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Economic Intelligence Report

THE ELECTRONICS INDUSTRY
OF CZECHOSLOVAKIA

1948-65



CIA/RR ER 61-44

October 1961

CENTRAL INTELLIGENCE AGENCY
Office of Research and Reports

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THE ELECTRONICS INDUSTRY OF CZECHOSLOVAKIA*
1948-65

Summary

The estimated net value** of production of electronic equipment in Czechoslovakia in 1960 was about 2,780 million crowns,*** or about \$230 million,† an amount greater than that of any other European Satellite and probably also greater than that of Communist China, but only about 4 percent of that of the USSR. More than 40 percent of the value of the Czechoslovak production is estimated to have represented military electronics (mostly wire communications equipment), and about one-third is estimated to have represented consumer electronics, which were primarily television broadcast receivers. The remainder, about one-fourth of the total production, is estimated to have been made up of industrial electronics, which also was dominated by wire communications equipment. Current projections indicate that, by 1965, industrial electronics will constitute the largest category of production, followed by consumer electronics and military electronics in that order.

The estimated net value of production of electronic equipment in Czechoslovakia increased about 85 percent during First Five Year Plan (1951-55) but increased more than 300 percent during the Second Five Year Plan (1956-60). A further increase of about 55 percent is expected during the Third Five Year Plan (1961-65). Relatively large investments made in the industry since 1955 facilitated the rapid expansion that took place during the Second Five Year Plan. Labor productivity also rose rapidly during 1956-60 and will become a greater factor in the expansion of production than additions to the labor force during the Third Five Year Plan.

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 September 1961.

** For an explanation of the use of the term net with reference to production of electronic equipment, see Appendix A.

*** After computation, data on values and index numbers have been rounded to three significant digits or less, and data on units, have been rounded to two significant digits.

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† Dollar values in this report were derived from crown values in 1957 prices and were converted at the rate of 12 crowns to US \$1 (for the methodology, see Appendix A, Section 4, p. 44, below).

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The variety of electronic equipment produced in Czechoslovakia is comprehensive, and the quality is generally good in comparison with world standards. Relatively large investments in research and development -- about 250 million crowns (\$21 million) in 1958 -- are expected to enhance further the quality of Czechoslovak electronic equipment, to expand the variety, and to help reduce the costs of production. A major objective of the research and development effort is to design electronic equipment that will utilize semiconductors and printed circuits and that will be compatible with the automation of production.

A recent decentralization of the management of the electronics industry of Czechoslovakia is expected to result also in reduced costs, and, in addition, to facilitate a reduction of the lead time required to introduce newly developed items into production. Since the fall of 1958 the electronics industry of Czechoslovakia has been subordinate to the Ministry of General Machine Building. Under the general direction of this ministry are the Association of Telecommunications Enterprises, six electronic branch enterprises, and one research institute, all of which are financially autonomous in production and marketing of electronic equipment. These organizations are responsible for most of the electronic equipment produced in Czechoslovakia, although some products defined as electronic in this report, notably electronic computers and measuring instruments, are produced under the management of the instrument engineering industry, another industry also subordinate to the Ministry of General Machine Building.

Exports of electronic equipment by Czechoslovakia have averaged about 15 percent of the net value of production during 1955-60. Imports have been substantially less during the same period. Consumer and industrial electronics have been exported widely to countries both inside and outside the Sino-Soviet Bloc, and military electronics have been exported to a few underdeveloped countries outside the Bloc. Present plans provide for exports to increase more rapidly than the total production during the Third Five Year Plan. Imports of electronic equipment probably will continue to lag well behind exports.

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I. IntroductionA. Purpose and Scope

This report is intended primarily to present estimates of the magnitude, composition, and growth of production of the electronics industry of Czechoslovakia from 1948 to 1960 and to project the future growth of production through 1965. The secondary objectives are to summarize current trends in the organizational structure, the technology of production, and the trade patterns of the industry.

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B. Definition of the Electronics Industry

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In this report, as in previous reports on the electronics industries of the countries of the Sino-Soviet Bloc, the electronics industry is defined in terms of the products included in the electronics industry of the US. These products are (1) electronic components, primarily resistors, capacitors, and coils; (2) electron tubes; (3) semiconductors, including transistors, diodes, and rectifiers; (4) wire communications equipment, including telephone and telegraph apparatus; (5) radio communications equipment, primarily point-to-point radio transmitters and receivers, radio and television broadcast transmitters, and microwave relay equipment; (6) consumer electronic equipment, including radio and television broadcast receivers, wired loud speakers, tape recorders, and phonographs; (7) noncommunications electronic equipment, including electronic computers, electronic measuring instruments, radar, sonar, navigational aids, electronic countermeasures equipment, infrared and ultraviolet equipment, proximity fuzes, and miscellaneous medical and industrial equipment using sonic, ultrasonic, and electromagnetic energy.

In the generic sense, electronic equipment can be defined approximately as devices that utilize the movement of electrons through conducting or semiconducting materials and/or propagate the radiation of electromagnetic energy, ultrasonic energy, or sonic energy through some conducting medium for purposes of communicating intelligence, controlling some function, or performing some physical task directly.

For convenience, electronic equipment* in this report is grouped in three categories determined by the end use of the equipment. These categories are (1) consumer electronics, primarily radio and television broadcast receivers; (2) industrial electronics, primarily radio and

* The terms electronic equipment and electronics are used interchangeably throughout this report.

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television broadcast transmitters, measuring instruments, civil wire and radio communications equipment, microwave equipment, and miscellaneous medical and industrial equipment; and (3) military electronics, primarily radar, radio communications equipment, and wire communications equipment.

II. Organization of the Electronics Industry 1/*

Since the fall of 1958 the electronics industry of Czechoslovakia has been subordinate to the Ministry of General Machine Building. Under the direction of this ministry are an organization known as the Association of Telecommunications Enterprises, six electronic branch enterprises, and one research institute. These organizations are responsible for producing most of the electronic equipment, although some products defined as being electronic in this report are produced under the management of the instrument engineering industry, as shown in the chart, Figure 1.**

The Association of Telecommunications Enterprises was created in order to coordinate production, marketing, and utilization of telecommunications products, particularly electronic equipment used as producers goods for the Ministries of Communications, Transportation, and Foreign Trade, and military equipment for the Ministry of Defense. The Association also directs joint units for research, development, planning, and bidding and is specifically responsible for marketing and supply, development of the production base in accordance with the plan, research and development, organizational development, technological development, direction of production, and training of employees. The Association has the primary responsibility for producing wire telecommunications equipment, including such items as switching equipment for telephone exchanges, switchboards, telephone handsets, teletype equipment, and special equipment for dispatching and for use in mines.

The six electronic branch enterprises and their primary products are as follows:

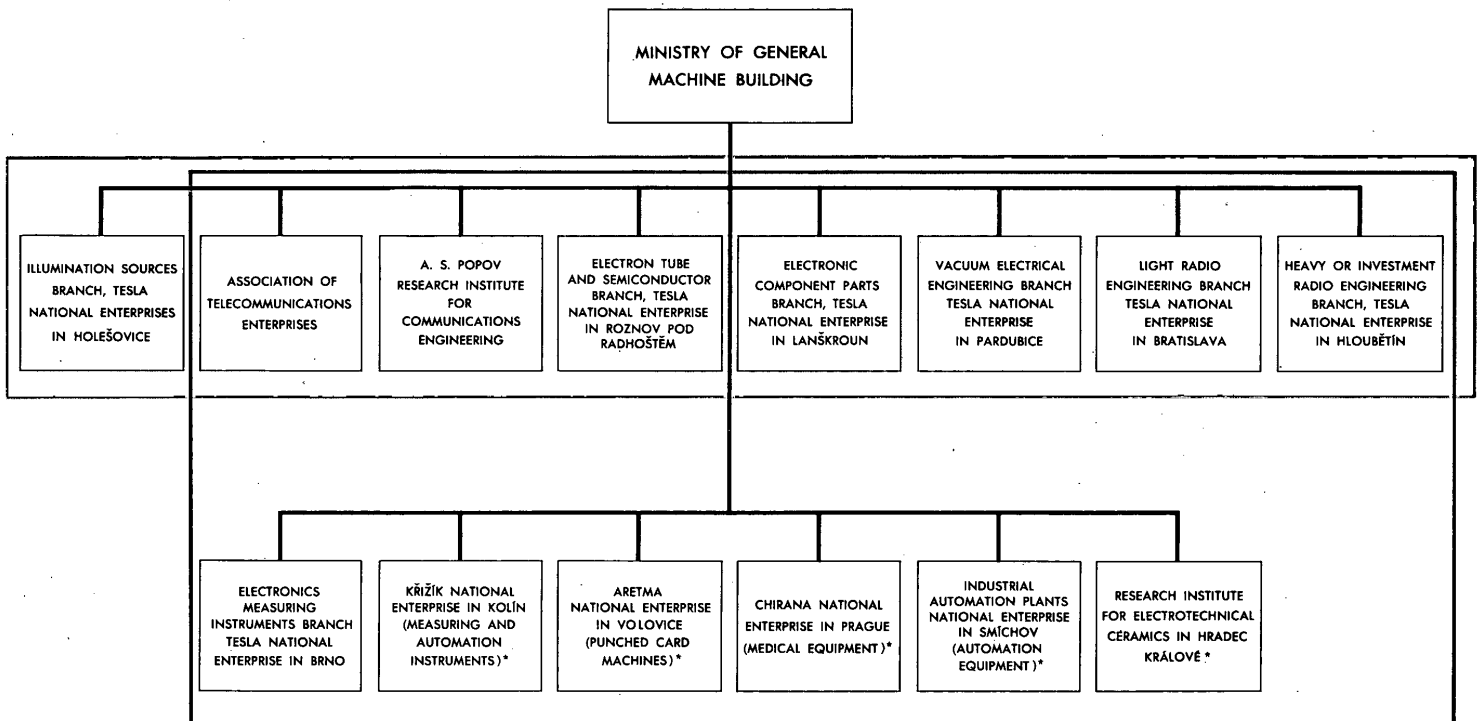
1. The electron tube and semiconductor branch, the Tesla National Enterprise in Roznov pod Radhostem. Primary products are electron tubes and semiconductors (transistors, diodes, and rectifiers).
2. The electronic component parts branch, the Tesla National Enterprise in Lanskroun. Primary products are electronic components

** Following p. 4.

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Figure 1

ORGANIZATION OF THE ELECTRONICS INDUSTRY IN CZECHOSLOVAKIA, 1960



— Electronics Industry as defined in Czechoslovakia
— Electronics Industry as defined in the US

*Not all products are electronic equipment.

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(resistors, capacitors, coils, and the like) and probably dry-cell batteries produced by the Bateria National Enterprise in Slany, which was transferred to Tesla Lanskroun from the Ministry of Agricultural Machinery and Automobiles in the fall of 1958.

3. The vacuum electrical engineering branch, the Tesla National Enterprise in Pardubice. Primary products are radio communications equipment (typically point-to-point radio communications equipment), television broadcast receivers, electronic analog computers, and radar equipment.

4. The light radio engineering branch, the Tesla National Enterprise in Bratislava. Primary products are radiobroadcast receivers, television broadcast receivers, phonographs, wire radio systems, loudspeakers, tape recorders, microphones, intercommunications systems, hearing aids, and commercial amplifiers.

