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THE HUNGARIAN TELECOMMUNICATION INDUSTRY: PAST, PRESENT AND FUTURE[1/]

Prepared by the
Hungarian Telecommunication Industry

1/ The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the secretariat of UNIDO. This paper has not been formally edited.

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INTRODUCTION

This paper was prepared by the Hungarian telecommunication industry to serve as background information for the Consultative Meeting to be held in Budapest, 7-11 March 1977.

By outlining the development of this industrial branch over the past 100 years, the paper transmits the context for the various specific technologies and plants that are described in detail in the other two meeting papers. It may also provide certain guidance for assessing the present structure and technological level of the Hungarian telecommunication industry.

The paper describes the long history of this industry and shows how its development proceeded on the basis of technological advancement and of requirements and capabilities of the industrial sector as a whole. As the developing countries continue to industrialize they face a similar, increasing demand for telecommunication equipment and increasing challenges for local manufacturing and technological development. The long-term and integrated character of telecommunication industry development as highlighted by the Hungarian example should receive due attention by the developing countries. The importance of planning and the need for decisions regarding the building of capacities in stages and for increasingly sophisticated technologies as telecommunication networks grow cannot be over emphasized.

The importance of communication has grown to a great extent during the past decades and in recent years both internationally and domestically and continues to grow. The control of the economy, organization of modern public administration and other similar activities require superior telecommunication services. Modern telecommunications play the role of a "nervous system" in every country's life. An information network of unsatisfactory volume and quality would restrain all branches of the economy.

The increasing requirements placed on telecommunications are considerable in terms of both quality and quantity. Besides conventional services such as telephony, telegraphy, transmission of music and pictures etc. many novel services have evolved, e.g. colour picture broadcast, data transmission, digital information, telecontrol etc. The magnitude of information flow doubles on an average every 10 years. These are the factors responsible for the rapid development of the telecommunication industry in the past and will ensure a further dynamic growth in the future.

The Hungarian telecommunication industry has a tradition of 100 years. The industry has become a notable branch of the Hungarian economy. Most goods produced are being utilized in foreign markets. The organization and system of management of this industry were determined by domestic traditions. The variety of products manufactured includes all the important items of communication equipment.

Modern, electric telecommunication techniques were initiated by the invention of the telegraph by Samuel Morse in 1837. The first telegraphic connexion was opened up in 1844 between Washington and Baltimore, a distance of approximately 12 km. Recognizing the possibilities inherent in electric telecommunications, Hungary was one of the first to use this new technique in its early stages, and the first telegraphic equipment was put into operation only three years later, in 1847, between Pozsony and Vienna.

One of the great tragedies of Hungary's history was the Hungarian war of independence of 1848-1849. Following its defeat, the country was paralysed by heavy political and economic oppression, in a period of great importance to the industrial revolution. The development of mechanized communications was used to serve the political and economic interests of the ruling foreign oppressors. Hungarian industry was prevented from unfolding; even equipment installed in the country was not built in Hungary. After the political compromise in 1867, the manufacture of telecommunication apparatus and telecommunications proper developed more rapidly, as the following data show: in 1867 - 20 years after the establishment of the first telegraph office in Hungary - only 181 stations were operating; in 1887, after another 20 years, as many as 31 Hughes and 1,159 Morse machines werein service, and immediate connexions had been established with neighbouring countries via the Budapest-Belgrade and Budapest-Bucharest lines.

I. THE FIRST 25 YEARS

As a result of the political and economic rights obtained in 1867, the Hungarian economy flourished, bringing with it an increasing demand for the manufacture of telecommunication equipment in view of the increased use of such equipment. Recognizing the expanding demand, the Hungarian Government encouraged the domestic manufacture of telegraph apparatus and equipment. Specialists from abroad were entitled to establish productive plants under the condition that they assumed the obligation of training Hungarian technicians at their premises.

Hungarians consider their telecommunication industry to date from 1874, when the first Hungarian entrepreneur obtained a licence to produce electrical telecommunication apparatus and equipment, the engineer Béla Egger. The firm he founded is famous in the history of the Hungarian telecommunication industry not only as the first productive plant established and owned by a Hungarian,

the production line of which is represented by its successor, the Beloiannis Telecommunication Engineering Factory (BHG), the largest works manufacturing professional equipment, but also as the birthplace of another enterprise that later acquired world fame under the trade name Tungsram. Two years later, in 1876, the Hungarian-owned factory producing electric telecommunication equipment and apparatus, which is well known today at home and abroad as the Telephone Factory (Terta) was founded.

