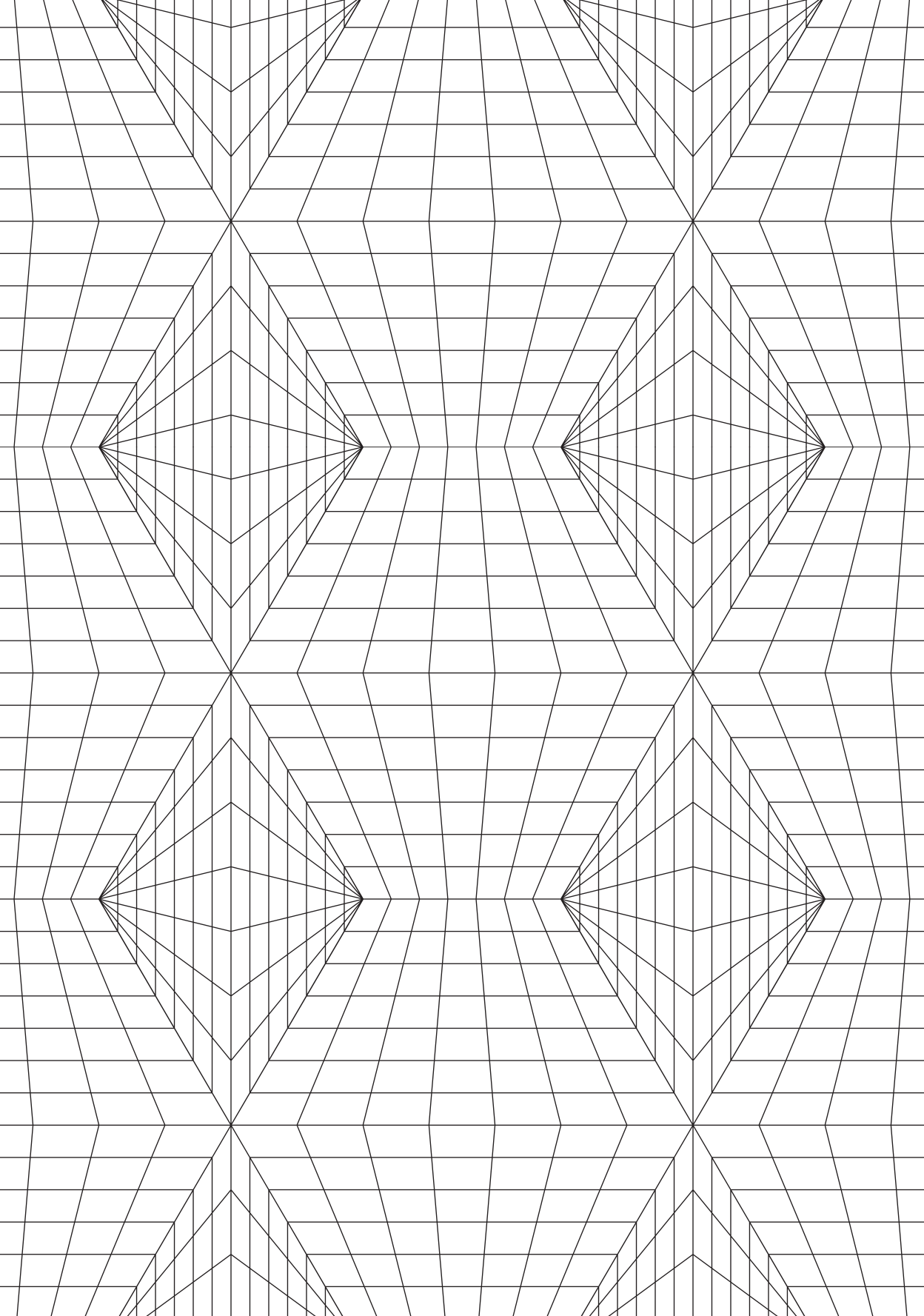
DISEÑO

VIIII/02_journal of design culture_Total(itarian) Design

DISEÑO



Disegno

Journal of Design Culture
Double-blind peer-reviewed, open access scholarly journal

Aims and Scope

Disegno publishes original research papers, essays, and reviews on all aspects of design cultures. We understand the notion of design culture as resolutely broad: our aim is to freely discuss the designed environment as mutually intertwined strands of sociocultural products, practices, and discourses. This attitude traverses the disciplinary boundaries between art, design, and visual culture and is therefore open to all themes related to sociocultural creativity and innovation. Our post-disciplinary endeavour welcomes intellectual contributions from all members of different design cultures. Besides providing a lively platform for debating issues of design culture, our specific aim is to consolidate and enhance the emerging field of design culture studies in the Central European academia by providing criticism of fundamental biases and misleading cultural imprinting with respect to the field of design.

All research papers published in Disegno undergo a rigorous double-blind peer review process.
This journal does not charge APCs or submission charges.

Contact: *Moholy-Nagy University of Art and Design*
H-1121 Budapest, Zugligeti út 9–25.
disegno@mome.hu

The full content of Disegno can be accessed online: ***disegno.mome.hu***

Published by: *Csaba Kovács*
Publisher: Moholy-Nagy University of Art and Design, 1121 Budapest, Zugligeti út 9-25.

ISSN: *2064-7778 (print)* ***ISSN:*** *2416-156X (online)*

MOHOLY-NAGY
művészeti egyetem
university of art and
design budapest

DISEGNO_VIII/02_TOTAL(ITARIAN) DESIGN

Contents

DISEGNO_VIII/02_TOTAL(ITARIAN) DESIGN

CYBERNETIC MODERN DESIGN IN EMERGING POST-FORDISM

SYSTEMS THINKING, INDUSTRIAL TRANSFORMATION, AND THE LOGIC OF FLEXIBLE ACCUMULATION

Sándor Őze

ABSTRACT

The article investigates how early cybernetics shaped late modern design within the broader transformation from Fordist mass production to post-Fordist regimes of flexible accumulation between 1945 and 1975. It argues that transformations of capitalist production regimes constitute a necessary framework for analysing the designed environment. Part I outlines Norbert Wiener's cybernetics as an interdisciplinary methodology emerging from the Fordist military–industrial production, highlighting its implications for automation, networked infrastructures, and information-based conceptions of economy and labour. Part II examines two Bauhaus successor institutions—the HfG Ulm and The New Bauhaus/Institute of Design—to show how cybernetic concepts informed the shift from object-centred to systems-oriented design, redefining the designer as a coordinator of complex socio-technical networks. The article argues that cybernetics simultaneously expanded design's methodological repertoire and integrated it more tightly into industrial rationalisation and flexible production, while also contributing to the depoliticisation of modernist utopias by reframing political and social projects as technical problems of control, communication, and optimisation.