5. The heavy or investment radio engineering branch, the Tesla National Enterprise in Hloubetin. Primary products are radio and television broadcast transmitters with antenna systems, broadcast studio equipment, radio communications equipment (probably microwave systems), industrial television equipment, radio receivers for long-distance communications, amplifiers for wire radio systems, and radar. The branch in Hloubetin also probably produces electronic countermeasures, infrared devices, direction-finding equipment, ultrasonic equipment, and proximity fuzes.

6. The illumination sources branch, the Tesla National Enterprise in Holesovice. Primary products are light bulbs, fluorescent tubes, infrared drying bulbs, glow-discharge tubes, and medical lamps.

The Association of Telecommunications Enterprises and the electronic branch enterprises, except the illumination sources branch in Holesovice and the primary batteries produced under Tesla Lanskroun, are included under the definition of the electronics industry (see I, B*). Under this definition, the electronic measuring instruments branch -- that is, the Tesla National Enterprise in Brno -- also must be included. Primary products of this branch are conventional electronic measuring instruments of all types and electron microscopes. The Tesla National Enterprise in Brno was transferred in the fall of 1958 from the electronics industry to the instrument engineering industry, which also is subordinate to the Ministry of General Machine Building.

* P. 3, above.

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Other organizations that produce some items defined as electronic in this report are conceptually included in the electronics industry of Czechoslovakia, although the Czechoslovak authorities do not consider them as part of the electronics industry. These organizations are as follows:

1. Aritma National Enterprise in Vokovice. Products are punched-card coders, verifiers and sorters, printout machines for punch-coded cards, electromechanical calculators, and analog computers.

2. Krizik National Enterprise in Kolin. Products are measuring and automation instruments, some of which involve electronic devices.

3. Chirana National Enterprise in Prague. Products are medical equipment, some of which involve electronic devices such as X-ray apparatus.

4. Industrial Automation Plants National Enterprise in Smichov. Products are automation equipment of all types, some of which involve electronic devices.

5. Research Institute for Electrotechnical Ceramics in Hradec Krolove. Among its products are quartz crystals for high-frequency and ultrasonic applications.

In this report the Metra National Enterprise in Blansko is excluded from consideration of the electronics industry of Czechoslovakia because it produces only electrical measuring instruments.

The electronics industry of Czechoslovakia is believed to consist of about 50 major plants and a few minor plants, most of which are now included in the Tesla National Enterprises. Each of the Tesla National Enterprises consists of several manufacturing plants, and the management of the main plant of each enterprise directs the operations of the other plants. Each enterprise operates independently to carry out its responsibility for fulfillment of the plan for the national economy in terms of quality, quantity, and assortment of products. The enterprise is required to provide for its own expenses from its sales, but each plant of an enterprise does not necessarily cover its costs from its sales -- that is, high-cost plants may have losses that are covered by the more efficient plants. Each plant does have the authority to conclude economic contracts with third parties independently of the management of the enterprise.

The present research institute for electronics was established in 1958 by the merger of the Research Institute for Electrical Engineering

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Physics (Vyzkumny Ustav pro Elektrotechnickou Fysiku) with the A.S. Popov Research Institute for Communications Engineering (Vyzkumny Ustav pro Sdelovace Techniku A.S. Popova) and was given the name of the latter. At the same time, minor research and development centers were transferred to the branch enterprises.

The Institute of Mathematical Machines (Ustav Matematickych Strojci), formerly of the Czechoslovak Academy of Sciences, was transferred from the electronics industry to the instrument engineering industry in the fall of 1958. It provides the research base for the new mathematical machines branch of the instrument engineering industry, products of which in all probability include electronic digital computers.

III. ProductionA. Total Output

Statistical series showing the magnitude and growth of the electronics industry of Czechoslovakia are given in Table 1.* At present the electronics industry of Czechoslovakia is estimated to be the largest of the European Satellites and probably larger than that of Communist China. Thus Czechoslovakia is second only to the USSR among the countries of the Sino-Soviet Bloc in the value of production of electronics, although in 1960 the Czechoslovak industry produced electronic equipment valued at approximately \$230 million, or only about 4 percent as much as did the USSR (see the accompanying chart, Figure 2**).

The electronics industry of Czechoslovakia grew slowly during the immediate postwar years. By 1950, however, the pace was accelerated, and production increased about 85 percent in the 5 years from 1951 to 1955. During the Second Five Year Plan (1956-60), unprecedentedly large investments were made in the industry.*** As a result of the increased level of investment during the Second Five Year Plan, the floorspace of manufacturing plants increased 50 percent, the productive capacity per unit of floorspace increased 160 percent, and the net value of production rose by 1960 to a level estimated at four times that of 1955. 3/

During the Third Five Year Plan (1961-65) the rate of growth of the electronics industry will be much less than that achieved during the preceding 5 years, but production is expected to increase about

* Table 1 follows on p. 8.

** Following on p. 9.

*** Annual gross investment is expected to average about 150 million crowns per year during 1956-65. 2/

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Table 1

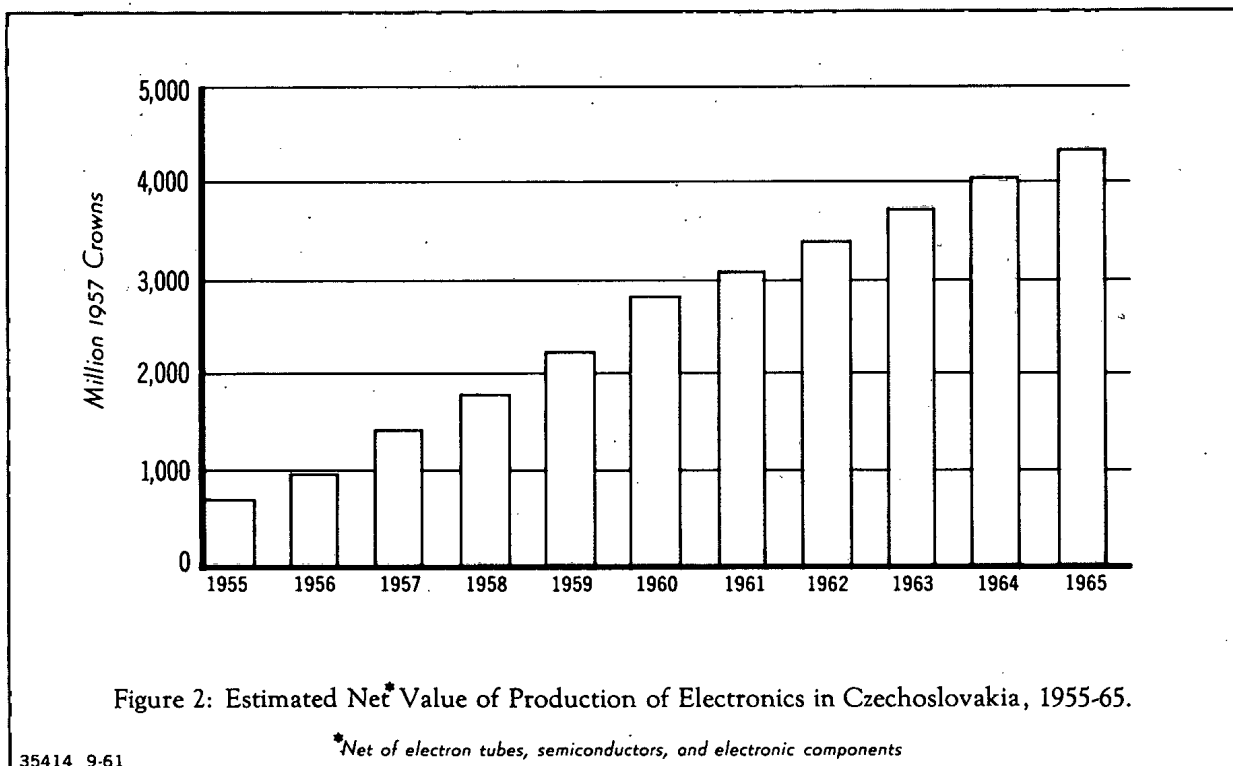
Czechoslovakia: Estimated Net Value of Production of Electronics
by Sector of End Use
1948-65

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Consumer electronics																		
Index (1955 = 100)	118	118	130	128	100	114	92	100	202	286	393	486	588	643	691	757	833	901
Value (million 1957 crowns)	184	184	202	200	156	177	143	156	315	445	612	756	915	1,000	1,080	1,180	1,300	1,400
Industrial electronics																		
Index (1955 = 100)	30	41	49	61	71	78	86	100	113	135	156	181	218	270	340	430	542	686
Value (million 1957 crowns)	91	124	148	186	216	238	263	304	345	410	476	552	663	822	1,040	1,310	1,650	2,090
Military electronics																		
Index (1955 = 100)	4	8	8	13	44	52	87	100	137	241	297	401	528	549	562	542	478	364
Value (million 1957 crowns)	10	19	19	30	100	118	197	226	309	545	670	905	1,200	1,250	1,270	1,220	1,080	822
Total electronics																		
Index (1955 = 100)	42	48	54	61	69	78	88	100	141	204	256	323	405	447	493	541	587	628
Value (million 1957 crowns)	285	327	368	416	472	533	603	686	969	1,400	1,760	2,210	2,780	3,070	3,380	3,710	4,030	4,310

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55 percent. Because the absolute increase in value of production in 1965 above that of 1960 is estimated to be less than the absolute increase in 1960 above that of 1955, the implication is that the rate of investment in the industry will decline significantly during the Third Five Year Plan.

B. Composition of the Industry

1. General

According to end use of the equipment produced, the electronics industry of Czechoslovakia is divided into three major sectors: (a) consumer electronics, (b) industrial electronics, and (c) military electronics.* The relative sizes and rates of growth of these sectors on the basis of the data shown in Table 1** are compared below. Discussions on electron tubes, semiconductors, and electronic

* For definitions of these sectors, see I, p. 3, above.

