DESIGN OF ELECTRONIC/ELECTRICAL SYSTEMS IN THE SOVIET UNION FROM KHRUSHCHEV'S THAW TO GORBACHEV'S PERESTROIKA

MADE IN THE USSR

FOUR ESSAYS ON RUSSIA
MADE IN THE USSR
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In the year 2070, "Made in the USSR will be a brand guaranteeing high quality", dreamed Mikhail Ladur, editor-in-chief of the journal *Decorative Arts in the USSR*.[1] In the early 1960s, the journals of design exuded optimism and confidence. Design, "industrial arts" (*promyshlennoe iskusstvo*), was to re-make the ugly, low-quality products into well-made and appealing ones. To learn from international experience was no doubt of crucial importance; the goal however was to formulate a supremely Soviet brand.

The display of home kitchens at the American National Exhibition in Moscow in 1959 shocked people in the Soviet Union and resulted in the so-called kitchen debate in the media between Soviet leader Nikita Khrushchev, and US leader Richard Nixon.[2] The US exhibition showed ideal, fully equipped kitchens with abundant high-tech electrical devices in the service of making the life of the suburban American housewife even more glamorous. Clever propaganda is effective. The US initiative of showing the latest technology for the home shifted the attention from prestigious military displays to the everyday, and thus made the enormous contrasts between the American and Soviet ways of life painfully visible. Showing that it was possible to make women's lives easier with high-tech electrical appliances even made the blessings of space travel seem very distant for visitors to the exhibition, many of whom were lonely mothers from dirty and noisy communal apartments on one of the innumerable Lenin Streets in Leningrad, Asbestos, Stalinsk, or any of the other towns in the Soviet Union. Nevertheless, Khrushchev's public response was: "We too have these things." Despite Khrushchev's public reaction to the enviable American display, he was well aware that, in comparison, his own country fell short.

The average standard of living was much lower in the USSR than in the West. The main output of Soviet industry was military equipment. Goods for personal consumption were constantly in short supply. The production of consumer goods, or *shirpotreb* – the term is a typical Soviet potpourri of abbreviations, literally "goods for broad consumption" – was given low priority. Forced upon the factory directors from above, mostly leftover materials and machines not designed for more important goals were used. The products produced were so unpopular that *shirpotreb* gradually became a swearword. Despite the constant scarcity of just about everything, despite having to wait in line for staple goods, these low-quality products often remained unsold and caused an enormous glut, or *zatovarivanie*. The phenomenon of *shirpotreb* was a result of the elimination of market forces, and without any proper market surveys, neither the consumers nor their needs were identified. What or how much was to be produced was left utterly to chance or the caprice of those in power. The postponement of happiness in the wait for the communist paradise that lurked in a constant tomorrow needed more concrete, material rewards today. Concerned with securing his popularity, away from the public eye, Khrushchev quickly assembled a group of individuals who were to tackle the competition to "catch up with and surpass America".

A few years later, VNIITE, the Federal Scientific Research Institute for Technological Aesthetics (*Vsesoiuznyi nauchno-issledovatel'skyi institut tekhnicheskoi estetiki*), was inaugurated. Founded in Moscow in 1962, VNIITE, one of the many scientific research institutes created in the 1960s that were focused on applied science, was, however, the only institute devoted to the aesthetic and ergonomic user side of design and construction.[3] As an institute for production design (what technological aesthetics concerned itself with), one of VNIITE's tasks was to improve the conditions of production as well as the products in, above all, heavy industry, especially machine and tool construction. This industrial branch of the economy was the pride of the Soviet Union and was often put on display (recall all the images from production plants and factories shown in Soviet propaganda). To be sure, reverse engineering and styling to make technologically outdated goods appear more fashionable was applied to achieve quick results, but, additionally, one of the tasks of the institute was to "invent" design methods within the planned economy by exploring the technology-science-art relation as much as possible.

One key was finding a language common to these different spheres of culture. Since the engineers liked the notion of "objectivity", an extensive discourse took place in journals and books on design about reconciling the culture of artists and that of engineers. In his article "On the Aesthetic Values of the Machine", the Marxist philosopher of art Karl Kantor suggested that this ephemeral concept can be understood by connecting the beauty of the artifact with the "objective beauty" of mathematics.[4] With its geometric forms, the modernist style delivered this "objective" universal language, which was at the same time appropriate because it was able to provide shapes for standard modules.