#cybernetics, #flexible accumulation, #post-Fordism, #depoliticization, #systems thinking

https://doi.org/10.21096/disegno_2024_20s

DISEGNO_VIII/02_TOTAL(ITARIAN) DESIGN

One of the most inspiring and—by now classical—associations in the history of technology is the parallel drawn between the Golem of the sixteenth-century Prague ghetto and the computers of the twentieth century. The interpretive overlap between Rabbi Loew's clay creature and programmed automata is most directly linked to Norbert Wiener, the father of cybernetics, and Gershom Scholem, the most significant twentieth-century scholar of Jewish mysticism. While Wiener (1966) employs the Golem in *God and Golem, Inc.* merely as a means of situating cybernetics and religion within a shared conceptual framework, Scholem—speaking in 1965 at the inauguration of Israel's first computer, named "Golem"—develops the analogy, analyses the sources of the Golem legend, and finally, through six questions and their discussion, "pits" the new Golem against the old one. The fourth of these questions broadly covers the subject matter of the present study: "Can the new Golem grow in stature and productivity? He certainly can, although with growing productivity we rather expect the Golem of Rehovoth [the new Golem] to shrink in size and to take on a more attractive and becoming exterior." (Scholem 1966, 62).

Although Scholem's question is not devoid of irony (he suggests the new Golem is clumsier than the old one), it nevertheless directs attention to a highly significant issue: the relationship between the design of a technology and its productive capacity.

CYBERNETICS AND LATE MODERN DESIGN

At some distance from the Golem analogy, this study investigates that relationship within a historical framework, between 1945 and 1975. Its primary working hypothesis is that the historical transformation of capitalism—in this case, the post–World War II restructuring of the production regime (from Fordism to the post-Fordist system of flexible accumulation)—constitutes a necessary point of departure for the analysis of our designed environment. From this perspective, I examine the influence of the early years of cybernetics on postwar modern design.

The interweaving of cybernetics and modern design is a well-studied field (Oswald 2012; Doblin 1974; Medina 2012; Krippendorff 1979; Fischer and Herr 2019) to which this study contributes an understanding of how cybernetics facilitated the integration of post-war modern design into the industrial structure of late capitalism. My aim is to demonstrate

how, during the 1960s and through the impact of Macy-period cybernetics, modern design came closer to the emerging networked industrial structure and, through it, to the production regime based on flexible accumulation (Harvey 1989). Put briefly, I ask how cybernetics facilitated the integration of post-war modern design into the industrial structure of late capitalism. My central claim is that the impact of cybernetics on design simultaneously expanded the practice and conceptual horizon of design, while also adapting it to the logic of industrial production, rationalizing and consolidating its visions of the future as well as its (diverse) political ambitions.

The study is divided into two parts. Part I introduces the key concepts of cybernetics and outlines its brief history, with particular attention to its effects on regimes of production. I investigate how flexible production already appeared in cybernetic research in the 1940s, thereby laying the foundation for the post-Fordist economic paradigm that became globally dominant in the 1970s.

Part II examines the relationship between post-war modern design and cybernetics. Here, I analyse the presence and influence of cybernetics in two post-Bauhaus institutions. I attempt to reconstruct the process by which late-modern design shifted towards systems design, both aligning with and, in part, anticipating the post-Fordist paradigm of the latter half of the twentieth century.

PART I

Frameworks

Cybernetics is difficult to approach. It is effectively a constellation of fields with continuously shifting frameworks and multidisciplinary aims. Its object can be research itself, tools, products, and general models for producing them. Its scale is unbounded: certain branches strive to understand cellular-level systems, while others think quite literally on a cosmic scale. It may be defined as an autonomous scientific discipline, a methodological approach, an intellectual movement, or a praxis. It can be interpreted as a bygone Cold War tendency and as a still-active and current organising force that established the basic logic of contemporary technology (Turner 2008).

To approach the history of cybernetics more closely, it must be restricted within reasonable limits. In the following, I will therefore briefly summarise not the specific research and results of individual branches of cybernetics, but rather the basic concept first defined by Norbert Wiener in 1946.

Why cybernetics? Although cybernetics exhibits numerous personal and historical overlaps, as well as conceptual convergences, with other system-theoretical endeavours of the second half of the twentieth century (such as general systems theory), this study focuses exclusively on early cybernetic research and identifies it as a formative force in post-war modern design. This necessarily reductive gesture not only keeps the scope

of the article within reasonable limits, but also reflects the fundamental differences between cybernetics and other theoretical constellations that developed partly in parallel with it (Umpleby and Dent 1999).

Among the various twentieth-century attempts to model systems, cybernetics stands out through its practical applications and its direct connection to information technologies and the emergence of digital design (Gergely 1979). Its technology-oriented perspective, attention to the interrelations of biological and mechanical systems, and concern with understanding automatic processes link it more closely to the history of post-war modern design than theoretical approaches that primarily aim to model relations among systems rather than their internal operations.

The post-war context of modern design is fundamentally shaped by its relation to industrial automation and by the adoption of emerging digital technologies as design methodologies. These constitute the principal areas in which cybernetics and modern design become intertwined.

I do not consider cybernetics a hard science, but rather as an intellectual formation, a culture-shaping force that created a general language and methodology for understanding systemic interrelations across numerous scientific domains. I will focus here on the early years of (first-order of) cybernetics, as defined and established by Norbert Wiener and his closest colleagues at MIT. The inquiry begins with the emergence of the concept of cybernetics in 1946 and ends in the late 1970s with the understanding that, given the nature of the concept, any end date can only be tentative.

About Cybernetics in General

"Cybernetics is the science of control
and communication in the animal and the machine."
—Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine*

The cybernetician engages in activities that may have biological, mechanical, physical, and social aspects. The aim of early cybernetics was to establish a universal methodology and scientific language that could make visible the commonalities among otherwise separate disciplines. Accordingly, cybernetics may appear in biology, analysing the automatisms of the human body such as neural networks or reflex systems; at the level of technological systems, in the description and design of automatic control systems, industrial infrastructures, robots, or computers; or at the level of social systems, where communication processes or the role of larger information networks come to the fore. Cybernetics thus serves as a bridge between the natural sciences, the technical sciences, and the social sciences since it seeks common, generalisable principles across different types of systems—such as the flow of information, mechanisms of control, and the structure of systemic processes in general.

Cybernetics is therefore an approach with its own methodology that situates the study of living and non-living systems within the same logical framework. By its very nature, it is interdisciplinary. Accordingly, it has been an international, collaborative scientific project —even though its two most significant trajectories, American and Soviet, with their institutional and network centres, could only function in relative isolation from one another.

The concept, by definition, entails a very broad frame. Through the institutionalisation process of early American cybernetics, we may come somewhat closer to understanding its general character. This process is in fact precisely datable.

American Cybernetics

The central figure of the American branch of cybernetics, and the one who gave the science its name, was Norbert Wiener. Between 1911 and 1944, Wiener participated as a theoretical mathematician in a series of science methodological discussions held at Vanderbilt Hall organised by scientists from Harvard Medical School. The explicit aim of these conversations was to illuminate blind spots that arose at the boundaries between specialised sciences and that could not be addressed within their own limited toolsets. The climate that emerged at Vanderbilt Hall foreshadowed the later work organisation of cybernetic research institutes: horizontal hierarchies and flexible collaboration across disciplinary divisions.