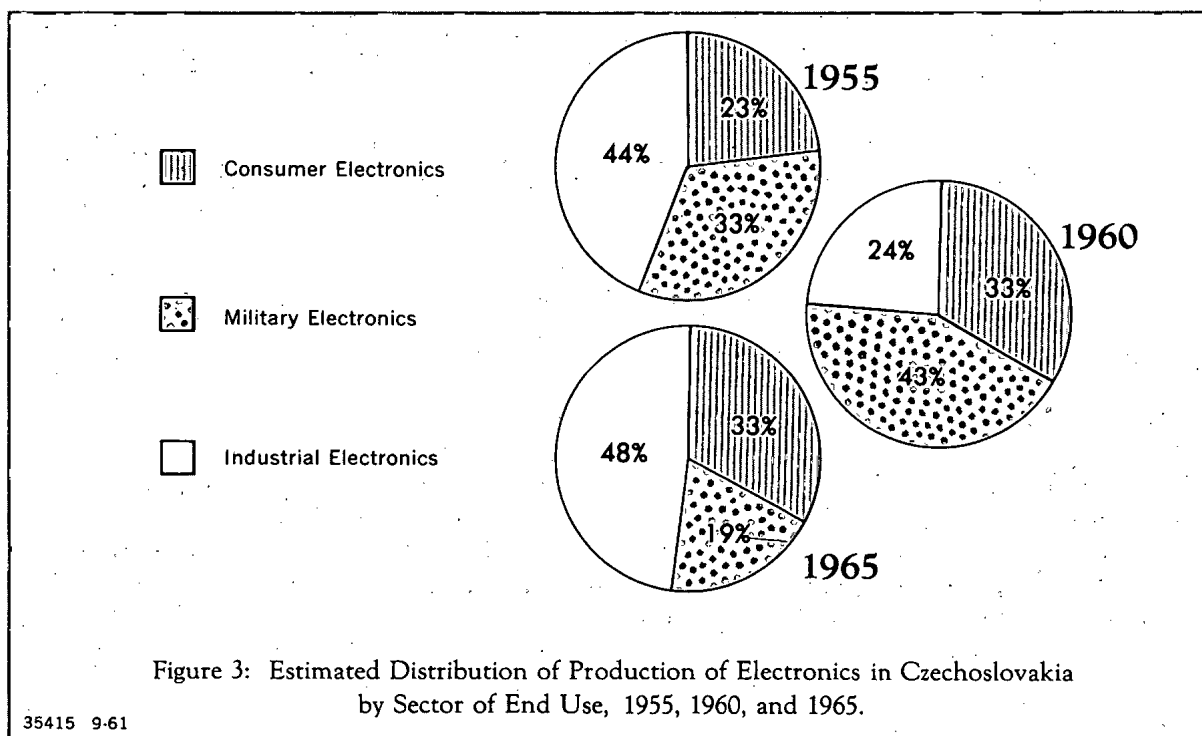
** P. 8, above.

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components also will be presented, although these items are not end products, and their value is already included in the sectors of end use.

Of the total net value of electronics produced during 1960 in Czechoslovakia, about 33 percent was allocated to consumer electronics, almost 24 percent to industrial electronics, and about 43 percent to military electronics. It is estimated that by 1965, however, the sector devoted to industrial electronics will be dominant, with about 48 percent of the total output of electronics, followed by consumer electronics with almost 33 percent and military electronics with only 19 percent (see the accompanying chart, Figure 3).



Through 1951 the consumer electronics sector comprised from nearly one-half to nearly two-thirds of the industry. In almost every year between 1952 and 1965 this sector was estimated to comprise about one-third of the total net output of electronics in Czechoslovakia, except in 1954 and 1955, when consumer electronics dropped to less than one-fourth of the total.

By 1951 the industrial electronics sector was nearly as large as the consumer electronics sector. From 1952 until 1956 the

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share of the industrial electronics sector was somewhat larger than either of the other two sectors, comprising about 44 percent of the total in 1955. Industrial electronics reached its lowest relative share in 1960 -- about 24 percent -- but will again become the largest sector during 1963-65.

Military electronics was less than 10 percent of the total net production of electronics before 1951. By 1957, however, the military electronics sector had become dominant and probably will remain so until 1963, when it is expected to give way to industrial electronics.

During 1951-55, production of consumer electronics declined about 23 percent, but production of industrial electronics doubled during the same period, and military electronics, starting from a very small base, was 12 times as large in 1955 as in 1950. In the Second Five Year Plan, consumer electronics increased to nearly six times the level of 1955, industrial electronics more than doubled, and military electronics increased to more than five times the level of 1955. It is estimated that consumer electronics will increase about 50 percent during the Third Five Year Plan. Industrial electronics will more than triple, whereas military electronics will actually decrease by almost one-third.

2. Consumer Electronics

Production of consumer electronics in Czechoslovakia is shown by major commodities in Table 2.* Until 1952, radiobroadcast receivers were the only item of consumer electronics in production. It is apparent, however, that by 1957 production of television broadcast receivers (television sets), which began in 1953, was dominant and continues to increase its dominance throughout the period of the estimate. Production of television sets in 1965 will be more than double that in 1959.

Production of radiobroadcast receivers in 1950 reached a peak that has been exceeded only in 1958 but may be exceeded again by 1963. The precipitous drop in production of radiobroadcast receivers during 1952-55 appears to have been due primarily to the initiation of production of television sets, although the rapid increase of production of military electronics during this period also may have impinged on production of radiobroadcast receivers.

The doubling of production of consumer electronics in 1956 above that of 1955 appears to have been facilitated primarily by a large increase in production of electron tubes in Czechoslovakia. Other

* Table 2 follows on p. 12.

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Table 2
Czechoslovakia: Estimated Production of Consumer Electronics
1948-65

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Radiobroadcast receivers																		
Units (thousand)	267.7	266.5	292.6	288.3	208.0	182.5	109.5	102.3	220.6	255.0	309.0	280.5	248.9	260	280	300	310	330
Value (million 1957 crowns)	169	169	185	182	132	116	69	65	140	161	196	178	158	160	180	190	200	210
Television broadcast receivers																		
Units (thousand)	0	0	0	0	0	12.3	15.0	17.2	40.1	79.1	133.5	196.6	262.9	290	310	340	380	410
Value (million 1957 crowns)	0	0	0	0	0	31	37	43	100	198	333	491	656	720	770	850	950	1,020
Phonographs and tape re- recorders																		
Units (thousand)	0	0	0	0	10	20	27	26	54.1	60.2	50.2	43.8	40	42	45	48	50	53
Value (million 1957 crowns)	0	0	0	0	6	12	16	16	33	37	31	27	24	26	27	29	30	32
Wired loudspeakers																		
Units (thousand)	0	0	0	0	0	0	2.2	58.2	101.4	125.5	123.8	143.0	160	180	200	230	250	280
Value (million 1957 crowns)	0	0	0	0	0	0	Negl.	12	20	25	25	29	32	36	40	46	50	56
Replacement electron tubes																		
Receiving tubes																		
Units (thousand)	1,300	1,400	1,500	1,500	1,600	1,600	1,700	1,800	1,900	2,100	2,400	2,800	3,100	3,400	3,900	4,300	4,800	5,400
Television picture tubes																		
Units (thousand)	0	0	0	0	0	0	0	0	0	0	0	3.4	37	40	50	60	60	70
Total value of replacement tubes (million 1957 crowns)	15	15	16	17	18	18	19	20	22	24	27	32	44	49	56	64	70	79
Total value (million 1957 crowns)	<u>184</u>	<u>184</u>	<u>202</u>	<u>200</u>	<u>156</u>	<u>177</u>	<u>143</u>	<u>156</u>	<u>315</u>	<u>445</u>	<u>612</u>	<u>756</u>	<u>915</u>	<u>1,000</u>	<u>1,080</u>	<u>1,180</u>	<u>1,300</u>	<u>1,400</u>

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factors probably were the availability of new manufacturing facilities and the mastering of the technology of producing television sets. It must be pointed out, however, that production of consumer electronics in 1955 was about 23 percent below its former peak in 1950.

In 1960, production of television sets exceeded the plan, but production of radiobroadcast receivers did not meet the plan goal. 4/ In spite of an apparent tendency toward deemphasis, production of radiobroadcast receivers is formally scheduled to be at an all-time high in 1965.

The electronics industry of Czechoslovakia is presently manufacturing at least 26 different models of radiobroadcast receivers, including battery-powered receivers, automobile receivers, large consoles, and transistorized receivers. Television sets are produced presently in at least four models with picture tubes up to 21 inches, with 12 channels, and with remote control. Other items of consumer electronics are various combinations of phonographs and tape recorders and wired loudspeakers. 5/

By 1959, consumption of replacement tubes became and continues to be more important in terms of value than production of either phonographs and tape recorders combined or of wired loudspeakers. Replacement tubes and components have been generally available for consumer electronics in use. 6/

3. Industrial Electronics

The estimated production of industrial electronics in Czechoslovakia is shown in Table 3.* It is evident that production of wire communications equipment is predominant throughout the series, although estimates for the sector entitled "other" reflect a more rapid increase from 1955 to 1965 because of heavy emphasis on electronic computers, measuring instruments, microwave equipment, and equipment used in industrial processes. Czechoslovak authorities maintain, however, that the most urgent requirement for enlarged productive capacity during the Third Five Year Plan stems from the need to produce more wire communications equipment. Several new plants as well as expansions of older plants will be devoted to production of wire communications equipment in order to satisfy domestic and export requirements. 7/

Czechoslovakia manufactures a wide range of wire communications equipment. The main groups of such equipment are automatic public telephone exchanges; automatic railroad telephone exchanges; automatic

* Table 3 follows on p. 14.

Table 3
Czechoslovakia: Estimated Production of Industrial Electronics
1948-65

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Radio and television broadcast transmitters																		
Index (1955 = 100)	12	38	50	75	88	88	88	100	100	112	125	138	150	162	188	212	238	275
Value (million 1957 crowns)	10	30	40	60	70	70	70	80	80	90	100	110	120	130	150	170	190	220
Wire communications equipment																		
Index (1955 = 100)	36	42	48	56	65	75	86	100	115	134	155	179	219	267	326	398	486	594
Value (million 1957 crowns)	71	83	94	110	128	148	169	197	226	264	305	352	431	525	641	783	956	1,170
Other industrial electronics ^{a/}																		
Index (1955 = 100)	36	42	48	56	65	75	86	100	141	204	256	323	405	599	883	1,280	1,820	2,520
Value (million 1957 crowns)	10	12	13	16	18	21	24	28	39	57	71	90	113	167	245	356	506	701
Total industrial electronics																		
Index (1955 = 100)	30	41	49	61	71	78	86	100	113	135	156	181	218	270	340	430	542	686
Value (million 1957 crowns)	91	124	148	186	216	238	263	304	345	410	476	552	663	822	1,040	1,310	1,650	2,090

a. Other industrial electronics include electronic computers, electronic measuring instruments, point-to-point radio, punched-card machines, electron microscopes, automation equipment, navigational devices, and microwave equipment for civilian use.

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branch telephone exchanges of any desired capacity; telephone dispatching equipment for industrial plants and mines; telephone sets for a wide range of uses, including watertight and gastight sets for mining application; carrier telephone equipment; high-frequency telephone equipment operating on very high-tension lines for power generating and distribution systems; high-frequency equipment for industrial telemetering and remote control; and teleprinter systems. Production of crossbar switching systems for telephone exchanges has recently been initiated. In addition, some carrier telephone equipment has been transistorized throughout, and printed circuits have been used. 8/

Czechoslovakia has long been a producer of long-wave, medium-wave, and short-wave radiobroadcast transmitters, having both amplitude modulation (AM) and frequency modulation (FM). More recently, television broadcast transmitters were put into production. At present, more than 30 types of radio and television broadcast transmitters are produced for domestic consumption and for export. Present plans call for production of color television broadcasting equipment by the end of 1965. Color television cameras and receiving sets received from the USSR were scheduled for closed-circuit testing in April 1961. 9/

Although Czechoslovakia claims to have reached "world standards" in the design and development of electronic analog and digital computers, series production apparently is limited at present to a few types of analog computers. A few digital computers have been custom-built by scientists for their own use in research organizations. 10/ Several digital computers also have been imported from the West and the USSR. Production of both analog and digital computers, however, is expected to increase substantially during 1961-65. One development peculiar to Czechoslovakia is a digital computer based on miniature electromechanical relays rather than on electron tubes, semiconductors, or magnetic elements. This computer has been publicized extensively and reputedly will go into mass production during the Third Five Year Plan. 11/

Czechoslovakia produces a complete line of punched-card machines, which code, verify, sort, compute, and print out data used in industrial and business establishments. These electromechanical machines are reputed to be superior to similar Soviet machines and are widely exported to countries both inside and outside the Bloc. It is estimated that punched-card machines represent a significant part of production of industrial electronics in Czechoslovakia. Furthermore, completion of a large new plant, currently under construction in Prague, will contribute to a substantial increase in production of punched-card machines during the Third Five Year Plan. 12/

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Electronic measuring instruments produced in Czechoslovakia represent an important segment of Czechoslovak industrial electronics. The assortment is comprehensive and of good quality. In addition, plans call for expanding production of electronic measuring instruments considerably in the Third Five Year Plan through the enlarged capacity provided by the recent completion of a new plant near Brno. 13/

Another important product of Czechoslovak industrial electronics is the electron microscope, which has a good reputation internationally. 14/ Large quantities of these microscopes have been produced for use in the scientific institutes of many countries both inside and outside the Bloc as well as of Czechoslovakia itself.

