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PLANNING METHODS OF ENGINEERING WITH SPECIAL VIEW TO EXPORTS[1]

by

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PLANNING METHODS OF ENGINEERING, WITH SPECIAL VIEW TO EXPORT INTERESTS IN DEVELOPING ECONOMIES

If a methodological study is being prepared with the aim of helping to found export development orientation in the engineering industries, or rather the planning of decisions to this effect, the problem has to be faced that this will have not only computational and engineering aspects but also others rooted in economic and even foreign policy; and these may frequently have much more decisive effects on the de facto situation of engineering than planning calculation techniques proposed. We believe that the truth of this statement is easy to see even from the theoretical point of view but we should like to stress at any rate that this conclusion was to be drawn also from the experiences gained in the course of Hungarian planning over two decades.

These statements have influenced the character of our study in which we are going to deal with three major groups of problems from the point of view of planning development and export orientation of engineering:

I. The major "kissing points" of general economic policy and engineering.

II. Mathematical methods used for planning of export development in the engineering industries and the main lessons of the Hungarian experience.

III. The role of financial incentives affecting the concrete activities of engineering development and export policies, the behaviour of enterprises /policy of incentives/.

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I.

ECONOMIC POLICY AND THE DEVELOPMENT PLANS OF ENGINEERING

Any problem connected with the expectations towards engineering /either compulsory in a given situation or desired in the long run/ must begin with the clarification of the macroeconomic problems. There is no "sterile" engineering planning or method, nor a pure export-oriented engineering planning.

The problems to be solved are different, depending on a country's size and stage of development. The difficulties are different in the countries which are well versed in trade and international relations or which are not /which have traditions in this field and those which have none/ and different again in the rapidly and the slowly developing countries. The decisions are also affected by the prevailing types of socio-political problems in the country in question and they depend on the endurance of the country /the sacrifice the State is willing to pay/ to sustain initial failures or on their utter incapability to sustain them.

The Hungarian planning practice starts from the following methodological premises

1. The development and export objectives of the engineering industries are influenced, above all, by the general concepts relating to economic growth:
   - the effects of demands deriving from the expansion of the domestic market;
   - the effects of the export-increasing /foreign trade/ requirements owing to the need to balance imports.

2. Further, the development of engineering is decisively affected by professional competence, the staff of workers and engineers /and technicians/ as well as their training and the conditions necessery to increase the staff and their training. These are the major factors influencing the attainable structure and growth rate of engineering.

3. A further decisive factor affecting development is the volume of domestic and international material resources available for the expansion of productive assets in engineering and for acquiring new trades. It is the general economic policy that has to answer the question what attitude it wishes to take in respect of the above circumstances. Based on an economic policy that has been decided upon and which sets itself realistic goals, the work aimed at selecting the orientation of the development of engineering may start.

4. Finally, the "international situation" of the country, whether it belongs to groups of integrated countries or not and what are the prospects for planning such integrated relations, also decisively influence the problem.

The relevant experiences of Hungary relating to economic policy may exemplify for the less or moderately developed countries to what tasks attention should be concentrated with an economic policy and engineering development orientation which aims at rapid economic growth. According to our experience

- when developing engineering, a less developed country must absolutely look for an international partner or partners among the more developed ones.

- In developing engineering, certain stages /different levels of technical requirements/ must be observed on the road to development in order to find national competence and the staff of cadres. In the initial period, in addition, also the formulation of points of emphasis /specialization/ has an important role which, in turn, depends on the possibilities of international cooperation.

- As regards the equipment necessary for engineering, the capacities can be relatively easily and quickly created for the production of many groups of consumer goods but several decades are needed to develop the production of more complicated productive machinery of adequate quality, to become competitive in the technical sense.

- The balance of foreign trade in engineering products will remain passive for a long time if it has to assert itself within the free competition conditions of the developed countries, but a relatively shorter time is needed if - with the help of close international cooperation - secure markets are secured for realization. If the engineering industries of the cooperating partners are developed, this will shorten the time necessary to catch up with technology. If, however, the cooperation is organized between less developed countries this will take longer but even the latter case is better than the lack of cooperation because it puts a smaller burden on the balance of international payments.

- Finally, an upswing of engineering development and the organization of export markets is inconceivable without state preferences. These preferences are partly affecting engineering in general but partly they must specifically promote the exports of machinery.

Of course, these statements had been not so clear at the beginning of Hungarian industrialization and the lessons of development /both the difficulties and the positive experiences/ have matured slowly. In Hungary the engineering industries[1/]

1/ According to the Hungarian classification, by engineering industries the following /sub-/ branches are meant:
Machinery and equipment; Vehicles; Electrical machinery; Telecommunication and vacuum technical products; Precision engineering; Metal mass products.

represent in 1967 already 27,8 per cent of global industrial output. For investments - the rate of which can be considered to be rather high by international standards /18-2o per cent of national income/[1] - the domestic engineering industries supply 5o per cent of the equipment, while 3o,6 per cent is imported from the socialist and 19,4 per cent from the capitalist countries.

The trade in engineering products on the organized market of the CMEA[2] countries shows an active balance for Hungary while on the market of the developed capitalist countries this balance is passive but to a smaller extent. Her active balance of machinery exports and imports can be explained with the high imports necessary, because she is particularly short of materials.

An active trade in machinery is possible for Hungary because the economic policies in the CMEA countries rely on the recognition of the particular endowments of the individual countries and on the joint solution of the problems. The passive balance developed in connection with the capitalist countries reflects, on the one hand, that it is difficult for the developimg countries to sell on the markets of

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1/ National income = Net Material Product in the UN terminology.

2/ Council for Mutual Economic Assistence developed machinery-exporting countries and, on the other, that the Hungarian technical culture has approached the level of these countries only in a few branches.

The place of engineering in the national economy can be planned only if the whole orientation of economic policy is clear and follows long-term objectives. The most important starting points for planning engineering derive from: a/ the standpoint in respect of the growth of investments, b/ the long-term requirements of the balance of trade.

a/ The growth rate of investments in the developing countries generally is for a considerable period higher than that of national income since every country recognizes that rapid advance can be made only by increasing the rate of investments. On the basis of the objectives relating to the volume of investment activity the requirements arising towards the engineering products /their volume and pattern/ can be examined with a fairly good approximation. It will usually turn out that the full range of the requirements cannot be met, nor can those of economic efficiency since the productivity of labour and the preparation period needed to develop products is unfavourable. Such contradictions can be best revealed by international comparison and these should be aimed at concrete groups of products or, in some cases, at the examination of the technical and economic parameters of plants. Unfavourable productivity is generally counterbalanced by lower wages. The real dilemmas arise, in the majority of cases, not in connection with production costs but with the technological parameters of the engineering products turned out. The experiences gained in developing the Hungarian engineering industry testify that the importance of the technico-economic parameters of the equipment delivered may be much greater for the users than the relatively high costs emerging in the production of this equipment. The cost problems can be solved to a certain extent by means of state preferences but the users cannot or hardly be stimulated to buy machinery of low efficiency.

Of course, the problem can be examined only in its concrete forms. As a general advice, only the conclusion can be drawn that it is advisable to insist on the up-to-date technological parameters in all cases whenever the quality and saleability of the products depends decisively on the equipment to be invested and with which they will be produced. In such cases it will be by no means expedient to prefer the use of the domestically produced equipment with low efficiency. /The planning and analytical methods used for individual analyses will be treated later./

The drawbacks of deciding upon the domestic production of some engineering product are less unequivocal if the domestic production influences the production costs unfavourably /e.g. it requires the employment of a greater number of workers/. In such cases it will be advisable to perform cost analyses to find out the effects of the domestic and foreign equipment available on the costs of the future product - or rather the difference in costs - and mainly to estimate by what date can the elimination of this disadvantage be expected.

By our experiences, as regards the first dilemma, the word of the technological experts will be decisive and, therefore, it is they who are called upon to disclose the factors affecting the quality of the product. In the second case the analysis should be performed by industrial economists or cost accountants whose task will be to analyse the effects on the

- costs of energy,
- costs of material consumption,
- wage costs,

choosing for basis of the comparison the internationally competitive prices.

Of course, each of the three cost factors play different roles depending on the industry in question /e.g. the technological level of equipment of fertilizer plants is interesting mainly from the point of view of per unit energy costs, the equipment of a foundry or other metallurgical equipment from that of per unit material consumption, etc./. Therefore, in the course of analyses, the specific role of these three factors must be examined, as a first step with all branches and investment projects.

Based on the informations obtained from the side of the investment plan an approximative system of requirements to be raised against the planning of engineering can be built up and the directions of the requirements can be surveyed.

As regards the technique of calculations, in the Hungarian planning practice the connections between the investment plan and the planning of engineering are based on the so-called balancing method. To this end a certain classification of the engineering products must be performed.[1/] The requirements of the investment market are assessed according to a certain specification and one of the main roads to procuring the information necessary for the planning of engineering is to analyse the parameter-requirements in connection with these groups of products. The second road of procuring information is much more aggregated and consists in employing the classification system by sub-branches. This method wishes to harmonize the possible value of production in a breakdown by statistical sub-branches with the needs presented in a similar breakdown. /The needs can be expressed in terms of the sub-branches by drawing conclusions from the above-mentioned classification of products on the branches in the statistical sense, that

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1/ The classification of engineering products is attached. As is known, the UN has also worked out such classifications /and also the CMEA/. From the point of view of the problem under consideration, any method may be employed for classification. The only requirement is that it should be clear and unequivocal in the country where it will be used.

is, it is examined what products are necessary to represent a statistical sub-branch./

The demands from the side of investments emerging on the basis of the informations received and the consumers' demands analysed in a similar way are market impulses which are confronted by those planning the engineering industry with the capacity analyses. On part of the central planners capacity analyses are conducted only for some important groups of products, not too many in number, always drawing into the work the specialists of the enterprises.

As regards the analysis of greater aggregates /that is, sub-branches/, these are not capacity analyses in the strict sense of the word. It is the factors affecting the changes in the volume of output of these branches which are subject to analysis. The method of these analyses is generally an investigation of the decisive factors affecting the changes and their market problems. The analysis covers partly the homogeneous groups of products - not too many of these - and partly the so-called sub-branch aggregates. Its major factors are: 1. the effect of the improving productivity of basic capacities on the value of output, 2. the date of putting into operation the investments in course in the branch in question and their effect on raising the value of output, 3. the "graduality" of changes in capacities, meaning that - owing to the indivisibility of capacities - there will be dates and places when and where "surpluses" may be expected which can be offered either for foreign trade purposes or for those of international production cooperation.

b/ An assessment of exports will, however, stress also other aspects than the "possibilities" based on the production capacities. To judge exports, also market information /research/ is necessary and that must be concrete, going into details of kinds of products. This research must be performed by the foreign trading organs and the enterprises and its results will appear in the comprehensive plan of foreign trade as the estimated framework of foreign trade thought to be attainable, as regards its order of magnitude. Experiences show that the informations from this field are by far not so firm for the planning of engineering as in the former connection, i.e. investments. Therefore, until an export plan can be said to reflect approximately realistic and correct figures for the engineering industries, several iterations will have to be inserted into the planning process. In addition, also such considerations must be weighed up which do not lend themselves to quantification, and also circumstances belonging to the field of foreign policy. In the course of these steps conclusions are drawn from the estimated development of the balance of trade on the requirements to be raised against the development of engineering.

In the course of economic growth in Hungary, a definite tendency could be observed in the period of industrialization for imports to grow quicker than national income or GNP. Between 195o and 1967 a one per cent increase of national income was accompanied by a 1,8-2,o per cent increase in imports. The growth of imports could have been even quicker, had domestic industrialization not spent - particularly in the first half of the period - great sums on expanding the capacities of industrial products than could be turned out also at home, and if the exportability of industry, more closely, of the engineering products had developed more favourably.

Our experience is that the smaller the realistic possibilities to improve exportability, the greater will be - maintaining otherwise an invariable rate of economic growth - the compulsion to invest into domestic "import substitution" /more exactly into projects slowing down the growth of imports/ and the greater the danger of an inefficient autarkic development orientation.

The import intensity of economic growth is very high in most of the developing countries until industry cannot meet market demands. Owing to the rapid growth of imports the equilibrium of the balance of payments causes everywhere much trouble in the first stage of development. Thus, the order of magnitude of the export requirements can be essentially recognized from the rate of growth of imports.

Knowing the social requirements raised against total exports, it is in the interest of each country to increase the share of machinery exports in the total since the engineering industry utilizes much qualified labour, its material and energy requirements /as well as the "consequential" investments/ are relatively low and its employment coefficient is suited to solve some social problems.

Still, it is a common experience that the foreign exchange earning capacity of this sector is growing in the beginning only at a very moderate rate and is even stagnating in some cases. The efforts of the governments and the enterprises are strongly limited by various factors. This can be explained by the fact that the development of engineering characteristically differs from that of other industries. In this field such problems must be solved which take much longer time and the peak performances of intellectual capacities are difficult to substitute - if only because of their heterogeneous character - with the aid of licenses, patents and know-how. Further, the effect of the investment project itself will much less determine for some longer time the technological parameters of the product to be turned out since the capacities are much more convertible and the technological and designing-developing activities do not become so rigid because of investments made, as is the case in other branches. These difficulties must be taken into account in planning engineering if realistic plans are to be drawn up.

It has been already mentioned that the difficulties in the way of an engineering export orientation can be surmounted in an underdeveloped or moderately developed and not too great a country /with an "open" economy/ only if international agreements are given great attention in planning from the very beginning. The planning of international agreements means practically: to analyse the development circumstances also of other countries eligible from this point of view and the consideration of the political factors that connect us with or sever from the country proposed as a partner. The role of this factor may be well illustrated on hand of the development of Hungarian exports of machinery.

The growth rate of Hungarian engineering output exceeded that of any other branch of industry and amounted to 11,7 per cent in the average of the last 17 years.

As a result of the rapid growth rate, also the internal structure of engineering has changed:

Changes in the pattern by sub-branches of engineering

	percentage distribution	
	1950	1966
Machinery and equipment	23,8	21,6
Vehicles	34,9	26,9
Electrical machinery	13,2	12,2
Telecommunication and vacuum technical products	6,0	15,9
Precision engineering	3,5	9,1
Metal mass products	18,6	14,3
Total	100,0	100,0

Since at the beginning of the fifties Hungary had been an underdeveloped country and also the weight of engineering was small, the question might be justly put what were the reasons for this growth from the market aspect and how was this great export of machinery founded in respect of technical parameters.

It will be worth while to compare the shares of the engineering sub-branches in production, as seen from the preceding table, with the shares of the same groups in experts:

Share of the engineering sub-branches in exports

	percentage distribution 196o	1966
Machinery and equipment	27,4	24,4
Vehicles	37,7	39,5
Electrical machinery	2,3	2,5
Telecommunication and vacuum technical products	12,2	2o,o
Precision engineering	7,3	11,5
Metal mass products	3,1	2,1
Exports, total	1oo,o	1oo,o

In the period under review the index number of exports from engineering products developed as follows:

195o	1955	196o	1965
1oo	192	264	455

The roles of the two great market factors accelerating the general growth of engineering production /i.e. investments and exports/ were conspicuous in this process. The export market had a considerable effect on the changes in structure and, according to some indications, this effect may be even greater than the changes in the pattern of the domestic market. The conolusion may therefore, be, drawn that in a small underdeveloped country with a rapidly developing engineering industry the first impulses to structural changes will very likely come from exports.

Examining, however, the distribution of exports by countries or groups of countries we can reach the important conclusion already mentioned, namely, the importance of lasting international cooperation contracts. The exports of Hungarian machinery were, as a matter of fact, distributed by markets as follows:

	percentage distribution 1967
Developed capitalist countries	3
Developing countries	4
Socialist countries	93
Total	100

Since the first part of our question, the market causes for the general growth of engineering production has been answered, we still owe some explanation of the expanding CMEA market for the engineering products. The analysis of the problem has the value only of an example if viewed from the international point of view.

Historically, the process began with the fulfilment of the reparation contracts following World War II. This meant substantial orders for the Hungarian engineering industry of those times and started the development of certain trends according to the requirements of the Soviet market. /Characteristic for such development were e.g. the exports of railway and road vehicles and ships./ Another decisive factor was that the CMEA countries mutually recognized each other's concepts in economic policy, assessing the particular features of each country and acknowledging right at the start of the process that the engineering branches must obtain a substantial role in increasing the export potential of Hungary and that this must lead to a considerable active balance in the trade in engineering products. The third factor were the rather modest results attained in the international specialization of engineering production.

The international specialization in engineering can not yet be considered deep enough and such possibilities are not much utilized as yet by the Hungarian exports. Up to now, mainly the differentiated export development of groups of products for final use have been on the order of the day. In the course of development, however, the problem has emerged that specialization of engineering production has been missing from the intra-CMEA conception of trade in engineering products. The reason was that lively trade activity developed mainly between the individual small countries and the Soviet Union with her vast economy and this pushed production specialisation into the background. In addition, the trade between the small countries showed more parallel development elements and behaviour than would be desirable. As a result of this process, the situation may be approximately characterized by saying that some Hungarian engineering branches reflect a strong export orientation, particularly towards the Soviet market, the trade in machinery is big but there is small cooperation in production and, therefore, trade is mainly restricted to finished goods.

What has been said here does not amount to an undertaking to analyse the engineering cooperation within the framework of the CMEA, we only wanted to illustrate a realization of economic policy that stable international trade agreements may have a decisive importance for the machinery export development efforts of the developing countries.

A great problem of developing machinery exports is the choice of the partner countries or markets for long-term orientation. It is a common experience that the underdeveloped country depends on the developed ones but the latter are not interested in buying machinery from the developing countries.

The statistical data on machinery exports show that in the trade of the capitalist countries in engineering products the Hungarian engineering industries play no substantial role and they have no such role either in shaping the balance of payments of the country in capitalist relation. Though for different reasons, the will to cooperate with the capitalist countries was missing on both sides and without it the purely operative "commercial" character of the trade could not provide a basis for an upswing of this activity. Hungary appeared the whole time as the "buyer" of machinery that could not be procured from the socialist countries and not as a partner to close cooperation. Also the capitalist countries saw in her only a sales market - not too big, indeed - and this market has been always restricted because of foreign exchange considerations since these countries have not shown interest for our machinery exports. As opposed to the trade with the CMEA countries, it has become proven here that he who wants to sell only, will sooner or later restrict his own market. Since, however, Hungary was not an important factor as a market for machinery, this truth had no considerable effect on the development of the Western economies.

We feel that the problem which hinders the cooperation in engineering production in international economic relations between the less developed and the developed countries /meaning here the level of trade in engineering/ is twofold: partly the guidelines of general and economic policies to brigde over the different interests of the developed and the developing countries with different political concepts have not yet been worked out or are hindered /often because of the lack of confidence/, partly the smaller and less developed countries can keep pace with difficulty - for objective reasons - with the advanced ones.

These problems could not, of course, be solved by the Hungarian planning either, but in the process of planning the means and measures that can gradually solve the contradictions are reckoned with as far as is possible.

In the final analysis, the Hungarian planning practice can build up the export development orientations of engineering with good routine methods and analyses as regards trade with the CMEA countries - particularly the trade with the Soviet Union - but it is on lose grounds in capitalist relations. Since the trends of general and economic policies had been formulated and the role of engineering had been also cleared in the growth process - as regards orders of magnitude - the planning of engineering keeps in view in socialist relations three basic tasks: 1. to reveal the most advantageous objectives of domestic development, 2. to assess the conditions necessary for the domestic development, 3. the preparations for the international discussions and long-term contracts. These three tasks are the foundation for further planning of the export orientation of the development plan for engineering.

Characteristics of planning in engineering, with a special view to the causes releasing structural changes

Planning in engineering is influenced already in selecting the development objectives by the two hypotheses of macro-planning already mentioned: the forecasts about the expansion of the domestic market and those relating to the volume of the exports side of the balance of trade and the export tasks that may be derived from these. Both informations are external and highly hypothetical for the engineering industries and inform only about the volume of development tasks and the needs.

If the planning has to be done for an engineering industry existing already at the time of planning, having already attained some importance, the selection of the development tasks will justify in most cases marginal analyses since the problem is to develop the bases. This will put the analysis of production costs and the labour and organizational conditions of development in a different light and the existing market phenomenn inform the planners about experiences gained up to that time.

If the development of engineering means at the same time the choice of new objectives, it will be more difficult to investigate the same conditions and will involve more uncertainties for the planners.

It is a particularly big and so far practically not solved problem - well- known also from theory - how to treat the indivisibility of capacities. Prof. Thomas Vietoris recommends a theoretically well supported me - thodology for the subject. Until the methodology can be practically applied in planning, according to our experiences some years of development are still necessary, but it will be worth while to make preparations for the application of the method. In the Hungarian planning practice the problem is not yet solved scientifically and therefore, we attempt to eliminate the contradio- tions in "roundabout" ways and to call the attention of the planners to solutions already applied in practice.

If a general framework must be given for the calculation and valuation methods recommended for the engineering industries we could propose something like the following methodological concept: Starting from analyses and hypotheses of economic and social policies, the global place and structural trends of engineering must be examined in the developing economy /with the aid of both traditional and mathematical methods. Then, after having analysed the factors deterministically influencing the expected role and structure of engineering, the development conditions of micro-decision and micro- structures must be cleared up by concrete factors.