With respect to the fashion of styling of goods, interesting asymmetries appear when comparing the public discourse of art and that of design. Interestingly enough, 1960s and 1970s progressive life was embodied in the modernist style preferred by the very highest echelons, such as those responsible for Soviet trade contacts with the West. With the Soviet wish to appear as a technologically advanced, progressive society in the international arena, journals on production design and decorative arts promoted a restrained and sober 1960s modernism from the Baltic States, Scandinavia, and Finland, whereas the ornamental Stalinist style was given as an example of bad taste. Promoting modernism, the design discourse thereby constitutes an interesting anomaly within the socialist-realist aesthetic paradigm which dictated the entire aesthetic system in Soviet art from 1932 to 1991.

With the foundation of VNIITE, a new attitude towards industrial production was introduced. Design, conceived as the visual and organizational restructuring of the artificial world for increased quality of life, was institutionalized on a wider scale for the first time in the USSR. A "design approach" meant the (re-)organization of the visual and material environment to make it more functional, that is, more effective from the perspective of the user. The goal of the design efforts was to create more comfortable living and work spaces in the era of increased automation – be it for the scientific organization of the apartment interiors of the housing blocks that were built in the millions after the war, or for the worker at the conveyor belt. This new approach was an alternative fundamentally different from the then current technocratic worldview.[5] Instead of the precedence of the production system narrow-mindedly taking care only of its own well-being, attention was now increasingly to be paid to the people who animated it. In the sense of technology in the service of the individual user (from the inhabitants of the new housing and their toilet plumber to the airplane pilot) this might appear as nothing more than common sense, but in the Soviet Union this perspective was a revolution of sorts.

In a country with prison labor camps in the Siberian permafrost and Kazakh deserts, a total lack of respect for human dignity had so far been the hallmark of the way industrial production was conducted, as well as of the possibility of consuming what came out. The design endeavor formulated at VNIITE meant that the human side of the man-machine constellation was taken seriously, a position which had been taken neither in industrial production nor in display technologies such as nuclear power plants.[6] When taking into account the tradition of forced labor in concentration camps or the extreme adaptation to the spaceships demanded of the Soviet cosmonauts, a design approach meant a radical break with the past. A remedy for the deep crisis between the state and its citizens in the wake of the revelation of Stalin's crimes, VNIITE became an experimental free zone for discussion of the position in the system of human agency in a wider sense. Technology should not decide everything any more, and instead of the worker being seen in terms of masses of cadres, individual varieties and preferences were at last to be introduced in the policy of the Five-Year Plan. In the structure of the enterprise and the factory, this meant that the technical experts (constructors, engineers) in control were now to be flanked by designers (artist-constructors, artist-engineers).[7]

One of the major projects of VNIITE was the redesign of the entire electronic/electrical industry for measuring tools. *ElektroMera* (Russian for "Electr(on)ic Measurement Instruments") was a design project conceptualized for the electrical and electronics industry between 1973 and 1979. It was a collaboration among the State Planning Committee (Gosplan), the State Committee for Science and Technology, the Council of Ministers of the USSR (*Gosudarstvennyi komitet po nauke i tekhnike soveta ministrov SSSR* – GKNT), and the Ministry of the Instruments Industry, Means of Automation and Systems Management (*Ministerstvo priborostroeniia, sredstv avtomatizatsiii i sistem upravlenii*). *ElektroMera* was intended for an initial launch on a nationwide scale as a preliminary test, with the ultimate goal of competing with companies such as Siemens and General Electrics on the world market.

ElektroMera was to pave the way for the production of electrical household goods. Although electrical devices became increasingly available to Soviet consumers in the late 1960s and 1970s, tape recorders and washing machines were not widely circulated. *ElektroMera* was also a concrete project for materializing this new policy of concern for the user, both in the sense of the factory worker, and the private consumer.

ElektroMera was a far-reaching project for media and communication which involved a great deal of science and technology that lay between military (prioritized) and civil (non-prioritized) production. The experiences gained from this project could thus subsequently – and this was the idea – be applied in the sphere of private consumer goods. International examples showed success was within reach. The popular Vespa had shown that the production of fighter aircrafts could be shifted to the production of affordable means of transportation. With its small rubber wheels, the scooter proved to fit the rough Italian roads perfectly.