Czechoslovakia produces radio relay (microwave) equipment for fixed installations that is capable of providing up to 60 telephone channels using multiplex frequency division or up to 24 telephone channels using multiplex time sharing or, alternatively, one television channel. Depending on the type of input, this equipment can transmit information satisfactorily up to 840 kilometers in 15 stages. Mobile microwave equipment for remote pickup in television transmission also is produced, but microwave equipment with the greater capacity required for the two-way transmission of television information must be imported. 15/

A modest amount of industrial television equipment has been produced since 1956. In addition, medical equipment and industrial automation equipment containing electronic components are produced, and such production is to be expanded rapidly during the Third Five Year Plan. 16/

4. Military Electronics

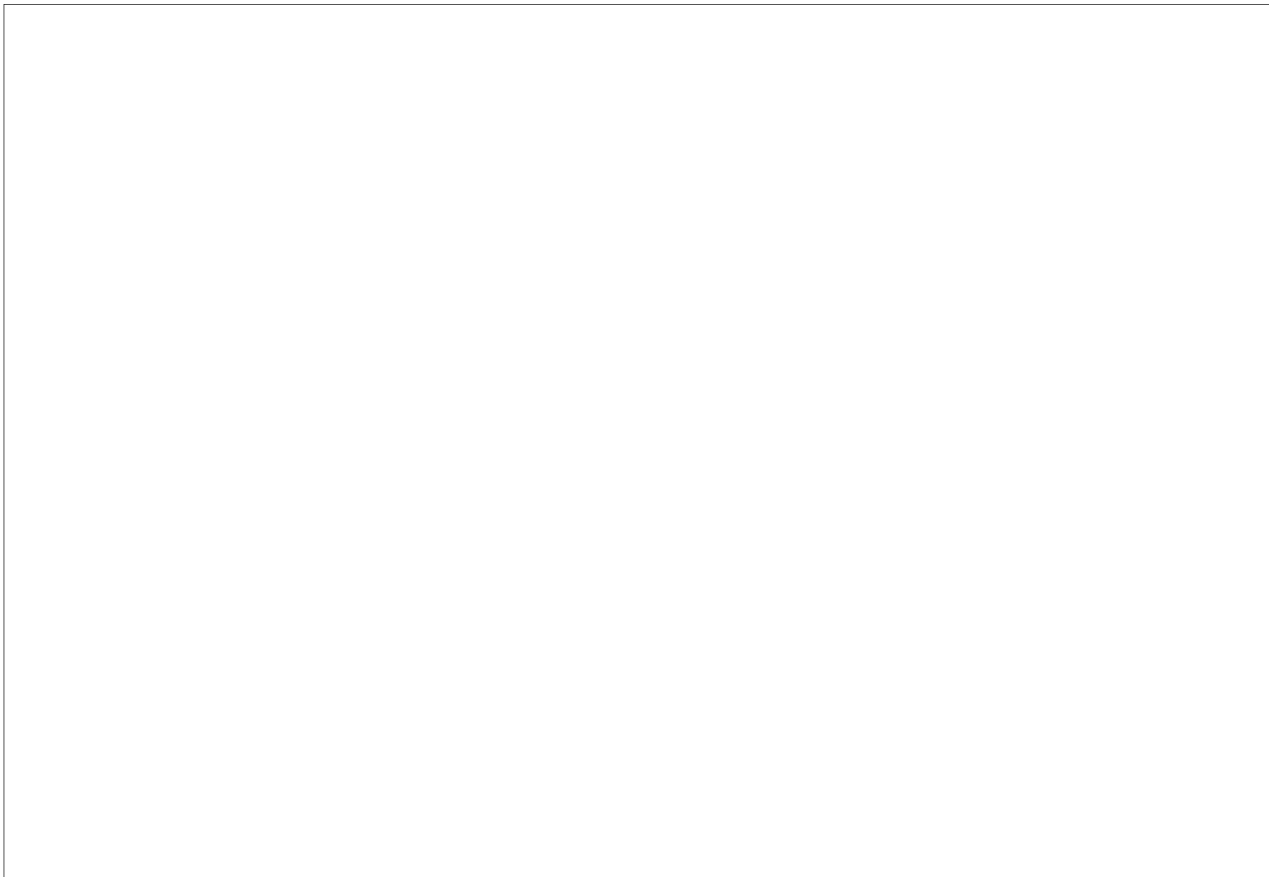
Czechoslovakia produces a large assortment of military electronic equipment, including radar, radio navigation devices, radio jamming transmitters, microwave equipment, and wire communications equipment. Furthermore, the Czechoslovak electronics industry apparently has been successful in producing the military electronic equipment required of it, for in May 1958 the minister of the former Ministry of Precision Machine Building declared that "we must not fail to mention the successes in the manufacture of special [that is, military] electronic devices." 17/

50X1

50X1

S-E-C-R-E-T

50X1



Military radio equipment for both ground and air forces is produced in Czechoslovakia. Since 1955, Czechoslovakia has concentrated mainly on production of the Soviet-designed R-series military radios,** equipment that is used primarily by the ground forces. 21/

Other military electronic equipment produced in Czechoslovakia includes substantial quantities of telephone hand sets, telephone switchboards, teletypewriters, carrier equipment, and possibly some proximity fuzes and infrared devices. 22/

5. Electron Tubes, Semiconductors, and Electronic Components

Production of electron tubes, semiconductors, and electronic components*** is shown in Table 4.† The total value of production of electronic parts in 1960 is estimated to have been more than

50X1

** It is estimated that Czechoslovakia produces the R-103, R-104, R-105, R-106, R-108, R-114, R-118, and the R-401. The R-106 probably is produced in the greatest volume.

*** These items will be referred to collectively as electronic parts.

† Table 4 follows on p. 18.

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Table 4

Czechoslovakia: Estimated Production of Electron Tubes, Semiconductors,
and Electronic Components
1948-65

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Electron tubes																		
Units (thousand)	2,381	2,600	2,800	3,100	3,300	3,600	4,000	4,314	6,130	8,257	9,470	11,223	13,000	14,000	16,000	18,000	21,000	24,000
Television picture tubes																		
Units (thousand)	0	0	0	0	0	0	1	4	10	35	100	200	300	330	360	400	440	480
Value (million 1957 crowns)	36	41	46	52	59	67	75	86	121	175	220	277	347	384	423	464	503	539
Semiconductors																		
Units (thousand)	0	0	0	0	0	0	0	38	200	540	1,100	1,700	2,500	4,000	6,200	9,700	15,000	24,000
Transistors																		
Units (thousand)	0	0	0	0	0	0	0	0	13	67	170	330	670	1,200	2,100	3,800	6,700	12,000
Diodes																		
Units (thousand)	0	0	0	0	0	0	0	38	190	470	940	1,400	1,900	2,800	4,100	5,900	8,400	12,000
Value (million 1957 crowns)	0	0	0	0	0	0	0	1	4	10	21	34	53	86	140	220	360	590
Electronic components																		
Units (thousand)	16,000	18,000	19,000	21,000	23,000	25,000	27,000	29,000	36,000	45,000	56,000	69,000	86,000	110,000	130,000	160,000	200,000	250,000
Value (million 1957 crowns)	15	16	18	20	21	23	25	27	34	42	52	65	80	99	123	152	188	233
Total value (million 1957 crowns)	51	57	64	72	80	90	101	114	158	227	293	375	480	568	683	839	1,050	1,360

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4 times that of 1955, and, by 1965, production is expected to be about 12 times that of 1955 and almost 3 times that of 1960. The estimated value of production of electronic parts was increasing at about the same rate as the estimated net value of production of all electronics during 1955-60 but will be increasing at about twice the rate for total electronics during 1960-65, primarily because of an expected rapid growth of production of semiconductors during the Third Five Year Plan. A large new plant at Piestany, Slovakia, for producing electron tubes and semiconductors will be completed during the Third Five Year Plan. 23/

A comprehensive line of electron tubes is produced in Czechoslovakia. Although an exhaustive listing of types of tubes produced is precluded, the following major categories summarize the scope of the Czechoslovak electron tube industry at present 24/:

<u>Category</u>	<u>Number of Types</u>
Network "heptal" and "noval" receiver electron tubes	57
Battery receiver electron tubes	7
Picture tubes	18
Medium-capacity transmission electron tubes	3
Magnetrons	7
Klystrons	14
Antenna-discharge switches	4
Photoelectric tubes	5
Photoelectric multipliers	4
Transmitters of pictures from the infrared spectrum zone into the visible zone	2
Electron tubes for television studio cameras and for industrial television	6
Electron optical transmitter of X-ray radiation	1

Although many types of modern electron tubes produced in Czechoslovakia are based on types of electron tubes originally developed and produced in the West, it is estimated that Czechoslovakia is self-sufficient in the supply of electron tubes in terms of product mix, quality, and quantity. Furthermore, Czechoslovak competence in production of electron tubes is reflected in the selection of Czechoslovakia by the Council for Mutual Economic Assistance (CEMA) to prepare lists of preferred tubes for the purpose of standardizing and specializing production of electron tubes in the Bloc. As of August 1960, technical exchanges had been accomplished, but no distribution of production tasks had been made among the electron tube industries of countries within the Bloc. 25/

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Semiconductors produced in Czechoslovakia include germanium diodes and transistors of the point-contact and junction types, germanium photocells, quartz diodes, and silicon diodes. Silicon transistors are still under development. In 1959, several types of germanium transistors in power ratings of 0.1 watt, 0.3 watt, and 10 watts were produced. In 1961, transistors with power ratings up to 50 watts were first produced in experimental shops. Transistors with frequencies up to 30 megacycles are in production, and preparation for production of transistors with frequencies up to 75 megacycles was underway in 1960. In all, Czechoslovakia produces about 65 different types of germanium devices. Difficulty in eliminating impurities from germanium has been the chief cause for rejection of germanium semiconductors in Czechoslovakia, but these semiconductors are generally regarded as comparable with any produced elsewhere in the Bloc. 26/

Czechoslovakia produces most types of passive electronic components. Electrolytic, paper, and vaporized-metal capacitors are produced, as are the major types of resistors, including carbon-deposited, composition, and precision wirewound resistors, and potentiometers, coils, relays, and some ferrites. This sector has been expanded rapidly since 1955, when production apparently lagged behind requirements. Large new plants for production of electronic components are being built at Jihlava and Blatna. Continued rapid expansion of production and improvements in product mix and quality are planned through 1965. 27/

IV. TechnologyA. Status and Trends 28/

Management of the electronics industry of Czechoslovakia apparently believes that the present decentralized structure of the industry, as outlined earlier,* will eliminate several major shortcomings of the industry in technical development. These shortcomings concern the excessive cost of research and development, tardiness in translating results of research and development into production, and delays in introducing modern methods of production designed to increase the productivity of labor. Undoubtedly the present organization will facilitate cooperation between research and development and production organizations because they are now under the same management.