Following from these considerations, we are of the opinion that complex and diversified planning methods are needed which are capable of examining various aspects and several kinds of interest. There exists no infallible planning method since, for the time being, we cannot anticipate many factors. Under such conditions it is highly important not to build castles in the air and seek answers to question which are not only important but which can also be given a realistic answer.

Traditional methods and analyses in planning

Principles and considerations

There are always points of view which prefer some directions of development when selecting from among the eligible /or proposed/ development programs. Such may be: some favoured export markets /as e.g. the market of the socialist countries from the point of view of Hungary/, traditional export products and markets, existing productive and development capacities.

If the country has already an engineering industry, it lies on hand to seek first such development possibilities on the market as will correspond to the favoured directions and possibilitities. Still, it would do harm to restrict the examination of development possibilities to these directions.

The choice of the development directions may be preceded as a first step by weighing ranking principles based on global analyses. It will be, e.g., expedient to consider what kind of export development may be most advantageous and most desirable with the given endowments of the country. Such preliminary considerations may be weighed even without having an adequate method for the calculation of future inputs and results.

An example may be quoted from an initial period of the development of Hungarian engineering, when, from certain points of view, it was advantageous if exports did not require any substantial and high-level technological development efforts. Under certain conditions and transitorily, such exports relying on the well trained production of tested products may be advantageous since they favour smooth production and a quick meeting of demands. For less developed countries it will be expedient to use in the beginning also such possibilities /e.g. small and medium electro-motors, simpler /traditional/ machine-tools, fittings for the construction industry, small and medium-size centrifugal pumps, air compressors, simpler kinds of tilling and sowing machines, etc./. Of course, big markets for such products have become scarce and if so, they do not secure too long perspectives. Another danger is that the production of less exigent products is likely to conserve the existing level of technology and, therefore - beyond a certain extent - it is no more a desirable trend of development.

It still belongs to clearing up the general "ranking principles" that the export development to be selected should correspond also to the resources of the country, Hungary, e.g., turns out the majority of the structural materials for engineering with her own metallurgy but she imports the majority of iron ore and other raw materials of metallurgy and an important part of sources of energy, too. At the same time, wages are relatively low and labour is sufficiently qualified. From these two endowments some years ago the idea has emerged that our country should develop the exports of such engineering products which realize /absorb/ as little material and energy and as much labour as possible. This, too, is a consideration that must precede the calculation of detailed plan targets.

It gave rise to further considerations that profound analyses performed some years ago showed that the efficiency of producing and exporting engineering products can be enhanced if they are turned out in such masses and, as a consequence, on such level of technology as will best utilize qualified and particularly, highly qualified technical labour.

Thus, from this point of view, the relative degree of mass production, as well as the level of the product and of production technology are essential premisses before the actual work of development may start.

Among the points of view orientating production and exports, it is also mentioned that in principle the quantity of products of the same kind should reach not only the lower limit of capacity still exerting an influence on the world market, but should exceed it as far as possible.

Finally, the analyses have led also to such conclusions that it is not sufficient to import the results of the work on technological development that is, the purchase of licences and technological procedures. It is at least of the same importance to participate in the international division of labour in a manner which is characterized by specialization in spare parts, partial units and complementary elements. Those industrial countries the engineering industries of which turn out a wide range of products import engineering products for their own productive consumption at an increasing rate. The point of view, therefore, which would push the development of exports towards big homogeneous quantities, should be at least complemented with the statement that in turning out a rational and competitive choice of products and in such export pattern a role must be accorded to an international division of labour which finds expression in the cooperation relating to spare parts, partial units and fittings.

Development policy in Hungary partly accounted for but partly also neglected the considerations quoted as examples. E.g. instead of the cautious orientation first mentioned it is held more important to create lasting and even dynamically expanding demand on exports. The satisfaction of a falling or stagnating demand on world level /e.g. on railway rolling stock, more backward traditional machine tools or tools for manual labour, etc./ could be still joined, Such products may even secure a comfortable market and adequate profi tability but such market cannot provide a lasting and dynamic export possibility, for the long term so much less since these products are not the bearers of the great technical progress of our times. It will be more expedient to look for the market of such products which are connected with developing branches and products. Such are in most countries the heavy chemicals, the processing of oil, road transport, long-distance pipe-lines and the connected telecommunication equipment and instruments, machinery for food production, cooling equipment, bureau machines, computers, electronics, etc.

It may be advantageous for a contry with medium or small industrial potential to join the development of a new group of products in its rising stage. Such a country alone is unable to advance at the head of the application of technical sciences nor to work out such development results which would enrich the world market with new products. If, however, it joins development in time and applies the results achieved up to that time, it may reach an advantageous situation from both the economic and the technological points of view /and this may open further economic possibilities/.

Analytical calculations

In harmony with the general information gathering treated above, a detailed and intensive market research will start. In this field the Hungarian planners perform concrete analyses in respect of narrower groups of products, by countries or groups of countries.

Market research requires, quite obviously, other methods in connection with the socialist countries where long-term plans are collated at regular intervals and agreements are made, and other ones again in espect of countries with which we have no such "planning relations". Market research is conducted by the foreign trading companies who also draw in the specialists of the productive enterprises.

Market research covers not only individual finished products, but also groups of them, complex machinery, or conversely, only partial groups or individual kinds of machines. Generally, it has proved advantageous if we appeared on the market with offers covering not only individual kinds of products but related groups of machinery, whole factories, or at least certain typical lines of machinery. It is, e.g. more advantageous to find a market for a whole line of machinery for food production /e.g. a group of machines turning out tomato-mash or a whole factory equipment/ than to export single machines.

Beside export demand, also the domestic demand needs some research. The ratio between the two cannot be established quite voluntaristically, since it depends to a large extent on how "open" is the economy of the exporting country. The size of the series satisfying the requirements of a rational scale of production can be established for the combined quantity of the products for domestic use and to be exported. Owing to technical development and, to a certain extent, in spite of it, the minimum quantity of individual engineering products meaning the lower limit of competitive production, is rapidly growing. If demand does not attain even this minimum quantity, the economic efficiency of production will become doubtful. This limit is, of course, not a sharp line, but more or less an elastic band the width of which depends also on the character of the product.

/E.g.for trucks this limit is substantially higher than for other similar vehicles with special bodies./ The problem of mass production marked out one of the most decisive calculation tasks of our engineering planners.

If the numerical relations are defined in a way that we establish by kinds of products the quantity anually released by the big enterprises capable of essentially influencing the market and relate our production to this figure, we obtain the relative degree of mass production. It relates to an individual product or a group of products. It is not formulated in the usual categories of mass production - series or individual product - but in natural units of measurement characteristic for the product. If, e.g, the leading enterprises on the world market have an annual output of 1000 - 1500 pieces of some kind of machine, and the corresponding Hungarian enterprise releases 800, the indicator of the relative degree of mass production will be 800/1250 = 0,64.

The examination of the relative degree of mass production of the engineering products may be classified as belonging to the "classical" planning methods.

Our calculations for the relative degree of mass production are, of course only gross approximations the role of which must not be exaggerated. It must not be viewed as a fatal disadvantage if the production volume resulting from domestic and export requirements does not attain a certain relative degree of mass production since, under the given conditions, development may be still economically efficient and advantageous. Similarly, a satisfactory degree of mass production provides no guaranty since the success of the export development program depends not so much on some initial conditions but rather on the correct concept of the whole program and on its proper implementation.

Similarly, an orientating figure will be the proportion of the annual volume - serving for working out the above indicator of the relative degree of mass production - to the whole world trade in the product /or to some determined part of it/. If this ratio is small, it means that the world market is supplied by a <u>multitude</u> of such leading enterprises and thus our appearance on the world market promises more results than in case the market were supplied by a mere dozen of enterprises. But, of course, even such figure has only an informative character.

Comparison of the relative degree of mass production of some engineering products. /Based on 1963-66 data/.

Products	Average European relative degree of mass production in comparison to leading world company	Hungarian relative degree of mass production in comparison to competitive European average
	percentages	
Metal-cutting machine tools	o,18	2,oo
Centre lathes	o,13	4,oo
Milling machines	o,29	1,31
Grinding machines	o,38	1,29
Revolver lathes	o,17	o,27
Non-cutting machine tools	o,23	o,38
Trucks	o,17	o,o3
Buses	o,36	1,67
Wheeled tractors	o,14	o,12
Caterpiller tractors	o,1o	1,21
Diesel engines	o,18	o,23
Motor-cycles	o,oo6	3,5o
Railway passenger coaches	o,1o	4,76
Railway wagons	o,13	o,33
Steam turbines	o,17	o,33
Boilers	o,o6	o,15
Cranes	.	2,2o
Household vacuum cleaners	o,25	o,34
Household refrigerators	o,17	o,3o
Radioreceiver sets	o,44	o,72
Lochs and padlocks	.	1,5o
Pumps	o,5o	1,6o
Air compressors	o,67	1,oo
Bath-tubs	o,25	1,8o
Ball-bearings	o,12	1,25

Experinces gained in drawing up export development programs for major individual projects and branches

Following from the character of the Hungarian economy, the development of exports has an essential role in most of the engineering branches. In recent decades there has been hardly any development idea or proposal worth mentioning in engineering where exports would not have been implemented explicitly with export objectives in view.

The concepts and programs about the development of exports hitherto prepared were born on various levels and affect various levels. This multi-level character of the proposals arises from the fact that - with the practical exception of the smallers ones - all major development projects were financed from central resources, under the supervision of the competent ministry.

The most concrete development programs of relatively small scope and taking only a few years usually referred to one or a few enterprises.

These programs are based on individual investigations and calculations performed for the economic and technological concepts of the development. Their lessons are difficult to generalize and, therefore, they will not be dealt with in this place.

A development program influencing the activity of several enterprises or a whole branch covers mostly five years or longer periods of planning. Their evaluation takes place in harmony with the annual and the five-year plans but separately, not infrequently on Government level.

The drawing up of some development program is initiated on the level of the enterprises or on that of the supervising body /ministry, directorate supervising several enterprises, the foreign trading organ, etc./ Such program will provide for major changes in the technological level of engineering, in the order of magnitude of output and the pattern of production. In addition, it has to pay attention to the changes on domestic and foreign markets, which necessitates perhaps major preparatory steps in home or foreign trade.

Another type of the development program is which aims at working out a development concept for the whole of the engineering industries or a part of it comprising, however, several branches. This kind of development programs cannot be squeezed into a five-year plan period since the gestation period of the development approximates or exceeds five years and the connected effects, the economic realization of the development may take even longer.

These factors induce, of course, such a degree and complexity of changes which can be foreseen - assuming even the greatest care - only with a certain likelihood.

Such comprehensive development programs comprise, of course, much less of details and many assumptions. Their working out requires quite different initial material, points of view and methodology.

By our experience, it is worth while to check each development program at about the middle of the period planned for and modify it if necessary. This is particularly recommendable in case of such products which are in the course of rapid technological development or such consumers which are parts of a similarly rapid development.

Example No.1.: Major methodological features of the development program of the Hungarian telecommunication industry.

Before surveying the features of this program, first the order of magnitude of the development achieved in ten years should be characterized. Before 1945 there were only three plants in the Hungarian telecommunication industry which were comparable by international standards. The first, the well-known "Tungsram" turned out incandescent lamps and electronic valves, the other telephone exchanges and extensions, the third radio receiver sets.

Two of them were subsidiaries of foreign companies and had no development capacities or facilities to produce all spare parts themselves. Between 1948 and 1958 the bases of the Hungarian telecommunication industry were created by building several new enterprises and by developing the existing ones. Following this period, rather a policy developing and modernizing these bases is characteristic, and the introduction of some new lines of production /TV picture tubes, transistor receiver sets, semi-conductors, micro-wave and transmission technique equipment, etc./. In this period the production of some up-to-date basic materials for the telecommunication industry had to be solved /introduced/ in metallurgy and the production of some products required by advanced technology /ferrit bars, printed circuits, etc./ has started. The conditions were created based on which later, in the 'sixties, the production of the telecommunication industry could be developed in the direction of bigger industrial equipment of greater economic efficiency /micro-wave systems, Crossbar telephone exchanges, transmission techniqe equipment, industrial television, etc./. Further, the development of vacuum technical products, vacuum-technical productive equipment , studio and amplifying systems which are up-to-date even on world level, has been also realized.

After this development, the situation of the telecommunication industry within engineering may be characterized by the follwing data: in 196o, it represented 1o per cent of total engineering output. In that year the share of export was 43 per cent in the output of the telecommunication industry. There are special "export" branches, where the majority of production is exported. The bases of such development have been created by the favourable cooperation connections with the socialist countries.

Analysing the world development tendencies of this industry, the growth of domestic demand and the economic efficiency of production, the problems of long-term development emerging at the beginning of the 'sixties were the following:

a/ The pattern of production had to be changed in a way that the share of consumer goods should diminish and their place be taken by industrial equipment so that their share in exports should also increase;

b/ It had to be achieved and a way found that the production of basic materials, spare parts and finished products should develop in proportion to needs;

c/ Conditions had to be created that part of the capacities should grow not in Budapest but in the country-side.

d/ In order to raise rapidly the technological level of the products, the industry had to be provided with a sufficient number of technical staff of proper qualification;

e/ The organization of the telecommunication industry had to be revised according to modern principles of management.

Partial programs were prepared on the above problems by the Ministry of Metallurgy and Engineering, the Directorate supervising the industry and the enterprises concerned. The work was coordinated by the Ministry.

The ministry examined, for instance, what conditions were necessary for a higher concentration of the production of articles of similar character. A plan was made how to solve the expansion of research and development capacities, and to create such productive capacities which are highly research-intensive near the research bases. A plan for the supply with technical staff was drawn up and the conditions of quick training worked out. It was established that the supply with engineers cannot be essentially improved in five years. Privisions were made to improve the equipment of the research and development bases.

f.

In the framework of the concepts on the development of the production of spare parts, provisions were made for the production of semi-conductors, transistorized constructions and the purchase of the licences for producing these. A factory was pointed out to produce the equipment for the domestic telecommunication industry with the aim of supplying machinery entirely from domestic sources. It was also found that the production of spare parts for the telecommunication industry must be centralized in order that the scale of mass production thus originating should enable production on a higher level of technology.

The program comprised also the tasks of the other ministries which were the conditions of realizing the telecommunication program in a complex manner. Such were e.g. the domestic basic materials necessary for the production of germanium, the development of the domestic glass products and ceramics, the planning of up-to-date information systems and system techniques.

Example No.2.: Organization of the program of the precision engineering industry

Twenty years ago the Hungarian precision engineering industry comprised but two big and some small plants. The Gamma and the Hungarian Optical Works turned out mainly optical instruments and other equipment for fine mechanics, the smaller plants, however, mainly electric instruments, simpler mechanical instruments and measuring equipment. The first period of development /about till 1955/ was characterized mainly by the growth of capacities and the development of new products came only then into the foreground. New groups of products were introduced: geodetic equipment, special X-ray apparatus, electronical and electric medical examination and healing equipment, nuclear instruments, automation elements and systems built from these, etc.

The output of the industry rose between 1955 and 196o to 1,77-fold and its share was almost 6 percent in the total output of engineering. About 35 per cent of its output was directly exported in 196o and another 3o per cent was exported built into other engineering products. Precision engineering is thus fundamentally an export industry.

When the necessity of preparing a comprehensive development program emerged, it had to be taken also into account that the range of the spare parts is to a great extent common for the telecommunication and the precision engineering industries and thus this part of the development program had to serve the interests of both branches.

Similarly, the bottleneck of the research and development basis was also coupled with the problems of the telecommunication industry, mainly because the qualification of engineers and technicians needed in the industries is very similar in both branches.

The development program prepared pointed out the following tasks:

a/ Productive capacities must be essentially increased, by 198o to more than twofold of that in 196o, mainly from the point of view of a long-term export concept.

b/ The pattern of production must be changed in a way that the production of some groups of products should cease in order to increase the output of automation elements and complete automation systems.

c/ Harmony between the production of spare parts and finished products must be secured.

d/ Capacities must be secured for the domestic planning and fitting of measuring and controlling instruments and automation systems.

e/ Proper organizations must be brought about for the maintenance, repair and servicing of precision engineering products, in cooperation with the home and foreign trade organizations and the supervisory bodies of the main users.

f/ New capacities for precision engineering must be built as far as possible in the countryside.

The development programs reviewed have been already implemented. From the evaluation of the realization we wish to stress only some methodological points of view:

In general, it would have been expedient to work out detailed partial programs for the realization of the tasks, observing much more the long-term points of view. This relates particularly to the market requirements, their differentiation and development over time as well as to the development capacities.

The relations of the branches to other cooperating industries and to the whole of the economy should have been worked out in greater detail.

Elaboration of a comprehensive development concept in engineering with the aid of "traditional" methods.

Utilizing partly the lessons of the individual programs and attempting to set new comprehensive objectives, an experiment was made in Hungary which tried to work out in the framework of long-term planning a technico-economic concept covering the development of the entire engineering industry.

This work was composed of about 5o studies, each dealing with problems relating to groups of engineering products. Thus, the products of the telecommunication industry are treated in five studies, prepared for 53 groups of products. Another five studies covering 59 groups of products dealt with the precision engineering industry. The total of the groups of products analysed was more than 3oo. The methodology issued prescribed in detail what questions should be answered and according to what points of view.

The points of view are succinctly summarized in the questions issued /Appendix No.1./

From two points of view this development program has fulfilled its task, from a third one, however, it has not.

The evaluation and broad discussion of the studies was suited on the one hand, for drawing a manysided and critical picture about the problems of the production, and technological level of the individual groups of products. On the other hand, the valuation attempted to establish the ranking of 18 engineering branches, based on "classical" technico-economic weighing, from the point of view of the possibilities and success of development. From the 18 branches, the five most advantageous ones were

- radio and telecommunication industry,
- precision engineering,

- strongcurrent electric machinery production,
- tool and machine-tool industry,
- car industry.

The least advantageous branches from the point of view of development were

- production of tractors and agricultural machinery,
- production of machinery for the food industry,
- production of metallurgical machinery,
- shipbuilding,
- ball-bearings production,
- production of machinery for construction and the building material industry.

It followed from the character of the data processed and the method of evaluation that the ranking within the individual groups was immaterial, only the comparison between groups made sense.

The individual studies contained also production estimates of the authors and were so published. They cannot be considered as conclusions checked with the aid of national economic programming.

Central planning /the ministry/ evaluated the studies with the aid of the valuation system presented in Appendix No.2. The method is, as a matter of fact, similar to an information system relying on inquiries.

The studies have not come up to expectations in respect of the production, export, etc. volumes since in the meantime these proved to be irrealistic. True, the points of view issued have not unequivocally demanded an exigent analysis.

Taken together, the lesson can be drawn that the most delicate /and unsolved/ problem of the studies prepared for the individual branches of engineering was the evaluation of demand and the allocation of resources in the interest of some optimum of the economy. But these program studies proved to be definitely valuable as regards technological development and in working out the conditions of development. But in this sense they only enriched the information of planning and could not be considered as planning in themselves.

The positive and the negative statements arrived at have finally led to the conclusion that the "classical" planning in engineering /the one based on individual analyses/ must be complemented by methods which bring into planning the macro-processes. This purpose is served by the mathematical methods reviewed in a later part of this study.

Disclosure of the development proposals and organization of their evaluation

The evaluation of an eligible export development program or the selection of the most advantageous one

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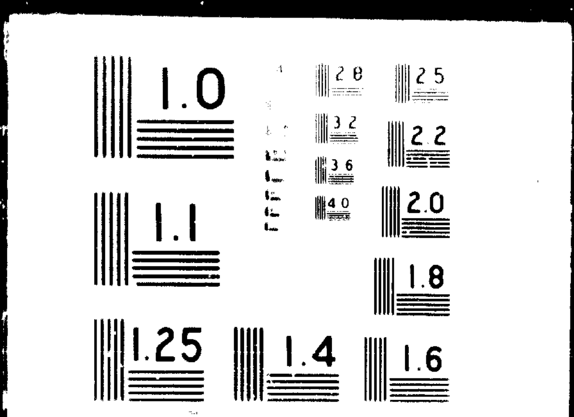


from among the possible ones is effected by weighing the results and the inputs in a complex manner. It should be stressed that the complex weighing does not mean a simple confrontation of monetary values. Economic efficiency as the quotient of the result and the input is in itself of smaller importance and decides only programs of smaller volume.

For the simultaneous consideration of all factors and circumstances no closed, formula-like method is used. Even in the cases when an advanced and manysided method is applied as mathematical programming, it will be expedient to use several objective functions, which yield optima corresponding to various points of view. Decision is finally taken by comparing the optima of different character.

The methods of evaluation are, however, different in the case of individually proposed <u>programs</u> when decision must be taken on its acceptance or refusal or when the most advantageous solution has to be chosen from among a few ones with the same objective and different again when the problem to be decided is put in a more general form.

