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INDUSTRIAL RESEARCH AND DEVELOPMENT CENTRES ^{1/}

1. Selection of Institute's Location
2. Considerations for Buildings Design

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INTRODUCTION

The subject of this paper is an attempt to formulate basic criteria for the decision on most suitable location and a consequent design of an industrial research and development centre.

To deal with this question it is inevitable to precise the term industrial research and development centre. In this paper the term industrial research and development centre means a complex of offices, laboratories, training rooms, auxiliary places and installations serving to the needs of applied research.

This precision of the term is important as well for the delimitation of the function of the centre in the frame of the whole scientific research and development basis of the given country as for the functional contents of the centre and its internal organization.²⁾

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- 2) Basic research contains a scientific activity to disclose new up to now unknown laws and processes in the nature and to enlarge and to deepen man's knowledge of the substance of natural and social processes. The first result of the basic research is a hypothesis based on knowledge of new facts, let us say on ascertainment of deviations of existing scientific precepts from the objective reality. In further phases scientific laws and a system of scientific knowledge are formulated. The basic research is based on extensive and systematic collection of facts, their classification, analysis and processing and on the use of existing knowledge.
- Applied research contains the activity to the practical use of knowledge of basic research and of technical and technological knowledge. It is, in effect, bringing scientific and empirical knowledge to concrete technical and otherwise usable forms, as are e.g. new devices,

Due to specific conditions of developing countries it is also presumed that apart from the practical research and development application in the given field of industrial activity of the country the centre will also fulfil an important task in the training of the necessary number of personnel for research and development.

I. LOCATION OF THE CENTRE ,

The location of the centre is to be considered as a process analysing macro-economic as well as micro-economic points of view.

When analysing macro-economic points of view the main aim is to determine the area of location of the centre on the basis of many-sided evaluation of desired relations of the centre to potential clients on one side and to the achievement of close working contacts with other relevant organizations on the other side.

Empirical knowledge from the existing process of macro-economic location of similar centres speaks unambiguously for areas of big concentration (existing or presumed) of industrial, social and cultural activities which means - predominantly and in developing countries especially - areas of capital or big port cities.

When analysing micro-economic points of view the main aim is to determine in the given area the concrete plot.

The selection of a suitable building plot ought to be a result of a complex confrontation between the desired function, contents and operation of the centre and between the specific territorial, technical, hygienic, natural,

2) materials, technologies etc. In this stage it is not introducing of results of applied research into current production practice but its laboratory, pilot plant verifying.

situational and other qualities of possible plots in the selected area. It is necessary - when selecting a concrete building plot - to take into consideration especially following needs:

- to provide a sufficiently big plot not only for the convenience of the construction itself and for the internal operation of the centre but also, above all, for the possible need of its perspective enlargement. Practically, it means that it is necessary to take into account a reserve of surfaces in the extent of 10 - 30 %. In some cases it would be desirable to enlarge this reserve by plots destined to the possible realization of construction of residential houses for the basic personnel of the centre;
- to select plots with good technical qualities. It means especially sufficient bearing capacity of ground soils and with these conditions related necessity that the highest level of underground water may not reach over 2 meters under the ground;
- to select such a building plot that has pre-conditions for a free dispositional solution for the whole complex of the centre and also for the orientation of individual objects to cardinal points - without the necessity to subordinate harmfully this solution e.g. to surrounding existing buildings and other limiting factors;
- it is desirable that the plot for building the centre that will undoubtedly fulfil important social aims may form an expressive compositional element in the selected city accentuated partly by an aesthetic situational value and partly also by a perfect transportation accessibility to individual functional components of the city organism;

- an important locational factor is a possibility (or impossibility) of use of existing installations of technical infrastructure. It involves especially supply of drinking and utility water, sewerage, supply of heat, gas and electricity. The impossibility of connections to the communal network would mean in its consequences either a factor excluding the location or a considerable draw-back of the construction by building own, separate installations. It is therefore necessary to take advantage of existing city industrial districts which - apart from the advantage of the proximity of potential clients - give real pre-conditions for the common use of technical installations;
- last not least it is necessary - when selecting a plot - to bear in mind a hygiennically undefective environment especially as to the cleanness of air and to the creation of a quiet working environment protected against noise.