Other current problems are not directly subject to solution by management but must be attacked at the technical level by electronic scientists and engineers. These problems were summarized in 1958 in a speech by the minister of the former Ministry of Precision Machine Building as follows:

* See II, p. 4, above.

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... It would be incorrect not to see a number of shortcomings which emerged during the rapid expansion of our low-current [electronic] engineering industry and which we have not yet been able to eliminate despite great effort. For example, the technical level and the productive capacity in the telecommunications branch are not yet quite satisfactory for the demands of modern communications technique. In the field of radioelectric board [navigation] systems we still have to make a great effort to conform to international requirements. In the field of parts [resistors, capacitors, coils, and the like] we have not yet reached world standards in regard to achievement of miniature size, adaption to tropical climate, and standardization of parameters. We still have a great deal of work to do to improve the quality and longevity of [light] bulbs and fluorescent tubes. We must eliminate a number of shortcomings in quality and variety of parts. We must overcome technical and technological [probably organizational] obstacles in the introduction and application of semiconductive elements, and in all branches, substantially improve the technology of production, especially in regard to mechanization and automation, thereby making the output more effective and economical.

The minister emphasized in the same speech the point that expanded production of electronic equipment must be accompanied by substantial cost reductions:

It is necessary to realize a substantial decrease in production costs for investment and consumer goods and for instruments and for electronic tubes and parts. First, it is necessary to lower the cost of materials, which in our manufacturing form a substantial proportion of the calculated cost. One way this can be achieved is by more economical designs and by a maximum application of standardized elements. It can also be achieved by better organization, mechanization, and automation of production,

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for which the [planned] substantial increase in production over the next years offers good prospects.

In spite of rather high costs of production in comparison with some countries of the Bloc, notably the USSR, and with most Western countries, Czechoslovakia has overcome difficult problems of development, design, and technology of production with respect to several complicated types of electronic equipment and sometimes has achieved technical parameters equal to or better than world standards. For example, various electronic tubes, particularly for television broadcast receivers, have been designed and produced successfully. Similar accomplishments have been made in radio and television broadcasting equipment, transmitting equipment for telephony and telemetry, air navigation instruments, industrial dispatcher systems, magnetophones, amplifiers, electronic measuring instruments, and radio relay systems.

In addition, the basic problems of development and production of semiconductors, dosimeters, and indicator devices for nuclear engineering have been solved. The electronics industry of Czechoslovakia also has achieved very high standards in production of radio and television broadcast receivers, speaker systems, and military electronic equipment. Although electronic computers are mostly in the developmental stage, much work has been done toward completion of designs of analog and digital computers that will utilize semiconductor and magnetic elements.

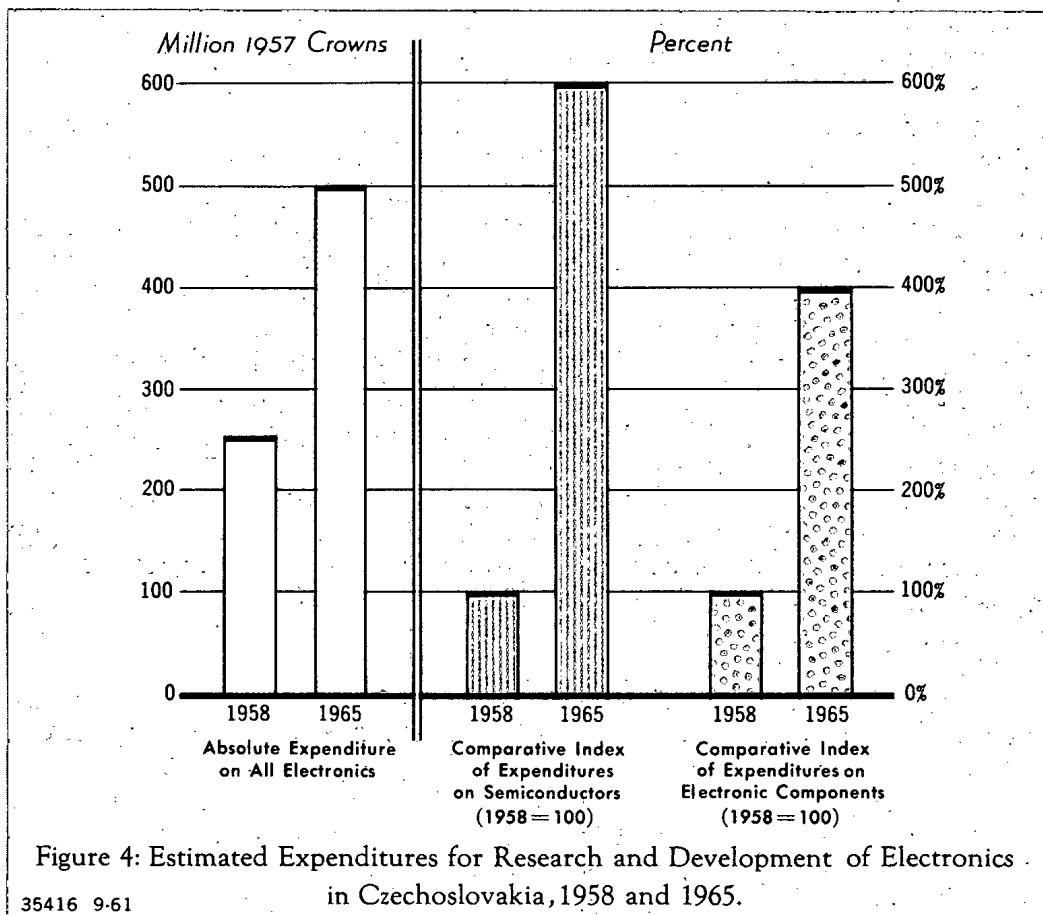
B. Research and Development

By 1958 the outlays for electronic research and development in Czechoslovakia had reached a sum equivalent to about one-eighth of the gross value of production of electronics, or about 250 million crowns (\$21 million) (see the accompanying chart, Figure 4*). Expenditures for research and development of electronics are expected to double by 1965 -- that is, to reach about 500 million crowns. In fields that require intensive development, the rise in expenditures from 1958 to 1965 will be even more pronounced. Expenditures for research and development of semiconductors in 1965 will be about six times those of 1958, and similar expenditures for electronic components in 1965 will be about four times those of 1958. 29/

In spite of these rapid increases, total outlays for electronic research and development are not expected to expand as rapidly as gross production. Present estimates indicate that, compared with the figure

* Following on p. 23.

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of 12 to 13 percent for 1958, expenditures on electronic research and development in 1965 will constitute a sum only 9 percent as large as the gross value of production of electronics.

The training of several thousand technical experts, who will be required to expand the research and development effort in the electronics industry, is expected to be one of the major problems confronting the technical sector of the higher educational system of Czechoslovakia during the Third Five Year Plan.

Basic research for electronics is carried out in the Research Institute for Communications Engineering, to which the major part of the Research Institute for Electrical Engineering Physics has been transferred. Other research institutes for development of products are attached to the electronic branch enterprises.

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The major areas of research and development for electronics in Czechoslovakia are semiconductors, electronic components, electron tubes, automatic telephone exchanges, communications equipment, materials, computers, radar, and applications of automation. In the design and development of semiconductors, electron tubes, and other components, primary objectives will be to facilitate automated production and to standardize and improve technical parameters. There are plans to develop and produce germanium transistors with a power rating of 100 watts and a top frequency of 100 megacycles as well as silicon transistors for high-temperature operation (probably military). Electron tubes are to be developed for computers and for industrial and military electronics requiring high-capacity ceramic tubes and air-cooled, high-efficiency transmitting tubes. Receiving and picture tubes for color television also are to be developed. Electronic components will be developed for operation over a wide range of temperatures and for use in tropical or other extreme conditions. Subminiature electronic components are to be developed for use in printed circuits. Communications equipment, computers, and electronic measuring equipment will be designed to use semiconductors and other new electronic components and materials.

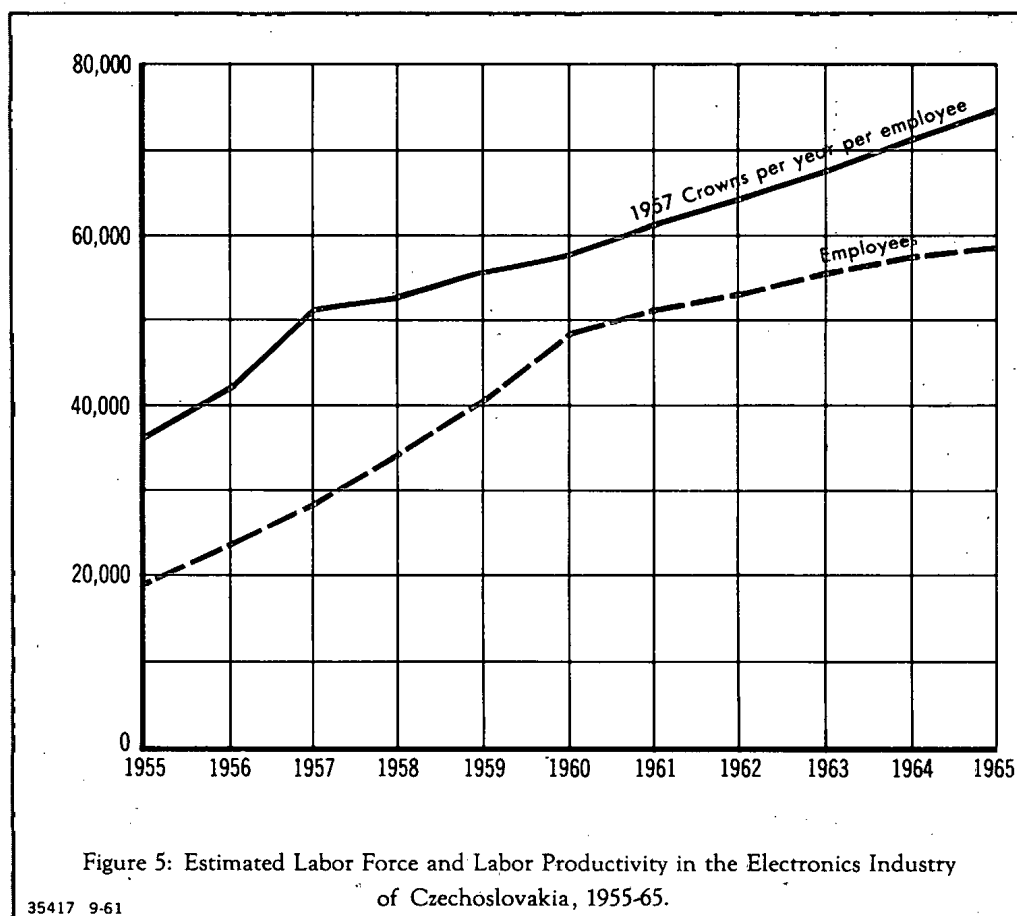
A major problem in the development of new types of electronic equipment is the development and production of new materials, particularly metals, plastics, insulation materials, lacquers, and semiconductor material. These new materials are required to achieve high operating parameters, reliability, durability, and lower production costs in electronic equipment. A spokesman for the Czechoslovak electronics industry has suggested that plans to accelerate development and production in the chemical and metallurgical branches of industry be speedily implemented.