The young Hungarian enterprises had not only to cope with initial difficulties, but also to face competition from foreign companies supplying foreign-made products even when exclusively domestic makes were specified.

The Hungarian enterprises managed to survive the competition owing to their business policy; licence relations; and the technical developments, inventions and patents of Hungarian specialists. The leading firms manufactured their products in well-equipped, mechanized plants and exported to several countries in addition to meeting domestic requirements. Towards the end of the nineteenth century capital concentration could begin.

The development of domestic telecommunication network and the telecommunication industry was furthered in 1889, when the Hungarian Postal Management took over the telephone network service and, with a view to promoting domestic manufacture, conducted a competition for telephone sets and subsequently for telephone exchanges of Hungarian design and make. At the turn of the century, 2,683 Morse and 152 Hughes telegraph apparatus were operating, their number having more than doubled since 1887, and about 30,000 stations were connected in the telephone network.

The achievements of the first 25 years of the domestic telecommunication industry are outlined below.

Hungarian specialists made independent technical improvements on usual telegraph apparatus, e.g. instead of the initial types working with embossed print the method of so-called "blueprint" was introduced. Later the Hollós type of writing device, discarding the local batteries, was adopted.

During the decade following the invention of the telephone, the first domestic design of postal standard telephone sets was completed, containing only the microphone on a licence basis. This set was awarded first prize at the Industrial Exhibition in 1886 and was exported to the neighbouring countries.

Domestic telephone exchanges were built. The first installed exchanges used imported equipment, which subsequently was produced by the domestic industry. Initially, partial units and components of the equipment of foreign design were assembled at Hungarian works; subsequently, the manufacture of the elements commenced and later complete exchanges were built on the basis of licences procured from the foreign manufacturers.

Hungarians take pride in the work of Tivadar Puskás, inventor of the telephone exchange, Edison's collaborator. The first telephone exchange was operated in Boston in 1877. Tivadar Puskás's younger brother, Ferenc Puskás, demonstrated the telephone exchange in Budapest; subsequently, based on the licence granted, the first domestic telephone exchange was opened up in 1881 with 50 subscribers.

Another epoch-making invention of Tivadar Puskás was the telephonograph system, which may be looked upon as the predecessor of radio broadcasting. The system was presented in 1881 at the Paris Electric World Exhibition. The Hungarian Government granted a licence to establish a telediffusion telephone network in 1893, which had been in operation during several decades with repeated modernizations.

An outstanding invention was the Pollák-Virág type of fast telegraph, displayed publicly in 1899 for the first time and awarded a prize at the Paris World Exhibition. This device recorded signals by means of cursive writing at a rate of approximately 600 words/minute. This high velocity, however, was ahead of its age; at that time such a speed in telegraphy was not yet required, and thus its utilization was not economically justified.

In appreciation of Hungarian progress in domestic telecommunication the International Telecommunication Union (ITU) organized its second Conference on Telegraphy in Hungary in 1896.

II. THE SECOND 25 YEARS

With the turn of the century, business began to boom also in Hungary, and big capital flowed into industrial and commercial enterprises. Road and railroad construction started on a large scale; new commercial and industrial establishments were founded in rapid succession. During this period, manufacturing industry came into being in Hungary. From the point of view of the further development of the telecommunication industry, it is significant that the related branches of industry started to produce materials required by the telecommunication industry for its own production on the one hand, and for meeting the conditions of and supplementing end-user requirements, on the other. Items produced included wires, steel wire, current supply systems, accumulators and tools. Suitable organizations for machine repair and of the building trade were established.

As industrialization progressed an increasing migration from the country to the industrial centres and towns took place, and the demand for means of communication, mostly the telephone, increased. Early in this period, the Hungarian Postal Management invited an international tender regarding a CB system telephone exchange for 10,000 lines that could be extended up to 20,000 lines. The tender was awarded to a Hungarian enterprise, and building this telephone exchange was the beginning of the large-scale manufacture of telecommunication equipment in Hungary.