The *ElektroMera* project was an experiment in the restructuring of production, logistics, and artifacts, with user-friendliness as its goal. It was led and supervised by designers and it was the first large-scale design project ever in the Soviet Union. Earlier, the designers in the Soviet Union had mostly worked with small-scale, isolated artifacts.

ElektroMera's logo was an "M" – reminiscent of an electromagnetic impulse diagram. Its goal was no less than to reorganize and coordinate an entire industrial branch to make it standardized in a country with eleven time zones and a population of more than 300 million. It was developed within the Electr(on)ic Measurement Instruments Association (*SouizElektroPribor*), a conglomerate that included nearly all producers of electrical and electronic measuring devices (different kinds of metrology equipment, gauges, indicators, etc.) in the USSR. The conglomerate comprised thirty-two factories with a combined productive output that consisted of, among other things, around one and a half thousand devices, apparatuses, instruments, and assemblies of instruments, and that covered nearly every part of the economy.[8]

There were numerous reasons why the electronic and electrical measurement industry was picked for this pilot project. For a military superpower at this time, defense technology meant electronics, nuclear research, rocketry, aviation, and weapons systems. And last but not least, the high level of accidents caused by the human factor called for ergonomic adjustments.

Since measuring devices are crucial to controlling systems and automation, increased attention was devoted to this wide-ranging area of production in the 1960s. The radio systems and radio telemetry used in space exploration, for the moon landing vehicle, reconnaissance of satellites, and other remote-controlled devices demanded precise measurements as did pipelines, electric power lines, hydroelectric power plants, and all kinds of automated systems operated by remote control. Despite the centralized planning system, standardization of these branches had not been sufficiently inculcated.

The *ElektroMera* initiative was a consequence of actions already taken in the sphere of standardization. According to reports published in *Pravda* in 1965, surveys conducted of control and measuring instruments yielded alarming results: as many as half the devices tested did not meet the required quality standards, and major resources were wasted on their repair and adjustment.[9] In 1965, the State Committee for Standards received additional financial support; a state standardization was included in the 1966–1970 Five-Year Plan; the new periodical *Standarty i kachestvo* (Standards and quality) was launched in 1966, and in 1970 a "state system of standardization" was introduced.[10]

ElektroMera was backed up by the infrastructures and human resources of VNIITE. As a "grade-one institute", VNIITE had access to the newest information in the design field, and could play an important role in the transformation of old routines and the initiation of new ones. The state-subsidized VNIITE was in the unique position of having both the expertise and the size to propose and participate in projects of a magnitude that even the biggest international companies were scarcely able to afford. VNIITE could call on the diverse expertise of every design bureau and scientific research institute within its entire all-union network. With regional offices rapidly established in industrial centers all over the country, VNIITE was the biggest design institute in the world until 1991, when state subsidies decreased drastically.[11] Its interdisciplinary work methods, characteristic of military research in general, show many similarities to what is today called collaborative design.[12] The collaboration expertise ranged from engineers, inventors, architects, and methodologists to standards experts, managers, economists, and human factors specialists. Most importantly, however, was that the executive group that coordinated the whole project consisted of designers.

In an article in *Tekhnicheskaia estetika* (Technological aesthetics), the heads of the executive group, Dmitry Azrikan and Dmitry Schelkunov, presented their *ElektroMera* design brief. Their goal was, in their own words, to coordinate the "technical compatibility", to induce "ergonomic equivalence", and to create "visual harmony".[13] Considering the well-known notion of standardization as a fundamental requisite for effective industrial production, this sounds like old news. The concept of interchangeable parts was introduced in the US weapons industry even before the American Civil War in 1861, and the Berlin-based electricity company AEG secured their market by hiring the architect Peter Behrens in 1907 to bring about its corporate identity, with the products and the graphic profile sharing common features.