Countries represented in CEMA have agreed to increase the division of labor among their electronics industries in order to avoid duplication in electronics research and development. Czechoslovakia has been assigned the principal task of coordinating the development of equipment required for an international automatic telephone exchange that will incorporate the principle of coordinate, electronically controlled dialing and that will utilize semiconductors to increase reliability and durability. In addition, direct cooperation of plants and institutes in East Germany with those in Czechoslovakia that are concerned with semiconductors, electron tubes, and several other unspecified areas of electronic technology has been carried on in recent years. 30/

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C. Labor Productivity

Data in Table 5* show that from the end of World War II to 1955 the value of production of the electronics industry of Czechoslovakia increased almost wholly as a result of additions to the labor force as shown in the chart, Figure 5. Labor productivity during this period was almost stable, rising only about 10 percent over a 10-year span. Although increases in the labor force were again the dominant factor in expanding production from 1955 to 1960, labor productivity increased significantly -- about 60 percent. During the Third Five Year Plan the increase in labor productivity will be a greater factor than the increase in the labor force in the expansion of production.



The underlying factor of the great expansion of total output and of labor productivity since 1955 was, of course, an increase in investment in the industry. [redacted] the annual investment in the electronics industry was expected to average

50X1

* Table 5 follows on p. 26.

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Table 5

Czechoslovakia: Estimated Labor Force and Labor Productivity
in the Electronics Industry
1948-65

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	
Labor force																			
Index (1955 = 100)	46	51	57	64	72	80	90	100	120	144	173	208	250	263	275	288	298	303	
Number of employees	8,800	9,800	11,000	12,300	13,800	15,400	17,200	19,200	23,100	27,700	33,300	40,000	48,000	50,500	52,800	55,300	57,200	58,200	
Labor productivity																			
Index (1955 = 100)	91	93	94	95	96	97	98	100	117	141	148	155	162	170	179	188	197	207	
Value (1957 crowns per employee-year)	32,000	33,000	33,500	33,800	34,200	34,600	35,100	35,700	41,900	50,500	52,800	55,300	57,800	60,800	64,100	67,100	70,400	74,100	

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150 million crowns during 1955-65. He also stated that during this period the ratio of return on investment is expected to double, implying that productivity of plant equipment is expected to increase sharply with respect to its cost. The calculated average ratio of return on investment for 1955-65 is about 2.5 to 1. Because the ratio is expected to double during the period, the initial ratio probably was about 1.7 to 1, and the terminal ratio will be about 3.4 to 1. These ratios appear to be reasonable, for, in comparison, US electronics firms average about 3 to 1. 31/

Because of the difficulty of converting to a common currency and a standard work year, comparisons of the absolute productivity of labor in the electronics industry of Czechoslovakia with similar indexes in other countries are not highly accurate, but labor productivity in the electronics industry of Czechoslovakia in 1959 apparently was about 40 percent of that in the US. 32/ This figure appears to be somewhat lower -- perhaps 5 to 10 percent -- than the percentage computed from a comparison of the absolute labor productivity in the electronics industries of the US and the USSR. 33/ Thus absolute labor productivity in Czechoslovakia is estimated to have been about 80 to 90 percent of that of the USSR in 1959.

V. TradeA. Volume of Trade1. Exports

The value of Czechoslovak exports of electronic equipment for 1952-65 (see the accompanying chart, Figure 6*) is estimated as follows:

<u>Year</u>	<u>Index</u> <u>(1955 = 100)</u>	<u>Million</u> <u>1957 Crowns</u>
1952	67	100
1953	59	88
1954	53	80
1955	100	150
1956	145	218
1957	145	218
1958	147	220
1959	207	310
1960	244	366
1961	287	430
1962	337	506
1963	397	596
1964	467	700
1965	550	825

* Following on p. 28.

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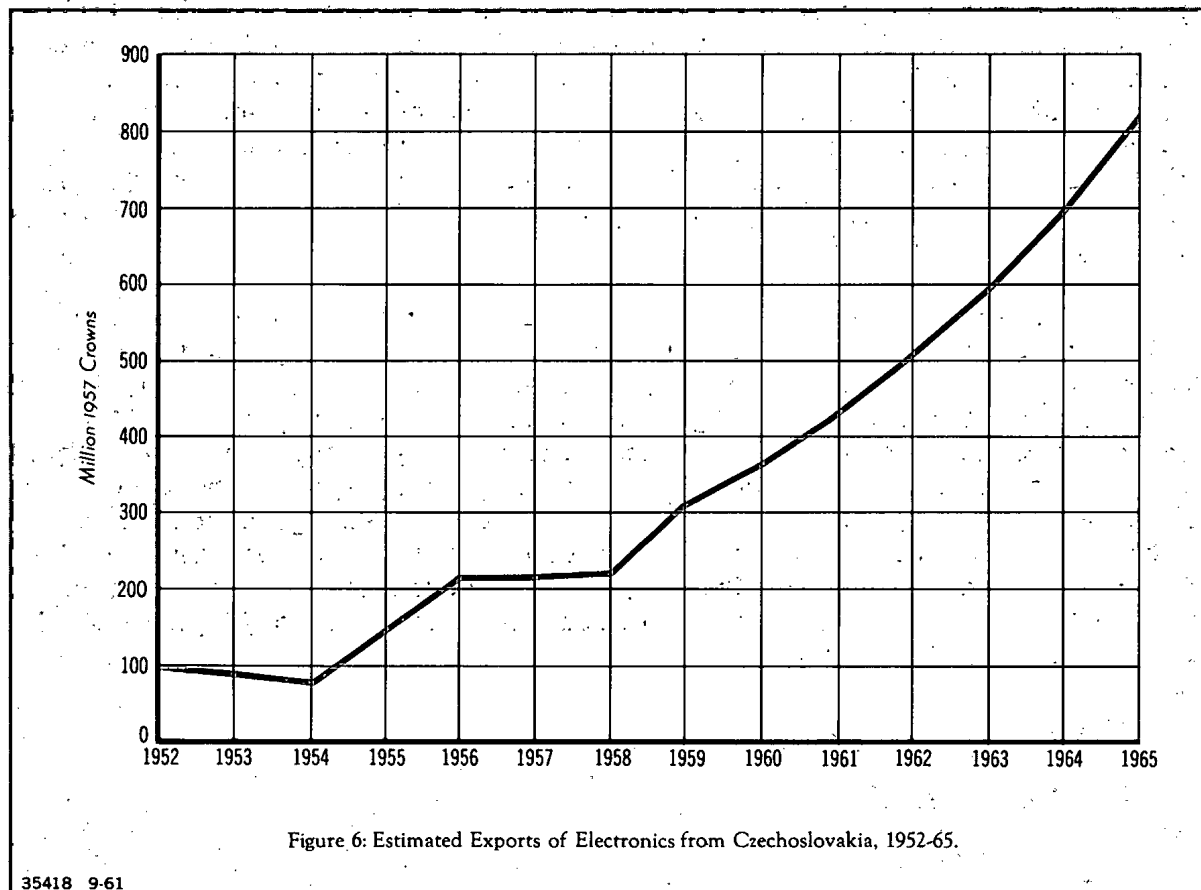


Figure 6: Estimated Exports of Electronics from Czechoslovakia, 1952-65.

Although the value of electronic equipment exported by Czechoslovakia more than tripled between 1952 and 1959, it declined in 1953 and 1954 and was almost constant during 1956-58. By 1965 the value of such exports is expected to be almost three times that of 1959, and electronic equipment is expected to increase steadily as a share of the total exports of industrial equipment by Czechoslovakia.

During 1952-65 the estimated value of electronic equipment exported by Czechoslovakia represents about 15 to 20 percent of the annual net value of production of electronics. Radiobroadcast transmitters have been exported on a significant scale since about 1955, and television broadcast transmitters have been exported recently.

Exports of wire communications equipment by Czechoslovakia to the countries of the Free World were almost five times as large in 1959 as in 1954, ^{34/} and such exports to all countries are expected to be seven times as large in 1965 as in 1959. ^{35/} Although the rate of increase implied for exports of wire communications equipment by Czechoslovakia during 1959-65 is more than twice that of exports of

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all electronic equipment during the same period, the expansion of production of wire communications equipment through 1965 is expected to be adequate to satisfy both domestic and export requirements.

Exports of electron tubes, semiconductors, and electronic components compared with exports in 1959 reportedly doubled in 1960. 36/ This increase in exports apparently reflects the demand of countries such as the United Arab Republic (UAR), Brazil, Argentina, the British protectorate of Jamaica, and other unspecified countries, where assembly shops have been set up for radio and television broadcast receivers, particularly radiobroadcast receivers using semiconductors.

Czechoslovakia exported about 200,000 radiobroadcast receivers during 1954-59,* and during 1959-61 about 170,000 television sets were to have been exported to East Germany, 37/ but no evidence of actual shipments has been noted. Czechoslovakia is expected to have available for export during 1961-65 about 625,000 television sets, accounting for one-half of the total value of electronic equipment to be exported during that period.*

Czechoslovakia has exported military electronic equipment to various underdeveloped countries since about 1956, but the quantity probably has never amounted to more than 5 percent of the total value of electronic equipment exported.

2. Imports

Although it has not been possible to quantify the value of all imports of electronic equipment by Czechoslovakia, the value of imports of nonmilitary electronics apparently has been substantially less than the value of exports of electronic equipment during 1952-60 and probably will continue to be less during 1961-65.

Imports of military radar from the USSR are estimated to have averaged in value about 60 million crowns per year during 1952-60.* Imports of military electronics by Czechoslovakia during 1961-65 probably will be much smaller than those during the previous 5 years.

Two other instances of significant imports can be quantified. First, during 1956-57, Czechoslovakia imported from the USSR 87,920 television sets valued at about 220 million crowns. 38/ Second, in 1958, Czechoslovakia purchased unspecified communications equipment valued at about 30 million crowns from Hungary, East Germany, and the USSR. 39/

* For the methodology, see Appendix A.

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B. Pattern of Trade 40/1. General

All Czechoslovak exports of nonmilitary electronic equipment are handled by KOVO, Foreign Trade Corporation for Import and Export of Precision Engineering Products, and almost all of the electronic equipment handled by KOVO is made by the Tesla National Enterprises. The Tesla trademark is registered presently in 75 countries, although Czechoslovak electronic equipment is exported also to additional countries. The appropriate component of the Ministry of Defense usually handles exports and imports of military electronic equipment. Imports of nonmilitary electronic equipment probably are handled by the consuming organizations.