The Second World War was the most powerful catalyst for the institutionalisation of cybernetics. The US government established the Office of Scientific Research and Development (OSRD) to coordinate laboratories and research projects providing the scientific foundations for wartime armament. The OSRD was headed by electrical engineer Vannevar Bush, Wiener's close colleague at MIT. As the central financing body linking the academic and military spheres from 1940 onward, the OSRD was crucial; Bush, as a member of the National Defence Research Committee, reported directly to Roosevelt. The largest institutional support went to MIT. Among the OSRD's most important research centres was the Radiation Laboratory (RAD LAB), devoted to radar development and the military exploitation of microwave technology (Turner 2008, 24–25). It was in this environment that Wiener and Julian Bigelow began designing the first applied cybernetics project: an automatic, radar-guided anti-aircraft weapon, part of the Churchill-initiated Tizard Mission.

Why would mathematicians design a weapon, and why could such a weapon constitute the first project of a science aiming to establish a universal language?

Wiener and his research group developed predictive algorithms to calculate aircraft trajectories and future positions. These measurements had to be integrated into a mechanical system that operated

the weapon. For the automated anti-aircraft system to function properly—the synchronisation of the predictive algorithm, radar, aircraft, and bullet's velocity—collaboration among diverse specialists and a shared language were required. Wiener and his colleagues realised that the weapon's automatisms had to be derived from basic human physiological mechanisms of manual targeting. This insight led to the involvement of physiologists such as Arturo Rosenblueth, and to the transfer of models from control engineering into technological systems, most importantly the feedback loop and homeostasis. These became fundamental concepts of cybernetics.

Beyond its function as a shared linguistic framework, the feedback model occupies a central role in cybernetic thought. It enables artificial and natural systems to be interpreted within a single conceptual frame. The significance of this lies not merely in their common description, but in the establishment of a shared logical foundation through which human–machine interaction or ecological–social entanglements can be understood as components of integrated systems. Feedback thus operates not simply as an analogy, but as the most elementary formulation of a technological–social–natural systems perspective—a minimal structural schema that helps to blur the boundary between the interpretation of artificial and natural entities. In postwar modern design, this unified interpretation of designed and natural elements becomes a defining element of the technological imagination.

The very name cybernetics refers to feedback loop and to its roots in control engineering. Derived from the Greek *kybernētēs* (helmsman/governor), it denotes the field of self-regulation and information theory. The relation between a helmsman, the wheel, and the rudder provides one of the earliest and simplest demonstrations of a feedback loop: the helmsman adjusts the wheel in response to the ship's deviation from course, thus altering its future state. In a dynamic system, the system output (the information that the ship is turning in the wrong direction) feeds back into the system input (the helmsman), which changes the future state of the system (corrects the rudder). Wiener and his colleagues also applied the general model of the feedback loop to describe the basic situation of the anti-aircraft gun, enabling the same problem to be presented in a common theoretical model to all participants in the research, even though they spoke different professional languages.

Cybernetics thus emerged as the science of information-based regulation of complex, dynamic systems. The anti-aircraft project not only illustrates the emergence of general models, shared languages, and interdisciplinary research, but also reflects cybernetics' most fundamental idea: that most phenomena can be interpreted as complex systems with biological, technological, and even social subsystems. These systems—often capable of self-regulation—can be known, described, modelled, created, and controlled. Just as Wiener and his colleagues

conceptualised both the automated weapon and the enemy pilot as interlinked subsystems of a larger bio-electro-technical system, a few years later researchers would interpret neural processes, industrial production lines, networks of humans, animals, and artifacts, even national economies and power relations, within the same systemic framework. In the two postwar decades, these ideas were institutionalised through deliberate, expanding networks of interdisciplinary collaboration, the positioning of cybernetics across university systems, and the financing of its advances by the technological industries most able to exploit them.

The Total Position of the Cybernetician

According to Wiener, science has fragmented into specialisations since Leibniz. Few would claim to be simply a mathematician, physicist, or philosopher without specialisation (Wiener [1950] 1989, 15). Yet to illuminate blind spots left by disciplinary science, collaborative, transdisciplinary methods are necessary. The basic precondition is to treat problems as interconnected systems and to employ a general language and methodology equally applicable to a society or a frog's brain.[1] Only the components and structures differ; the tools of description and understanding remain the same.

The starting point of cybernetics, then, is the "total position" of the researcher: a knower, describer, controller, and designer of the comprehensive systems that constitute reality. This role, like that of Llull, Pascal, or Leibniz (the "patron saint" of cybernetics, Wiener 1948), extends to the creation of "thinking machines." The cybernetician is the possessor of a holistic knowledge, conceiving the world as a biotechnical structure, an information network, a dynamic system. The ideal artifact produced by such a figure is the cybernetic system: a biological or technological (or hybrid) system capable of feedback-based self-regulation. In Wiener's technophilosophy, a human being, a machine, a state, or even a continent can each be understood as cybernetic systems of different complexity. ([1950] 1989, 8–12)

Cybernetic Production Alternatives in Fordist Technology Development

As noted earlier, the history of cybernetics cannot be separated from American military-industrial research. The organised, institutional framework of the field, its first projects, and its earliest dedicated studies were funded and commissioned by the OSRD under Vannevar Bush. This is significant not only for the micro-history of cybernetics or American technopolitics, but also for embedding the field within broader economic processes.

If we emphasise the catalytic role of military research within Fordist production regime(s), cybernetics can be interpreted as part of an apparatus whose transformations shaped the structural transformation of production in twentieth-century capitalism. In the American case—home both to Fordism and to the dominant stream of cybernetics—wartime mobilisation and the associated state interventionism ("military

[1] *"What the Frog's Eye Tells the Frog's Brain?" (Lettvin et al. 1959) is historically important cybernetic research. It describes how vision is not a passive recording of stimuli but an active process of information selection. (Frogs have bug detectors!) Preprocessing within the retina, a finding of major significance for cybernetics—raising the question of whether the processing of information in machines and living systems might be governed by similar principles.*

Keynesianism") fundamentally determined the postwar character of Fordism. Between 1939 and 1944, the central instrument of recovery from the Great Depression was military production, during which the state extended control even over research previously detached from direct state authority (such as university laboratories) (Roberts 2016, 32–34). This was particularly true in sectors tied to military high technologies: nuclear research, radar, industrial automation, electrical engineering, and telecommunications. The leading figures of early cybernetics (Bush, Wiener, John von Neumann, Bigelow, and Ashby, among others) all worked in these industries (Wiener 1989 [1950], 15–28).

Cybernetics played a formative role within these sectors: it created shared languages and methods for technological design, enabling collaborative divisions of labour in a military-industrial apparatus otherwise dense with formal hierarchies. Beyond providing the linguistic and methodological basis for horizontal technological development, cybernetics was, by the late 1940s, already engaging questions of production-system optimisation, particularly in relation to industrial automation. Its modes of operation, and diverse conceptualisations of industry and production nonetheless shared certain defining features: industry was understood as a network of productive systems; labour was envisioned in decentralised frameworks; and economic processes were conceived as information-based structures (Turner 2008, 26–32).