In the preparation of the decisions to be taken on individual cases the analysis of results and inputs has, of course, an important role. In addition, in

Hungarian practice the economic efficiency of exports or the procuring of foreign exchange is of decisive importance. Its measure is the forint input necessary to earn a rouble or a dollar according to the proposed export program.

In its calculation the price of the product, the imports and the domestic inputs necessary for production are taken into account. Another indicator was also used where the price in terms of foreign exchange was compared to the weight of the engineering product, yielding information about the utilization of the metal as a more or less scarce resource.

In this sense, also the expected volume of exports has a role in the evaluation. In vain does some program promise an above-average profitability or foreign exchange yield if the volume is so small that it does not contribute to the average efficiency of the whole economy to any significant extent.

The expected duration of the exports influences the decision to no small extent. In this case the duration is measured on two scales. One of the measures is the lifetime of productive equipment. Obviously, a different valuation attaches to the duration of the sales of such consumer goods the production of which requires only a few means of production with a short lifetime /tools, clichés, etc./ and a different one again to such goods which require equipment of high value and long lifetime. In the first case it is more likely that demand will continue as long as the equipment is worn out and needs to be exchanged.

At the same time, also the lifetime of the product must be taken into account. Even if demand continues but the lifetime of the product expires and the equipment is not suited for turning out other products, this will be disadvantageus from the point of view of the development program.

Some years ago a mechanized bath-tub factory was put into operation with a highly mechanized foundry. The tools /moulds/ are most closely connected with the types, forms and sizes of the bath-tubs and the whole equipment can be used essentially only for casting tubs; for other purposes it can be used only under much less favourable conditions.

Demand for bath -tubs seemed to be very reliable and on the rise both at home and abroad since it is connected with the improving living conditions of the population. Nor could it be alleged that the changes in the types of tubs were too quick or that there were too many types. Still, even with such stable export products it had to be examined whether the cast iron tub will not be substituted by welded plate tubs or plastic tubs. Only after a thorough analysis as to the lasting character of the market was the decision on the realization of the factory taken.

The analysis of the technological level with direct and indirect methods is a condition of the realization of development. It is direct if the given development is a stage of a longer purposeful development process which must take place in order that the next stage becomes possible. In such cases the rise in technological level becomes manifest partly in the growing value of fixed assets, partly in the rising qualification and training of the staff and in the growing organization of the plant.

In the course of the analysis we may assume with some justification that, even if fixed assets have to be changed when switching over to a new, more advanced technology, part of the machinery may remain on the old level of technology, they need not be exchanged since they will be able to supply also the machines corresponding to the new technology. Such machines can be mostly found among those performing the preparatory operations /cutting into pieces, clipping, roughing,/ and the complementary and finishing ones /drilling and cutting threads, smaller finishing operations/. Of course, neither these machines got stuck in development, but they are less sensitive to the most modern technical requirements. Such machines may supply that part of the fixed assets of a given program which is already prepared for further development. The more such machinery in the stock of fixed assets /if justified/, the less inputs are needed for further development.

The competence and training of the workers and employees is also available. Thus, in the final analysis, the effect of a realized stage of development on a consecutive stage becomes appreciable in terms of fixed assets, training of manpower and the rate of development of production.

If the subject of the evaluation is not a definite development project but the question is which to prefer from several possibilities for the development of engineering, this is more difficult to answer in a practically usable and well orientating manner, without mathematical methods. But let us disregard now the mathematical methods to be treated in the next part of our study and put up with the methods which can be used without computers.

We have already mentioned the series of studies prepared with the aim of analysing the long-term development possibilities of the Hungarian engineering branches. It has been also stated that this venture comprised more than 5o independent studies and treated more than 3oo products /according to a predetermined, centrally issued methodology/.

Evaluation took place in three steps. The Committee evaluating the individual studies in detail drafted questions which were issued to the specialist panels and had to be answered in writing. /The questions are attached, see Appendix No.1./ Part of the questions had to be answered by quoting figures, part of them, however, with simple yes - no.

The about 5o studies and the answers given to the questions were studied by the above Committee, consisting of 3-4 permanent members and a varying number of specialists of the field in question. The answers given to the questions were discussed with the leading members of the panels drafting the studies in order to secure an unequivocal interpretation of the questions and the answers. Then the valuating committee formulated its opinion about the development of the about 3oo products.

In the second step of the evaluation a wider Committee comprising delegates of the Ministry of Metallurgy and Engineering, the National Planning Office, the National Board of Technological Development as well as those of the home and foreign trade, the consumers and the development institutes - always in a composition corresponding to the subject - discussed the substance of the statements of the studies, the answers given to the questions and the proposal of the evaluating committe of the first instance.

The wider Committee discussed all of the groups of products and took a stand in the majority of cases. The major types of the findings were formulated as follows: "it is worth while to engage in the production of the product on the basis of domestic demand", "it is worth while to engage in the production of the product on the light of domestic and export demands",
"it is not worth while to engage in the production of the product."

It must be added that this statement did not amount to an immediate concrete decision, it was only a recommendation. Otherwise, the sifting of the products was not too rigorous which is also testified by the fact that the volume of the products recommended required greater capacities than was available.

The third step of the evaluation was performed again by a narrow Special Committee. The purpose of this stage was to summarize the findings of the wider

Committee and to draw up a list for the ranking of the main groups of products from the point of view of long-term development prospects. The ranking did not serve for the basis of any operative decision, it was only of informative character.

The basis of the summarized evaluation were 27 questions selected from the original list of questions. The more than 3oo groups of products were summarized according to the 18 branches. /For the list see Appendix No.2./

The main problem of the evaluation was that only a smaller part of the answers given to the questions was of yes - no type. On the other hand, it was not intended to prepare some immediate decision based on the evaluation. Only information was required about the desirable direction of development, whether it is worth while to work out more detailed and concrete programs and what are their expectable results. In this sense, the purpose of the whole undertaking was to disclose and summarize the structural development proposals. The evaluations were prepared in a way combined with estimations. We think the method deserves a brief review since, in spite of its improvised character, we feel that it facilitated orientation among the many relatively complicated and intersecting points of view and opinions.

All answers were quantified. The yes - no type answers were quantified according to the division of the answers to the question between yes and no. On the basis of these figures obtained the 18 branches were ranked within each question, putting the branch having obtained the highest figure in the first place as the most advantageous one and the one with the smallest figure, the least advantageous one, in the last.

The rankings thus established had some technical and economic contents since they expressed some priority according to various partial points of view.

Next, these were summarized by attributing weights to the questions, multiplying them with the serial number of the branches and adding them up. This procedure, however, does no more express any concrete technological or economic contents, only an opinion and judgement.

Since this method is all too subjective, various systems of weights were applied. The results showed different rankings of the 18 branches. From these the cases deserved particular attention where the relative ranking of the branches did not change <u>in spite of the different weighting.</u>

The application of such method which is mixed with subjective evaluations will, of course, loose its importance against the procedures more relying on mathematical methods. Still, because it is easier to survey, and simpler to handle, it is suited for a first and quick review. Research is under way to work out a mathematically formulated version of the method.

II

MATHEMATICAL METHODS APPLICABLE TO THE MEDIUM-TERM PLANNING OF ENGINEERING EXPORTS

The careful analyses relying on theoretical assumptions cannot - even with the best competence, goodwill and training - always find the deeper quantitative relations dominating the events; even though they approach the phenomena in greater detail, from many aspects, they can rarely reveal the internal, decisive quantitative relations. The same can be said about the planning of engineering. To arrive at a well-founded program, the exact, mathematical investigation of the quantitative relations is absolutely indispensable.

In the following we wish to outline the methods worked out through a whole series of experiments in Hungary for the planning of the exports of engineering products.

Regression and correlation calculations

The regression and correlation connections indicate the relationship between the growth of engineering output and the exportable quantity from the same; with its aid the "export-elasticity" of engineering can be computed. The importance of the method lies in the fact that, if no special measures creating new conditions are planned to improve export capacity /as e.g. price reduction, or a sudden improvement of quality, or the releasing of entirely new products/, the regression analysis and correlation calculations will show the factors already at work which influence the efficiency of the exports of engineering products most intensively. /Although the adoption of some export development program must be accompanied by an adequate system of incentives; in this sense, the circumstances cannot be the same./

According to our practical calculations the three factors having the most decisive role are: the ratio of qualified manpower, the relative degree of mass production /the ratio of the size of domestic series to that in the factories working with the most advances technologies in the world/ as well as the degree of technological equipment /the ratio of highly valued equipment to the sum of wages/.

To prove the above, a conrete calculation performed in the Hungarian engineering industry is quoted.

Purpose and method of the calculations

The main purpose of the analysis was to investigate - mainly on the basis of representative data on products - which are the general factors asserting themselves as a tendency, on which the economic efficiency of engineering depends and what is the role of the individual factors.

The representative analysis going down to the level of products enables us to get an insight into the economic relationships that should be taken into account in rational decisions to be taken on engineering. This conclusion may be supported by the following considerations:

a/ In analyses where engineering is broken down only by sub-branches, the engineering products figure only in a highly aggregated form /each of the engineering branches turns out several thousands of articles/ and thus the factors which show great dispersion by products, as e.g. the degree of mass production, can be hardly examined numerically. Therefore, an analysis of the products will give more comprehensive and fuller knowledge than that of the branches.

b/ Owing to the aggregations, it may happen that in the analyses dealing with branches the factors which have primary importance from the point of view of efficiency, remain partly concealed.

It should be noted that an analysis by products has also disadvantages. A too broad application is today still impossible, we must rest satisfied with the analysis of selected products which involves - as all sample surveys do - certain random error and bias.

The other disadvantage is that many data can be established for products with much greater uncertainty than for branches /because of the accounting problems of domestic costs, particularly overhead/. As regards the foreign exchange prices, the situation is a special one. These prices can be exactly given for products /only products actually exported have been examined/. But the actual sales prices of the individual products show great dispersion depending on the concrete conditions of the transaction.

In the course of the analysis the total inputs of 79 engineering products have been determined from the major resources.

In the course of analysing the products, from the several factors and resources investigated the roles of three basic factors could be approximately established from the point of view of the development of export efficiency:

1. The proportion of qualified technical staff /mainly engineers and technicians/.

2. The technological equipment of labour.

3. The relative degree of mass production.

In the course of the analysis by products the economic efficiency was approximated with the aid of the following quotient:

$$\frac{\text{Domestic inputs /in forints/}}{\text{Sales price /in dollars/}}$$

Domestic inputs were determined in several ways. Three of them were the following:

a/ Prime costs reduced to wages /the total national economic wage costs of the product/ worked out with the aid of the inverse matrix of the price model;

b/ Production price /prime costs reduced to wages plus 25 per cent profits and lo per cent on the value of fixed and circulating assets engaged/;

c/ Approximative value of the shadow price /using the results obtained from the national economic programming to be reviewed later/.

In the majority of cases the dollar price was identical with the actual returns from exports on the major capitalist markets in 1964-65.

The method of the analysis was to perform multi-variable regression calculations where the dependent variable was in turn some variant of the indicator expressing economic efficiency and the independent variables were simultaneously the above mentioned three factors of efficiency: the share of qualified technical staff, the technological equipment of labour and the relative degree of mass production. In this manner - with the aid of partial regression coefficients an answer could be given to the question to what extent did the factors mentioned influence the efficiency characterized by the above quotient.

The three factors of efficiency were approximated on the basis of the data available in the following manner:

Ratio of qualified technical labour:

$$x_1 = \frac{\text{total wage of technical staff}}{\text{prime cost reduced to wages}}$$

where the total wage cost of the technical staff includes all wages paid to technical staff in the last and all preceding stages of production and prime cost reduced to wages are calculated in the same manner for total wages; the tool for calculating these items is an input-output table used in the price model.

Technological equipment: $x_2 = K/W$

where K is the gross value of the equipment and tools used in the economy as a whole for turning out a product multiplied by the average number of shifts worked and W is the prime cost reduced to wages, as above, /the wage stands here instead of employment/.

Relative degree of mass production: $x_3 = Q_h/Q_k$ where Q_h is the volume of the product turned out in a year and Q_k is the quantity turned out of similar products by leading competitive enterpr ses on the world market.

The efficiency functions derived are the following:

$$Y_1 = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3$$

$$Y_2 = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$$

$$Y_3 = c_0 + c_1 x_1 + c_2 x_2 + c_3 x_3$$

where Y_1 = prime costs reduced to wages per sales price in dollars,

Y_2 = production price per sales price in dollars,

Y_3 = shadow price per sales price in dollars,

a_0, b_0, c_0 are constants of the functions, and

a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3 are partial regression coefficients.

a_1 means e.g. by how many forints is the prime cost /reduced to wages/ necessary to procure one dollar lower if x_1 /meaning the share of qualified technical labour/ is higher by one unit.

The analysis was not restricted to determining the parameters of the three regression functions. Also other interrelations were analysed and the result emerged that from the point of view of the development of efficiency the above interrelations are most important in the engineering industries.

Efficiency interrelations:

Reviewing the concrete interrelations established, let us first look at the development of the three selected indicators of efficiency in respect of some engineering products:

Table 1

National economic inputs necessary to earn one dollar, regarding 41 engineering products, Ft/$

Code No.	Name, according to Hungarian list of products	Prime cost reduced to wages Y_1	Production price Y_2	Shadow price Y_3
409	Electromotor	26,9	47,4	50,5
416	Door-lock	26,9	43,0	48,7
504	Nut, unrefined	32,2	59,0	61,3
592	Incandescent Lamps /40 W/	31,4	50,9	56,0
608	Aluminium Tube	22,6	39,4	42,3
619	Stock-lock	23,8	36,5	41,2
622	Universal Pliers	64,9	95,0	112,9

Code No.	Name, according to Hungarian list of products	Prime cost reduced to wages Y_1	Production price Y_2	Shadow price Y_3
623	Padlock "Cato"	31,7	45,2	53,1
624	Acid Cell	19,5	33,1	36,3
1398	Electric Stove	22,8	39,o	44,3
1435	Upholstered Seat	47,5	78,8	85,4
135o3	Noval-tube /Rectifier/ EL 84	32,9	5o,8	57,6
135o8	Noval-tube /Common/ DY 86	19,2	35,3	4o,o
13511	Noval-tube /Common/ EF 8o	32,5	5o,5	57,o
13517	Noval-tube /Rectifier/ PY 83	29,2	47,8	52,1
1399o	Radio Transmitter Receiver AR 612	62,1	94,2	1o7,1
2oo26	Bus IK 55	15,8	26,2	29,o
2oo48	Fast-twister	2o,2	32,9	38,9
2oo49	Fast-twister with Basket	27,2	43,8	52,2
2oo58	Press Shearer OP 16	19,8	3o,9	37,4
2oo62	Lathe EU 5oo/15oo	22,7	36,6	44,2
2oo63	Aluminium Cable ASZB 6kW	19,6	38,4	38,9
2oo64	Milling Machine UF 222	14,8	23,3	28,8
2oo65	Tractor U 28	35,5	67,4	72,6
2oo71	Crane Engine "Hors"	17,2	3o,o	32,1
2oo78	Ball Bearing 62o5	33,9	6o,9	67,7
2oo81	Lathe RT 8o	13,6	22,5	26,7
2o1o3	Bus IK 63o	22,3	37,1	4o,9
2o127	X-Ray Apparatus "Diagnomax"	24,8	39,9	44,8
2o4oo	Cast-Iron Bath-tub	2o,9	36,3	38,9
2o4o4	Padlock "Tuto"	19,1	29,3	32,9
2o4o5	Padlock "Tutius"	27,8	43,5	48,3
221o1	Portal Crane 5 t	19,8	34,6	37,8
221o2	Vacuum-cleaner "Venus"	31,7	52,7	59,7
221o3	Lorry "Csepel" 45o	31,5	54,9	59,8
221o4	Refrigerator "Lehel" 12o l	56,2	91,o	1oo,2
221o5	Railway Passenger Coach CCCP	16,2	27,6	31,o

Code No.	Name, according to Hungarian list of products	Prime cost reduced to wages Y_1	Production price Y_2	Shadow price Y_3
22106	Motorcycle "Csepel" 250	29,5	51,1	56,3
22108	Steam-turbine "Lang" 24 MW	25,2	45,5	51,1
22111	Steam Boiler 120 t	21,0	41,2	43,5
22200	Grinding Automaton KU 250/750	37,5	61,6	73,0
	Average /unweighted/	28,1	46,5	52,0

The data of the table show that:

1. There are substantial differences in the levels of the three kinds of input indicators. The inputs at "production prices" /Y_2/ exceed the prime costs reduced to wages by 65 per cent on average which corresponds on the whole to the national economic average as well. At the same time, the average level of the "shadow prices" is about 12 per cent higher than that of the production prices. This is connected with the fact that engineering requires a greater share of highly qualified labour than the economy on average and the valuation of this labour is relatively high according to the shadow prices.
2. The dispersion around the average is considerable with all three kinds of the indicators: 35-40 per cent of the average value. The per unit input of the most advantageous article is about half of the average, that of the most unfavourable one is 2,1 - 2,3-fold.

Table 2

Numerical values of the efficiency factors X_1, X_2, X_3

for the 41 engineering products

Code No.	Name, according to Hungarian list of products	Total wage of technical labour/prime costs reduced to wages per cent X_1	Technological equipment Ft/Ft X_2	Degree of mass production per cent X_3
4o9	Electromotor	17,2	4,o1	4o x/
416	Door-lock	15,3	3,o6	15o
5o4	Nut, unrefined	14,9	5,16	13o x/
592	Incandescent Lamps /4o W/	15,4	3,72	15o
6o8	Aluminium Tube	15,8	4,72	12o
619	Stock-lock	13,o	3,o9	15o
622	Universal Pliers	14,4	2,72	7o x/
623	Padlock "Cato"	12,6	2,45	15o
624	Acid Cell	19,6	3,o5	5o x/
1398	Electric Stove	17,4	4,29	3o x/
1435	Upholstered Seat	16,8	3,53	4o x/
135o3	Noval-tube /Rectifier/ EL 84	15,8	2,9o	1oo
135o8	Noval-tube /Common/ DY 86	15,7	3,o3	1oo
13511	Noval-tube /Common/ EF 8o	15,o	3,15	1oo
13517	Noval-tube /Rectifier/ PY 83	16,3	3,42	1oo
1399o	Radio Transmitter Receiver AR 612	15,7	2,76	4o
2oo26	Bus IK 55	16,8	3,72	167
2oo48	Fast-twister	17,7	3,8o	15o x/

Code No.	Name, according to Hungarian list of products	Total wage of technical labour/prime costs reduced to wages per cent	Technological equipment Ft/Ft	Degree of mass production per cent
		X_1	X_2	X_3
2oo49	Fast-twister with Basket	17,7	3,75	15o x/
2oo58	Press Shearer	17,7	3,33	33
2oo62	Lathe EU 5oo/15oo	18,o	3,83	4oo
2oo63	Aluminium Cable ASZB 6 kW	18,8	5,82	4o x/
2oo64	Milling Machine UF 222	18,6	3,44	131
2oo65	Tractor U 28	17,1	4,41	12
2oo71	Crane Engine "Hors"	17,2	3,66	1oo x/
2oo78	Ball Bearing 62o5	17,4	4,6o	125
2oo81	Lathe RT 8o	18,o	4,o9	27
2ol03	Bus IK 63o	16,7	3,7o	167
2ol27	X-Ray Apparatus "Diagnomax"	18,4	2,88	13o x/
2o4oo	Cast-Iron Bath-tub	14,8	4,36	18o
2o4o4	Padlock "Tuto"	13,o	3,12	15o
2o4o5	Padlock "Tutius"	15,6	2,77	15o
221ol	Portal Crane 5 t	16,6	4,22	22o
221o2	Vacuum-cleaner "Venus"	18,2	3,64	34
221o3	Lorry "Csepel" 45o	16,7	3,7o	3
221o4	Refrigerator "Lehel" 12o l	15,9	3,34	3o

Code No.	Name, according to Hungarian list of products	Total wage of technical labour/prime costs reduced to wages per cent	Technological equipment Ft/Ft	Degree of mass production per cent
		X_1	X_2	X_3
22105	Railway Passenger Coach CCCP	20,0	3,80	476
22106	Motorcycle "Csepel" 250	16,4	4,43	50 xx/
22108	Steam-turbine "Lang" 24 MW	19,1	3,80	33
22111	Steam Boiler 120 t	19,1	4,59	15
22200	Grinding Automaton KU 250/750	17,6	3,72	129
	Average /unweighted/	16,7	3,70	113

x/ estimated values

xx/ with Japan included

Table 2 shows there are significant differences between the products examined as regards the numerical values of the three efficiency coefficients. The greatest differences can be found in the degree of mass production.

The dispersion is strong also in respect of technological equipment, where the highest value occurring is almost 2,4-fold of the lowest /5,82 and 2,45/.

For the share of the wage of the technical staff the same ratio is 1,7:1 /20:12,6/.

The next stage of the analysis was to investigate the interrelations between the efficiency indicators and the factors of efficiency shown.

First the connection with the efficiency indicators was examined if the products were ranked by the share of technical wages, technological equipment and the degree of mass production. It could be established that the higher values of all three efficiency factors involve, as a tendency, smaller per unit inputs, with considerable dispersion.