To summarize this broad trade pattern, an outline of Czechoslovak exports and imports of electronic equipment in terms of products and importing countries is presented below.

2. Export Patterna. Industrial Electronics(1) Radio and Television Transmitters

Czechoslovakia has exported radio and television transmitters of many types to about 15 countries. Large medium-wave radio transmitters of 300 kilowatts have been a popular item for export. Specific countries that have received transmitters from Czechoslovakia are Argentina, Communist China, Colombia, Cuba, Guinea, Mongolia, Poland, Rumania, and the UAR (both Egypt and Syria).

(2) Electron Microscopes

Since 1957, Czechoslovakia has exported electron microscopes to more than 20 countries, including Australia, Canada, East Germany, Hungary, Poland, Rumania, the UAR, the UK, the US, the USSR, and several countries in Western Europe.

(3) Wire Communications Equipment

Czechoslovakia widely and increasingly exported wire communications equipment, principally telephone exchanges, carrier frequency equipment, and telephone handsets, in the last 5 years. Importers of this equipment have been Afghanistan, Albania, Cuba,

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Finland, Greece, Lebanon, Poland, Rumania, Thailand, Turkey, and the UAR.

(4) Test and Measuring Instruments

Czechoslovakia supplies principally to the USSR miniature service and workshop instruments for radio and television broadcast receivers and laboratory precision measuring instruments.

b. Electronic Components, Electron Tubes, and Semiconductors

Czechoslovakia exports electronic components, electron tubes, and semiconductors to more than 30 countries, including Bulgaria, Scandinavian countries, West Germany, and other countries of Western Europe; South American countries, particularly Argentina and Brazil; the UK; and the USSR.

c. Consumer Electronics(1) Radiobroadcast Receivers

Czechoslovakia has exported radiobroadcast receivers, of which the small, transistorized types are becoming the most popular, to Albania, Argentina, Bolivia, Bulgaria, Canada, Colombia, Finland, Jamaica, Lebanon, Turkey, and the UAR.

(2) Television Broadcast Receivers

Czechoslovakia reportedly promised 20,000 television sets for delivery to East Germany in 1959, but no evidence of delivery has been noted. A further consignment of 150,000 television sets is supposed to be delivered to East Germany during 1960-61. These sets are to have 21-inch screens with a 110-degree angle of deflection in the picture tube.

(3) Phonographs and Tape Recorders

Czechoslovakia has delivered phonographs and tape recorders to Bulgaria and Guinea.

d. Military Electronics(1) Radio Communications Equipment

Czechoslovakia has exported military radio communications equipment to Bulgaria, Communist China, Cuba, Ethiopia, and Indonesia.

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(2) Radar

Czechoslovak radar probably has been exported to Cuba and the UAR, although these exports may be confused with Soviet-produced radar that has been reexported by Czechoslovakia.

(3) Wire Communications Equipment

Czechoslovakia has exported military wire communications equipment to Indonesia and the UAR.

3. Import Pattern ^{41/}a. Industrial Electronics(1) Wire Communications Equipment

Czechoslovakia has imported telephone exchange equipment from Bulgaria since 1958.

(2) Test and Measuring Instruments

Czechoslovakia has imported unspecified test and measuring instruments from the Netherlands, Poland, West Germany, and the USSR.

(3) Radio Communications Equipment

Czechoslovakia has received rather large quantities of radio communications equipment from East Germany, Hungary, and the USSR. This equipment may be that required for microwave lines being constructed in Czechoslovakia as part of an intra-Bloc microwave relay system.

(4) Television Transmitter and Associated Equipment

In 1956, Czechoslovakia imported a television transmitter and associated equipment from France for the equivalent of \$334,000.

(5) Electronic Computers

Czechoslovakia has imported a few large digital computers from the USSR and the UK for use in scientific institutes.

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(6) Microwave Relay Equipment

Czechoslovakia imported from the USSR in 1959 microwave relay equipment for the construction of a microwave relay line for the transmission of television data between Prague and Bratislava.

b. Electronic Components, Electron Tubes, and Semiconductors

(1) Electron Tubes

Czechoslovakia has imported electron tubes from Communist China and the USSR.

(2) Transistors

Czechoslovakia has imported transistors from West Germany.

(3) Electronic Components

Czechoslovakia has imported electronic components from the USSR.

c. Consumer Electronics

During 1956-57, Czechoslovakia imported 87,920 television sets from the USSR.

d. Military Electronics

Czechoslovakia has imported large quantities of military radar equipment from the USSR since World War II, primarily for use in the air defense system of the Bloc.

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APPENDIX A

METHODOLOGY1. Productiona. Gross and Net Output

The electronics industry of Czechoslovakia in 1957 was composed of the facilities presently included in the six electronic branch enterprises, the Association of Telecommunications Enterprises, and the facilities of the Tesla National Enterprise in Brno, which is now in the instrument engineering industry. (For the present organization of the industry, see II.*) Thus in 1957 production of electronic equipment by other organizations** in Czechoslovakia was not accounted for by the electronics industry as conventionally defined by the Czechoslovak government, but production of illumination sources (defined as nonelectronic in this report) was accounted for by the electronics industry of Czechoslovakia in 1957.

Precise adjustment for this situation could not be made, because of lack of information to quantify production of electronic equipment by organizations other than those considered by the Czechoslovaks to be in the electronics industry. As an approximate compensation for the omission of this production, however, the value of output of illumination sources was left in the figure for the gross value of production of electronics in Czechoslovakia in 1957, which was given as 1,569.5 million crowns by a member of the State Planning Office of Czechoslovakia. 42/

The index of the gross value series for production of electronics in Czechoslovakia was constructed on the basis of the following information:

- (1) The index for 1960 was planned to be 400 and for 1965 to be 700 with 1955 as the base year. 43/
- (2) The index for 1958 was 600 with 1948 as the base year. 44/
- (3) The index for 1960 was 200 with 1957 as the base year. 45/

* P. 4, above.

** See II, p. 4, above.

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The above index numbers were integrated into one index for the period 1948-65 with 1955 as the base year. Average annual rates of growth were used to connect the terminal years of the given index numbers. The gross value series was then constructed on the basis of the absolute value for gross production given for 1957 and the integrated index.

The net value series as constructed here is not a true value added series, because certain intermediate materials and services are double counted. However, double counting of the value of electron tubes, semiconductors, and electronic components (already included in the value of the end products) has been eliminated by subtracting from gross output the value series constructed for these items (see Table 4*). Replacement tubes are considered to be end products and, therefore, are included in the net value of production. The value of replacement tubes was estimated to comprise about one-third of the value of production of electron tubes for 1957-65 and about one-sixth for 1948-56.

The gross value and net value of production series derived from the above methodology are as follows (in million 1957 crowns):

Year	Gross Value Series		Net Value Series	
	Index (1955 = 100)	Value	Index (1955 = 100)	Value
1948	42	330	42	285
1949	48	377	48	327
1950	54	424	54	368
1951	61	479	61	416
1952	69	542	69	472
1953	78	612	78	533
1954	88	691	88	603
1955	100	785	100	686
1956	141	1,110	141	969
1957	200	1,570	204	1,400
1958	252	1,980	256	1,760
1959	318	2,500	323	2,210
1960	400	3,140	405	2,780
1961	447	3,510	447	3,070
1962	500	3,920	493	3,380
1963	560	4,400	541	3,710
1964	626	4,910	587	4,030
1965	700	5,500	628	4,310

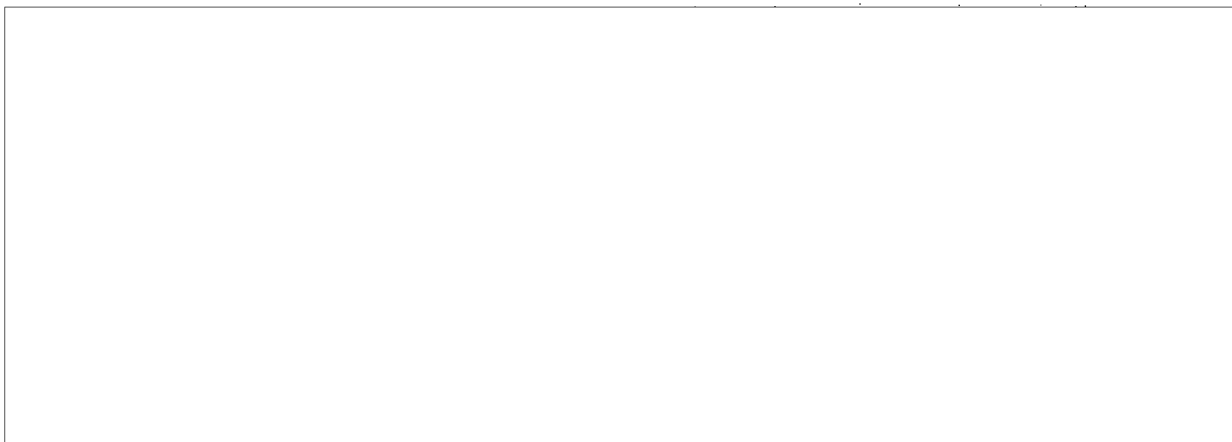
* P. 18, above.

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The projections through 1965 for gross and net value of production that are shown above and the projections that follow for individual commodities and subsectors are considered to be reasonable in the light of past performance of the industry and the evidence of investment in the industry given by construction of new plants and renovation of old plants.

b. Consumer Electronics

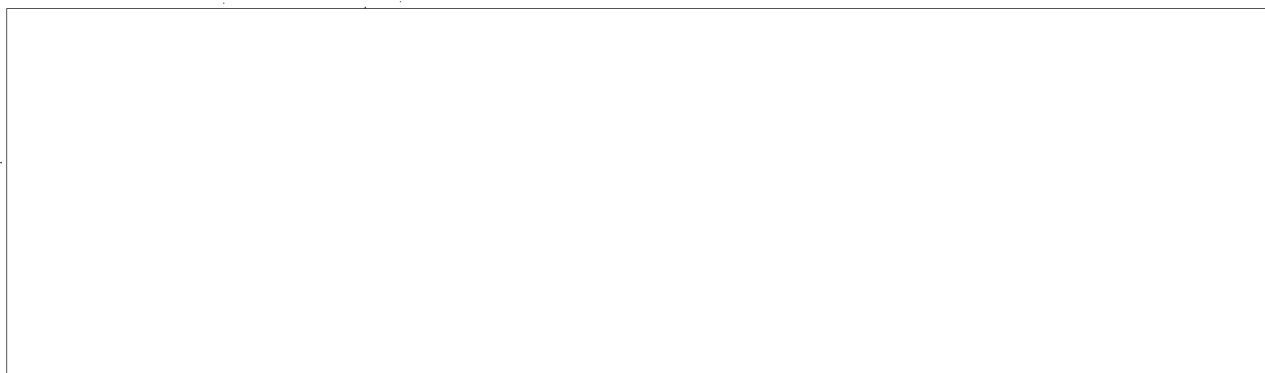
(1) Radiobroadcast Receivers



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Planned production was given for the year 1965. ^{52/} Annual production for the years 1961-64 was estimated by interpolating at the average annual rate of increase scheduled between 1960 and 1965. The completed series is shown in Table 2.*

(2) Television Broadcast Receivers



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* P. 12, above.