The significance of these conceptions lies in their historical timing: even during the most productive period of militarised Fordism, with its reliance on assembly lines and state intervention, elements of flexible, project-based organisation and decentralised, automated industrial processes had already appeared in embryonic form in the network of cybernetic research institutions.

Cybernetic Logic and Flexible Accumulation

The perspective of cybernetics became embedded in economic, social-organisational and managerial discourses during the two decades following World War II (Franklin 2015, 39–89). The direct extension of *cybernetic logic* (Franklin 2015, 43; Tiqqun 2020, 51–60) to economics, the human sciences, and the social sciences began at the Macy Conferences (1941–1960), the most significant interdisciplinary conference series in the institutional history of cybernetics. In *Control—Digitality as Cultural Logic*, Seb Franklin (2015) undertakes a brief discourse analysis of these conferences, reconstructing the ideological stance and polarisation of early cybernetics. He goes on to critique the social applicability of cybernetic logic and its core models in the following terms: To grasp economic behaviour as functioning at the same level as instinctive reaction to stimuli is to uphold the classic assumption of liberal political economy—namely, that humans are intrinsically economic. To posit this economic being as (1) productive of homeostatic self-regulation across entire social systems and (2) requiring the construction and maintenance of a set of social, educational, and political (that is, epis-

temic) norms that valorise communicational exchange while rendering noncommunication aberrant is to add a "neo-" to this socioeconomic liberalism. (Franklin 2015, 50)

Beyond the critique of the fundamental question, Franklin identifies an important fracture among participants along two distinct lines of economic approach. One group of cyberneticians (including John von Neumann, Leonard Jimmie Savage, Paul Lazarsfeld, and Walter Pitts) shared a general "economic" perspective that pushed the individual, human dimension into the background, while the other group (Norbert Wiener, Warren McCulloch, Gregory Bateson) located the social application of cybernetic logic precisely in its critique of this reductionist economic view.

According to Franklin, this division fundamentally determined both the economic embeddedness and the ideological polarisation of cybernetics:

> *The contours of this basic opposition are illuminating if one seeks to track the intensification of the relationship between cybernetics and capital that developed through the second half of the twentieth century. The fundamental differences between two valences of cybernetics—one appearing as a stage in capital's expansion toward the informatic mode of real subsumption and one—perhaps naively—posited as incompatible with capitalist modes of production and social organisation—can be illustrated through two focal points in the opposed perspectives that emerged in the cybernetics group: the first concerns the relationship between games and social activity in general, and the second is centred on the depth to which computational metaphors for the human can be extended.* (Franklin 2015, 51)

Taking stock of the milestones of early cybernetics and summarising its economic outlook and its visions of production, we find ourselves faced with the defining criteria of post-Fordist flexible production (Boyer and Durand 1997, 11–18). Cybernetics emerged within the context of Fordism (specifically in the military-industrial sector), and one of its most significant aims was the construction of alternatives to Fordist manufacturing technologies (notably automated production). Participants in production worked in projects, under flexible contractual relations with employers; they conceived of labour activity, its object, and the act of design itself as information networks. The nature of labour was based on specialised knowledge that extended beyond national borders, operated within global institutions, and took shape using industrial infrastructures connected with those institutions.

The macroeconomic and social vision of cybernetics, moreover, was closely aligned with neoliberal economic philosophies: although polarised, it nonetheless built upon the classical liberal ideal of *homo economicus*, supplementing it with the notion of a self-regulating and perpetually existing (homeostatic) economy and with institutions whose function was the maintenance of communicational exchange.

Cybernetics was thus a technological and managerial catalyst for the emergence of a flexible regime of production. Through its new models of industrial organisation and economic management, as well as the establishment of the basic languages of digitalisation, cybernetic research laid the foundations for the design and work-organisation methods of contemporary technological industries. This microelectronics-based sector continues to determine the technological and organisational logic of the accumulation regime to this day.

PART II

Classical Modernism and Cybernetic Logic: Two Examples

Although cybernetics only became an established field with institutions and representatives during World War II, the concept can retrospectively be extended to systems that reflect its basic logic. In its broader usage during the 1940s, Wiener and his collaborators were able to connect early cybernetic research to existing scientific results and to integrate already developed concepts into their own interpretive framework (Wiener 1948).

The techno-utopian branches of the classical avant-garde in the early twentieth century created, across a wide range of media, multiple variations of what can retrospectively be regarded as cybernetic systems. In the first short example below, I demonstrate the applicability of the language of cybernetics to modern design through a paradigmatic work of classical modernism. In the second example, I present the appearance of cybernetic logic and subject matter in another widely known work.

László Moholy-Nagy's *Telephone Pictures* (1923)

The concept of the *Telephone Pictures* is simple: the designer telephones an enamel factory, and a factory worker answers. Moholy-Nagy dictates the colour codes and coordinates, and the worker, using the painting machine, produces the line composition and its variations.[2]

This process, described with the tools of cybernetics, may be represented as a negative feedback model (fig. 1).

[2] *László Moholy-Nagy explained the making of the Telephone Pictures within this framework in 1944. Whether the works were in fact produced in precisely this manner remains uncertain. In* Moholy-Nagy: Marginal Notes, Documentary Absurdities (1972)*, his first wife, Lucia Moholy recalls that the artist personally went to the factory. Regardless of the actual sequence of events that led to the production of the pictures, I take Moholy-Nagy's—presumably retrospective—narrative as my point of departure.*

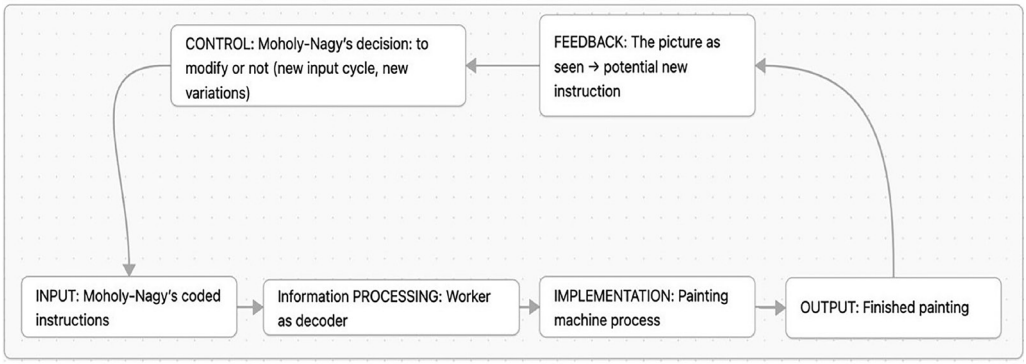


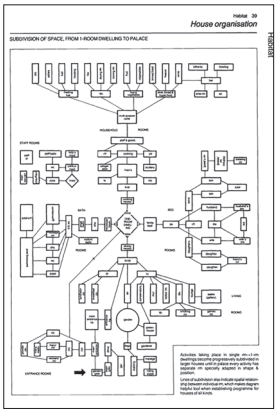
FIGURE 1. *Formation of telephone picture variations in a negative feedback model.*

Describing the work with cybernetic concepts does not reveal much since the feedback model is by definition suited to the representation of dynamic systems. What is more interesting is that through the lens of cybernetics we can model the painting, its process of creation, and its creator as a dynamic, variable biotechnical system.