In order to characterize the interrelations numerically, the correlation coefficients have been computed. The results are summarized in Table 3.

Table 3

Individual correlation between the factors of efficiency and the individual indicators of efficiency

Notation	Independent variable	Correlation with the dependent variable		
		Y_1	Y_2	Y_3
X_1	Share of "technical" wages	-0,33	-0,26	-0,26
X_2	Technological equipment	-0,29	-0,18	-0,21
X_3	Degree of mass production	-0,31	-0,36	-0,33

Beyond what has been already established, the figures in Table 3 also show that the individual factors of efficiency are in closest connection with the prime costs reduced to wages. This is understandable. For instance, the raising of the technological equipment of labour will increase the cost of the assets. From the assets the prime costs reduced to wages take into account only amortization, while both the production price and the shadow price also reckon with a factor for assets engaged /the shadow price with a smaller, the production price with a bigger one/. The situation is analogous if the share of the wages paid to the technical staff is raised in proportion.

The three factors combined determined the per unit inputs more decisively than any of them taken separately. This is shown by the results of the correlation calculations summarized in Table 4.

Table 4

Total and partial correlation between the efficiency factors investigated and the per unit inputs

Dependent variable		Total correlation	Partial correlation with the independent variables		
Notation	Denomination		X_1	X_2	X_3
Y_1	Prime costs reduced to wages / dollar	-0,49	-0,28	-0,25	-0,31
Y_2	Production price / dollar	-0,45	-0,23	-0,15	-0,36
Y_3	Shadow price / dollar	-0,44	-0,23	-0,18	-0,33

This means that the total correlation with the first efficiency factor examined is moderately close, while it is somewhat weaker with the two other indicators of efficiency. In respect of the degree of mass production, the partial correlation is essentially identical with the individual correlation while it is somewhat weaker in respect of the two other factors.

As a result of complex regression analysis /which simultaneously takes into account the three independent variables/ the parameters of the functions described were obtained. /Table 5/

Table 5

Regression coefficients and constants

Forint/$

Dependent variable		Partial regression coefficients			Constants
Notation	Denomination	X_1/%/	X_2/Ft/Ft/	X_3/ %/	
Y_1	Prime costs reduced to wages / dollar	-1,66	-3,68	-o,49	73,9
Y_2	Production price / dollar	-2,1o	-3,3o	-o,7o	1o1,7
Y_3	Shadow price / dollar	-2,31	-4,52	-o,73	115,7

According to the data in Table 5, if the share of wages paid to the technical staff is one per cent higher, the prime costs reduced to wages necessary to procure one dollar falls by Ft 1,66, the production price by Ft 2,1o and the shadow price by Ft 2,31

A raising of the technological equipment by about Ft 2o ooo /annual average wages were around that figure/ will reduce the prime costs reduced to wages necessary to earn one dollar by Ft 3,68, the production price by Ft 3,3o and the shadow price by Ft 4,52.

A 1o per cent increase of the degree of mass production in comparison to the Western European average will bring savings of o,4o - o,73 Ft/$.

The above interrelations can be expressed in a more generalized form if the Ft/$ values are converted to indicators as a percentage of the average of the efficiency indicators. /Table 6/

Table 6

Regression coefficients and constants as a percentage of the average of efficiency indicators

Dependent variable		Partial regression coefficients			Constants
Notation	Denomination	X_1/%/	X_2/Ft/Ft/	X_3/ %/	
Y_1	Prime costs reduced to wages / dollar	-5,9o	-13,11	-1,41	262,9
Y_2	Production price / dollar	-4,53	- 7,1o	-1,5o	218,8
Y_3	Shadow price / dollar	-4,45	- 8,7o	-1,41	222,4

Application of trend calculations

In the planning of the production and export possibilities of engineering the computation of various trends may also be frequently expedient.

Their use enables mainly the extrapolation of the prevailing tendencies. In the knowledge of the determined or the prevailing growth rate of the economy and, relying on the experience of earlier periods, the relation between the development of engineering and the whole of the economy /the changes in its structural position/, by extrapolating the proper trends and their interrelation preliminary estimates may be obtained about the impulses the growth of the economy will exert on the engineering industries and what will be the main direction of movement of the latter.

As a matter of fact, trend calculations can be used mainly in the initial stage of planning, to assess the place and development of engineering. Generally, if we speak about trends, what is meant is an analytical trend. According to our experiences, this is, namely, the kind of trends which proved to be best suited for more exact extrapolations.

The drawing up of a development plan starts almost in all cases with the elaboration of trends since in this way the effect of the general growth of industry on that of engineering and on export possibilities to be created by the development of engineering can be established in the first approximation.

On the basis of the global production of industry and engineering the following trends could be established for 1950-1966:

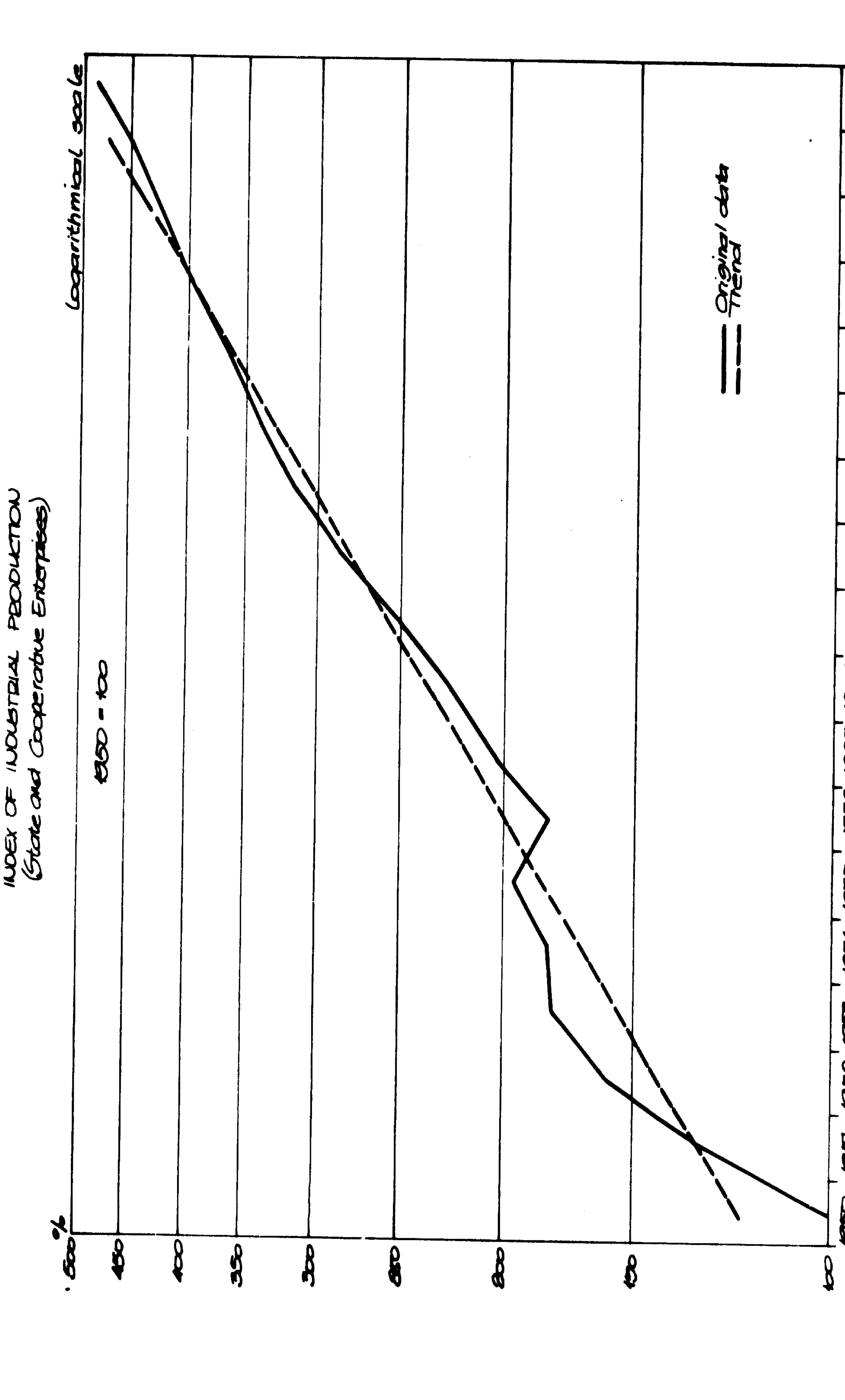
Trend of industry: $Y = 120 \cdot 1{,}09^{x}$

Trend of engineering: $Y = 133 \cdot 1{,}091^{x}$,

$\sigma = 37{,}6$ per cent

For the trends themselves see pp. 82, 83

The accuracy of the computations and the character of the conclusions to be drawn from them is much impaired by the fact that in the mid-fifties there were strong fluctuations in Hungary both in industry as a whole and in engineering and thus the deviations from the trend are considerable.


INDEX OF INDUSTRIAL PRODUCTION
(State and Cooperative Enterprises)
1950 = 100
Logarithmical scale
Original data
Trend
%
500
450
400
350
300
250
200
150
100
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
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1962
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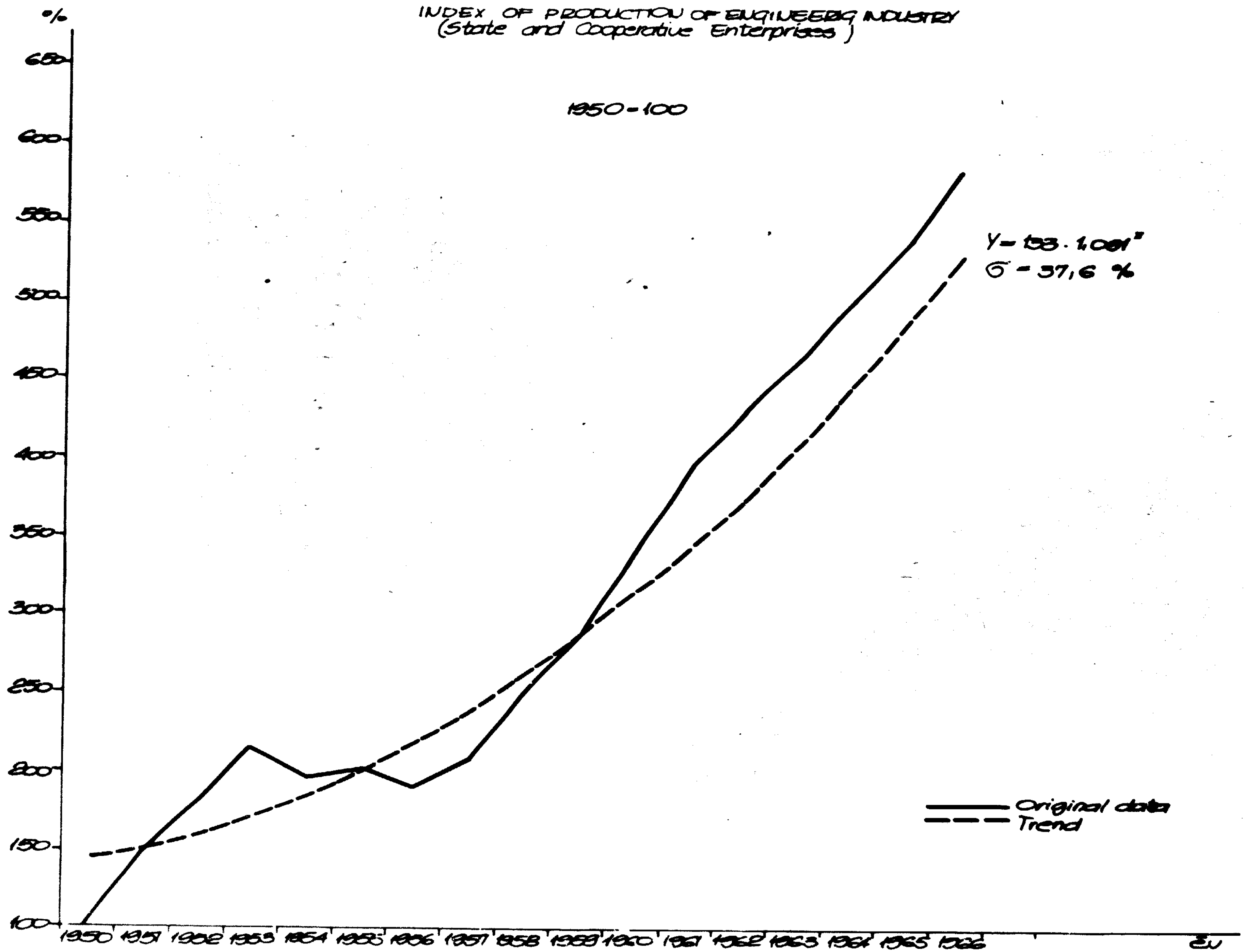
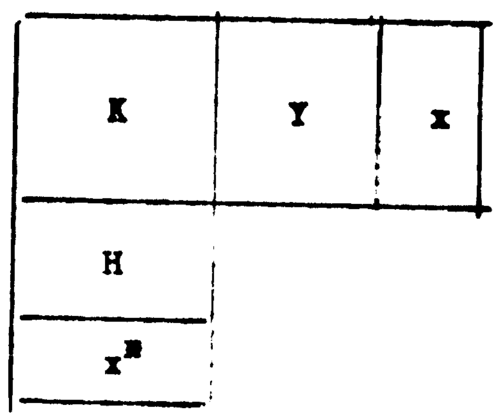
1964
1965
1966
1967


INDEX OF PRODUCTION OF ENGINEERING INDUSTRY
(State and Cooperative Enterprises)
1950 = 100
%
650
600
550
500
450
400
350
300
250
200
150
100
1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966
Y = 133 . 1,081ˣ
σ = 37,6 %
Original data
Trend

Application of Input-Output tables

In Hungarian planning practice the input-output analyses are usually performed for the "global social product". The global social product is in our terminology the sum of the material values produced in a given period - usually a year - in the national economy. The balance of the global social product is essentially an aggregate balance showing the flow of the social product between branches. It is called upon to disclose the relations, material connections between branches of economy, or sectors. The fundamental idea of planning with the aid of the input-output table is the following:

The form of the table:



where K is the matrix of direct material requirements, with k_{ij} showing the quantity of output of sector i, absorbed as an input by sector j,

Y is the final utilisation, consisting of the columns of gross investment, consumption and export,

x is the vector of gross output, equal to the sum of the columns in K and Y,

H is the lower wing of the table comprising amortization, wages and accumulation,

x_i is the global social product of sector i,

x^* is the transposed of vector x.

Now, if the sum of the columns in matrix Y is equal to y /the vector of net output/ and the sum of the rows in matrix H is equal to vector h, /the value added/, and

$K \langle x \rangle^{-1} = A$, where $\langle x \rangle^{-1}$ is the inverse of the diagonal matrix formed from the elements of vector x, and A is the matrix of technological coefficients, whose element a_{ij} shows the quantity of output of sector i absorbed by sector j per unit of output in sector j, the basic formulae necessary for planning will be:

$y = /E-A/x$ where E is the unit matrix, the other notations being known, and

$x = /E-A/^{-1}y$ where $/E-A/^{-1}$ is the inverse of the matrix $/E-A/$, the matrix of the cumulated or total coefficients, its element r_{ij} showing the quantity of output of sector i required both directly and indirectly for one unit of final demand in sector j.

In Hungary three types of the input-output method are known /denoted in turn by A, B and C/ differing in the treatment of imports. In variant A, imports are included in the material utilization of each sector, thus in this variant e.g. the spare parts of machinery imported for mining will figure as the output of the engineering industry absorbed by mining. The division of imports by sectors relies on the consideration which domestic industry would have produced the articles in question, the production of which sector has been substituted by imports. In variant B the imports used in material consumption are in a single row vector. Finally, in variant C, the imports and the domestic inputs figure separately in each cell of the matrix. The system is complemented by a chessboard table of imports enabling the transition from each variant to the other.

The most stable connections are represented by the table of type A, since this expresses the real input-output relations.

The various types are used mainly in connection with the planning of the balance of payments.

Statistical input-output tables have been computed in Hungary for the years 1957, 1959, 1961 and 1965. The variants A, B and C were compiled each time.

The sector breakdown of the tables hitherto computed was rather different. For 1957 the table comprised 38 sectors, for 1959 45, for 1961 and 1965 already 83. The number of sectors in the planned table for 197o is 2o.

With the method in question the global economic processes belonging to a given engineering export program can be disclosed. It can be used in two forms in planning:

- for the purposes of simple input-output analysis,
- for linear programming based on the input-output table.

The input-output table is a useful tool for analysing the export processes of the engineering industries.

In the short term, our experience is that the technological conditions do not change suddenly in an economy, it may be thus also assumed that the input coefficients remain stable in the short term.

If, however, we assume that the input coefficients are stable in a period, we will be in a position to plan, on the one hand, the quantity of goods available to the economy by the end of the period and, on the other, to distribute these goods. This plan of distribution will - keeping in view the desirable volume of engineering products to be exported, for which, as has been mentioned in the first part of this study, information can be derived from the general plan of economic policy providing a framework for the tasks and possibilities also of the engineering branches.

The use of the input-output techniques in planning relies, as a matter of fact, on the total /cumulated/ coefficients. The technological coefficients show, namely, only the direct connections but not the total material inputs of the branches. The utilizing branches - in this case the engineering sectors - use e.g. electric energy not only directly, but also embodied in the metallurgical products. This is of outstanding importance, since, if a large-scale development of engineering is planned, it will involve also the development of the energetic basis and not only to the extent indicated by the technological coefficient at the intersection of the "engineering" columns and the row of "electric energy" but beyond it, because the development of engineering raises additional requirements against metallurgy and that again induces the growth of demand on energy, etc...

The calculations of this cumulated demand /multiplicator effect/ takes place with the aid of the inverse matrix. The inverse matrix, which is computed for each input-output table compiled, shows immediately these cumulated inputs per unit of final demand. With its aid also the import, labour, amortization and accumulation content of a unit of additional output can be easily determined.

Table 7

Cumulated inputs in some branches per loo forint of final demand, average of 1959-64

Branch	Imports	Amortization	Wages and incomes	Accumulation	Total
Electric energy	8,4	28,6	24,o	39,o	loo,o
Metallurgy	26,5	15,8	19,1	38,6	loo,o
Engineering	24,4	1o,5	28,o	37,1	loo,o
Chemical industry	29,4	11,7	17,9	41,o	loo,o

Thus, from the input-output table the indirect and the cumulated inputs from labour, energy, imported products etc. per unit of exports of the engineering industries can be calculated. In possession of these data it can be, of course, also calculated what additional burden originates - owing to the indirect and reverberating effects - for the other sectors of the economy if the export performance of the engineering industry is to be increased.

Planning has generally two possibilities: either to determine the output deemed necessary for the end of the period and fit the inputs to that or, to estimate the structure and level of inputs, trace through the technological connections the primary inputs and obtain the possible output in this way. When the intention is to increase the output of engineering for export /if this task is prescribed/, the first method will obtain greater emphasis. In such cases the task is, obviously, not only to adapt the inputs to the output task but the structure of output must itself adapt to the situation emerging because of the primacy of export tasks.

Since the resources available to the economy cannot be neglected even if we start from the output tasks, the first step will concentrate on the determination of the optimum total level and pattern of output under the given conditions, with the increased exports of engineering products. Although the planning of this level and structure is a most serious task, since it affects problems connected with the planning of the whole pattern of the economy, it transcends the engineering industry as well and cannot be treated in the scope of this study. From the point of view of planning the engineering branches it must be assumed as given; only in this way can planning start from the needs.

Thus, if the volume and pattern of final demand is known, together with the technological matrix, only the adequate production levels must be determined. In the knowledge of these data, however, the reverberating effects due to indirect relations must be assessed with sufficient accuracy in order to be able to examine the harmony between the necessary output levels and the available capacities and labour. In principle, only the application of the inverse matrix will yield sufficiently accurate results for the accounting of indirect effects.

By starting from the <u>needs</u>, we can reach in the above manner a certain necessary level of inputs and output. It may, however, easily happen that the available capacities and manpower, etc., are not in harmony with the orders of magnitude necessary for the given program. In this case the needs must be adapted to the resources available and then the calculation performed by starting from the resources and the result will be an output program. For the second step the inverse matrix is no more necessary.

According to our experiences the solution obtained in the first round exceeded as a rule in respect of inputs the possibilities allowed by existing resources and with the narrowest bottlenecks the claims had to be reduced and it had to be examined with smaller inputs how to secure the determined output, Obviously, a relatively acceptable solution may be arrived at by several iterations only.

It follows from the nature of such procedures that they must converge on some result and the result will much depend on the steps taken in the individual stages of the iteration process.

Another circumstance must be mentioned. As is known, various inputs can partly substitute each other. Accordingly, the technological coefficients may be flexible to some extent. /This will, of course, also depend on the length of the period to be planned./ Therefore, there is some chance to harmonize final demand and the production levels even if neither the pattern of demand can be adapted to the capacities nor conversely. These substitutions can be relatively easily calculated since only such modifications have to be taken into account which are palpable as a direct effect on the change of the coefficients.