ElektroMera's conceptual invention, however, was the redefinition of the *entire system* of relations that embraced man and the artificial environment, from the nationwide meta-structure down to the working conditions on the shop floor to the fruits of labor distributed to improve the acoustic quality in a music lover's living room. The idea was to produce a few models of decent goods on a mass scale, so as to reach the majority of consumers, in contrast to the existing chaotic redundancy of the same models produced in such small quantities that they reached only the uppermost elite. The lack of planning was to be solved through an optimization of the assortment which embraced ideas of standardization of the basic needs of the user/consumer. Therefore it was first of all thought to be necessary to redesign the type of goods that were produced and then the individual goods themselves.[14]

With its goal of coordinating "technological compatibility" with "visual harmony", *ElektroMera* wanted to "universalize" all the units of production. A prerequisite for the planning of the material world on a large scale was the use of standardized modules, rather than complicated, randomly decorated objects. For multipurpose objects, every detail needed to be interchangeably formulated and constructed.

ElektroMera was to unify the principles of planning and designing machinery, equipment, and buildings, in order to economize the design effort on multiple levels of production. The aim of the program was a "systemic approach to planning, self-financing, organization, and automation of control and management".[15] In order to redesign the production processes of the hundreds of thousands of workers responsible for the manufacture of more than 1,500 products, a clever algorithm had to be defined. The "metalevel" called for was to approach all the material objects as a single system. This system would be made coherent by standardizing and connecting all the functions of the products with every part of the industrial conglomerate. The material system was subdivided into "means of production" and "product" with all the different appliances conceptualized as one single product. The method for restructuring entailed unifying all the material resources and all the procedures of interaction with those resources, according to a clustering principle based on a complex set of standardizations. The nomenclature and assortment of the electro-products had to be optimized, with the challenge being the formulation of a maximum of functions from a limited selection of simple elements. The initial step was to make the parameters, the metrology, and the constructions compatible. Modules were defined, thus enabling a quick and convenient modernization of select parts.[16]

Much effort was put into making a product with greater transparency, which communicated with the user in a coherent way. The functions therefore had to be directly linked to the construction. The task was to coordinate the many different instruments and equip them with a common user interface.[17] The user-centered functions were optimized in collaboration with VNIITE's test laboratory for ergonomics. The machines should "actively turn" to the operator, as underlined by Azrikan and Schelkunov. The same clustering and standardizing principles used for the material product were applied to the overarching structure. As the common language of the entire design program, the corporate design "cemented" all the components into a visual entirety.

In short, *ElektroMera*'s special mission was to formulate an alternative to the system of production current at the time and the clumsy artifacts produced by it. *ElektroMera* was to materialize the concrete products and give them a specific "socialist" identity. Above and beyond the obvious money-saving advantages from a nation-wide meta-structuring, they were to make a dif-

They wanted to take control over how people run their daily lives. He who creates has the initiative.

Technical everyday objects qua moving parts in the machinery of society. Like man.

ference in the real-world working conditions along the conveyor belt and the radio-listening in the kitchen.

Due to the post-World War II economic crisis, various models of how to make Soviet production become more effective were discussed.[18] Cybernetics raised expectations that the material world would be reformulated, and promised new ways of achieving social goals, and, within economics, it was a method of optimizing the functioning of the system. The rise of the designer as a new profession that would introduce innovation and change into the essentially static production structures coincided with the years when cybernetics developed into being something close to a nearly universal remedy for problems in the Soviet Union.[19] Nevertheless, in the Soviet case, the link between cybernetics and design has hitherto received no scholarly attention. The literature on cybernetics and economics is abundant. These studies, however, do not pay any heed to the human side of the system, but only to quantitative efficiency. I have spent some time pondering these topics and have come to realize that *ElektroMera* conceptualized the material base for the theories formulated within the framework of cybernetic modeling and computer networks of the 1960s and 1970s.

During the years of increased automation, from the early 1960s to the end of the 1970s, a number of initiatives to reform and optimize the sphere of economics were introduced in the Soviet Union. In November 1962, at a Central Committee Plenum, Khrushchev pressured his party colleagues to assume rational management methods that would be easier to implement in the system of centralized state-owned economy than under capitalism, with its fragmented structure of private companies.[20] In preparation for Aleksei Kosygin's economic reform in 1965 with its call for increased flexibility and a shift from heavy to light industry, even Western methods of management were extensively examined.[21] With the goal of finding ways to raise the efficiency of the socialist production system without giving way to the evils of the capitalist market, the use of mathematical modeling and computer networks was put forward as a better alternative.[22]

In one of these models, "industrial cybernetics", sometimes called "management cybernetics", for example as introduced by Stafford Beer for the steel industry in England, information was derived from mathematical simulations which replaced information obtained from the market. Since supply and demand were nonexistent in the planned economy, the cyberneticians leaned upon "objective computations".[23] In Beer's model, the exceedingly complex, probabilistic company was likened to a homeostat, adaptable and self-regulatory like a living "organism" where the standard market mechanisms of supply and demand were replaced by feedback loops with data about sales rates, materials available, costs, and so on. Translated into cybernetic terms, the entire Soviet economy was seen as an enormous organism that could be optimized by way of computer networks through the channeling and management of information flows.