Ernst Neufert: Data and Typification in *Architect's Data*

Ernst Neufert was Walter Gropius's secretary at the Bauhaus. Later, he was among the few Bauhaus members who were able to continue their design careers in Germany under National Socialism. Neufert became closely tied to the power apparatus of the Third Reich. In the second edition of his 1936 magnum opus *Bauentwurfslehre* (*Architects' Data*), the 1943 preface was written by Albert Speer. From 1938 onward, Neufert was employed by the Reich, working on the standardisation of architecture and of military-industrial infrastructure.

The starting point of *Architects' Data* is the idea that architecture and human spatial presence can be described, converted into data, and from this a universal architectural methodology can be developed. Like cyberneticians, Neufert regarded architecture and humans as a uni-



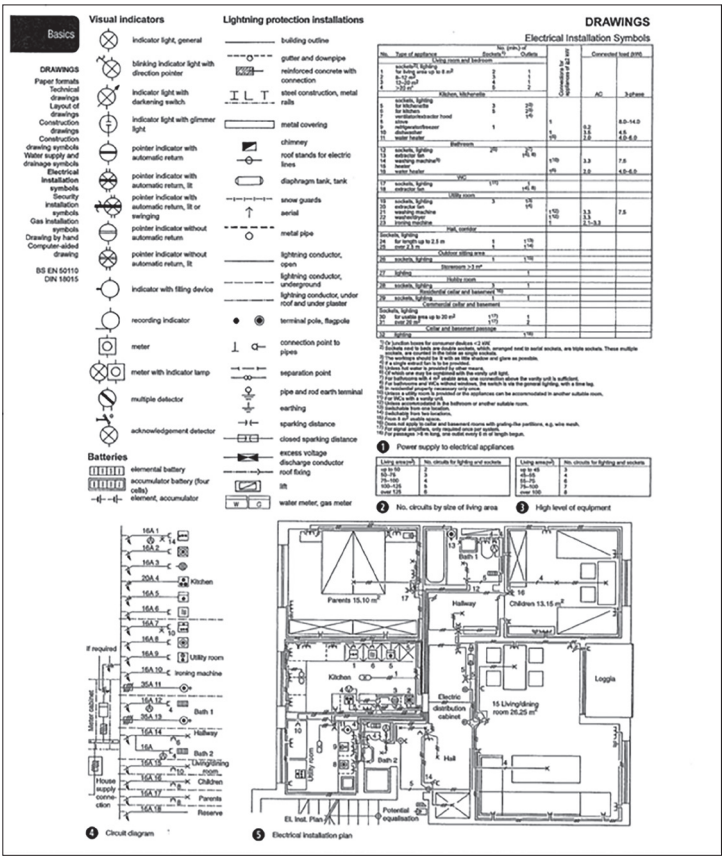


FIGURE 2. *Ernst Neufert's standardised installation symbols for a building's electrical network (left) and the subdivision of living space and specialised spatial uses in his network-based diagram (below). Adapted from Neufert's* Architects' Data *(1998).*

fied system. For example, by measuring the physiological effects of optimal room temperature, he established general design procedures and created a universal sign system. He also devised basic symbols for the general description of a building's electrical networks and created a universal measurement and data-based language which paved the way for manufacturing and design automation. Neufert's *Architects Data* is still regarded as a foundational work and can be considered an early precursor of parametric design.

The reliance on data, development of universal methodologies, and simplified modelling of complex systems are also found in the logic of cybernetics. Neufert's hyper-rational description tied to large-scale industrial technologies and oriented toward automated production reflects the mindset of the industrial rationalisation aims of the post-war era. It also resembles the system-building, language-generating position of the cybernetician in the way it encodes the human-biological and technological meta-system into a unified graphic structure.

Post-War Modern Design and Cybernetics: Two Examples

In the two decades following the World War II systems design emerged as one of the main currents of modern design. It appeared in the design-related exhibitions of MoMA, in the Bauhaus successor institutions, in the corporate design of major American multinational companies (Harwood 2011), and from the 1960s onward in the increasingly influential computer industry.

The basic premise of systems design is that a designed object does not exist in isolation but as part of a technological, social, and biological system. The development of its theoretical foundations was closely intertwined with the international expansion of cybernetics. In the following short institutional overview, I illustrate this process by highlighting two institutions most directly linked to the Bauhaus where specialised design education took place, and by briefly presenting several key figures. Specifically, I examine the emergence of the cybernetic paradigm at the Hochschule für Gestaltung Ulm and at The New Bauhaus/Illinois Institute of Design. I do so with the understanding that the full scope of its impact on students, faculty, and the functioning of education would require far more extensive institutional research.

Hochschule für Gestaltung Ulm

The influence of cybernetics appeared most visibly at the Bauhaus's German successor institution, the Hochschule für Gestaltung Ulm (HfG). The rise of semiotic and information-theoretical approaches was closely linked to the internal debates that followed the school's founding, debates that centred on the question of whether design should be defined as a scientific or as an intuitive endeavour. The conflict culminated in the resignation (and soon after departure) of Max Bill, who served as rector between 1953 and 1955. Bill would have placed the Bauhaus tradition of craft, designer-centred practice artistic heritage at the core of education,

while most of the institution's theoretical faculty members approached design and the role of the designer through the emerging sciences of information shaped by cybernetics. With the appointment of Tomás Maldonado as rector in 1956, the cybernetic approach to design became the primary focus of the curriculum (Oswald 2022).

Already in 1951, the school's anti-fascist, science- and function-centred program included a teaching module entitled "Information," which initially covered broadly defined political journalism. In connection with the conflict surrounding the design approach developing at the institution, Max Bense took over the management of the module, now operating officially as the Information Department, in 1955. This is when cybernetics became a taught subject. In the same year, Bense invited Norbert Wiener as a guest lecturer to introduce the basic context of cybernetics. The Information Department quickly developed into the intellectual centre of the school and shaped the character of practical design studies as well, emphasizing information-based design methodologies and industrial typification. Although after Bense's departure in 1958 the department lost its direct cybernetic and information-theoretical orientation and returned to the function it had served in Bill's period (journalism), cybernetics nevertheless remained an active part of the curriculum through other instructors. For instance, methodological courses by Horst Rittel and Gui Bonsiepe were taught within a cybernetic framework, and Abraham Moles—later president of the French cybernetics society—taught the social sciences (Oswald 2012; Krippendorff 2008, 63–64).