Dependance on the choice of the individual steps is, however, only one of the difficulties. Another one is the measurement of inputs. In our planning practice the contribution of the engineering industries to the global social product and the inputs are measured in terms of the "gross production value". This concept of the Hungarian statistical and planning practice is the aggregate of the "gross production values"x/ of the individual

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x/ The "gross production value" as a micro-economic category is determined on enterprise level by adding up the following items, determined with the aid of accounting methods:

a/ Value of finished products at producers' prices.

b/ The value of investments made on own account and with own forces, at producers' prices.

c/ The value of services performed, and the production of energy, at producers' prices.

d/ The value of changes in inventories at prime enterprises in the engineering industries. /The same relates to all other sectors as well./ From this method there follows a certain duplication in the value of the global social product since a product may be taken into account several times in terms of value. If, from one period to the other, there occurs a change in the organizational setup of the engineering industries, also the extent of duplications will change. Our planning practice relies on empirical evidence for the estimation of the changes in this duplication.

Though the "gross production value" comprises by definition, also the material inputs, our experience is that neither the so-called net indicators /as value added or the sum of wages and net income/ are free of problems. Hungarian practice applies, therefore rather the "gross" categories.

As regards the long-term planning of engineering, the question emerges again whether to start from the level of production and final utilization /that is, from the total output of engineering and, within it, from the desired exports/ or from the structure of inputs. Of course, no general or unequivocal answer can be given, but if our aim is to clear up the macroeconomic conditions of the export capacity of engineering, the first method should be chosen.

We must not neglect the problem that, beyond what has been already mentioned, in long-term planning the changes in the input coefficients or rather the planning of these changes cause serious difficulties. No Hungarian experience can be recorded as yet in this field but the methodology of long-term planning is now under elaboration in the National Planning Office and we hope to be able to render account of some experience by 197o. As regards medium-term planning, an investigation was conducted in the car and tractor industry about the expected changes in the input coefficients between 1966-197o.[x/] This analysis dealt with the material and labour inputs in the following way.

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x/ The method was devised by the Long-term Development Section of the Technological Institute for Engineering in the course of constructing a model for the car and tractor industry.

The material inputs were worked out by taking into account the material requirements of the products and spare parts, first for 1965 and then the changes were assessed for 197o.

The products turned out were converted with the aid of certain multipliers into so-called "leading products" and part of the changes in material input coefficients was explained in terms of the material requirements of these leading products.

Another part of the coefficients was the material requirement of the spare parts. To determine the inputs needed, such factors had to be taken into account as the rising average lifetime of the passenger cars or trucks and other vehicles sold and still in use /since this affects the ratio between general repairs and maintenance/, the share of rapidly outworn parts /by kinds of materials/, the demands of the various users on spare parts, etc.

In assessing the changes in technology the assumption was that

- the enterprises develop in the period investigated /five years/ mainly the traditional technologies and

- no major specialization or concentration will take place in either technology or products.

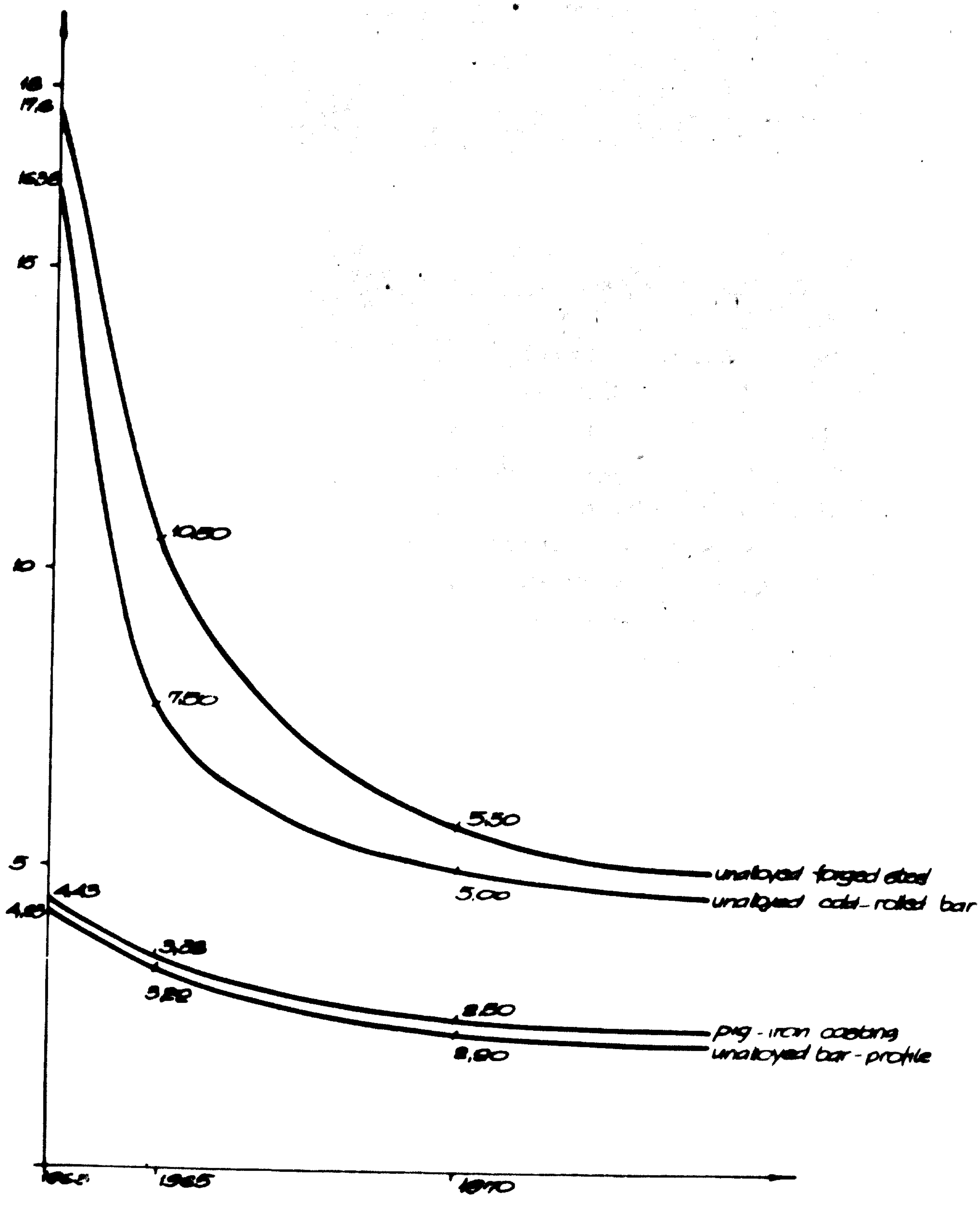
These abstractions enabled first the establishment of trends showing the earlier development of the material inputs and then the extrapolation of the changes.

The following analyses revealed some rules at work. Thus, e.g., in respect of the inputs from some materials:

- A general tendency for substituting unalloyed forged products for pig iron could be established with dumpers, buses, Diesel-engines and spare parts. The per unit inputs from unalloyed forged steel rose /e.g. with Diesel-engines by lo per cent!/ at the expense of mostly pig iron and partly at that of unalloyed steel bars and thick plates, clearly pointing to a substitution relation.
- With the growing series in the production of buses, dumpers, and trucks, and under the effect of the spread of welding techniques, in the material requirements of the chassis the per unit inputs from unalloyed bars, tubes and plates increased.

- Similar investigations were carried out for the changes in the inputs from unalloyed steel sections, aluminium plates and sheets, aluminium castings, non-ferrous metals and products from the same, ball-bearings, etc.

As regards spare parts, it was established that the average material requirements of the spare parts are diminishing /the share of more labour-intensive spare parts is increasing/. The lower limit of this reduction was found to be - with most products - the point where the material requirements per one million forint of spare parts divided by the material requirements per one million forint of finished product /e.g. a tractor/ approximated unity. This seemed to be generally valid even if there were differences in respect of individual kinds of materials. In the period under investigation this reduction of the material requirements of spare parts took place at first steeply and later along a flat curve. This could be well observed for such materials as (un)alloyed forged steel, unalloyed rolled and drawn bars, pig iron, unalloyed bars sections, etc. /See p. 99. ./


18
17,6
15
10
5
10,50
7,50
5,50
5,00
4,43
1965
1970
unalloyed forged steel
unalloyed cold-rolled bar
pig-iron casting
unalloyed bar-profile

By generalizing the findings of the above investigations, the <u>ohanges in the input coeffici-ents</u> were determined and the input coefficients for 197o were worked out. The results are shown in the following table.

Table 8

Materials	Ohange from 1965 to 197o 1965 = 1,000	
	Dumpers	Buses
Pig-iron Casting	o,949	1,ooo
Steel Casting	o,949	1,ooo
Forged Steel, Alloyed	o,924	-
Forged Steel, Unalloyed	1,c51	1,o51
Bar Profile Steel, Unalloyed	o,949	o,949
Bar Profile Steel, Alloyed	o,975	1,ooo
Thin-sheet, Unalloyed	1,o51	o,949
Medium Sheet, Unalloyed	o,924	o,975
Thick Unalloyed Plates	o,924	o,975
Tube, Hot-rolled	1,ooo	1,1oo
Tube, Cold-profiled	1,ooo	1,o76
Bar Profiled, Unalloyed	o,924	1,13o
Bar Profiled, Alloyed	o,975	-
Aluminium Plates	-	1,ooo
Aluminium, Alloyed	1,27o	1,ooo
Non-ferrous Metal Semi-produot	1,13o	1,ooo
Bronze and Slide Bearing Semi-product	-	1,ooo

As regards the changes in the labour input coefficients, the factors examined were the following:

- direct labour requirements,
- indirect labour requirements,
- the requirements in respect of salaried employees, /office workers/.

The direct labour requirements could be easily established from the norms prescribed in terms of hours for the products.

The indirect labour requirements were calculated with the aid of technico-economic parameters in the following breakdown:

- workers engaged in carrying the materials and products within the factory,
- technological supervisers, /relying on the technologically necessary per unit time of checking, the checking time comprised in the mechanical operation, etc./,
- maintenance staff /average time necessary for maintenance in relation to mechanical operation hours/,
- workers engaged in producing tools and equipment,
- machine fitters and regulators.

The labour requirements first established for plants in the industry were broken down to products and in this way the per unit labour requirements expressed in hours were obtained. For illustration, the per unit labour requirements obtained for 197o are shown for buses and dumpers:

Table 9

	Buses longer	Buses shorter	Dumpers 3,5 cu.m.
	than 11 meters		
Normative hours per unit	16oo,o	29oo,o	35o,o
Total of normative hours, 1ooo hours	192o,o	377o,o	175,o
Direct labour	873,o	1714,o	8o,o
Indirect labour	315,o	591,o	87,o
Total physical labour	1138,o	23o5,o	167,o
Employees	344,o	67o,o	55,o
Workers + employees	1532,o	2975,o	222,o
Per unit labour requirement /heads per pieces/	1,2767	2,2885	o,444o

Such detailed survey cannot be performed in all cases for obvious reasons. In our opinion in planning for shorter periods, one or two years, the assumption of an unchanged input pattern is justified without making any serious mistakes.

Planning problems connected with the application of input-output techniques

The planning procedure relying on the input-output table comprises not negligible sources of error. This problem has been in the centre of interest of international literature and several Hungarian studies have also dealt with the margins of error of the input-output tables. There is a general consensus among economists as regards the causes of the possible errors. A listing of the major causes will not be immaterial in this place since the engineering industries are where the biggest errors may occur in planning, because it is here that the coefficients show the greatest fluctuation.

As a first approximation, the errors may be divided into two major groups: the first comprises the inaccuracies of statistical observations, measurement and computations, the second relates to the abstractions, simplifying assumptions made in the table, that is, to problems of contents. From the point of view of planning, it amounts of course, to the same whether the error made is formal or not, but the distinction becomes important if we wish to reduce the margins of error or wish to know the expected inaccuracies.

The causes of the errors owing to the contents are the following:

- Homogeneity of the table. The planning using the input-output table relies on the hypothesis that the pattern of each unit of input is the same. This abstraction neglects the fact that the same product can be turned out with the aid of essentially different technologies, with material inputs there is a broad scope for substitution. Therefore, even in the most detailed sector breakdown, where the abstraction of homogeneity may seem to be more or less justified, the pattern of inputs may rapidly change.

- Linearity of the inputs is another simplifying assumption. There have been investigations to assess the magnitude of the error due to this assumption by constructing cost functions for the branches. As is known, the cost functions take the form of a "U" but the deviation between the maxima and minima was only about 10 per cent in the cases examined and thus we may safely assume that the assumption of linearity does not cause too great errors.

- The static character derives from the structure of the table itself. Dynamics, meaning the changes in the coefficients over time, can be introduced into the model only through external factors.

In our planning practice the input-output table is used with the fact figures for both the direct and the cumulated input pattern and this amounts to the neglection of technological development. The problem presents itself in two aspects: partly the level of input falls and partly its structure changes since development is uneven also in this respect.

In view of the above considerations it should be obvious that the hypothesis of unchanged coefficients is unacceptable for the long-term. The problem is within what period it is permissible to start from a fact table. Our experiences seem to verify that a table can be used for planning purposes over a period of 3-5 years with a 5 per cent margin of error /the latter relating to the average and not the maximum deviations/.

To judge the magnitude of the error, most often the following method is used in statistical analyses:

$$\| V_t - Q_{t-1} \cdot Y_t \|$$

where V_t = gross output in year t in a breakdown by sectors,

Q_{t-1} = matrix of cumulated inputs in the preceding year,

Y_t = final utilization in year t

If all data originated in year t or t-1, that is, if they related to the same year, the absolute value denoted by the formula would be zero. Owing, however, to some of the above enumerated causes, the matrix of cumulated inputs $/Q_{t-1}/$ will change in the next period and there arises a difference between the actual and the "planned" output. /The quotation marks indicate that in this case the planning took place ex post in possession of the actual fact figures./

The above calculations were performed and also the deviations of the "planned" data from the real ones were computed. The conclusions were the following ones:

- The big and small coefficients behave differently /for practical reasons, the input coefficients above 3 per cent are considered as big/. The big coefficients hardly fluctuate - between 3-5 per cent on average - but the fluctuations become more intensive the smaller the coefficients.
- As regards either the rows or the columns, the changes in coefficients tend to balance out. This process is stronger in respect of the columns than in respect of the rows: the standard deviation is 60 per cent on average, with the

rows it is 4o and with the columns only 2o. Thus the decompensation effect is 2o per cent with the former and 4o with the latter. Thus, the decisive cause of the fluctuation is not the change in the level of inputs but some of the other factors listed among the sources of error.

Since the level of inputs has been found to be much more stable than the part of the gross output used for productive consumption in the individual branches, the conslusion had to be drawn that those branches are "most unstable" which release a great portion of their output for final utilization. The share of final utilization in the gross output of engineering was between 55 and 65 per cent in the years 1964-1966 and this must be observed in planning the engineering branches.

- A third statement - which may seem trivial - was that the deviations considerably increase with the years from the date of compilation. In the year following the compilation of the table and the next one the errors will be minimum but in the third and the following years the greatest deviations will reach 1o-2o per cent and beyond 5 years they will grow to such extent that the table will be no more suited for planning long-term orientation.

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1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2

The changes, fluctuations in coefficients have been observed in concrete analyses of data on engineering. The computations have led to the rather surprising result that it will not be the increasing of the number of sectors - otherwise leading to homogeneity - that will result in more reliable, or more stable coefficients, but, on the contrary, the aggregation of the sectors. For instance, the fluctuation in total engineering of the consumption of iron and steel was only 2,5 per cent in four years, while that in non-ferrous metallurgy was 22 per cent. It seems that the pattern of big and small coefficients has a dominating role in shaping the deviations.

A tracing of the changes in input coefficients is a particularly difficult task if the table is all too detailed, if it contains too many sectors. Various methods are applied to establish the actual changes in the input coefficients.

According to a study on the subject, between 1955 and 1958 no regularity could be established for the changes in inputs. For the purpose of illustration the changes in the iron and steel inputs of some important products are shown.

Table 1o

Material inputs in 1955

Product	Hot-rolled steel	Cold-rolled and drawn steel	Cast-ings	Forged parts
	kilograms			
Drilling Machines				
OF 2	175	17	2597	145
RF 2	315	51	4967	141
RF 31	543	73	6989	297
Milling Machines				
VF 23	653	32	4841	35o
UF 23	583	36	4315	573
Else				
Bicycle "Tura"	2,4	13,5	o,3	2,2
Motorcycle "Pannonia"	5o,5	3o,5	1o,7	15,o
Head of Sewing Machine 3o	o,5	3,o	16,1	o,7

Table 11

Material inputs in 1958

Product	Hot-rolled	Cold-rolled and drawn steel	Cast-ings	Forged parts
	k i l o g r a m s			
Drilling Machines				
OF 2	188	22	2561	181
RF 2	3o5	58	45o5	185
RF 31	685	1o5	7778	48o
Milling Machines				
VF 23	611	29	4o84	382
UF 23	649	26	3955	258
Else				
Bicycle "Tura"	2,3	12,8	o,3	2,2
Motorcycle "Pannonia"	59,7	25,8	1o,6	15,3
Head of Sewing Machine 3o	o,6	2,7	14,o	o,7

The tables show that the per unit inputs are not constant nor can the direction of the changes be established or generalized. The changes in each year between 1955 and 1958 are indicated by + and - signs in the following table.

Table 12

Changes in material inputs

from 1955 to 1958

Product	Hot-rolled	Cold-rolled and drawn steel	Cast-ings	Forged parts
Drilling Machines				
OF 2	- + +	+ - -	- + -	+ - +
RF 2	+ - +	- + -	- - +	+ + -
RF 31	+ + -	o + +	o + +	o + +
Milling Machines				
VF 23	+ - +	+ - +	+ - -	- + -
UF 23	+ - +	+ + -	+ - -	- + -
Else				
Bicycle "Tura"	- + -	- - -	o - o	o - o
Motorcycle "Pannonia"	+ - +	- - +	- o o	+ - +
Head of Sewing Machine 30	- + +	- - +	- + +	- + o

Linear programming based on input-output table; applications in engineering

It is known that with certain transformation and extension the input-output table can be used as a linear programming model. This method has been applied by the National Planning Office of Hungary. It is a unique feature of the Hungarian application that a planned input-output table has been used for this purpose and not a table reflecting economic processes that have already taken place.

The transformation of the input-output table for use in a programming task for planning has not caused serious difficulties, only some conditions fixed in the table had to be removed. The table considers, namely, the export and import coefficients as determined magnitudes, while in the programming model they are treated as variables. In addition, the model took into account technological variants, it made a distinction between production in old, reconstructed and new plants. With the conditions thus changed, the resources are no more considered as fixed either. Instead, lower and upper bounds are applied depending on market conditions.

The starting point for the engineering model was also an input-output table comprising 81 engineering sectors, 14 other industrial sectors and 18 ones for the other branches of the economy.

The reason why it is considered adavantageous to use an input-output table for the programming of engineering production is that - as has been stressed in the first Chapter of this study - the output and foreign trade targets of a real national economic plan cannot be selected at random, there exists a mutual interdependence between the individual targets. /Obviously, the export target for engineering sets limits to the production plan and conversely, if the production plan is decided this will also determine the possibilities of foreign trade./ These interrelations are most palpably described precisely by the input-output table.

A few short remarks are necessary about the application of the model which has otherwise already been tested in planning:

The variables of the model are the planned outputs of the productive sectors of the economy on the one hand and the export required from the economy as well as the necessary imports, on the other. /The procedure covered 18 sectors./

The programming reviewed serves in Hungarian planning to check the harmony between resources and utilization. A surplus production arising at individual places or imbalances manifesting themselves in surplus demand are eliminated, as a rule, by operative management but the restoration of the balance may have several unexpected and reverberating effects. The mathematical program is called upon to lead to a plan that will be in equilibrium, precisely because it can trace all indirect effects through the input-output table.

Thus mathematical programming fulfils a double task: it partly performs - through the input-output table – the balancing of resources and utilization and partly provides a foundation for considerations of efficiency. Indeed, it makes further corrections on the plan proposals beyond establishing equilibrium.

The objective functions used up to now have been most diversified depending on the economic policy thought to be decisive in the plan period. The following objective functions have been used:

- maximization of the balance of payments by trading relations /meaning here the socialist and non-socialist countries/;
- maximization of the additional consumption by the population.

Beyond these "clean" objective functions, there were also such in which these were combined with the aid of parametric programming. In these cases the two /or more/ objective functions were mixed, according to different weights.

Two-level programming

The tasks and conditions of a given structural trend or export development objective can be planned in detail by products with the method of the so-called two-level programming.

In the following we are going briefly to review the methodology of planning in engineering with the two-level programming, relying on calculations actually tested in Hungary. Also the methodological problems and the deficiencies of the method will be shown.

The mathematical bases for the calculations mentioned were provided by the Dantzig-Wolfe decomposition method. Since it is widely known and accessible, the description of the mathematical formulae will be neglected and, instead, efforts will be made to present the experiences gained in the practical application of the method.

Let us mention that, although among the variables of the model we find also such as investments, or the production attained with the aid of investments, any of these may be left out if not necessary for the investigation of some export development trend.