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Planned production was given for the year 1965. ^{57/} Annual production for the years 1961-64 was estimated by interpolating at the average annual rate of increase scheduled between 1960 and 1965. The completed series also is shown in Table 2.*

(3) Phonographs and Tape Recorders

The figures given for domestic sales were used as production figures for 1956-59. ^{58/} Production in 1954 and 1955 was estimated at 25 percent of the production of radiobroadcast receivers based on the ratio of radiobroadcast receivers to phonographs and tape recorders in 1956. Production was arbitrarily tapered off back to 1952, when production first became economically significant. The production series for 1960-65 was estimated at about 16 percent of the number of radiobroadcast receivers produced based on the ratio of radiobroadcast receivers to phonographs and tape recorders in 1958 and 1959.

(4) Wired Loudspeakers

Production of wired loudspeakers began in 1954. The change in annual inventory of wired loudspeakers was estimated to equal production during 1954-59. ^{59/} Production to 1965 was extrapolated at the rate that obtained during 1956-59.

(5) Replacement Electron Tubes for Consumer Electronics

The annual volume of replacement receiving tubes was estimated to represent about 10 percent of the inventory of receiving tubes in use in consumer electronics. This percentage and the estimated prices of tubes were derived from analogy with US data. ^{60/} In 1957 prices the average unit price for receiving tubes was 11.34 crowns, and the average unit price for picture tubes was 255.4 crowns. The annual volume of picture tubes allocated to replacement was obtained by subtracting the number of tubes installed in newly manufactured television sets from the total number of such tubes produced annually.

(6) Prices of Consumer Electronics

Retail prices for the average television and radiobroadcast receiver and phonograph or tape recorder were computed from official Czechoslovak sales data. ^{61/} The retail price of a wired loudspeaker also was obtained. ^{62/} To convert retail to f.o.b. factory prices for radiobroadcast receivers, phonographs and tape recorders, and wired loudspeakers, the retail prices were deflated by 42.5 percent.

* P. 12, above.

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This percentage was given for a typical radiobroadcast receiver in 1957. 63/ The retail price of television broadcast receivers was converted to an f.o.b. factory price by deflating the retail price by 19 percent, which is equivalent to an analogous factor computed for the USSR, representing the estimated turnover tax and cost of sales and distribution in the USSR. 64/

The f.o.b. factory prices derived from the above methodology are as follows:

<u>Item</u>	<u>Price</u> <u>(1957 crowns)</u>
Radiobroadcast receiver	633
Television broadcast receiver	2,497
Phonograph or tape recorder	610
Wired loudspeaker	201

c. Industrial and Military Electronics

(1) General

The value of production of industrial and military electronics in 1948 was derived by subtracting the estimated value of production of consumer electronics from the estimated total net value of production. The value of production of wire communications equipment for 1948 was estimated from figures given for the Two Year Plan (1947-48). 65/ The difference between the value of production of wire communications equipment and the estimated value of total industrial and military electronics was arbitrarily divided evenly among military electronics, radio and television broadcast transmitters, and other industrial electronics. Thus in 1948 the estimated value of production of industrial electronics was 90.8 million crowns, allocated as follows: 70.8 million crowns for wire communications equipment; 10.0 million crowns for radio and television broadcast transmitters; and 10.0 million crowns for other industrial electronics. In addition, military electronics was allocated 10.0 million crowns.

(2) Industrial Electronics

(a) Wire Communications Equipment

The value of production estimated for 1948 was used with an index of production for 1948-59 given for the Tesla Karlin Plant, which was the primary producer of wire communications equipment during the period, to derive the value series for that period. 66/

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The index for 1959-65 was based on an index given for the Tesla Karlin Plant and on information that three new plants for production of wire communications equipment would be activated during the period. 67/ The value series for 1960-65 was based on this index.

(b) Radio and Television Broadcast Transmitters

The estimated value of production during 1948-58 was based on the estimated value for 1948 and the estimated number of radio and television broadcast transmitters produced during the period. 68/ The series was extrapolated to 1965 by geometric progression on semilogarithmic graph paper that approximated the average annual rate of increase between 1950 and 1958.

(c) Other Industrial Electronics (electronic computers, electronic measuring instruments, point-to-point radio, civil navigational devices, punched-card machines, electron microscopes, automation equipment, and microwave equipment for civilian use)

The estimated value of production of other industrial electronics for 1948-55 was based on the value estimated for 1948 and the index estimated for wire communications equipment. The series was extended through 1960 on the basis of the index estimated for the net value of production of total electronics. The series for 1960-65 was estimated on the index for production of semiconductor diodes using 1960 as the base year. The choice of these indexes for other industrial electronics was influenced by qualitative statements concerning the importance of the various commodities included in the category. 69/

(3) Military Electronics

The quantity of military electronics for the entire period of the estimate was derived as a residual by subtracting the estimated annual values of production of consumer and industrial electronics from the series estimated for the total net value of production of electronics. Spot checks on production of radar, military radio, and military wire communications equipment in Czechoslovakia indicate that the estimated residual for military electronics is of the correct order of magnitude.*

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d. Electron Tubes, Semiconductors, and Electronic Components(1) Electron Tubes(a) All Electron Tubes

Absolute figures for physical production were given in terms of units for 1948 and for 1955-59. An index of physical production was given as 250 for 1965 with 1958 as the base year. 70/ The average annual rates of growth were computed for 1948-55 and for 1959-65, and the series was completed by applying these rates of growth to the series of physical production.

The value series for electron tubes was derived from the series estimated for net value of production of total electronics on the basis of analogy with US data indicating that the value of production of electron tubes averages about one-eighth of the net value of total production of electronics. 71/

(b) Television Picture Tubes

The physical production in number of units of television picture tubes was given for 1960. 72/ Production for 1959 was established from information that requirements would be met by domestic production for the first time. Production for 1958 was estimated on the basis of the rate of production of television picture tubes given for December 1958. 73/ Production for 1956 and 1957 was related to that for 1958 by index numbers given in Czechoslovak press reports. 74/ Production in 1954 and 1955 was estimated from information indicating that production was initiated in 1954 and that twice as many television picture tubes were produced in 1956 as in 1954 and 1955 combined. 75/ Production was extended to 1965 at an average annual rate of increase of 10 percent.

(2) Semiconductors

The production series for semiconductors was estimated from statements that total production of these elements would be 20 percent of production of electron tubes in 1960 and equal to production of electron tubes in 1965 and that the production of transistors alone would be about 12 million units in 1965. 76/ Presumably the statements referred to production in terms of physical units. Also, the assumption is that production of transistors would increase about 1.8 times as rapidly as production of all semiconductors during 1960-65. With the additional information that production of semiconductor diodes and rectifiers became economically significant in 1955 and that of

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transistors significant in 1956, it was possible to complete the production series of semiconductors shown in Table 4.* 77/

The value of production of semiconductors for 1957 was estimated on the basis of data on production at the Roznov plant, which produces electron tubes and is the sole producer of semiconductors in Czechoslovakia. From data concerning planned cost reduction and a planned increase in production in 1957 above 1956, it was determined that in 1957 the Roznov plant produced electron tubes and semiconductors valued at about 140 million crowns. 78/ [redacted] the Roznov plant produced about three-fourths of all electron tubes and semiconductors produced in Czechoslovakia. 79/ Thus the total value of electron tubes and semiconductors produced in 1957 was about 185 million crowns. Subtracting the estimated value of production of electron tubes in 1957, 175 million crowns, leaves about 10 million crowns as the estimated value of production of semiconductors in 1957.

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The relative shares of transistors, crystal diodes, and rectifiers in the total value of production of semiconductors in 1957 was estimated on the basis of analogy with US data that the unit price of transistors was about twice that of diodes and rectifiers. 80/ The crown unit prices thus established for 1957 were used to compute the value of semiconductors using numbers estimated in the series of physical production.

(3) Electronic Components

The index of production of components for 1955-65 was based on an index of 850 given for 1965 with 1955 as the base year. 81/ Production for intervening years was computed at the average annual rate of growth. The index for 1948 to 1955 was assumed to be the same as that for electron tubes. The production series of physical units was computed from the index using physical production for the year 1957, which was estimated to be about 45 million on the basis of production at the Tesla Lanskroun Electronic Components Plant. 82/

Data on the US and USSR indicate that the production value of electronic component parts averages about 6 percent of the net value of output of the electronics industries of these countries. 83/ However, because production of components was lagging in Czechoslovakia in relation to the total production of electronics, 84/ a factor of 3 percent rather than 6 percent was used to estimate the absolute value of electronic components for 1957. The values for the other years of the series were computed from the index of physical production.

* P. 18, above.

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2. Labor Force, Labor Productivity, and Output-Capital Ratioa. Labor Force and Labor Productivity

The number of employees in the electronics industry of Czechoslovakia was given in absolute terms for 1946, 1950, and 1960. 85/ In addition, an index of the number employed in the industry was given for 1960, with 1955 as the base year. Employment during 1946-60 could thus be estimated by calculating the average annual rates of growth between known years. The number of employees in the industry for 1960-65 was estimated by the methodology below.

From the estimate of the size of the labor force for each year during 1946-60 and the estimate of net value of production for the same period, an index of labor productivity was calculated. The index was extended to 1965 at the typical rate -- about 5 percent per year -- which obtained from 1957 to 1960. This index was then used to calculate the index of employment in the industry during 1960-65 -- that is, the index of net output was divided by the index of labor productivity.

b. Output-Capital Ratio

The output-capital ratio for 1955-65 was calculated from the increase in the estimated net value of production in 1965 above 1955 and the value of total investment given for the period. 86/

3. Tradea. Exports

The index of the value of exports of electronics from Czechoslovakia was given for 1952-59 and extended to 1965 at the average annual rate of increase computed from the index given for 1965. 87/ The value of exports in 1965 was planned to be 15 percent of the gross value of production in 1965, or about 825 million crowns. 88/ This figure and the index of exports were used to compute the value series of exports of electronics during 1952-65.

Because the inventory of television broadcast receivers in domestic use is planned to increase by about 1.1 million units during 1961-65 89/ and because production during the same period has been estimated, it is possible to estimate the receivers available for export during the period -- about 625,000 television sets worth about 1.6 billion crowns. This quantity is calculated to be about 50 percent of all estimated exports of electronic equipment during 1961-65.

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The availability of radiobroadcast receivers for export during 1954-59 was calculated by subtracting the number of radiobroadcast receivers sold domestically from the total number produced. 90/



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4. Crown-Dollar Ratio

The crown-dollar ratio applicable to the total value of electronics produced in Czechoslovakia was calculated from the per capita production in crowns given for the US in 1957 by the State Planning Office of Czechoslovakia. 92/ A similar figure for per capita production in US dollars was derived from US data 93/ and divided into the per capita figure given in crowns to derive the crown-dollar ratio in terms of 1957 crowns and 1957 US dollars. The resulting ratio was 12.07 crowns per dollar for electronics compared with the official exchange rate of 7.2 crowns per dollar.

The crown-dollar ratio of 12 was used to convert the 1957 crowns used in estimates of production of electronics in Czechoslovakia to 1957 US dollars for the purpose of comparison with the value of production of electronics in other countries.

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