the Birth of Soviet Mathematical Economics." *Historical Studies in the Natural Sciences* 46, no. 5 (2016): 633–68.
- Leeds, Adam E. "Spectral Liberalism: On the Subjects of Political Economy in Moscow." Ph.D. diss., University of Pennsylvania, 2016.
- Lemke, Thomas. *The Government of Things: Foucault and the New Materialisms*. New York: New York University Press, 2021.
- Medina, Eden. *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile*. Cambridge, MA: MIT Press, 2011.
- Moiseev, Nikita. *Lyudi i kibernetika* [People and cybernetics]. Moscow: Molo-daya gvardiya, 1984.
- "Mulli Suhak Yönguso esö 1956–yöndo yön'gu saöp ül chöngghwa" [Research of the Laboratory for Physics and Mathematics in 1956]. *Suhak kwa mulli* 1 (1957): 97–98.

- Nam, Chinu. “Usuhan kyosu pangpöp ŭl ch’angjo hago ilbanhwa haja! Chosön kyöngje chiri kyosu esö sujajök charyo wa saengsal ryöngyölto ŭi iyong” [Let’s create and generalize excellent teaching methods: On the use of numerical data and production linkage maps in teaching Korean economic geography]. *Kisul Kyoyuk* 11 (1960): 23–25.
- Nam, Süngil. “Purŭjyoa simnihak e taehan pip’an” [Critique of bourgeois psychology]. *Chörhak yöngu* 3 (1988): 43–48.
- Nieto Larrain, Ignacio, José-Carlos Mariátegui, and David Maulén de los Reyes. “Back and Forth: Cybernetics Interrelations and How It Spread in Latin America.” *AI and Society* 37, no. 3 (2022): 1001–12.
- Peters, Benjamin. *How Not to Network a Nation: The Uneasy History of the Soviet Internet*. Cambridge, MA: MIT Press, 2016.
- Petrov, Alexander Ilyich. *Kyöngje t’onggyehak kyöjōng* [Textbook on economic statistics]. Translated by Yun Kibok. 3 vols. Pyongyang: Chungang t’onggyeguk ch’ulp’ansa, 1954.
- Pias, Claus. *Cybernetics: The Macy Conferences, 1946–1953*. Zurich: Diaphanes, 2016.
- Pickering, Andrew. *The Cybernetic Brain: Sketches of Another Future*. Chicago: University of Chicago Press, 2010.
- Prozorov, Sergei. *The Biopolitics of Stalinism: Ideology and Life in Soviet Socialism*. Edinburgh: Edinburgh University Press, 2022.
- Ri, Chongnim. “Taeryang saengsan e issösö ŭi t’onggyejök p’umjil kwalli” [Statistical quality control in large-scale production]. *Kwahak kwa kisul* 7 (1956): 6–14.
- Ri, Hyojun. “Chönja mulli ŭi ŭngyong e taehayö” [On the applications of electrophysics]. *Kwahak kwa kisul* 10 (1955): 33–41.
- Ri, Hyöngwön. “Hyöndae t’onggye chadong chojonghak ŭi palchön ch’use wa koch’a chöeryang chochongniron e taehayö” [On trends in the development of contemporary statistical cybernetics and high-dimensionality optimal control theory]. In *Chonghap nonsölchip* [Anthology of scientific articles], 124–54. Pyongyang: Kwahagwön ch’ulp’ansa, 1965.
- Ri, Hyöngwön. “Kyöngni ŭnyōng esöüi hamnijök in kyesan pangböp” [Rational methods of calculations for management]. *Kisul kyoyuk* 9 (1962): 32–35.
- Ri, Söksim, and Kim Kapsu. “Kach’i e chöpkünhan kagyök kyesan ŭi sido” [Attempt at calculating a price approaching value]. *Kyöngje yöngu* 1 (1960): 34–41.
- Rim, Kapsun. “Sangsa hyöng chönja kyesan’gi ŭi yönsan och’a rül kat’ün kyesangi rossö kyesan hanün pangpöp” [Method for computing the calculation errors of an electronic analog computer using the same computer]. *Kwahagwön t’ongbo* 5 (1961): 43–45.
- Rindzevičiūtė, Eglė. *The Power of Systems: How Policy Sciences Opened Up the Cold War World*. Ithaca: Cornell University Press, 2016.