1. General features of the calculations

The assumptions and simplifications employed are the following:

a/ The usual simplifications of the single-period linear programming model:

- the variables of the model are continuous, that is, the indivisibility of individual activities and resources is neglected,
- only linear equations are used,
- the model is deterministic, that is, it does not represent the uncertain data with random variables,
- it plans for a single period, neglecting that activities are phased over time and does not deal with time horizons longer than the period of programming.

b/ Approximative procedure: the solutions of the Hungarian model are only approximative in character, owing to difficulties in computation techniques /computer capacity/. This means that the solutions are near the optimum, they satisfy the system of constraints, consisting of 2000 equations, but are not necessarily identical with the exact optima.

c/ Reality of the constraints. The model takes into account the structural limits of the economic activities. It can hardly, or not at all, take into account the subjective limits, due to behaviour which, however, strongly affect the economic processes.

d/ Reliability of the data. The final results much depend on the reliability of the informations used. Precisely because the level of data supply is very uneven and inadequate data may impair the success of the calculations, this is worth while to be paid particular attention and the system of informations must be organized with utmost care.

2. The fundamental idea of the Hungarian model

With the aid of two-level programming such plans may be drawn up which are not worse in any respect than the plans formulated with the traditional methods, but in certain respects - mainly in the balance of payments - they will be more favourable. The programming actually performed made a comparison with the plan drawn up with traditional methods.

The calculations performed.

Two-level programming required the performance not of a single calculation, but of a whole series of calculations, carried out in the following order:

- sector-level basic calculations,
- sector-level sensitivity analyses,
- national economic basic calculation,
- national economic sensitivity analyses.

The individual stages of the calculations will be briefly reviewed and the particular solutions applied in the calculations of the engineering sectors presented in detail.

3. Sector-level basic calculations

The calculations covered 48 sectors of the economy. Each sector comprised both production and foreign trade. The latter is, thus, not independent or autonomous, but e.g. the textile exports and imports appear in the textile sector and the exports and imports of machinery in the engineering sectors, etc.

Individual sectors were generally represented by 6-lo groups of products. /In except cases these were, indeed, products, but generally even a product meant groups, the aggregate of concrete articles that could be summarized according to some common criterion./

To each product /group of product/ belong various alternative activities. The alternative activities belonging to product i were the following:x/

1/ Output at the end of the period for which the program was prepared
   - in old plants /$x_{i,1}$/,
   - in reconstructed plants /$x_{i,2}$/
   - in new plants with technology I /$x_{i,3}$/
     with technology II /$x_{i,4}$/

2/ Imports at the end of the period
   - from socialist countries /$x_{i,5}$/
   - from non-socialist countries /$x_{i,6}$/

3/ Exports at the end of the period
   - to socialist countries /$x_{i,7}$/
   - to non-socialist countries /$x_{i,8}$/

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x/ It should be obvius that the eight activities listed are not necessarily found with each product, but only those which can be economically interpreted. There are, however, some special activities which are connected with the particular endowments of some sector.

The volume of the individual activities provided the variables of the model and by determining the volumes the sector program consisting of complex production, investment, technological development, export and import plans was obtained.

It was required that the sector program established in the framework of the basic computations should not be worse in respect of inputs and output than the targets determined with the traditional methods, but should be dominated by at least a single criterion /e.g. the balance of foreign exchange in one of the two relations/.

The sector calculations of the engineering industries showed the following structure:

The model for engineering was built up from the models of 11 sub-sectors. These sectors and the products comprised by them were the following:

Name of the sector	Products belonging to the sector
1. Shipbuilding	Portal Cranes
	16 ton Floating Cranes
	100 ton Floating Cranes
	Seagoing Cargo Ships
	Boylers for Power Stations
	Push- and Tugboats
	Cargo Ships for Inland Waters

Name of the sector	Products belonging to the sector
2. Public Road Vehicles I.	"Csepel" Engines and Spare Parts
	New Engines and Spare Parts
	Front Axle Housings
	Rear Axle Housings and Driven Front Axles
	Auxiliary Gearboxes for Change Speed Gear
	Power Steering Units
	Lorry of 5 t capacity
	Lorry of 8 t capacity
	Lorry of 12 t capacity
	Buses /up to 11 m length/
	Buses /longer than 11 m/
3. Public Road Vehicles II.	Dumpers 3,5 cu.m.
	Dumpers 6 cu.m.
	Tractors 4o HP
	Tractors 9o HP
	Electric Material for Automobile Building
	Structural Spare Parts /Without dumper/
	Spare Parts for Tractors and Dumpers

Name of the sector	Products belonging to the sector
4. Precision Engineering I.	Automation Devices
	Electronic Measuring Instruments
	Office Machines and Devices for Organisation Technique
	Material Testing Instruments
	Geodetic Instruments
	Optical Devices
	Optician's Products
5. Precision Engineering II.	Electric Instruments
	Electro-Mechanical Parts
	Electric Installation Material
	Medical Apparatus
	X-Ray Apparatus
	Steel Medical Instruments
	Laboratory Equipment and Implements
	Geophysical Instruments
	Fuel Pumps
	Other precision engineering products
6. Telecommunication industry I.	Incandescent Lamps
	Fluorescent Tubes
	Receiver Tubes

Name of the sector	Products belonging to the sector
	Transmitter Tubes
	TV Picture Tubes
	Other Electron-Tubes
	Semi-Conductors
	Vacuum Engineering Machines
7. Telecommunication industry II.	Machines for Telecommunication
	Telephone Apparatus
	Telephone Exchanges
	Transmission Equipment
	Radio Transmitter-Receivers
	Microwave Equipment
	Radio Home Receivers
	TV Home Receivers
	Amplifier Studio Equipment
	Tape Recorders
	Electric Railway Safety Appliances
	Electric Spare Parts for Telecommunication
8. Machine-Tool Industry	Universal Precision Lathes
	Special Precision Lathes
	Medium Size Lathes

Name of the sector	Products belonging to the sector
	Grinding Machines
	Knee-Type Milling Machines I.
	Shaping Machines
	Special Purpose Machines
	Drilling Machines
	Knee-Type Milling Machines II.
	Special Milling Machines
	High Precision Machine Tools
	Semi-Automatic Disc Lathes
	Production Lines
	Machine Tools Operating on Special Principle
	Metal-Working Machine-Tools
9. Railway Vehicles	Diesel Engines
	Electric Locomotives
	Diesel Locomotives
	Electric Power Cars for Tramways and Suburban Railways
	Multiple Unit Diesel Trains
	Railway Passenger Coaches
	Railway Freight Wagons
	Railway Tank Wagons
	Spare Parts for Railway Vehicles
	Wheel Sets

Name of the sector	Products belonging to the sector
1o. Agricultural Machinery	Tillage Machines
	Seeding-Manuring Machines
	Plant Protective Machines
	Harvesting Machines
	Machines for Stock-Breeding
	Loaders
	Grape, Fruit and Vegetable Cultivating Machines
11. Metal Mass Products	Aluminium Kitchen Pans
	Enamelled Ware
	Bolts and Nuts
	Padlocks
	Hand-Tools
	Industrial Armatures

In the course of the basic calculations each sector determined its plan proposal which would be the most advantageous from the point of view of the balance of trade. Of course, the sub-sectors established not one but several proposals each. From these the final one was chosen in a way that the aggregate of the proposals made by the sub-branches should on the level of engineering total

- not require more from central resources than was made available to the sector,
- yield the output required from them,
- yield the most favourable result from the point of view of the balance of foreign exhhange.

As a rule, this objective cannot be reached with the aid of selecting a single plan proposal, but by a proper combination of these. This combination comes about by attributing weights to the individual plan proposals and the individual proposals - relating to the same sector - are mixed in proportion to the weights.

The constraints of the engineering program computed may be divided into two groups:
- special sector constraints,
- central constraints.

The special sector constraints were supply obligations, capacity resources and the market limitations to foreign trade. Central constraints were the balances of individual products, some national resources, and foreign exchange prescriptions.

The model enabled the reallocation of central resoruces between the individual sub-sectors, the only condition being that the aggregate of the sectors should not transgress the limits set.

The objective functions used in the calculations were the following:

- optimization of the balance of trade with socialist countries in terms of foreign exchange;
- optimization of the balance of trade with the non-socialist countries in terms of foreign exchange.

b/ Sector-level sensitivity analyses

Under the effect of changes taking place in the system of conditions the constraints can be changed and the calculations repeated with the modified constraints. The importance of the repeated calculations lies in the fact that it is not necessary for the changes actually to take place; it is sufficient to assume them in order to investigate what madifications become inevitable to attain the objectives set in case of possible future changes.

4. Experiences of the national-level calculations

In connection with these calculations the question can be put: what allocation of the resources between the sectors will yield a solution that is optimal for the economy from some point of view. That is, while the national estimations for the resources are taken as being given, their allocation between the sectors is not considered as given.

As regards the sensitivity analyses on national economic level, these agree in respect of mathematical contents with the sector-level analyses. However, the weight of the problems to be decided is different. In this case nearly "optimum" programs belonging to various alternative economic policies have to be determined. In individual concepts of economic policy various ideas will dominate about the living level, foreign trade, employment, etc. Thus, the "optimum" programs provide an opportunity for comparing these individual concepts. It must be also established whether the individual economic policies are attainable at all.

Some methodological experiences

As has been mentioned earlier, the calculations actually carried out in Hungary - though based on the Dantzig-Wolfe method - are, as a matter of fact, of approximative character owing to difficulties of computation techniques /limited computer capacity, lack of an adequate staff of researchers in terms of both numbers and qualification/. We hope to be not far from truth by assuming that such circumstances may emerge also in several other countries in a similar situation as Hungary. In consideration of this fact it will not be useless briefly to review the simplifying procedure that greatly facilitates the calculations.

First, a few words must be said about the system of constraints. The system comprises so-called sector conditions and central conditions. The steps used in the calculations are the following:

a/ Sector program. - It is a simple programming procedure according to some objective function expressing the development concept of the sector. As a rule, each sector strives to prepare several optimum programs.

b/ Preparation of the plan proposals. - The sector programs are detailed by products, the plan proposal comprises aggregate data on sector level.

c/ Mixing of the plan proposals. - Each sector submits its plan proposals to the centre /in Hungary: to some of the planning agencies, the National Planning Office, the Ministry of Finance/ and they will be scrutinized there. The centre attaches a weight to each proposal of each sector.

If the weight is zero, this means that the proposal is rejected, if it is one, the proposal is accepted. If the weight is between 0 and 1, the proposal is only partly accepted, it will be "mixed" with other proposals of the sector.

The process of scrutinizing is, as a matter of fact, the solution of a linear programming task whose variables are the weights of the proposals submitted.

After the first central calculations, the iteration process begins, that is, the first three steps are repeated with the conditions changed.

d/ Weighting. - The sector programs are multiplied by the weights obtained from the central calculations and thus a mixed sector program will be obtained.

e/ Aggregations. - Various aggregate indicators are formulated /e.g. total exports, total imports, etc./.

The accuracy of the approximative procedure here described strongly depends on the aggregation of the central mixing model, on the number of the sector plan proposals and on the number of iterative steps. It may be established that the exact optimum can be satisfactorily approached and as regards the practical performance of the calculations, they are essentially simpler than the exact Dantzig-Wolfe method.

5. Role of the shadow price calculations

To each solution of a programming task there belongs also a system of shadow prices. In this study no attempt will be made to give the mathematical definition of the shadow price or to clear up the concept in general, but exclusively the application of the shadow prices will be illustrated on hand of our model.

We have a linear programming task, /in our case the two-level programming/, where e.g. the balance of foreign exchange has been optimized. The calculation is performed with the given numerical values for the constraints, that is, definite final uses are prescribed, definite limits are set to fixed assets, imported machinery, employment and exports. To each of the constraints belongs a shadow price expressing the change in the balance of payments in terms of foreign exchange if the constraint were increased by a unit.

The shadow price has been treated in each case as a quotient: the increment of the objective function per the increment of the constraint. From this follows also the dimension of the shadow price: the unit of measurement of the objective function divided by the unit of measurement of the constraint.

The sign of the shadow price depends on its economic content. If a bound is not exhausted, its shadow price will be zero. If an upper bound is exhausted then - if the objective function is maximized - the shadow price will be positive. The situation is a reversed one with a lower bound and a maximizing objective function: in such cases the shadow price will be negative. It expresses, namely, by how much the objective function deteriorates, if the activity forced upon the program is increased by unity.

The expression "valuation of non-optimal activities" is a concept related to the shadow price. Sometimes it is called - inaccurately - the shadow price of the activities. The economic content of this kind of valuation is the following: by how much would the value of the objective function deteriorate if at least a unit of an activity originally not comprised by the optimum program were forced upon it.

From our experiences with the shadow prices we wish to point out only a single scope of problems: how stable is the system of shadow prices. From this point of view the relative shadow prices, the frequency of zero value shadow prices and the dispersion of the shadow prices deserve attention.

a/ Relative shadow prices

For these the next table presents the shadow prices of three "clean" programs in the national economic level programming, not their absolute values but their relative magnitudes, ratios to each other. To this end a uniform basis of comparison had to be introduced. Quite voluntaristically, we chose here the shadow price for the final utilization of food products.

Branch of industry	Final utilization	Bounds on the non-socialist exports	Bounds on the socialist imports
Relative shadow prices x/ in a program with fixed exports and maximizing the balance of foreign exchange in non-socialist relations			
Electric energy	27,3	-	61,4
Metallurgy	42,8	446,8	171,5
Chemical industry	171,7	-	518,5
Engineering industries	89,1	278,9	287,6
Relative shadow prices x/ in a program with fixed exports to non-socialist countries and maximizing the additional consumption			
Electric energy	114,o	-	-
Metallurgy	89,9	34,2	87,o
Chemical industry	134,1	-	131,4
Engineering industries	1o9,7	34,9	8o,7
Relative shadow prices x/ in a program with fixed exports to socialist countries and maximizing the non-socialist balance of foreign exchange			
Electric energy	157,6	-	291,2
Metallurgy	81,9	238,5	265,2
Chemical industry	124,3	-	312,o
Engineering industries	72,3	365,o	17o,3

x/ Food industry = 1oo, in each of the cases b/ <u>Frequency of zero shadow prices</u>

As has been mentioned, if a bound does not get exhausted, its shadow price will be zero. This evidently follows from the economic interpretation of the shadow price. In case of an upper bound: if the optimal program has not fully exhausted a resource, in vain would we rise the volume of this resource by a unit, the objective function <u>would not improve</u> at all. In case of a lower bound: if an optimal program overfulfils an obligation "by itself", in vain would the obligation be increased by a unit, the objective function would not deteriorate on this account.

In the course of the calculations it turned out how often the various bounds obtained a zero shadow price in all the programs. The closer this number to 43 /the total number of the programs/ or to 8 /the number of the "clean" programs/ the more safely can a bound be considered as "redundant", that is a factor which <u>does not constitute</u> a bottleneck for the economy. The closer the number to zero, the more unequivocal the statement that we have to deal with an actual bottleneck, with a factor actually <u>limiting</u>

our choice. The bounds obtaining figures other than zero but much smaller than 43 and bigger than 8 were sensitive to the general economic assumptions of the model, that is, they were unstable.

For instance:

- from among the bounds on imports from the socialist countries the shadow price was never zero in coal mining, the aluminium industry and the construction material industry;
- in respect of the bounds on exports to socialist countries, the shadow price was in all programs zero for many branches /electric energy, oil-refining, the chemical industry, the food industry/;
- in respect of the bounds on exports to non-socialist countries, the shadow prices were never zero for the metallurgy, engineering and agriculture, meaning that it would be advantageous to expand the markets for these products - from the point of view of the given internal economic relations.

c/ Dispersion of th3 shadow prices

In order to investigate the stability of the system of shadow prices, the arithmetic mean, the standard deviation and the variance /the quotient of the standard deviation and the mean/ have been computed for the shadow prices obtained from the "clean" programs:

Resources	Mean	Variance
Fixed assets	27,4	29,12
Imported machinery	746,6	13,34
Total employment outside agriculture	3483,o	57,45
Male manpower in agriculture	2732,9	74,17

From the above, the following conclusions may be drawn:

Most of the shadow prices relating to final utilization are moderately sensitive, but those of the foreign trading activities are highly sensitive.

The shadow prices of the resources deserve attention: only the shadow prices of machinery imported from non-socialist countries seemed to be relatively insensitive. The shadow price of fixed assets was moderately sensitive, that of employment highly sensitive.

To sum up: the relative proportions of the shadow prices are highly sensitive to both the objective function selected and to the established pattern of foreign trade.

6. Utilization of two-level programming in the analysis of the export targets for engineering products

If, in a given period, a goverment intends to increase the export capacity of the engineering industries, the two-level programming may render help in judging the reality of such efforts.

It has been already emphasized, and we wish to stress it again that an evaluation of the exporting capacity of the engineering branches - even if we do not intend to create additional capacities and carry new investment burdens - cannot be conceived of without fitting the engineering branches into the whole of the economy. We cannot push the development of any engineering branch without having information about the effects of this decision on the other fields of the economy. /A boosting of a branch may draw off raw materials from other ones, or may raise the wages in engineering and the increased demand on labour may draw off also the workers of other branches, etc./.

The two-level programming is capable of assessing the effects of all these phenomena or those belonging to different export development variants and of creating the optimum combination of these effects.

The most serious argument against the use of the model may be, from the theoretical point of view, that it is too much aggregated; it represents the individual sector of engineering only with a few products. In the Hungarian calculations each sector was represented by 6-lo produsts only, but this order of magnitude is not necessary. The literature of the problems connected with the aggregation of products is wide, the selection of an aggregate best suited for the circumstances cannot cause any serious difficulties.x/

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x/ E.g. the method devised by prof. Thomas Vietoris can be successfully used for solving the problem in question. Still, for technical reasons we had to chose a simpler method for the Hungarian practice. It must be also noted, that the levels of programming need not be the same as in our practice. A method is conceivable where the highest level is the total of engineering and the individual program sectors are various smaller engineering units. There is no lower limit of further breaking down the sectors if more detailed results are aimed at.

The two-level programming - particularly its sector-level calculations - determined not only the global tasks of the engineering branches but, depending on the predetermined details, assessed also the various products. These products are, however, necessarily aggregated to a certain extent since engineering is so diversified in respect of both products and plants that the possibility of a programming aimed at completeness must be excluded in principle.

Application of production functions for planning purposes

In connection with the input-output methods, it has become clear that as soon as we attempt to plan for longer periods, the evaluation of the changes in input coefficients causes difficulties. Experiments with the measurement of the changes in coefficients, where a start was made from the individual analysis of the factors bringing about the changes /examination of the concrete material and labour input normatives/, yielded satisfactory results only for short periods, but over short periods no regularity could be found for the changes in the material inputs.

The problem prompted to establish also some control of the long-term planning relying on the input-output analysis. One of the checking methods, which lies on hand, is to doubt the gross and net production and output relations between branches as established with the aid of the input-output table and try to work out the same data also with the aid of other methods. True, in this way we cannot obtain additional information about the pattern of inputs but perhaps more reliable data may be derived on the gross and net output of the individual branches, that is, about the level of inputs and the shifts in proportions between branches.

For said purpose experiments have been going on for some years with the aim of constructing empirical production functions for the individual branches of the economy.

The cause of the first calculations of practical importance was the determination of a rational measure for the "charge on assets engaged" introduced in Hungary in 1964.[x/] As a matter of fact, the problem was a programming task: through the size of the charge to be introduced such allocation of the production factors had to be secured as would result in an optimum national income. For the sake of interest, the calculations performed will be briefly reviewed.

The initial assumptions of the calculation were the following:

1/ there exists an aggregate /macroeconomic/ production function;

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x/ The charge on assets engaged is a concept similar to interest. It is paid as a percentage on the value of the fixed and circulating assets. As regards its character, it is a source of accumulation on national level.

2/ there exists an aggregate cost function, the variables of which are live labour and the stock of capital, on any level of production, similarly to the production function;

3/ the above two functions can be empirically determined /the statistical tests satisfy the hypothesis of the existence of these functions/;

4/ the production function is of the Cobb-Douglas type, thus the marginal rate of substitution between capital and labour and its elasticity may be computed.

If the above hypotheses are realistic - and the calculations performed point in this direction - the optimum proportion between the charges on assets and on wages must be identical with the marginal rate of substitution between capital and labour - assuming, of course, that these factors had been allocated among the branches in the best possible way. The most interesting conclusion of the calculations.performed was that the rational valuation of the assets depends to no small extent on the stability of the ratio between consumption and accumulation of national income. With increasing accumulation the valuation of the assets will be higher and conversely.

Now, if we start from the hypothesis that the assets are valuated differently in various branches, the basis of the valuation will be the part of net output attributable to the growth of capital on the basis of the production function and the percentage change in the organic composition of capital:

$$Q_1 = A \cdot \frac{K}{L} \cdot \frac{\alpha}{\beta}$$

where: Q_1 = the proportion between the charges on assets and on wages,

A = a proportional factor,

K = capital

L = labour

and α and β are the exponents of capital and labour in the Cobb-Douglas function.