With its potential to concentrate enormous resources on research projects that did not need to provide any immediate profit, the USSR spent considerable resources on the development of computer networks to interconnect factories with Gosplan, the State Planning organization at the top. One important agent high up in the hierarchy who could connect Gosplan with the Ministry of Instrumentation, Automation and Control Systems was Germen (Dzhermen) Gvishiani, the vice chairman, in effect chief executive, of GKNK. A state committee for *applied* science and technology, Gvishiani furthered methods of cybernetic management. Himself the author of numerous books on industrial management[24], the progressive Gvishiani was especially excited about *ElektroMera*, as a design project for the real world. He was closely associated with Kosygin via marriage to Kosygin's daughter (Kosygin, Premier of the Soviet Union, was himself also a practical man, as a former textile engineer, a minister for finance and minister for light industry).

The early 1970s saw not only the launching of *ElektroMera* on an experimental level, but also that of OGAS, a nation-wide computer network for the collection and processing of information for the planning and management of the national economy.[25] As a replacement for the existing, disorderly overlapping of information, these computer centers would assemble and re-distribute information from all fields of the national economy, from the top of the state planning system, *Gosplan*, down to the material-technical base. The computer network was to rationalize and reorganize production on a national-economic level, and the design efforts projected by VNIITE were to give life to real products. Fitting into the channels of information becoming flesh, the goods produced were to be materialized through *ElektroMera*. With standardized electronics compatible with *ElektroMera*, the smallest entities of computer systems, in combination with a unified branch system for electronics and measurement tools, would unite different factories and companies and ultimately the whole Eastern Bloc. East Germany, with its standards that were compatible to West Germany, forms an especially interesting case.[26]

During the early 1960s one of the most vital spheres of activity of COMECON was to coordinate and consolidate the production processes and the products of the member countries.[27] A coherent system of standards represented one of the first significant steps towards effective compatibility and integration of applied science, technology, and design. Given that transfer of knowledge was of paramount importance within the Soviet Bloc, standardization was essential in facilitating cooperation among the socialist countries, but was also a means of consolidating the border with the West: in order to produce a self-sufficient economy, the economic zone has to be clearly defined.

Cybernetics offered a major advantage to a dictatorship like the Soviet Union in that it "broadened the range of controllable processes", as Aksel Berg, Chairman of the Council on Cybernetics, insisted. This was "its essence and major merit".[28] The publication in 1961 of his book on cybernetics in communism[29] coincided with the erection of the Berlin Wall. Now the Soviet Bloc had its defined economic zone, and the experiments with cybernetic management could be transferred from the realm experimental simulations to the real world.

The early 1960s was a time characterized by a fear in the West of the potential that a centralized command economy had in comparison with the limitations of rival firms in the capitalist system. Less than twenty years later, the goods deriving from *ElektroMera* were to be launched. *ElektroMera* was to change the face of the Soviet Union nation-wide with its goal of bridging the enormous gap between wishful thinking and the concrete electrical devices available to consumers. The first electrical devices were to be put on sale by 1980, coinciding with the promises as to when the bright future of Communism was to be reached.