The enumeration of the stated factors does not claim to be complete. It contains, however, basic factors in a degree enough to make impossible their omitting when selecting a concrete building plot in the process of micro-economic location.

The practice in the construction of similar centres and especially the practice in their operation proves that it is necessary to pay increased attention and maximum exact endeavours to the process of location. It is dictated by the fact that errors in the location have such consequences that their removal is even by the best construction and operation of the investment practically impossible. The basis of a locational success is, therefore, in connection to the construction of an industrial research and development centre:

- a clear specification of the sense and function of the centre in the frame of the country's research and development basis;
- a formulation of desirable relations to relevant organizations;
- a detailed operational and organizational scheme expressing most suitable mutual internal relations and connections of individual objects and installations of the research and development complex;
- a specification and a quantification of territorial and technical conditions as to the quality, size and site of the building plot;
- a premeditated effort to integrate the building plot with the city organism.

When performing the locational process itself, it is necessary to use the advantageous method of mutual comparison of variants of selection of more building plots.

II. CONSIDERATIONS FOR BUILDINGS DESIGN

The primary design basis for the construction of an industrial research and development centre ought to be its general plan. By the term general plan it is meant a complex solution of fundamental questions of the situation and height of all buildings, constructions and establishments, of the technical infrastructure network, of the organization of security and protection, of the garden trimming of the plot including principles for the creation of favourable working environment so as to secure an economical construction and operation, to apply progressive technology and to enable the possibility of a further logical development.

The general plan is worked out on the basis of an organizational and operational scheme which expresses relations and connections between particular functional elements of the research and development complex, expresses further principles of conflictless movements of materials and employees as well as cardinal relations of the whole complex to environs.

The general plan is worked out by the method of a physical plan in such a degree of detail so as to become a starting point for determining suitable stages of construction and a basis for partial projects of individual buildings and accompanying establishments. By its existence, the general plan creates decisive pre-conditions for providing a conceptual construction.

A formulation of concrete considerations for buildings design in general terms is practically impossible. The basic function of the centre and especially contents of its activity have a decisive influence on its organizational structure, on its suitable size on the specifics of its operational conditions.

It seems the only possible way to deal with the subject is to illustrate basic design considerations on a concrete example from the Czechoslovak practice, on the example of the Institute for Research and Utilization of Fuels. It is an institute of the Ministry of Fuels and Energetics. Its seat is in Běchovice (some 15 km near Prague) and it has a branch in Brno (second biggest city in Czechoslovakia and an important industrial centre).

The main function of the institute is to contribute by its scientific, research and technical activity to achieve new knowledge in the field of processing and use of solid, gaz and liquid fuels and to contribute to the implementation of this knowledge. The institute carries out also expertize and review work and renders expert assistance to industrial enterprises, organises cooperation with local and foreign research institutes and international organizations.

The chosen organizational structure ought to enable practical fulfilment of the function of the institute. In our case the institute is led by a director to whom are subordinated:

Assistant Director

Division of Refining of Fuels

Division of Utilization of Fuels

Personal Management

Economic and Technical Division

Director of Branch.

Individual divisions are the basic element of the research and development activity of the institute. They are divided into centres or sections as shown in the annexed graph 2 (Annex 2).

The number of employees of the institute is some 400 people.

The total surface of the plot is 2,5 hectare and the plot covered by buildings and related establishments does not reach 5 %.

The consumption of electrical energy is around 400.000 - 450.000 kWh which represents power-input of some 0,2 MW.

Off-take (a consumption) of water from the public water-piping is around 30, resp. 28 m³ per 24 hours.

The quantity of waste-water discharged to public sewerage system is ca 20 m³ per 24 hours.

The situation of this institute - which is shown as an example - is realized in a special area on the border of the capital city. Part of this area is a series of further research and development centres, e.g. Research Institute of Materials, Research Institute of Construction of Machines, Institute for Research of Motor-Cars, Research Institute of Electrical Engineering etc.