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VOL. 65

- Rindzevičiūtė, Eglė. "Purification and Hybridisation of Soviet Cybernetics: The Politics of Scientific Governance in an Authoritarian Regime." *Archiv für Sozialgeschichte* 50 (2010): 289–309.
- Rosenblueth, Arturo, and Norbert Wiener. "Purposeful and Non-purposeful Behavior." *Philosophy of Science* 17, no. 4 (1950): 318–26.
- Rosenblueth, Arturo, Norbert Wiener, and Julian Bigelow. "Behavior, Purpose and Teleology." *Philosophy of Science* 10, no. 1 (1943): 18–24.
- "Saengsan kongjŏng ūi chadonghwa" [Automation of production processes]. *Kyŏngje chisik* 10 (1960): 30–31.
- Schmitt, Carl. *Constitutional Theory*. Durham: Duke University Press, 2008.
- Schmitt, Carl. *Political Theory: Four Chapters on the Concept of Sovereignty*. Edited and translated by George Schwab. Chicago: University of Chicago Press, 2005.
- Scott, James C. *Domination and the Arts of Resistance: Hidden Transcripts*. New Haven: Yale University Press, 1990.
- Scott, James C. "Soviet Collectivization, Capitalist Dream." In *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, 193–222. New Haven: Yale University Press, 2020.
- Seibel, Benjamin. *Cybernetic Government: Informationstechnologie und Regierungsrationalität von 1943–1970*. Wiesbaden: Springer Vieweg, 2016.
- Sirazhdinov, Boris Alexandrovich Sevastyanov, and Sagdy Khasanovich. "Suri t'onggyehak kwa kongŏp saengsan kwalli" [Mathematical statistics and the management of industrial production]. *Kwahak kwa Kisul* 12 (1955): 49–54.
- "Sŏjŏk annae" [Publication announcement]. *Kisul kwahak* 2 (1962): 65.
- Son, Kyujin. "Ssoryŏn Kwahagwŏn Chadonghwa Mit Wŏng'yŏk Chojak Yŏnguso ūi saeroun chŏnjagwan sik sangsa kyesan'gi" [New vacuum tube analog computer at the Soviet Academy of Science's Laboratory for Automation and Telemechanics]. *Kisul kwahak* 1 (1957): 60.
- Stites, Richard. *Revolutionary Dreams: Utopian Vision and Experimental Life in the Russian Revolution*. New York: Oxford University Press, 1989.
- Sukharev, S. B., and A. M. Barngolts. *Kongŏp kiŏpso saŏp ūi kyŏngjejŏk punsŏk* [Economic analysis of industrial enterprises]. Translated by Kim Chigyun. Pyongyang: Chungang t'onggyeguk ch'ulp'ansa, 1956.
- "Suri unyŏnghak ūi che pangpŏp ūl inmin kyŏngjekka punya e nŏlli chŏgyong haja" [Let's widely implement the many methods of mathematical management in all fields of the people's economy]. *Suhak kwa mulli* 1 (1961): 1–6.
- Sutela, Pekka. *Economic Thought and Economic Reform in the Soviet Union*. Cambridge: Cambridge University Press, 1991.
- Szalontai, Balázs. "The Evolution of the North Korean Socio-political System, 1945–1994." In *Routledge Handbook of Contemporary North Korea*, edited by Adrian Buzo, 11–41. London: Routledge, 2020.
- Tiqqun. "L'hypothèse cybernétique." *Tiqqun* 2 (2001): 224–339.

- Triclot, Mathieu. *Le moment cybernétique: La constitution de la notion d'information*. Seyssel: Champ Callon, 2008.
- Tsutsui, William M. *Manufacturing Ideology*. Princeton: Princeton University Press, 2001.
- “Uri nara chayŏn kwahak pumun ŭi kwahak palchŏn changgi chŏnmang kye-hoek” [Long-term prospective plan for scientific development in all areas of our country’s natural sciences]. *Kwahagwŏn t’ongbo* 1 (1959): 1–20.
- West, Diana Kurkovsky. “Cybernetics for the Command Economy: Foregrounding Entropy in Late Soviet Planning.” *History of the Human Sciences* 33, no. 1 (2020): 36–51.
- Yeang, Chen-Pang. “From Modernizing the Chinese Language to Information Science: Chao Yuen Ren’s Route to Cybernetics.” *Isis* 108, no. 3 (2017): 553–80.
- Yun, Sejung. *Yongkwangno nŭn sum shwinda* [The furnace is breathing]. Pyongyang: Chosŏn chakka tongmaeng ch’ulp’ansa, 1960.
- Zhōu, Jí. “Zhōngguó Kēxuéyuàn Jìsuàn Jìshù Yánjiū Suǒ kēyán gōngzuò sānshí nián” [Thirty years of research of the Institute for Computer Science of the Chinese Academy of Sciences]. *Jìsuànjī yánjiū yǔ fāzhǎn* 23, no. 8 (1986): 1–15.