An outstanding technical achievement of the second 25 years of the telecommunication industry was the perfection of electric bulbs at the United Incandescent Lamp and Electrical Co. Ltd. (Tungsram). In 1903, Sándor Just and

Ferenc Hanamann obtained patent protection for their tungsten-filament bulbs, having brought about a considerable increase of efficiency as compared with carbon-filament bulbs. With the introduction of the mass-production of tungsten-filament bulbs the company became known through the world and in Hungary it formed the bas. of the telecommunication industry. The technical development of the works is characterized by the fact that while in 1894, daily production amounted to 4,000 carbon-filament bulbs, they produced already 3,000 tungsten-filament bulbs a day and exported to 10 countries.

Besides the manufacture of electric bulbs, Tungsram developed electron tubes applicable in practice and started mass production in 1917 as the third largest manufacturer in the world. Since then it has become the largest and most important manufacturer of active components within the domestic telecommunication industry.

During this period, the quantity of telecommunication equipment doubled every 10 years, which represents at the same time the capacities of the telecommunication industry. In 1917, there were 100,000 operating telephone stations. To obtain a better exploitation of the lines, the duplex system was introduced in toll traffic. Between 1900 and 1917, the length of installed trunk lines increased from approximately 70,000 km to 600,000 km. Likewise, the number of staff employed in the division of telephone and telegraph equipment of Tungsram increased - from 600 in 1910 to 1,600 in 1917.

The technical achievements of the domestic industry also should be noted. They were obtained as a rule in close co-operation with the specialists of the Hungarian Post, especially with those of the Experimental Station of the Post.

After 1898, when wireless telegraphy came into existence, experiments were initiated with this technique as early as 1903. A high-capacity station was built up which secured a trouble-free bridging of the distance Fiume-Ancona in 1906.

In this period, Mihály Dénes demonstrated his first sound-film tape transmitting music in 1917, the first stage of the sound film. In 1919, he

demonstrated publicly his television apparatus named "Telehor", relaying pictures from a distance of several kilometres. In 1928, he renounced the patents for the invention, and so the realization took place in Germany.

The invention of electron tubes in 1915 was the most important milestone of this period in the technical development. On the one hand it laid the bases for a new branch of telecommunication engineering, radio broadcasting, and by creating the high-frequency technique, on the other, secured novel possibilities for a further development of long-distance communication.

Radio broadcasting was an event of direct interest to the broadest public, and its diffusion gave a powerful impetus to a further development of the telecommunication industry. Broadcast transmission was realized first in America in 1920. In Hungary the first experimental broadcast transmission was started three years later by means of an imported 250-W capacity transmitter. Parallel with this, the production of equipment required for radio engineering began, and a further improvement was made in receiving electron tubes, resulting in their production on a large scale.

An important event of this period from the point of view of the development of domestic telecommunication industry was the establishment of the first research laboratory at Tungsram. New processes, inventions and patents elaborated here made possible the development of the international vacuum-engineering industry. Owing to the domestic application of such new processes and inventions, the enterprise was able to secure a leading position and has constantly held a place among the five leading works of the world.

Tungsram established a Department of Plant Operation for a continuous scientific organization and control of the economic side of the enterprise, as well as an independent machine building of their own aiming at an improvement of productivity and at automation.

The first results of this latter activity were the facilities permitting the production of 15 million electric bulbs and 250,000 electron tubes in 1925.

After the First World War, and especially with the beginning of radio broadcasting, the telecommunication industry began to progress rapidly the world over. This is when our telecommunication industry is assigned a considerable part within machine industry due to its considerable exports. However, Hungary, exhausted by the war, was not in a position to put up alone the capital required for the development of production, and thus began the penetration of capital from abroad, which meant a successive implanting of big foreign concerns in domestic enterprises of the telecommunication industry.

III. THE THIRD 25 YEARS

The third 25 years was a period of truly revolutionary development: the radio valve had appeared on the scene. With the spread of radio broadcasting, information, culture and entertainment went on the air direct into the homes of those who possessed a suitable set for reception. The telecommunication industry hit upon its largest base for sales outlet, the consumer sphere, securing a never-expected growth.

During this period two great events interfered with the fast development of the Hungarian industry: (a) the world economic crisis in the 1930s, and (b) the Second World War. Nevertheless, production doubled every 10-12 years. Furnishing 45-50% of the exports of the machine industry, the telecommunication industry became one of the most important in the country.

During the first third of this period, each of the largest enterprises specialized in an individual line and, thus concentrated its intellectual and financial resources on a limited range of products. In this way the volume of production was large enough to make serial manufacture competitive.