Another analysis determined, by starting from the data covering the period between 1950-1963, the parameters for the production functions of all branches of industry, examining the uncertainty and fluctuation of the data as well.

The production function used in this analysis, to which the parameters have been fitted summarizes the results of researches connected with the production functions. The independent variable in it is

Y = value added, by branches

the dependent variables are:

L = live labour used, in terms of hours,

K = the stock of assets.

The functions has five parameters:

a = proportionality factor without any economic meaning,

ε = exponent of the exponential function expressing disembodied technical progress,

μ = returns to scale /expressing the percentage increase in value added if the factors of production increase by one per cent/;

s^x = the marginal rate of stubstitution between the two factors in the first year;

further, two parameters indicating the reliability of the regression function:

R^2 = the measure of multiple correlation expressing the accuracy of the estimation, and

δ = the measure of auto-correlation.

In view of the fact that the number of years observed was relatively small /14/ and, at the same time, a great many parameters had to be used, the production functions constructed were pretty near to the fact figures. Some signs, however, indicated that not each of the functions computed comprises realistic parameters /see Table 13/.

Since the use of the bookkeeping data on fixed assets has not led to satisfactorily results in the initial calculations, these were substituted by the actually utilized fixed assets /gross value of the fixed assets multiplied by the degree of extensive utilization/. This abstraction seems justified from the economic point of view since the volume of production can be related only to the utilized part of fixed assets. The production function used was of CES type, that is, with a constant elasticity of substitution. /The quotient of the proportion between capital and live labour and their marginal rate of substitution must be constant in each case. If this coefficient of elasticity is e.g. 2, and the proportion of capital to live labour is 8, the marginal rate of substitution must be 16./ The results obtained are shown in Table 13, p. 147

From the data in Table 13 the following conclusions may be drawn:

1/ Parameter "a" is the power of an exponential function, indicating a proportionality factor not much fluctuating around unity, thus it could have been even omitted from the function. /At least this is what the relative dispersions of the branches - not reaching even 5 per cent - indicate./

Table 13

Characteristics of the production functions, 1950-1963[1/]

	a	ε	μ	s^x	R^2	δ
State-owned industry, total	-0,0522 /0,0193/	0,0296 /0,0072/	1,2157 /0,1716/	188	0,9918	0,8993
Heavy industry	-0,0384 /0,0206/	0,0418 /0,0418/	1,1464 /0,1569/	677	0,9914	1,0122
Mining	-0,0278 /0,0277/	0,0167 /0,0063/	0,5912 /0,1320/	459	0,9758	1,0984
Electric energy	-0,0124 /0,0299/	0,0397 /0,0239/	0,7033 /0,3552/	300	0,9902	1,0103
Metallurgy	-0,0631 /0,0303/	0,0218 /0,0082/	0,9411 /0,1959/	112	0,9712	1,0742
Engineering	0,0003 /0,0161/	0,0370 /0,0050/	1,2732 /0,0923/	16	0,9964	0,9568
Construction materials	-0,0228 /0,0258/	0,0015 /0,0150/	0,9864 /0,2103/	0	0,9856	1,3458
Chemical industry	-0,1165 /0,0334/	0,0127 /0,0269/	1,9557 /0,4521/	313	0,9905	1,0017
Light industry	-0,0281 /0,0117/	0,0084 /0,0068/	1,7569 /0,1502/	24	0,9963	1,8254

1/ The data in parentheses indicate the standard deviation of the parameters

2/ Disembodied technological development is also exponential according to the construction of the function, the value figuring in the table is also a power. The values shown for technological development may seem too high in international comparison; it should be, however, taken into account that the function has not accounted for any other technological development /embodied in capital/.

The estimations for parameter "ε" seem to be inacceptable in some branches /construction materials, chemical industry, electric energy/. Apart from these three branches it seems realistic, that the figures for the other branches are situated around the average of industry.

3/ The third column of the Table illustrates the returns to scale. <u>Engineering</u> which showed a favourable picture also from the point of view of technological development, responds sensitively also the growth of resources: its output increased much quicker than the factors engaged in production. It is an interesting feature of the values on the returns to scale that in the same branches where the data were irrealistic in respect of technological development, also the estimates of sensitivity to factor inputs were unreliable, fluctuating to a great extent. It seems as if the irrealistic values for technological development were compensated in this factor.

4/ The values obtained for the marginal rate of substitution seem to be least reliable. The value for industry total is outstandingly high, the component for engineering being surprisingly low. Very likely, beside real causes, also the deficiencies in the construction of the function play some role. The main economic reason might be the great investment activity in the period examined which influences, as a rule, the marginal rate of substitution.

5/ Finally, the parameters relating to the reliability and economic interpretation of the estimates have shown that the calculations are, in general, suited for drawing some conclusions on planning. Suffice it to mention that the correlation exceeds in each case 99 per cent.

The calculations have proven - in spite of the problems mentioned - that the relationships between the volume of production and the resources as well as the assumptions about the shifts in proportions between the factors of production can be quantified.

In the final analysis, the calculation of production functions may yield usable informations in three main fields:

- the investment and labour requirements of development concepts,
- the allocation of resources,
- the long-term tendencies in the development of prices and the pattern of prices.

x x x

The methods described do not and cannot comprise all mathematical methods conceivable as tools: the possibilities offered by mathematics are inexhaustible. Only some of the methods were mentioned, namely those which have been already successfully used in Hungary.

Follow-up of the programs approved

In a quickly developing economy it is almost natural that the conditions of individual development projects are not quitte identical with those assumed, even at the start of implementation, and later they get even more modified. The changes in conditions influence the realizability of the program. Therefore, in some form we must react on the modification in conditions, we must have some possibilities to forestall the undesirable effects of possible changes.

From among the conditions of a program, changes in some of them are always "expected" and even measureable within a certain confidence interval. About another part of the changes we have, however, no information before they actually occur. As a matter of fact, the changes can be classified according to this criterion: to one group belong those which can be already taken into account in the course of planning, the program can "take measures" for the case of their occurrence and can thus more flexibly adapt to them; the other group comprises changes the occurrence and effect of which is incalculable.

In the first case the effects of the modifications may be approached with the aid of the sensitivity analyses, while the second justifies the implementation of a flexible operative economic policy and incentive system promoting the realization of the program. To this extent in real life the term "optimum" obtains an interpretation different from the mathematical one.

If we were entirely certain about all assumptions and all data of a program, it would suffice, as a matter of fact, to perform a single programming and the solution thus obtained could be considered unequivocally as optimal. In practice, however, we are unable to draw up a long-term plan calculation we could look at so confidently. Therefore, instead of a single programming, a whole series of programs must be prepared.

In such a series it can be examined what will be the consequences if, instead of the original assumptions, we start from others and what if the numerical data do not exactly reflect the real world.

The difficulty of the task consists precisely in how to simulate in the program the probable changes and how to assess them. The answer is that in the course of the repeated calculations we determine the values of the constraints, the input coefficients, etc., in view of the expected technological development and make efforts in the meantime to account for the probability of the occurrence of certain "unexpected" events. /E.g. a technological process which is today still in the research stage but may be introduced still during the period of the program and may essentially change the pattern of inputs, or strongly distort the prices in comparison to those now in force./

With a series of calculations to be performed an answer can be obtained to the question how sensitively will the "optimum" program react on the new conditions or, what new solution provides the optimum in the changed system of conditions.

We attempted to answer these questions with the aid of sensitivity analyses. The series of calculations performed in their scope lead - on the basis of the new assumptions and initial data - to another "optimal" program. These are thus in all cases, relative optima and only their joint examination and comparative analysis will help to reach a rational decision. /Accordingly, the concept of "optimum" must not be overestimated from the economic point of view./

In a part of the sensitivity analyses hitherto performed we studied what programs are arrived at if there occur changes in the constraints or the type of the objective function.

In other sensitivity analyses it was again investigated what effects will ensue if the numerical characteristics of the model are changed within a model of a given construction. E.g. in the course of programming for the cotton industry it was examined whether the optimum program undergoes a change if the prices of machinery are higher or lower in the cost functions.

It has been found that the simplest and most useful way of sensitivity analyses is to compare the results of the parallel calculations. /As a matter of fact, this is what is always done if the effects of changes in the structure of the model are to be examined but it may be done also if the subject of the analysis are the changes in the numerical characteristic values of the model. In such cases the comparison is performed with fixed discrete values of the magnitude in question./

In some cases it is possible to apply special procedures for the purposes of such investigations, to perform so-called parametric programming.

Parametric programming is conceived of as follows:

The characteristics of the task to be programmed or at least part of them are not constants but functions of a variable called parameter. It follows that the optimum program itself - determined by the characteristics of the task - is a function of the parameter. The parameter is usually denoted by λ and the optimum program by x^*, then

$$x^* = c^* . \lambda$$

When economically interpreting the parametric programming, we know that the changes in the parameter usually do not express the actual changes over time of the economic magnitude in question. We do not know the actual, real value of the parameter, therefore we change it, let it pass through different values and establish in the meantime how the optimum program changes as a function of the parameter. In this case, therefore, we wish to draw economic conclusions from the functional relationships existing between the various parameters and the optimum program.

According to the above, parametric programming is, in its fully generalized form, a task difficult to solve in practice. Therefore, essential reservations must be made in practice to obtain a solvable task. The most important one is: the characteristics of the task should be linear functions of the parameters. Neither is it the same which characteristics of the task depend on the parameter: e.g. only the coefficients of the objective function, the constraints or only the coefficients in the constraints or all these taken together. Computation procedures which are easy to handle have been worked out up to now only for certain special cases.

The task can be rendered somewhat easier owing to the fact that in practice we are usually not interested in all possible values of the parameters. A further facility: in a considerable part of the cases not all changes in the parameters will cause substantial changes in the optimal program. This problems has been investigated also somewhat closer and it has been found that also two different programs may have the same structure /the set of the serial numbers, or index numbers of the variables having a positive value in the program are called here the structure./ E.g. in two programs there are the same variables with a positive value; among others also the variable No 1., but in the first program x_1^* = 1ooo and in the second x_1^* = 2ooo. Programs of the same structure indicate the same direction of development but they may differ in how far we must go in the direction indicated.

In the course of parametric programming one of the following two cases can be often met:

a/ To several values of the parameter following upon each other, or even to a whole range of them, may belong the same optimal program.

b/ To several values of the parameter following upon each other, or even to a whole range of them, may belong optimum programs of the same structure, although the magnitude of the individual variables differs within the idenotical structure.

In the first case we may say that the ranges of the parameters are identical in terms of quantity, while in the second case we may say they are identical in terms of quality.

For economic analyses it is always highly important to know the limits of these renges of identity. The knowledge of the expectable effects may - as has been stressed - show where the activity has an effect defined by the criteria of efficiency.

/If, e.g., the parameter on which the program depends is the world market price of some engineering product, then, depending on the fall in the price, we may set reasonable limits to the production and exports of the product in question./

A solution having essentially the same contents, but being in come cases of higher value, is the sensitivity analysis performed with the aid of stochastic programming, where the variables of the program are random variables and the optimum solution denotes a solution possible within a certain confidence interval. /Though we must confess to have no serious experiences in this field./ It is known e.g. that the deviation of engineering output from the planned quantities follows the pattern of normal distribution. From that the confidence interval of optimal solutions can be computed.

As regards the changes in other factors affecting the development of exports or the structure, we have practically no planning methods for these. In respect of these non-quantifiable conditions, the modification of some elements of the system of incentives may provide some satisfactory solution. The system of incentives, certain effects of economic policy that can be taken into account under certain conditions are treated in Chapter III.

III.

Systems of incentives connected with the implementation of the policy of machine export promotion.

1.

General characteristics of the systems of establishing an interestedness in exports

In the engineering industry the increase of exports depends, among others, on the attitude of the producers /enterprises/. This attitude cannot be "prescribed" in an administrative way, but it has to be directed by economic regulating means and incentives. A greater importance is given to this in engineering industry by the fact that central development decisions influence the exports less than for instance in the basic material industry. The necessity of incentives comes up in the economy of most of the developing or medium-developed countries and this is proved also by the expreiences in Hungary.

In many countries, measures of import restriction and export promotion are adopted in order to stabilize their international payment conditions. According to our experiences, however, import restriction, as a method, cannot assure a lasting solution. On the one hand, because any kind of restrictive import policy has, in general. a braking effect on development; and, on the other hand, because its effects in developing or medium-developed countries can be especially disadvantageous, as they obtain the more developed technology, up-to-date raw materials, semi-finished products primarily through imports. Therefore the restriction of imports - considering the rate of technical development which is experienced all over the world - means necessarily that their backwardness to the most developed countries will increase even more.

The solution can be found exclusively in developing exports in such an economical way which makes it possible on a long-term basis that the increase of foreign exchange receipts of exports should keep abreast with the increase of import needs. Naturally the development for purely export purposes /in other words, the production of commodities for which there is no requirement at all, or only to a minimal extent, in the internal market/ cannot be a general aim, except in the case of countries having a very limited internal market and having a deficit in raw materials. But we have good reason to presume that if a part of the production capacity established according to the requirements of export markets will be used for sales on the internal market, this will result in the substitution of imports which affect indirectly the foreign trade balance in a favourable way.

A basic problem of the development with the aim of exporting is that in foreign markets there is a keener competition, the risk of marketing is bigger, and in most cases the prices which can be obtained are lower than those of the internal market. /To a certain extent, the trade between socialist countries forms an exception to this. This trade is carried on under government agreements being valid for several years, and containing compulsory quotas, and these agreements give the security of marketing for the contracting parties/. There is a basic question of the endeavours directed to export promotion: are the producers interested, or can they be made interested, in undertaking a bigger risk, and is it possible to compensate the lower receipts to be anticipated when selling on external markets. It is obvious that producers cannot be expected to increase the export if it means a loss for them. In countries where there is a great effective demand in the internal market, the high profit which can be achieved at the favourable local prices may make possibly for the producers, with a view to utilize their capacity better, to undertake lower profit in export sales, or even a certain loss. In general, however, it is necessary for the state to assist the export sales by various methods.

The forms of assistance of machine export in Hungarian practice can be divided into two big groups:

A. general systems of making interest in exports,

B. individual export subsidies.

A.

General systems of machine export promotion.

Apparently, the best way of supporting the export promotion programs discussed in the preceding chapters of this study is by giving individual /enterprisal/ encouragement. No doubt, this is necessary and later on we shall state what methods are used for this purpose; nevertheless, the prerequisite of the elaboration and realization of any kind of export promotion program is to maintain a general system of interestedness in exports. If this does not exist, the initiative precisely in this kind of export promotions is lacking, and it can hardly be imagined that this can be substituted by the initiative of the state.

The creation of a general interestedness in exports in a national economy sets the following two problems:

a/ elimination of the disadvantages in export sales as compared to domestic sales;

b/ assuring a profit to exporting enterprises which is bigger than that of domestic sales.

If we wish to make the system general, working automatically in all forms of marketing, it is clear that the rate of foreign exchange should be examined.x/

x/ In the following we assume that this method can be used by countries whose national currency is not convertible and who are not members of some multilateral trade agreement or where the state makes it compulsory that foreign exchange originating from marketing abroad should be sold to the state bank.

Our experience shows that the official rate of foreign exchanges fixed on the basis of the gold parity maintains /and sometimes even increases/ the difference of earnings between domestic and foreign marketing, as it does not take into consideration the difference between the production costs of the industry of different countries. The exchange at official rate of foreign exchanges earned by exports is, as a matter of fact, contrary to the interestedness in exports, since the difference between the price level of the international market and that of the external market should be fully borne by the producer. It is customary in international practice that the banks value the different clearing foreign exchanges - when buying exchanges - at different rates, if the country concerned effects its trade, or a great part of it, within the framework of clearing arrangements, The deviation from the official exchange rate, however, follows the effect of the movements of the international money market, and it does not take into account at all, or in a very small degree, the differences arising from the point of view of production costs.

If the official rate of exchange being in force presents these problems, one would consider as logical to resort to the devaluation of the national currency, with a view to increase the interest in exports. But in this connection the following should be taken into consideration:

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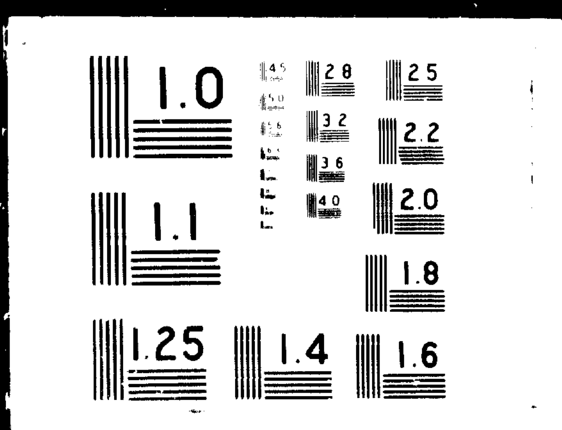

- The general devaluation would affect not only the foreign trade turnover, but also e.g. tourist traffic. The experience prove, however, that the comparison of foreign exchanges outside the field of commodity flow /e.g. on the basis of the consumer's shopping basket/ show a smaller difference than the comparison on the basis of production costs. Therefore a devaluation based on the latter might decrease unreasonably the value of the national currency in tourist traffic, whereas a devaluation based on the former comparison /namely the one according to the consumer's shopping basket/ would not be sufficient for the encouragement of exports.

The change of the official rate of exchange, i.e. the general devaluation of national currency - if its aim is encouragement of exports - would not mean a sufficiently selective solution. Partly, because it can put in advantageous or disadvantageous position, from the point of wiew of export, such branches of industry, where this is undesirable because of the general economic structure, and partly, because it can establish a disproportion between the exchange movement of the commodity flow and of the field outside commodity flow.

- Naturally, a general devaluation of currency would make also the import more expensive. Though this may be advantegous for the international balance of payments, but at the same time restrains technical development and thereby, viewed in perspectives, the export as well. /In the following we refrain from discussing the impact on imports, as it is not the objective of this study/.

Owing to what has been mentioned, in the planning of Hungarian economic policy it as more useful to seek methods which have the same effect in certain fields - from the point of view of export encouragement - as the change of exchange rates but at the same time which can be used in a sufficiently selective way /even according to branches of industry/ and which make their effect felt only in foreign trade turnover. Such a method can be in the foreign trade the valuation of foreign exchanges in a way deviating from the official rate - called shadow exchange rate -, or the use of "foreign trade co-efficients".

Having studied this question in greater details we have found that if the foreign exchange produced by exporting companies is bought by the state or by an authorized bank at a higher rate than the official one, this produces a double effect, depending on the extent of the deviation from the official rate:

- for some enterprises it will be possible to eliminate the disadvantage of selling in export markets, as compared to domestic marketing,
- for other enterprises export sales may become even more profitable than domestic marketing.

The extent of foreign trade coeeficients can be fixed in different ways. Experiences in Hungary show /what is also proved by the literature on economics of other countries/ that in practice it is useful to apply the principal of "avarage costs" or "marginal costs".

The principal of "avarage costs" means that calculations should be made on a national scale about the exchange price income of the total export sales, expressed uniformly in one of the foreign currencies, and this should be compared with the price income arising from the supposed domestic marketing of the same volume of products. The ratio of the two gives the value of the coefficient. Actually, comparison is made between the price income and not between foreign and domestic production and marketing costs. This is essential because the calculation takes into consideration the profits from marketing, too, which depends not only on production and marketing costs. /If the aim of the study is to find the means of export encouragement, of course the profit which can be attained in the domestic market cannot be left out of consideration./

Here by the term "costs" the costs of export, i.e. foreign exchange earnings should be understood, in other words, it should be calculated what is the average value of domestic sale which corresponds to a given unit of foreign exchange income /e.g. 1 $ /. If an enterprise gets the same income by selling the foreign exchange earned through its export as if it would have sold the goods in the domestic market, in principle it is the same for the enterprise wether it exports or not. But if the income is bigger, most probably it will induce the enterprise to export.

The basic data of the same calculations can be used for the definition of the "marginal costs" here, again, we mean income and not production costs/. Whether we calculate the ratio /foreign trade coefficient/ of export price incomes and price incomes in the domestic market according to products, groups of products, enterprises or industries, they will surely disperse around the average of national economy. Obviously, there are products which can bring a much smaller export income than what could be obtained in the domestic market, and fall beyond the "margin" within which it is paying to export. Of course, it would be difficult to fix this "margin" in an exact way. After experiments we have come to the conclusion that if the ratio of domestic and export income of a product exceeds the average of national economy by more than 50 %, it is not practical to subsidize the export of this product.

The following table is given to illustrate what has been mentioned:

Branch[x/]	Domestic income/ export income	Share in total exports
Machine industry	52 Ft/$	10 %
Light industry	80 "	15 %
Basic material industry	58 "	30 %
Agriculture and food industries	64 "	45 %
Average of national economy	60 Ft/$	100 %

x/Naturally, the dispersion around the average values of different industries is also considerable. /The average of national economy has not been calculated by averaging of the above branches/.