The impact of cybernetics (and of information theories based on it) at Ulm cannot be reduced to individual careers, courses, or specific objects designed at the school. Rather, it constituted one of the fundamental organising principles of teaching and institutional thought. This is evident not only in the methodological models of Rittel, Maldonado, or Bruce Archer, which laid the foundations of the school's design-educational structure (Dubberly 2004, 7), but also in the cybernetically based design theory of students-turned-instructors such as Klaus Krippendorff and Gui Bonsiepe. Cybernetics contributed to a redefinition of the role of the designer. No longer understood merely as a form-giver or aesthetic decision-maker, the designer was reconceived as the coordinator of complex systems and diverse interests. Parallel to the position of the cybernetician, the designer emerged as a "total" figure, whose central task was the control and management of the design process conceived as a system—a role inseparable from the postwar transformation of production organisation.

The post-Fordist industrial structure, in which the standardised, hierarchical, and spatially fixed logic of mass production was replaced by flexible, customizable, and information-driven production, demanded the integration of diverse expertise, manufacturing technologies, differentiated (or more precisely individualised) user needs, and new market strategies. This required a design attitude capable of organizing these system elements into a coherent whole. The cybernetically based

pedagogy and methodology of the HfG Ulm was therefore not merely an educational reform but an anticipatory response to the restructuring of the relationship between design and industry: the designer as a systems thinker and strategic integrator became one of the first professional prototypes of post-Fordism.

The New Bauhaus/Illinois Institute of Technology – Institute of Design

At the other direct successor institution of the Bauhaus, The New Bauhaus founded by László Moholy-Nagy, the perspective of cybernetics was already evident in the late 1940s, particularly in the courses of Buckminster Fuller and Konrad Wachsmann. Fuller, one of the most significant representatives of modern design at the time in the United States, developed his own system theory, focusing his work on the design of ecological and technological subsystems. His ideal designer, the so-called *comprehensive designer* (Fuller 1963, 173), was conceived as a figure who crossed disciplinary boundaries, created bridges between different forms of design activity, and coordinated design processes within a unified system. In his most famous work, *Spaceship Earth*, Fuller compares the entire planet and its ecological-social problems to an automated system of a spaceship, with the designer as the controller of biotechnical processes. Fuller lectured as a guest at Ulm, at Black Mountain College, and at MIT.

Between 1949 and 1964, Konrad Wachsmann taught at the school, where he also established his own research institute, the Advanced Building Research Division. Like Fuller, Serge Chermayeff, Moholy-Nagy, or György Kepes—just like all early cyberneticians, and numerous modern designers who emigrated to the United States—, Wachsmann participated in American military-industrial developments during the Second World War. He focused on architectural typification and the design of mass-producible modular infrastructures and building elements. After the war, he continued project-based research on state and military architectural automation, for example, for the Federal Housing Agency and the US Air Force. The Advanced Building Research Division functioned as a supporting institution for these projects. Wachsmann's work and teaching were based on cybernetic thought. The most illustrative example is the Modular Coordination Classification System (1951–52). Funded by the Federal Housing Agency, the project envisioned a general, modular, mobile information centre that could be installed in any space and that, using early punch-card technology, classified design-related information and made it easily accessible in an integrated system for designers. Wachsmann and his students built the system into an integrated desk-like furniture unit. He also imagined the organisation and content of teaching in algorithmic order—a model he later expanded, as a professor at the University of Southern California, into a cybernetic system encompassing architectural education and university structures across the United States (Isbilen 2023, 125–31).

With its merger with the Illinois Institute of Technology and its transformation into the Institute of Design (ID), the school shifted even more decisively toward systems design in the 1950s. During the transformation, the ID was directed by Serge Chermayeff, who taught continuously at leading American universities (MIT, Harvard, Yale) between 1949 and 1971, precisely when cybernetics was gaining traction in American academia. Chermayeff turned to design methodology and architectural methodology; in his *Community and Privacy* (1965), co-authored with Christopher Alexander, he examined the potential of computer technologies in architecture and urban planning. Their initial model for analysing cities in terms of changing social processes came from Heinz von Foerster, a cybernetician and originator of second-order cybernetics. Alexander's later work also reflects the influence and perspective of cybernetics, focusing on information as the fundamental element of architectural representation and on language-making. His essential book *Pattern Language* articulated a new architectural methodology and language (Alexander 1977, 9–23).

After Chermayeff's resignation, Jay Doblin became head of the Institute of Design in 1955, and under his leadership the entire curriculum was oriented toward a cybernetic interpretation of design. The school's own contemporary self-description refers to the period between 1955 and 1969 as the "system era" (Institute of Design. n.d.). This perspective is also reflected in Doblin's invitation of Ken Isaacs as a visiting lecturer in 1961, who taught his methodology of flexible, modular, homeostatic environments. The structure, which Isaacs called the "matrix," originated in a 1957 course at Cornbrook, whose required reading was Wiener's *Cybernetics* (Margolin 2002, 64–65).

Under Doblin, the Institute's educational policy was directed toward the professionalisation of design, emphasizing the industrial and economic rationalisation of design and highlighting the role of the designer—paralleling the Ulm HfG—as a system controller and manager. In his theoretical writings, Doblin used cybernetic models to describe design methodologies (e.g. information in a design-model; the design circle), linking these to the impact of increasing industrial automation on design and to the emergence of postwar flexible production. (Doblin 1985, 18–32) Perhaps most explicitly in his late essay "A Short, Grandiose Theory of Design" (1987), Doblin tied cybernetics-based design methodologies to the conditions of post-Fordist production. The models presented there sought to interpret and facilitate the design process within a structure of production where the central issue was adaptation to corporate ecosystems and industrial networks (Doblin 1987).

The developmental trajectory of the Institute of Design rooted in The New Bauhaus illustrates how modern design adapted to industrial and economic transformation. Wachsmann's modular pre-digital systems, Fuller's complex eco-technocratic visions and the position of the comprehensive designer as a managerial figure combined the holistic logic of cybernetics with the designer's role in flexible production organisation

and with the requirements of automated industrial production. In the postwar decades, the school increasingly placed design education in the service of economic and industrial integration: under Doblin, the central aim of education became the professionalisation of design and the advancement of industrial rationalisation, explicitly aligned with post-Fordist conditions of production. In Doblin's theory of design, this educational policy was articulated in the language of cybernetics-based methodological models. He also summarised the nature of economic transformation (from "Victorian repetition" to industrial automation, individual consumer culture, and the rise of the technological sector) within this framework:

> Automation is more than replacing workers with electronic controls. In production it means a shift in concept from the Victorian "repetition" machines that perform highly specific tasks to a new breed of cybernetic machines that have sensory-response capacities. These machines can sense the need for a particular product, respond by making enough of them to satisfy the demand, and vary each product to suit the demands of individual customers. The computer, the exemplification of the new breed of machines, is rapidly becoming the largest industry. (Doblin 1970, 126)

* * *

Beyond the two institutions discussed above, cybernetics appears in the careers of numerous designers as one of the central organising principles of thought and creation. Yet this study cannot aim to be exhaustive in presenting every career in modern design linked to cybernetics. Within the analysis of the field's entanglement with the postwar modern movement, however, figures such as György Kepes, Iannis Xenakis, Nicolas Schöffer, and Eliot Noyes[3] are just as indispensable as the designers and cyberneticians mentioned above.