The advantage of concentration of more industrial research and development centres in one area is given, first of all, by the fact that a high level of technical equipments of the area can be achieved by investments of common interests (sewage disposal plant, common source of water, electrical energy, gas etc.) Further advantage are investments creating suitable conditions for the living environment, for service and social and health care for employees (gardens, building of common kitchens and dining rooms, health centres, fire protection, repair service etc.)

As already said, generally valid considerations for building design considerations are - without a knowledge of the contents of work of the centre - practically impossible to state. The example of a concrete institute may give an idea of elements that are to be taken into consideration when preparing a project of an industrial research and development centre.

Annex 1

Research and Development Network in Czechoslovakia

Opinions are - or should be - based on experience. Opinions of this paper are based on Czechoslovak experience of the organization, planning and function of research and development in Czechoslovakia. It seems, therefore, necessary to complement this paper by some facts on the organization of research and development in Czechoslovakia, its role and position in the structure of national economy. Taking into consideration that this paper should serve developing countries it is obvious that this description is meant as an illustration only and that by no means it should be considered as an instruction for use. This description should only give an idea to readers how research and development is organized in a developed country with a centrally planned economy.

The main components of Czechoslovak research and development network are:

- a) the Czechoslovak Academy of Sciences,
- b) the universities to the extent of their scientific work,
- c) research and development institutes under the supervision of ministries or other state administrative bodies,
- d) research and development institutes and organizations in the sphere of enterprise which are legally and economically independent,
- e) research, development & technological centres that are part of enterprises and factories.

The main focus of the work of Academy is basic research. This research and - of course - also applied research is performed by specialized institutes of the Academy, e.g. Institute of Mathematics, Astronomical Institute, Geophysical Institute, Institute of Physics, Institute of Nuclear Research, Institute of Electrical Engineering, Institute of Physical Metallurgy etc., Central Institute of Geology etc. There are some 100 specialized institutes of the Academy.

Each faculty of the university is a complex scientific centre which combines scientific and research work with the training. Aside from their own scientific activity connected with education, the universities cooperate in solving state tasks in the sphere of basic and applied research. They also perform tasks on order from industry in the field of applied research.

Institutes operated by ministries and other central administrative bodies do applied research, information services, testing etc.

Further mentioned independent institutes and centres of research in enterprises and factories deal with applied research and with putting into effect the technical progress.

The total number of people in Czechoslovakia working in research and the distribution work are shown in Tables 1 and 2 and Graphs 1 and 2.

Even though scientific research work is chiefly the concern of professional organizations many scientific and technological societies play an important role in disseminating scientific knowledge. The most important perhaps is the Czechoslovak Scientific and Technical Society which has some 165 000 members of the scientific and technological intelligentsia.

The coordination of research and development is ensured by

- planning of topics in R + D
- financing of R + D
- economic tools.

The main function of the plan is to stipulate - on the basis of an estimate of progressive tendencies in scientific and technical development - main trends and tasks of research and development. The starting point are prognoses the elaboration of which is organized by the Federal Ministry for the Development and Investment.

Research and Development is financed either from the federal budget or from the budgets of national republics (Czech and Slovak) or is subsidized from the federal or national budgets. Otherwise research work is being done under contract (i.e. on economic principles). Applied research in factories and enterprises is financed from the enterprise resources.

Apart from the said direct subsidies there are some indirect economic tools influencing the development of research. These are taxation reliefs and easy credits.

The example of the organization of one of the Czechoslovak Research Institute is shown in the Annex 2 of this paper.