In proportion its capabilities, Hungary contributed creatively to the general technical development of telecommunication through new processes and patents. At the outset of this period, the series production of the rotary-

system automatic telephone exchange was begun. Radio valves as amplifiers permitted cables to be used instead of overhead lines for telephone connexions, foremost with a view to reducing atmospherics. At the end of the 1920s, domestic industry was producing and installing cables, and then producing and mounting the necessary equipment.

In the field of long-distance transmission, the development of the electron tube opened the way for a multiple exploitation of the twin wires serving for transmission. The Hungarian industry soon recognized the importance of the production of this equipment and included it in its manufacturing programme towards the end of the 1930s.

The Orion Works, founded in 1913, started the series production of radio-reveiver sets in the early 1930s and about 10 years later accounted for 25% of world radio exports. Several Hungarian enterprises in this period were manufacturing radio sets. Competitiveness was enhanced to a considerable extent by the domestic development and manufacture of the electron-tube. Modern, high-quality valves were produced in large quantities.

The marked development of radio engineering made it imperative to produce components (resistances, capacitors) on a large scale. For this purpose a specialized enterprise, Remix Works, was established at that time.

A 120-kW, medium-wave sender built by domestic industry and several relay stations were put into service in 1933. The studio of this sender was likewise of Hungarian design and make. The acoustical fundamentals of this work were laid by György Békésy's experiments, who in the course of these tests produced a model of the human ear. For his accomplishments in this field, he was awarded the Nobel prize in 1961. His work influenced the development of the domestic electro-acoustical industry.

The basis of the technical development of the telecommunication industry consisted in this period in the development of electron tubes, which made possible new and further achievements in high-frequency techniques. Tungsram

Research Laboratory obtained outstanding results in solving problems in connexion with electron tubes, some of which were:

Elaboration of GK-type tungsten material

Practical application of coiled coils

Creation of the Krypton lamp

Anti-microphonic tubes

Recognition of space coupling

Elaboration of the low-noise, high-frequency pentode

Elaboration of full glass tubes

Elaboration of electro-luminescent light sources

Responsiveness to technical progress is reflected in the fact that Tungsram and Orion jointly established a television laboratory in 1934 and managed to transmit stills and subsequently motion pictures at short distances. These experiments were interrupted, however, by the Second World War. In 1946, for the first time in the world, microwave-signals reflected from the moon could be received by means of radar equipment built with the help of the Tungsram Research Laboratory.

In the years immediately before the Second World War, the domestic telecommunication industry was up to date technically, produced an economically well-founded wide range of products, met domestic requirements almost entirely and exported a considerable volume. This branch of industry was related in many ways to western European companies and was strongly dependent on them, especially in technical respects.

Five years after the War, the volume of production of the Hungarian telecommunication industry already surpassed the maximum level of production in 1938 and earlier. With the nationalization of telecommunication engineering enterprises effected in this period, a decisive change took place in the further development of this branch of industry.

IV. THE FOURTH 25 YEARS

In 1950, an important date in the history of Hungarian industry, a socialist industry was initiated, within the framework of which machine industry was assigned the leading role. This orientation implied that the machine industry would become a main component of the national economy, first because the machine industry continually adopts the latest results of scientific and technical research and consequently its products also are vehicles of scientific advancement and thus contribute to a permanent modernization of the technical-material resources of the economy.

The policy with respect to the machine industry was that it should:

(a) Satisfy the permanently increasing requirements of society and the economy by producing a sufficient volume of the most up-to-date products;

(b) Secure supplies in large quantities in accordance with the demand of other countries of the socialist camp;

(c) Develop and manufacture new products.

The telecommunication industry has become an important branch of the machine industry, accounting for a permanently growing share of production. While this branch accounted for 4.7% of the total production of the machine industry in 1950, it accounted for nearly 15% in 1975, at the same time being the most export-oriented branch within the machine industry and industry as a whole. Actually over 50% of total production is exported. During the last 25 years the volume of production has grown by a factor of 31 while the number of staff employed in the branch has increased by a factor of nearly 6.5 which clearly shows the considerable improvement in productivity, the trend and magnitude of technological and technical changes.

More than 10% of the 100,000 highly qualified specialists employed in the branch are concerned with research and development. Until the industry was nationalized research was carried on in the telecommunication and vacuum-engineering industry almost exclusively in the Tungsram Research Laboratory. This research, however, was extended to the entire domain of vacuum techniques. In the special field of telecommunication engineering, original results were achieved at the Orion Works and at some smaller Hungarian firms. At most of the major enterprises scarcely any independent research and development had been carried out owing to their relationship with foreign firms; specialists

working in such enterprises mainly were concerned with the adaptation of foreign manufacturing designs. These relations with foreign companies in the field of technical development ceased with nationalization. It became imperative to organize independent research and development.