In 1979 hundreds of boards and realistically looking prototypes (see illustrations) were shown in VNIITE's own exhibition hall at the Pushkin Square in central Moscow, followed by a tour of exhibitions worldwide (for example in Germany, Yugoslavia, India, and Finland). After showing the *ElektroMera* project to a delegation from Siemens visiting Moscow, Yuri Soloviev, director of VNIITE, recalls: "They were shaken: if this program was implemented and its products were to appear on the market, they said it would be a very serious blow for them."[30]

With its motto "Workers of the world, unite!" the Soviet Union built a society during its almost seventy years of existence that so differed from the Western capitalist model – which was intrinsic to the definition of design in the canonical literature of the field – that even the most basic notions of design do not apply.[31] To date, the general interest of the young academic discipline of design history has mostly centered on consumer goods in the affluent world. Given the common Western success story of industrial design as a marketing strategy to increase sales, it becomes clear that a different set of tools is required to describe design made in the Soviet Bloc.[32]

So far, presentations of design in Eastern Europe during the Cold War have made additions of a chair, a *sputnik*, and a car to the canon of design. *ElektroMera*, however – the "artifact" that my inquiry investigates – is of an entirely different magnitude. In order to do this investigation, not only the designed artifact needs redefinition, but also the borders of academic disciplines. The objects of inquiry require a wider context than that established by the mere pin-pointing of style, a typical art history approach, or by giving descriptions of machines, devices, processes, and structures, as is done in traditional history of technology. These efforts are not sufficient to analyze design as the systemic organization in the service of enabling flexibility and change – including a focus on the comfort of the user without excluding aesthetic concerns. What I propose, therefore, is the alternative of discussing design in a context of systems thinking and cybernetics and ergonomics – without excluding art history and aesthetics – to render visible characteristics that have so far not been considered.

If we are to make a meaningful connection between design and the productive processes that are shaping the world, I suggest that we must look toward the design of systems, and not only to how the individual car is streamlined, or how the legs of a table are bent. Form implies fixity, and once set up, it cannot be adjusted to its environment. Therefore, as suggested by historian of architecture Brandon Hookway, "we must look at the design of systems as well as the changing role

Those demiurges of real-socialism. Patternmakers expect perfection.

1. Зона отдыха на территории предприятий, оборудованная скамьями, столами и напольными шахматами (макет). Отделена от входной зоны завода декоративной стенкой
2. Объемно-пространственное решение цеха гальванических покрытий (макет)
3. Объемно-пространственное решение цеха механической обработки (макет)
4. Объемно-пространственное решение сборочного цеха (макет)
5. Модели производственной одежды для персонала Объединения: а, г — костюмы мужской и женский для работников службы сервиса и выставок; б, д—халаты мужской и женский для работников администрации и конструкторского бюро; в, е — костюмы мужской и женский для станочников, слесарей и вспомогательных рабочих

Models and prototypes for factory departments and work clothes for the electrical measuring industry in the Soviet Union (ElektroMera).

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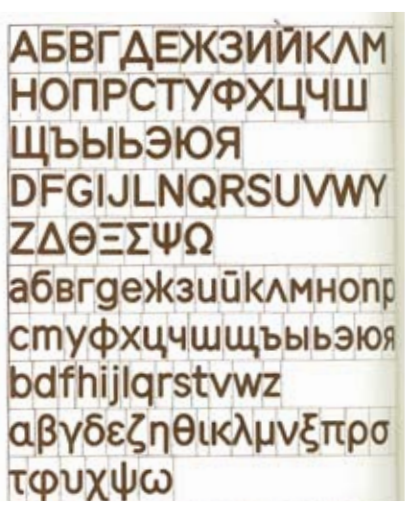
of the designer in the productive process as a whole, rather than simply the design of forms".[33] In this article, *ElektroMera* was discussed in such a framework. Boiled down to its very basics, what these complex phenomena that connected design and cybernetics in the Soviet Union all had in common was standardization – or rather the problem of lacking implemented standardization, and although the ambitious design historian should investigate these phenomena from the hands-on oily bolts and screws to the abstraction of the entire artificial world, here we confined ourselves to a few aspects.[34]

Despite good intentions, *ElektroMera* was but one more failed large-scale project in Soviet industry.[35] It is not within my competence to explain as to why the efforts to make Soviet products of consumption more widely available were eroded by inconsistencies and corruption. Rather than their failure, my concern is to place them in relief outside the paradigm of current design history, for otherwise they would have been discarded as not actualized possibilities.[36]

The Soviet military dictatorship is known as a society with little concern for the well-being of its civilian subjects. Nevertheless, as my investigations on design from the 1960s to the 1980s show, wide-ranging efforts and considerable financial resources were spent on research to change this, at least within the limits of the projects and experiments. In the attempt to make concrete consumer goods, *ElektroMera* was a reality check, with the important aspect, as I see it, that it challenged the view of whether products should be made for military display or for making the non-glamorous every-day life more livable. Whether the state concern was really for the well-being of the people, or only about putting power on display, is a judgment beyond the scope of this article.