Table 1. Number of employees in research and development
in Czechoslovakia

Year	Thousands	% of total man-power
1962	102,9	1,33
1965	128,2	1,53
1967	137,6	1,63
1968	140,9	
1980 expected	220,0	

Table 2. Structure of research and development network
(1967)

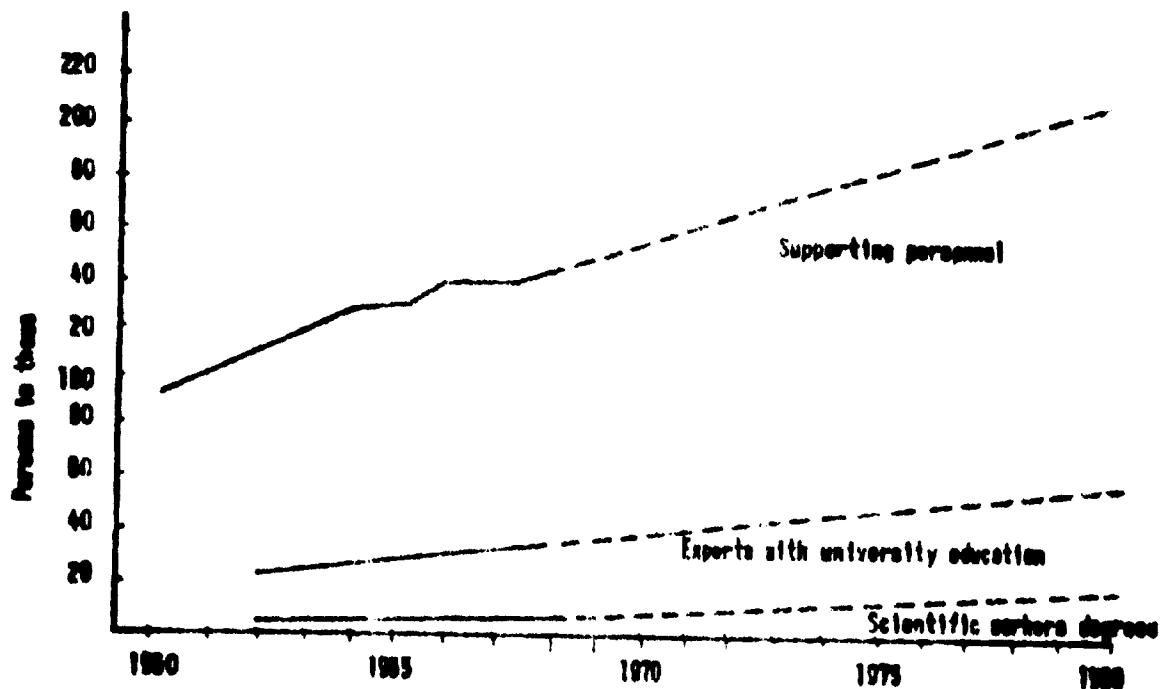
	Number of employees	
	in thousands	in %
Total	137,6	100
Academy and universities	16,5	12
Industry 1)	88,7	64,5
Construction	5,1	3,7
Agriculture and forestry 2)	12,2	8,9
Transportation and communications	2,8	2,0
Health service	6,5	4,7
Others	5,8	4,2

1) including geology but not food industries

2) including food industries

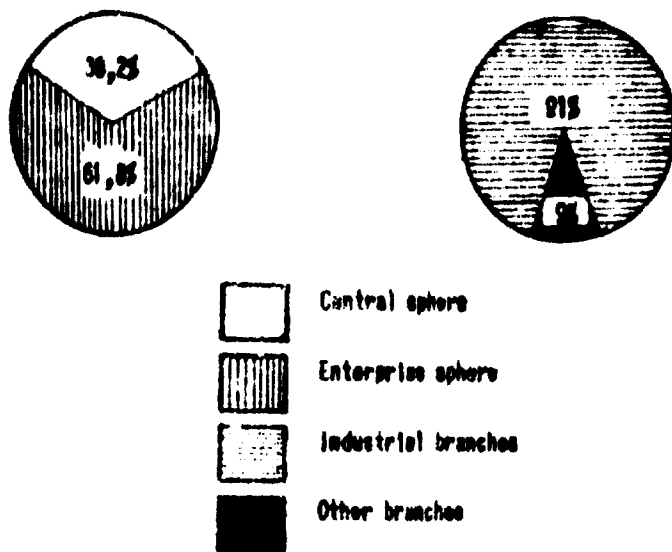
THE RATE OF INCREASE IN NUMBER OF SCIENTIFIC WORKERS OF THE ROM FROM 1960, INCLUDING THE PREDICTED FIGURE FOR 1990