With a view to meeting the requirements for specialists, departments of wire communication engineering, radio engineering, microwave techniques and vacuum techniques were established at the Budapest Technical University. These departments have contributed to solving a number of industrial research and development problems within short periods. Of the two industrial research institutes concerned with the telecommunication industry, the Telecommunication Research Institute started activities in 1950. The establishment of the research base was justified, since certain special research subjects had to be explored and the basis of research and development in microwave techniques had to be established.

The institute has preserved from the outset its leading position in the domestic study of microwave techniques, and the very high level reached in the field of telecommunication systems made it the leading institute within the organization in a number of fields. As a result of continuous development, the various types of microwave equipment meet world standards.

Besides undertaking research on microwave systems, the institute achieved considerable results in the field of transmission engineering equipment, UHF techniques, instruments and components needed for the equipment, and recently computer techniques. It has developed up to now as the taxonomic research and development base of the branch to one of the most significant intellectual centres of the telecommunication and vacuum engineering industry.

The prospective main field of the Institute's activities remains microwave connexions, digital transmission and interconnexion techniques, and computer techniques on the basis of development priorities. The main spheres of activity in the field of applied research are:

Systems techniques

Network theory

Elaboration of the principle of new circuits

Elaboration of new technological processes

Elaboration of new methods of computerized planning, software development

Elaboration of new methods of measurement and testing

In product development the main spheres are:

Development of microwave radio-relay equipment (broad and small number of channels)

Development of transmission engineering equipment

Development of data-teledigesting equipment

Elaboration of microwave ferrite equipment

To bring about a reasonable centralization of the hitherto unorganized individual research and development in active and passive electronic components, and a systematic development of electronic building elements meeting ever-stricted requirements (as well as their modern production technologies), the Industrial Research Institute of Telecommunication Engineering was established in 1953.

Most of the new technologies of Hungarian electronic components production have been elaborated at the Institute since having been adopted in mass production. Production staff is even trained at the Institute to utilize the new processes.

Ahead of many world-renowned concerns, the Institute has been concerned with the problems of reliability of electronic components, with test methods and with consulting to utilize test results. In this field the Institute has gained international authority, while at home it has contributed considerably to increasing the reliability of the products of the telecommunication industry.

Owing to the lack of relations abroad, the Institute created using its own resources, the necessary research equipment for the purpose of research and development in the field of components and formed in this way a modern component research base. Thus, the elaboration of the various technologies of transistor production, among these especially the germanium technology, can be regarded as significant results. Parallel with these was initiated the elaboration of the production technology of silicon semi-conductors and space controlled transistors. Today the development and the production of semi-conductor and insulating-base integrated circuits is continuing at an accelerated pace.

Based upon previous experience obtained in the field of semi-conductor technology, the Institute elaborated the technology of the SSI-MSI complexity bipolar and MOS integrated circuits. The objective of the Institute is to elaborate highly complex LSI circuits required in computer engineering and automation.

One way to realize high complexity is the hybrid technique enabling the production of such circuits on special demand in small batches economically. The

development of thick-layer and thin-film technologies has been practiced at the Institute at a very high level, and it is now in a position to supply a wide range of hybrid integrated circuits through small-batch production to customers, even according to the latter's design. The realization of hybrid circuits is feasible by means of single-layer or multi-layer technologies; active semi-conductor elements to be implanted into hybrid circuits are: diodes, transistors and integrated circuits.

A parallel study of semi-conductor base and hybrid techniques permits the most suitable integrated circuit designs for performing the various electronic functions, and meeting both technical and economic requirements to be created. Based upon hybrid circuit techniques, it was possible to develop other micro-electronic components such as fluid-crystalline markers or thermal printers.

For the coming period the crucial tasks consist in the research and development of such new, modern components that are not yet manufactured in Hungary and the production of which has to be laid down in accordance with the objectives of Hungarian industrial policy. These are among others: new kinds of semi-conductor equipment, especially silicon semi-conductors, as well as opto-electronic equipment (luminous diodes, photo-diodes, visualizing equipment); various integrated circuits (semi-conductor-base circuits and insulating-base circuits); memory elements and storing units. In addition an important task is to develop further manufactured classical components to fit integrated circuits as regards size, service life and reliability.