ElektroMera was to have integrated Lenin's grandiose plan for electrification, Stalin's plan for automation, and Khrushchev's plan for the cybernetization of the whole country.

But the Soviet dream world was closer to catastrophe than to reality. The Berlin Wall fell and companies in the capitalist world such as Siemens and General Electrics could, once again, breathe freely. "Made in the USSR" was a dream which never came to be.



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3 The "scientific-research institutes" that carried out applied research by 1968 numbered 2,388. Of these, about 400 concerned themselves with engineering, and about 1,000 served as independent construction bureaus. See Raymond Hutchings, *Soviet Science, Technology, Design: Interaction and Convergence*, Oxford 1976, pp. 28–29. Hutchings incorrectly calls the construction bureaus "design bureaus" which causes confusion insofar as their work did not include any ergonomic or aesthetic considerations whatsoever.

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7 In the literature *glavnyi konstruktor*, e.g. the chief engineer, is often translated as "designer" even though no consideration is given to the user of the machine.

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10 Grigorii I. El'kin & Evgenii R. Petrosian, (eds.), *Standartizatsiia v Rossii 1925–2005* [Standardization in Russia 1925–2005], Moscow 2005, pp. 7–39.

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21 See for example Dzhermen M. Gvishiani, *Sotsiologiia biznesa: Kriticheskii ocherk amerikanskoi teorii menedzhmenta* [Business sociology: A critical essay on American theory of management], Moscow 1962.

22 Michael Ellman, *Soviet Planning Today: Proposals for an Optimally Functioning Economic System*, Cambridge 1971; William Conyngham, J., *The Modernization of Soviet Industrial Management*, Cambridge 1982.

23 Stafford Beer's *Cybernetics and Management* (1959) appeared in numerous editions in the Soviet Union. The second Russian edition was published in 1965, the same year that Kosygin unleashed his countrywide economic reform.

24 Gvishiani had edited translations on this topic with authors from the United States.

25 Frank Dittmann, "Technik versus Konflikt", *Osteuropa*, vol. 59:10.

26 For standardization within the Soviet Bloc, see Raymond G. Stokes, *Constructing Socialism: Technology and Change in East Germany 1945–1990*. Baltimore & London 2000.

27 Grigorii I. El'kin and Evgenii R. Petrosian, (eds.), *Standartizatsiia v Rossii* [Standardization in Russia], *1925–2005*, Moscow 2005.

28 Aksel I. Berg, "Kibernetika i nauchno-tekhnicheskii progress" [Cybernetics and scientific-technological progress], in A. Kuzin, ed., *Biologicheskie aspekty kibernetiki* [Biological aspects of cybernetics], Moscow 1962.

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30 Yuri Soloviev, *Moia zhizn' v dizajne* [My life in design], Moscow 1994, p. 194.

31 For a recent discussion on the redefinition of design, though not taking into account the Eastern Bloc, see the *Journal of Design History: Special Issue; The Current State of Design History*, vol. 22:4.

32 Hitherto, the design literature on Eastern Europe and the Soviet Union has avoided problematizing the definition of design. See for example the recent exhibition catalogue edited by David Crowley and Jane Pavitt, *Cold War Modern: Design 1945–1970*, London, 2008. On post-World War II Soviet and Russian design, see additionally writings by Constantin Boym, Alexander Lavrentiev, Yuri Nazarov, Susan B. Reid, et.al.

33 Brandon Hookway, "Cockpit", in Beatriz Colomina, et. al., (eds.), *Cold War Hothouses: Inventing Postwar Culture from Cockpit to Playboy*, Princeton 2004, p. 45.

34 The story of standardization and logistics in the Soviet Union is to my knowledge not yet written. The history of logistics in the West is currently being studied by Monica Dommann.

35 For the problem of implementation, see Slava Gerovitch, "The Cybernetics Scare and the Origins of the Internet", *Baltic Worlds*, vol. II:1; Clive Dilnot, "Some Futures for Design History?", *Journal of Design History*, vol. 22:4.