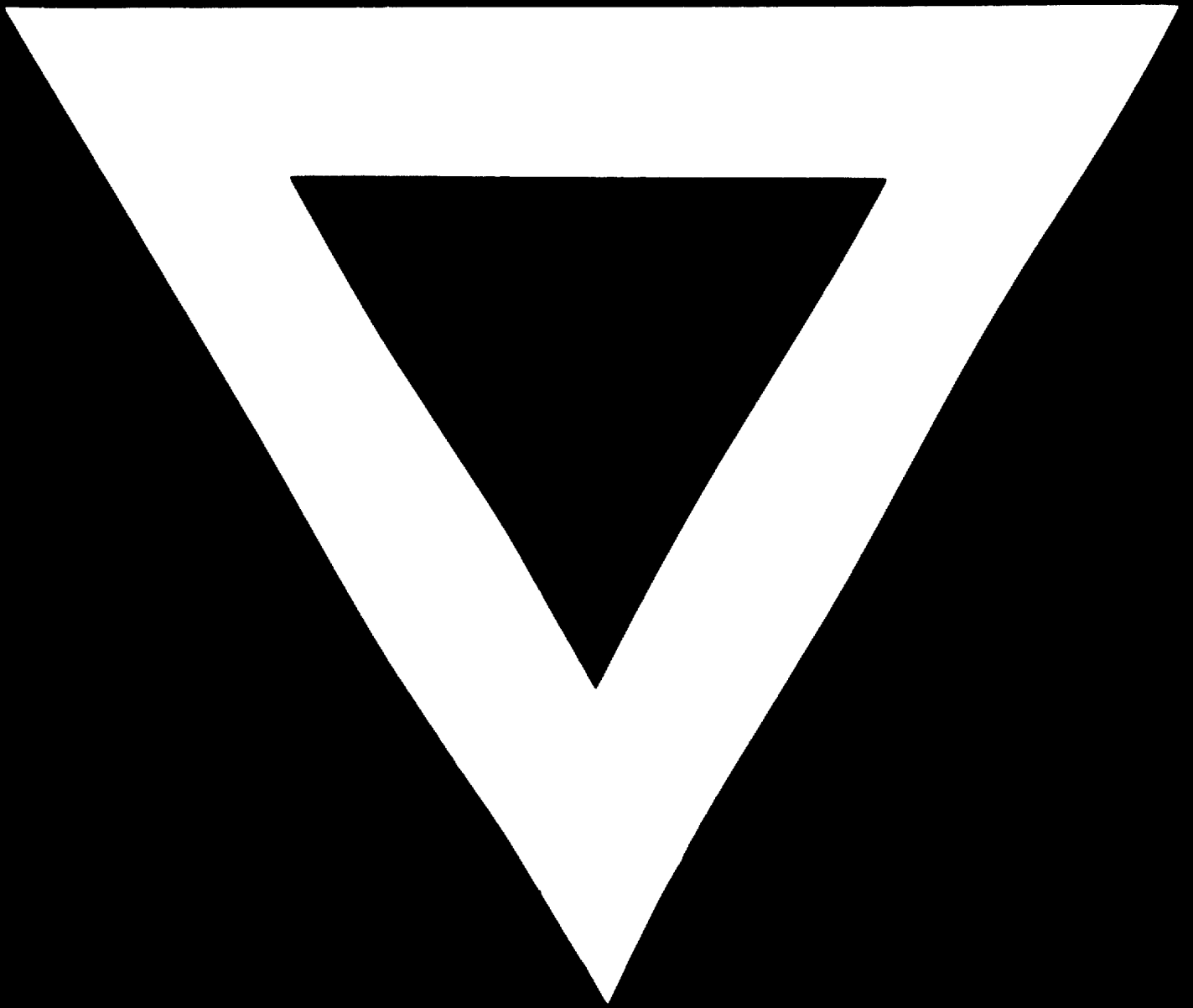
GRAPH 2



GRAPHIC ILLUSTRATION OF THE DIVISION OF ROM INTO CENTRAL AND ENTERPRISE SPHERE

GRAPH 1





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