Cybernetics as a Force of Depoliticisation in Design: Two Examples

As indicated in Part I, cybernetics is not ideologically homogeneous. We have classified early cybernetics into two major orientations in terms of applicability to socio-economic relations. On one hand, there is a form of "economic reductionism" that breaks down behaviour into information flows and optimisable decision rules; on the other hand, one finds an approach that interprets social and natural systems analogically through the basic concepts of cybernetics. The ideological divergence of the Macy Conferences is particularly significant here because this fault line is likewise identifiable in the design practices that emerged in the wake of early cybernetics. In this respect, the difference appears between design that understands systems planning/interpretation as an emancipatory social practice (A—e.g., Gui Bonsiepe and Klaus Krippendorff) and design that conceives systems planning as a tool of effective industrial rationalisation or management technique (B—e.g., Eliot Noyes).

[3] *First working in the architectural office of Gropius and Breuer, and later at Harvard and MoMA on the institutionalisation of the modern movement, Noyes then passed through the research and development laboratories of the US Air Force, and eventually became a design consultant for IBM, where he redesigned the entire information technology corporation. He developed unified interface systems for IBM computers, created the company's first corporate identity (which became the archetype of the global tech corporation), and contributed to the design of several IBM buildings as well as the company's business management strategy. Noyes's career encapsulates the full trajectory and applications of cybernetics: from the 1950s onward and in his role as designer-manager, he worked for the company under flexible contractual arrangements with his own independent team. The most distinctive element of his oeuvre lies in the establishment of the design language for the first global corporation of the information technology industry (Bruce 2006; Harwood 2011).*

In the former case (A) the language of cybernetics necessarily reduces political conflicts of interest to questions of technological infrastructure. In the latter (B), the end point of design is efficient production—which, in many cases, also includes social aspects (e.g., Konrad Wachsmann and Jay Doblin)—that is, the most extensive possible exploitation of the industrial-economic conditions of design. In both cases, the depoliticising dimension of cybernetics' deeply technocratic language prevails.

Cybernetic research focuses on the present-tense understanding and modelling of given problems. It is a mode of problem-solving that regards the task facing the designer as always describable and thus knowable. The viewpoint that the designer's primary task is to analyse, understand, and solve the problems of the existing system is difficult to reconcile with the utopian visions of modern design in the interwar period. The often hazy and at times irrational utopian future imagined by design understood as an instrument for constructing a new man and a new society and a completely new form of living does not fit into the operationalised reality of cybernetics—measured by all available means and modelled within its own system. In the case of cybernetic design, the transformability of the future is derived from the understanding and control of total systems. Cybernetics (and the systems theories that emerged from it) provided the theoretical foundations of systems-oriented design and preserved the conception of a designer figure as total as the utopian constructor of the early radical modernists while simultaneously displacing its explicit political content. In the two decades following the World War II, the comprehensive designer calibrates, options, calculates; the human being is seen as a user, and the use of the designed object is viewed as a unified biotechnical feedback loop composed of human–machine inputs and outputs. This perspective differentiates, for example, Buckminster Fuller's flying city design from Georgii Krutikov's flying city project. In Fuller's Cloud Nine (1960), the focus is on the technology of flying geodesic domes and a vision of a utopian technology. The designer asks what possibilities there are for solving the detected eco-crisis through the technology he has invented. By contrast, Krutikov's diploma project at VKHUTEMAS (1917) imagines on a technology yet to come. It does not specify anything; it simply plays with the idea of how a home might be provided for the "new human" once the earth's resources have been exhausted. It seeks to provide an image of a future reality in which, through technology, the spaces of work and life become more radically separated than ever before.

A similar parallel may be drawn between the towers of Vladimir Tatlin and Nicolas Schöffer. Tatlin's 1917/18 *Monument to the Third International* functions, from a future vantage point, as the political–cultural centre of a world society formed by the total expansion of revolution, commemorating the events of 1917. In this vision, we see the technology of world society appear in the rotation of the tower's glass bodies and in the grand steel spiral. For Tatlin, technology appears as a collective

force, possessed by human society and directed by the Communist Party, which revolutionises and represents society as a whole, freed from class divisions.

Like the *Monument to the Third International*, Schöffer's *Tour Lumière Cybernétique* (1962–1973) can also be understood as a manifesto with its own vision of the future. In Schöffer's case, the data-driven control theory of cybernetics projects a harmonious, hyper-rational future in which social functions are regulated by a technological apparatus that collects and interprets real-time data. By gathering and quantifying the society's aggregate information, the tower produces a kind of "democratic synthesis." At the urban scale, environmental and institutional data measured by the tower's sensors (transport, media, weather, etc.) would regulate the rhythms of the city in a continuous feedback loop. The aim is not the communication of information but an affective impact (a spectacle of light and sound) that softly controls social life. In this perspective, politics—and, more generally, the organisation of human communities and their conflicts of interest—becomes marginal. As Schöffer himself formulates it, the most significant difference between Tatlin's tower and his own is that while Tatlin's is political, the aim of the cybernetic towers is to establish a kind of "osmosis" within the political and social relations of the continent. Schöffer thus articulates, through cybernetics, a profoundly depoliticised vision of the future. In this conception, individual, group, or class participation is less relevant, and the idea of shaping society is reduced to real-time, data-driven, rationalised, technocratic governance. Schöffer's thinking clearly projects utopian tendencies of total social integration. "The tower will certainly not be an end, but an example and a beginning. It will be a detonator opening the way to other achievements on other scales, which will be able to weave ever closer links between people and life with a view to their greatest success, that is to say their greatest happiness." (Schöffer 1969) However, the strict logic of cybernetics and the idea of human organisation and political action drops out of the equation. Whereas in Tatlin's vision total informational and political control is held by the revolutionary party—which, according to the Leninist ideas of the period, concentrates the entirety of the politically active community of interest—in Schöffer's case this role is transferred to the technological apparatus, whose operating logic is cybernetics. (Jørgensen 2024)

While in the *Monument to the Third International* the primary informational function is the maintenance of the revolution through party agitation (Punin 1993 [1920]), in the cybernetic tower it is the creation of social "harmony" by means of data-based operationalisation. The basic situation of Tatlin's tower is the revolutionary transformation of humankind; in Schöffer's it is the total extension of contemporary technological logic. Naturally, the *Monument to the Third International* and the TLC tower are radical examples that sought to present their own underlying logics—Bolshevism in Tatlin's case, cybernetics in

Schöffer's—in total form, but precisely for this reason they are suitable for revealing the differences in technological outlook between the prewar and postwar modern movements.