In 1950, the structure of the production of this branch of industry was mainly determined by vacuum-engineering products (luminous sources, electron tubes), radio sets and components thereof. Only about a fourth part of the production consisted of major telecommunication engineering equipment - telephone exchanges, instruments, transmitters and receivers etc.

Industrial research institutes and new telecommunication-engineering enterprises were established during the first half of the 1950s, the consolidation of the development apparatus of the works, the structure of production of the telecommunication industry had changed essentially by the end of 1950.

The changes were justified by the reasonable concept of industrial policy according to which the proportion of telecommunication engineering equipment of the character of investment goods, being more labour exacting, requiring high intellectual capacities and being comparatively less material exacting, should be increased in consideration of the natural endowments of the country. On this basis quite new lines were brought into existence such as:

Radio transmitter-sender equipment in 1951
Microwave electron tubes in 1952
Microwave equipment in 1953
Semiconductor equipment in 1954
TV sets, video tubes, tape recorders in 1956
Ferrite products in 1958
Certain professional electro-acoustical equipment

Existing lines, including telephone exchanges, transmission engineering equipment, electro-acoustical products, radio sets, electron tubes, luminous sources, passive components were expanded with further new types.

As a result of increased capacities and of improved productivity, the production of telecommunication industry in 1960 reached a 5.5-fold value as compared with what it was in 1950, and its share within the machine industry increased to 7.8%. Exports amounted to 38.8% of total production, 83.5% going to centrally planned economy countries and 15.5% to market-economy countries.

Because of a significant rise in the living standards, production was oriented to the consumer to meet the voluminous demand for TV sets, radio sets and tape recorders. Large telecommunication equipment (telephone exchanges, professional electro-acoustical products and transmission engineering equipment) accounts for an increasing share of exports.

In 1960s changeover began from first-generation electron tube techniques to the so-called second generation semi-conductor techniques.

To meet ever-increasing export demands, manufacturing lines of enterprises were reorganized. Subsequently a powerful decentralization of industry all over the country was initiated. In 1956 industrial enterprises were granted the right to export certain products direct. This authorization was extended towards the end of the 1960s to telecommunication engineering enterprises as well.

As a result of the structural changes, the production of telecommunication industry reached in 1970 a 21.5-fold value as compared with 1950. During these 20 years industry as a whole grew by a factor of 5.6, the machine industry, by a factor of 8.2. The outstanding importance attributed to telecommunication industry is obvious.

In absolute figures the production of the telecommunication industry amounted to 12.4 thousand million forints in 1970, or 11.3% of the production value of the machine industry. About 62% thereof consisted of professional equipment, 19% of consumer durables and 11.0% of electronic components.

The export share increased further until 1970 and reached 45.0%. Of total exports 80% went to countries with centrally planned economies and 20% to market-economy countries.

In the 1970's the second generation of discrete semi-conductor techniques begin to be replaced by the third generation techniques comprising integrated circuits. During this period adaptation takes place of small computers and peripheries belonging to the special sphere of computer engineering.

The production of the Hungarian telecommunication industry 100 years ago was limited to telegraph equipment. Today it manufactures the following specialities:

Telephone exchanges, telephone sets

Transmission engineering equipment, carrier-frequency and telegraph equipment

Microwave equipment and system and the measuring instruments required

Electro-acoustical equipment and systems (sonorization of open-air and closed space, studio technique, educational equipment)

Communication radio transmitter-receiver, radio and TV broadcasting and transmitter equipment

Computer-engineering equipment

Consumer durables (radio sets, tape recorders, colour and black/white TV sets)

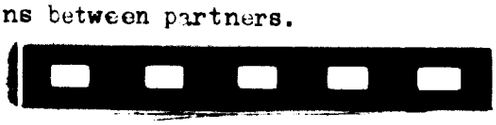
Active and passive telecommunication engineering components (resistances, capacitors, switching and connexion elements, semiconductors, integrated circuits, electron tubes, video tubes)

Other products, though not strictly speaking telecommunication engineering products (mostly luminous sources, various technological equipment, production lines)

The equipment produced makes it possible to build up complete complex information networks. Development work and manufacture of the products is performed at 15 factories and 2 independent research institutes.