The practice of systems-oriented design transformed the modern design imaginary, rationalizing it and pushing into the background the radical utopian tendencies of classical modernism. Cybernetics provided a toolkit for the emergence of new languages and new methodologies for design theory and practice, thereby drawing the methods and forms of modern design closer to the transforming postwar industries. The basic logic of cybernetics—thinking in knowledge-producing networks and in flexible work organisation associated with them—became embedded in the institutional history of modern design. It shaped the aims, scale, future vision, and practice of design. Among systems-oriented design projects one finds numerous works that, within different frameworks, address the erosion or opposition of the existing economic–political system (e.g., Bonsiepe's Cybersin project and Fuller's Spaceship Earth), and also works that regard design as a tool of effective industrial integration (e.g., Noyes, Doblin, and Wachsmann) within a production system based on flexible accumulation. These very different projects nevertheless share a common feature: they conceive of design as the solution to a mapped and describable set of problems, and they regard information as the raw material of design.

The influence of cybernetics on design simultaneously expanded the conceptual horizon of design, its practice, and the range of methodologies. At the same time, the language of technological rationalisation, subordinated the utopian, confrontational political dimensions of modern design. Whether in techno-utopian or market-pragmatic form, design became a question of modelling information and regulating inputs and outputs. Cybernetics was therefore not only a toolkit but also a depoliticising frame for the transformation of postwar modern design.

REFERENCES

Alexander, Christopher. 1977. *A Pattern Language*. Oxford: Oxford University Press.

Boyer, Robert, and Jean-Pierre Durand. 1997. *After Fordism*. London: Palgrave Macmillan.

Bruce, Gordon. 2006. *Eliot Noyes*. London: Phaidon.

Chermayeff, Serge, and Christopher Alexander. 1963. *Community and Privacy*. Garden City: Doubleday.

Doblin, Jay. 1970. *One Hundred Great Product Designs*. New York: Van Nostrand Reinhold.

Doblin, Jay. 1985. "Information and Design: The Essential Relation." In *Design in the Information Environment: How Computing Is Changing the Problems, Processes and Theories of Design*, edited by Patrick Whitney and Cheryl Kent, 18–32. Carbondale and Edwardsville: Southern Illinois University Press.

Doblin, Jay. 1987. "A Short Grandiose Theory of Design." *STA Design Journal*, Analysis and Intuition, 6: 6–16.

Dubberly, Hugh. 2004. *How Do You Design: A Compendium of Models*. San Francisco: Dubberly Design Office.

Dubberly, Hugh, and Paul Pangaro. 2019. "Cybernetics and Design: Conversations for Action." In *Design Cybernetics: Navigating the New*, 85–99. Cham: Springer.

Fischer, Thomas, and Christian M. Herr. 2019. *Design Cybernetics*. Cham: Springer.

Franklin, Seb. 2015. *Control: Digitality as Cultural Logic*. Cambridge, MA: MIT Press.

Fuller, R. Buckminster. 1963. *Ideas and Integrities: A Spontaneous Autobiographical Disclosure*. Englewood Cliffs: Prentice Hall.

Gergely, Tamas. 1979. "On the Unity Between Cybernetics and General System Theory." *Kybernetes* 8: 45–49.

Harwood, John. 2011. *The Interface: IBM and the Transformation of Corporate Design, 1945–1976*. Minneapolis: University of Minnesota Press.

Institute of Design. n.d. "Forming a New Bauhaus." Accessed 29 November 2025. https://id.iit.edu/new-bauhaus/

Isbilen, Ezgi. 2023. *Universalism and Its Discontents: Konrad Wachsmann's Twentieth Century Architecture*. PhD diss., Virginia Polytechnic Institute and State University, Architecture and Design Research.

Jørgensen, Nina Stener. 2024. "The Power of the Tower: Nicolas Schöffer's *Tour Lumière Cybernétique* for La Défense (1962–1973)." *Architectural Histories* 12 (1): 1–19.

Jørgensen, Nina Stener, and Guillaume Laplante-Anfossi. 2022. "Closing the Open System: Review of Nicolas Schöffer's *La Tour Lumière Cybernétique* (1973)." *Footprint: Open Architecture—Tradition, Possibilities and Shortcomings*(Autumn/Winter): 135–44.

Krippendorff, Klaus, ed. 1979. *Communication and Control in Society*. New York: Gordon & Breach.

Krippendorff, Klaus. 2008. "Designing in Ulm and off Ulm." In *HfG Ulm; Die Abteilung Produktgestaltung; 39 Rückblicke*, edited by Karl-Achim Czemper. Dortmund, Germany: Verlag Dorothea Rohn: 55–72.

Lettvin, J. Y., H. R. Maturana, W. S. McCulloch, and W. H. Pitts. 1959. "What the Frog's Eye Tells the Frog's Brain." *Proceedings of the IRE* 47, (11): 1940–51.

Medina, Eden. 2011. *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile*. Cambridge, MA: MIT Press.

Margolin, Victor. 2002. *The Politics of the Artificial: Essays on Design and Design Studies*. Chicago: University of Chicago Press.

Moholy, Lucia. 1972. *Moholy-Nagy: Marginal Notes, Documentary Absurdities*. Krefeld: Scherpe.

Neufert, Ernst. 1998. *Architects' Data*. 2nd int. Eng. ed. Oxford: Blackwell.

Oswald, David. 2012. "The Information Department at the Ulm School of Design." *Blucher Design Proceedings* 1 (1): 46–50. Proceedings of the 8th International Committee for Design History & Design Studies (ICDHS). São Paulo: Blucher.

Oswald, David. 2022. "Cybernetics, Operations Research and Information Theory at the Ulm School of Design and Its Influence on Latin America." *AI & Society: Journal of Knowledge, Culture and Communication* 37: 1045–1057. doi:10.1007/s00146-021-01339-1. Punin, Nikolai. 1993 (1920). "The Monument to the Third International." In *Art in Theory, 1900–1990: An Anthology of Changing Ideas*, edited by Charles Harrison and Paul Wood, 337. Oxford: Blackwell.

Roberts, Michael. 2016. *The Long Depression*. Chicago: Haymarket.

Schöffer, Nicolas. 1969. *La Ville Cybernétique*, translated by Jørgensen and Laplante-Anfossi. Paris: Tchou.

Scholem, Gershom. 1966. "The Golem of Prague and the Golem of Rehovoth." *Commentary* 41 (1): 62.

Tiqqun. 2020. *The Cybernetic Hypothesis*. Translated by Robert Hurley. South Pasadena: Semiotext(e).

Turner, Fred. 2008. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: University of Chicago Press.

Umpleby, Stuart A., and Eric B. Dent. 1999. "The Origins and Purposes of Several Traditions in Systems Theory and Cybernetics." *Cybernetics and Systems* 30: 79–103.

Wiener, Norbert. 1948. *Cybernetics: Or Control and Communication in the Animal and the Machine*. Cambridge, MA: MIT Press.

Wiener, Norbert. 1966. *God & Golem, Inc.: A Comment on Certain Points Where Cybernetics Impinges on Religion*, vol. 42. Cambridge, MA: MIT Press.

Wiener, Norbert. (1950) 1989. *The Human Use of Human Beings: Cybernetics and Society*. Reprint, London: Free Association Books.