According to objectives of industrial policy and in the sense of selective technical development, this sector remains a progressive branch of the machine industry to be developed further as a priority. The main tasks of research and development are determined in national programmes and co-ordinated with other sectors. To realize prospective goals international co-operation must be strengthened. The development of this branch of industry will also in future be mainly determined by the aspects of exports.

Therefore, the pace of development will be controlled first of all by export dynamics, besides some consumer durables and telecommunication engineering equipment. In addition to conventional sales the intention is to supply complete information systems on a larger scale and lay a greater stress on co-operation, implying long-term relations between partners.



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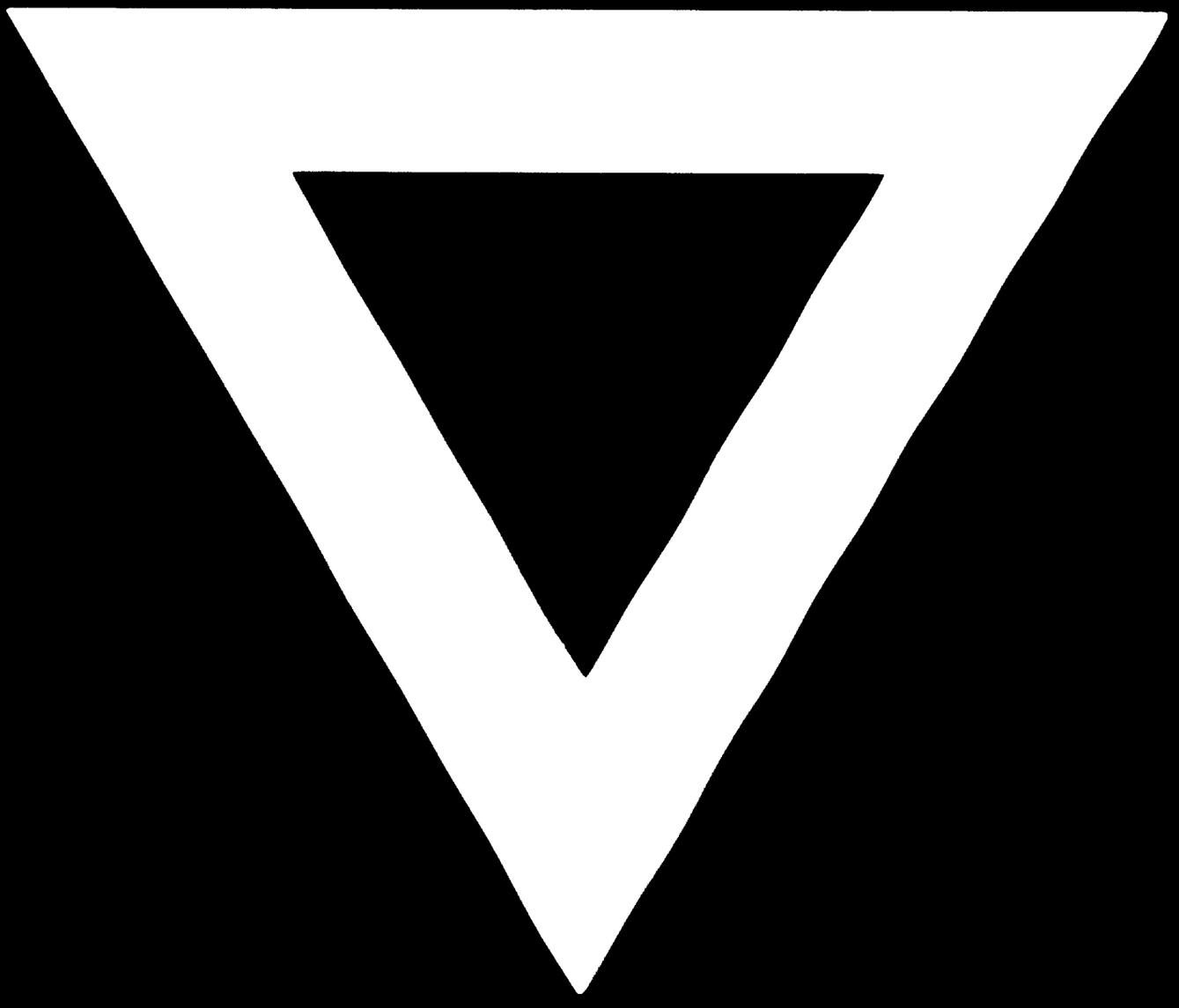

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