The foreign trade coefficient can be calculated both with the principle of "average" and of the "marginal costs". There can be no doubt that the principe of limit means a stronger encouragement for export, as it enables in a wide range the export of products earning a ratio below the average. Its risk is that it may bring about a general price increase in the domestic market and undesirable inflationary tendencies. The primary reason for this is not the fact that the enterprises endeavour to achieve a higher income in the domestic market assured by the "marginal rate", since in many countries the absorbing capacity of the internal market is rather restricted. It is much rather through increasing the costs of imports that the high foreign trade coefficient has effects linked up with each other. /In another context we have already referred to its disadvantageous effect on technical development/.

At the same time the definition based on the "principle of averages" is more selective, it means an encouragement first of all to exports which produce a more favourable ratio than the average of national economy. But it does not exclude that - in certain cases and by adopting other methods - the state should not subsidize / support / enterprises exporting at a higher ratio than the average.

This approach to the question is not without problems in the case of new developments. In principal a better coefficient should be given than the average to the new developments, if the production costs are favourable, the requirements, in principle, should increase.

On the basis of the considerations mentioned before, in the new system of economic management introduced in Hungary on January 1, 1968, the foreign trade coefficient has been determined on the basis of the principle of average.

> It should be noted that in the practice of Hungarian economic management, the introduction of foreign trade coefficients plays an important role, as it does not mean simply the creation ot the method of export encouragement. Preveously a double price system was in force in the internal market, according to which the producing and user's enterprises received and paid respectively the prices valid in the internal market for the exported goods as well as for the imported ones. The difference between the price of the external market and that of the internal market appeared in the result of the foreign tradeenterprises in the form of a sum to be paid to the state or in the form of state subsidy.
>
> Therefore it has been a matter of basic importance for foreign trade activity to establish the organic relationship between internal and external prices and to put an end to the double price system.

In other words, the foreign trade coefficient represents the domestic price of the foreign exchange in the field of commodity turnover and the costs related to commodities, and this domestic price is uniform both for the purchase by the bank of the foreign exchange delivered by the exporter as well as for the sale of exchange to the importer. The experiences gained concerning the foreign trade coefficient as a market regulating instrument are as follows:

- Its establishment determines the interest in foreign trade for the whole economy and at the same time permits the comparison of receipts and expenses arising in forints or in foreign exchange. It orientates the enterprises in their decisions concerning the product composition of exports.
- As it is valid for a longer time, its original effect can only be changed - in cases when it it absolutely necessary - by applying other economic, market regulating instruments.
- In view of the fact that in Hungary export has a very high share in the national income, the export interest established as a result of the foreign trade coefficient can play a decisive role also in the direction of the general technological development.

For the non-commercial traffic affecting the population - including also tourist traffic - a so-called "non-commercial" rate can be fixed. It can be fixed starting from the consumer purchasing power parity in such a way that the importance on tourisme is taken into consideration. For instance the non-commercial rate of exchange of the US $ corresponds with the supplemented rate of exchange quoted by the National Bank of Hungary: 1 $ being equal to 30 Forints. The rate of exchange of the currencies of other capitalist countries can be determined in relation to the US $, according to the gold parity.

In planning statistics, the settlement of foreign trade turnover is effected by the coefficients being uniform for every foregin exchange and valid for exports as well as for imports. One of the elements of these coefficients is the official sup lemented rate, the other, which can be changed more flexibly, is called "price factor" /actually the disagio/. From January 1st 1968 the extent of the price factor has been fixed at 100 % for the dollar and 2o % for the rouble, accordingly the coefficient values used in the internal settlement of enterprises are: 1 dollar being worth 60 forints, 1 rouble being wort 40 forints.

From what has been mentioned it follows that the foreign trade coefficients express the average "producing" costs of the dollar and rouble, under the conditions of the given commodity structure, commercial conditions and prices of Hungarian foreign trade. The coefficients are not differentiated according to commodities and are equally valid for exports and imports.

The present difference between the dollar and rouble coefficients is caused a number of factors, such as:

- The commodity structure of Hungarian export greatly differs with countries of dollar settlement from countries of rouble settlement.
- There is a certain difference also in the level and proportion of prices prevailing in socialist and non-socialist markets. In the trade with socialist countries the prices, based on capitalist world market prices, are established taking into consideration a longer period - in order to eliminate the distorting effects of the market - and they are valid for a longer period, too. In the trade with non-socialist countries, prices reflecting the current conditions of supply and demand exist.
- The cost needs of exports are also different in the trade with socialist and non-socialist countries.

For example:

- in general Hungarian export to non-socialist countries have higher transport costs than the export to socialist countries;

- the export receipts which can be attained in the different capitalist markets are considerebly influenced also by the customes tariffs and discriminations applied by partner countries;

- in exports to non-socialist countries we have to reckon with additional commercial charges /e.g. commissions, etc./ which do not arise in the trade with socialist countries.

Naturally it is also clear from the above that the formation of foreign trade coefficients should be connected with the change of market conditions, with certain elements of trade policy aims and, consequently, with the change of the Hungarian export structure as well.

/In order to facilitate this survey, in the following we leave out of consideration the fact that in Hungary there are two kinds of foreign trade coefficients. This abstraction, however, does not affect the valuation of the axperiences of the system of coefficients./

According to our experiences, the extent of the average production of foreign exchange of the national economy can be determined by the following method:

1. We convert the foreign exchange price which can be attained in the external market to free dollars, at the valid rate, reducing the amount by the costs arising in foreign exchange in the course of marketing /freight, comission, etc./.

2. Against this, we set the current, expectable internal price of the exported commodity /including the calculable profit/, adding to it the costs arising in forints in connection with the export /packing, transport/ as well as the comission of the Hungarian foregn trade company.

The comparison of all foreign exchange values under 1. with the total forint amount under 2. gives the extent of the average production of exchange of the economy, and this forms the basis of the establishemnt of the foreign trade coefficient.

The most important effect we expect from the foreign trade coefficient is that it should induce most of the enterprises automatically, - without state subsidies - in accordance with the princille of proper interestedness, to compare directly the results of foreign and domestic marketing and to decide in favour of exports when working out its development and marketing programme.

We have examined, therefore, how the application of foreign trade coefficients influences the promotion of export.

We have already referred to the fact that the average of the own costs of exchange production of the different branches of economy, and within them the branches of industry and enterprises, disperses considerably around the average costs of exchange production on a national scale. Due to the fact that the central bank buys from the enterprises the exchange earned by export on the basis of the foreign trade coefficient, irrespective of their own costs of exchange production, those enterprises, whose own costs of foreign exchange production is lower than the average of national economy, are put into a more advantageous position.

These enterprises can make an "extra profit" in the export sales, compared to the domestic sales. It is obvious, therefore, that they will seek the development of exports first taking into consideration their existing capacities and later by expanding these capacities. The extra profit enables them to give better salaries to their workers and engineers and thus to employ the best larger staff, and also to use a bigger part of their income for investment purposes.

The endeavour to increase exports, however, comes up against the competition in the external markets. If the enterprise does not want to give up the extra profit on exports, the competition compels it to keep up with the requirements of up-to-dateness, quality, etc. arising in the markets. For this aim it has to make use of the resource available for development purposes, too. In this way the endeavour to meet the market requirements brings about the continous increase of the technical level of production. If the enterprise uses parts, component units, materials, etc. supplied by an other domestic enterprise, for incorporating them in the product to be exported, it is obvious that the enterprise, too, will raise its requirements towards the cooperating partners in order to assure that the final product is up-to-date. For the higher requirements it can pay by ceding a part of the extra profit on exports. Thus it also contributes to raising the general technical level of inland production.

This process is also advatageous for the whole of the economical life, as the country participates in a more intensive form in the international division of labour by the export of the product of such an enterprise which can produce foreign exchange at a lower cost than the avarege of the national economy. Thereby it makes use of the comparative advantages offered in the international division of labour.

Let us have a look at the table given on page 9. Among the different branches only the machine industry is below the avarage. It is logical that we shall find here the most branches and enterprises, which can realize extra profit on exports as a result of the foreign trade ceofficient. Though the system of foreign trade coefficient has been introduced on January 1st 1968 only, the data of even these few months show that there is a definite tendency for the increase of exports in such branches of machine industry.

Denomination of branch	Exchange production avarage Ft/$	Export increase January - August 1967 taken 100
Machine industry altogether	52	112
Vehicles	55	140
Machinery, equipment	50	150
Telecommunication, vacuum technics	53	156
Instrument industry	65	83
Electrical machining	72	102
Metal ware	73	107

Thus a part of the export can be realized by means of the foreign trade coefficient under more favourable conditions, the other part under less favourable ones. The enterprises whose exports produce an exchange production which is more favourable than the coefficient, can make extra profit compared to what they could make by domestic marketing, while enterprises having less favourable foreign exchange production - compared to the domestic marketing - can export with a deficit or with a smaller profit.+/

Note: For simplicity's sake, hereinafter we shall refer to the former gropp of enterprises as "profitable", to the latter group as "showing deficit", but we would emphasize that the enterprises "showing deficit" may be profitable in the domestic marketing, only they cannot make extra profit in exports due to the foreing trade coefficient.

The question is raised, wether the export "showing deficit" i.e. producing foreign exchange at a less advantegeous extent than the coefficient, should not be given up. This would be unambiguosly to the national economy only if the favourable export "showing deficit" could be eliminated without any difficulty by a surplus of another export the coefficient of which makes it possible to realize a profit /in other words, if capacities of production and manpower can be conveted for this purpose/, and at the same time all of the newly introduced commodities could be marketed in foreign countries immediately.

The eliminated "deficitous" export could be balanced - in part or in full - by the simultaneous decrease of imports from the same market.

Unless either one of these two conditions are fulfilled, the equilibrium of the foreign trade balance would be jeopardized owing to the introduction of the coefficient. Therefore, under the existing circumstances, we cannot give up the volume of export "showing deficit" without any consequence. A sudden decrease of exports would in any case bring about a great disorganization of the whole economic activity, and a considerable decrease of employment and living standards.

In order to maintain the determined level of exports /even to enlarge the exports showing deficit/, it is necessary for the state to compensate institutionally the enterprises concerned for the difference of results arising between home and export marketing. This purpose is served by the system called state reimbursements" compensating for the differences of productivity. In its form , this system means export subsidy, in its content, it means the reimbursment of the difference of price income. In Hungary we consider the system of state reimbursements as an economic instrument of export management, as a necessary, but a temporary category /though it will not be in function for a short time/.

The aim of the state reimbursement system is to counteract /or divert the effect of/ the foreign trade coefficient in certain fields, in order to ensure an export level of optimal structure and tendency which is necessary in the given circumstances. Its application must comply with the following requirements:

- It should promote the export turnover in a volume necessary for the equilibrium of the foreign trade balance, but it should restrict exports which earn foreign exchange at costs much higher than the average of national economy, i.e. the uneconomical exports.
- It should represent such an objectively given regulation for the enterprises, which enables them to have secure and independent management system. The state reimbursement fixed for a longer period

should play the same directive role in the management of enterprises as the foreign trade coefficient.

- It should also contribute to the gradual formation of a more favourable commodity pattern and direction of export turnover, which under the given circumstances would be optimal.

As is clear from the above, the state reimbursements are not granted automatically, but on certain conditions, sucha as:

- The enterprises can get state reimbursements, if comparing the home expenditure and their price receipts calculated by the foreign trade coefficient, their export activity shows a lasting deficit which can be eliminated only after a longer time. The export of the product of the enterprise concerned is to be maintained because of foreign trade balance reasons.
- The state reimbursement is generally not fixed for covering the deficit of specific products or groups of products, but the whole export activity of the producing enterprises concerned is taken as a basis. State reimbursements can be fixed for individual products separately only in exceptional cases.
- The question whether the state reimbursement is justified should, in general, be examined and decided separately for the two main payment areas /countries with dollar and rouble settlement/ like in case of the foreign trade coefficients.

The state reimbursement becomes an integral part of the income of the enterprise; the general regulations concerning the income of enterprises /taxation, etc./ regulate their utilization.

There are different forms for the application of state reimbursement:

- Export premium being proportionate to the turnover /linear premium/

  It means that on each unit of foreign exchange earning produced by export - over and above the foreign trade coefficient, and to complement it - the enterprise gets budget allowance /premium/ of a fixed rate.

  Theoretically this form is applied for enterprises which have a not much hig er index of foreign exchange production than the foreign trade coefficient so that it can be presumed that by the help of various measures it can become a "profitable" enterprise whithin a relatively short time, and therefore we do not wish to rdduce its export.

- State reimbursement paid according to a fixed volume of turnover.

  If the export which is unfavourable in comparison to the foreign trade coefficient is to be maintained at the most, at the existing level, or if we want to prevent the decrease of export during a temporary period, it is possible to give a fixed reimbursement to the enterprise in one sum yerly. It can increase its export above this level only at the expense of its own result, but it has to achieve the foreign exchange receipt prescribed as a precondition of the state reimbursement. Another form can be if in such a case the linear premium is approved on condition that the enterprise can benefit by it only until the predetermined turnover is reached.

As can be seen from the above, it is partly due to necessity that the foreign trade coefficient is counteracted by the ap liaction of state reimbursement. According to our experiences namely, the ideal solution of stopping from one year to the other such exports of machine indus ry which "show deficit", i.e. being less advantageous than foreign trade coefficient, cannot be carried out. On the one hand it is obvious that the enterprises should be given the opprtunity to adapt themselves to the new circumstances and on the other hand the decrease of exports should be prevented.

On the basis of these considerations the state reimbursement does not provide an extra profit, i.e. an advantage for the export, it assures only an identical situation with the domestic marketing. Therefore the question can be raised why it can still be ranked among the systems encouraging the export promotion, and what its function is as such.

Here it should be recalled that one of the conditions of state reimbursement is that it is fixed at the level of enterprises. The average production of foreign exchange of an enterprise can be derived from the actual costs of foreign exchange production of the commodities produced for export by the enterprise. Expreiences show that these costs present great differences even within one enterprise, as compared to the average of the enterprise.

However, the state reimbursement is allowedat a given time, taking into consideration, the given export structure of the enterprise, but for a longer period /3 to 5 years/. If the enterprise changes the commodity pattern of its export by increasing the export of those commodities which can be marketed at a more favourable index than its avarage of foreign excahnge production, in this relative way the enterprise can make extra profit on exports. Let us take the following example:

The machine tool works "Matador" works with an average cost of foreign exchange production of 70 forint per dollar /in other words, it gets 10 Ft/$ state reimbursement/.

The export structure of the works in 1967:

Product	Unit cost of foreign exchange prod. Ft/$	Export value 1ooo $	Cost of exchange production	Price income in 1ooo Ft	Profit + Loss -
1. Radial drilling machine RF 1o	74,2	600	44 500.	42 000	- 2 500
2. Radial drilling machine RF 11o	50,0	300	15 000	21 000	+ 6 000
3. Horizontal milling m.F 5	65,0	600	39 000	42 000	+ 2 000

4. Universal lathe VE 100	80,0	200	16 000	14 000	- 2 000
5. Univers l lathe VE 200	75,0	300	22 500	21 000	- 1 500
Total:	70,0	2000	140 000	140 000	-

If the enterprise did not get a state reimbursement, its entire export activity would be in deficit, as its total amounts to 140 million forints, while its foreign exchange earning is 2 million $, for which it would get only 12 million forints calculated according to the foreign trade coefficient. Due to the state reimbursement it can realise its total export with deficit, and within it, the products under 1, 4 and 5 can be exported with a deficit, which is sompensated by the export of the products under 2. and 3. The reimbursement is guaranteed by the state for the years 1968-1970. Therefore the enterprise makes calculations how it would be possible to change this neutral position into a profitable one. It is evident that the enterprise should increase the export of the items under 2. and 3. at the expense of the other items. This can be carried out with the existing capacities, with smaller inputs, already in 1968, by making certain rearrangements. In this way the following result can be achieved:

Product	Unit cost of for.exch. prod. Ft/$	Export in 1000 $	Cost of exchange production in 1000 forints	Price income
1. Radial drill RFlo	74,2	400	29 680	28 000
2. Radial drill RFllo	50,o	500	25 000	35 000
3. Hor.milling mach. IE 5	65,o	600	39 000	42 000
4. Univ.lathe VE 1oo	80,0	50	4 000	3 500
5. Univ.lathe VE 2oo	75,0	450	35 750	31 500
Total:	65,5	2000	131 430	140 000

This means that at same level of export but with the change of the composition, the enterprise can make a profit of more than 8 million forints in comparison with the previous year. If this profit is spent for the promotion of the export of the items under 2 and 3, a 10 per cent increase of exports in the following years can bring a profit of further 5 to 6 million forints. Naturally the state reimbursement induces the enterprises not only to such changes of the export composition, but also to the reduction of production costs, as they can also make a profit by reducing the unit costs of foreign exchange production. These efforts at the same time make them more competitive in foreign markets, and in the perspective of a few years they can make state reimbursements superfluous, as the enterprise willbe able to make profit by foreign trade coefficient as well.

Connection between export and income regulation.

From what has been mentioned it can be seen that the basic principle of the state reimbursement is to assure for the export a profit position which is identical with the domestic marketing. This identical position makes the enterprises interested in the increase of exports especially in those cases, where it is possible to change its structure of products by a relatively small expenditure in favour of products with which a favourable foreign exchange production can be achieved. A further precondition is that the demand of the domestic market for the products of the enterprise concerned should be satisfied on the whole, because otherwise the enterprise's endeavour will be to market the products at home, all the more so as there is in general a smaller risk for domestic marketing, the costs of marketing are larger, even at a theoretically identical profit position. These points of view are especially important in the machine industry, because the possibility on changing the structure of products is great, and there is always a smaller business risk in the internal markets than when exporting. That is why the system of state reimbursements, if necessary, should be made suitable for assisting the encouragement of exports by supporting specific export developments. A general form of this can be, if instead of the mere difference between the foreign trade coefficient and the own average cost of foreign exchange production of the enterprise, a greater amount of state reimbursement is granted. /Referring to the example of the machine tool works mentioned before: the amount of reimbursement given is 15 Ft/$ instead of 10 Ft/$. This enables the enterprise to make a higher profit on exports already at the beginning than by domestic marketing, and this profit can further be increased by the measures referred to in this example. Such a subsidising of export is justified only if the products, or a greatest part of them, of the enterprise concerned are up-to-date, and the conditions of the external market also offer it the perspective development of exports and consequently - by increasing the magnitude of series - the decrease of production costs as well. In this respect there is a great need of the individual development analyses mentioned previously.

The other form of export subsidy can be the state reimbursement granted on certain fixed conditions. There is a possibility, namely, for increasing progressively the amount of state reimbursement allowed up to the level of the average costs of foreign exchange production, if a certain value is exceeded. This induces the enterprise not only to imrpove the pattern of export and to reduce the costs, but also to increase its export within the shortest time possible, by developing and modernizing its products.

> Let us take again the former example: in 1967 the export of the machine tool works amounted to 2 million dollars. As a condition of granting the state reimbursement it can be stipulated that if the works increases its export in the next year to $ 2,5 million, it will get a reimbursement of 13 Ft/$, and if it suceeds in increasing the export to $ 3 million, the rate of reimbursement will be 16 Ft/$.

This form os state reimbursement can directly be connected with the implementation of an export development programme. If the machine tool works mentioned in our example was a new investment, the introduction of its products in foreign markets requires various costs which do not arise in the case of already introduced products or in the internal market. In such a case the state reimbursement can be a useful form of the support of export to overcome the necessary temporary period, possibly 2-3 years.

The only general problem of state reimbursement, as a system, is that the enterprises get it as a price income. /This is due to the fact that its aim is to divert /raise/ the foreign trade coefficient in order tom maintain the level of exports, that is to say, it means the reimbursement of the price income difference existing between internal and external marketing./ Due to this, there is a direct relationship between the state reimbursement and the profit of the enterprises only in such a case when the share of export in the total marketing of the enterprise is considerable. If the enterprise can increase the price of its products sold in the internal market, the increase of price income achieved in this way can easily be higher, than the difference of price income assured by the state reimbursement. In this case, in our oppinion, the enterprise will not endeavour to maintain or increase its export. This means that the encouragement of export which can be attained by the state reimbursement is greatly influenced by the effective demand of the internal market for the products concerned, as well as by the limits of its absorbing capacity. This problem too, is closely connected with the attitude of the economic policy mentioned in Chapter I concerning the objectives for the machine industry market, the budget policy of the state and with the income policy, etc.

Consequently it seems desirable to propose the working out also of such a system of export encouragement, which eliminates this problem of the state reimbursements and which can create a clear-cut interestedness in exports.

The solutions may be found in the introduction of such a form of machine export encouragement, which would be carried out within the system of state regulation of income. The different varieties of this form are not unknown in any industrially developed country in whose economic policy the objective of supporting the machine export is included. To make it more concrete, here we have the different tax allowances and various forms of tax refunds in mind.

As the aim of this study is not only to analyse the forms of export encouragement in general, but also to survey the experiences of the practice adopted in Hungary in this connection, we think it is more useful to discuss the solution used in practice. We have to point out, however, that the experiences that we have at our disposal of this solution could not be collected during a long time.

This solution motivates the introduction of such a tax-free state allotment, i.e. of a tax refund, which directly increases the profit of enterprises to be encouraged for the development of export.

From the point of view of the enterprises the tax refund is a more favourable form of support than the reimbursement of the price income difference and at the same time, it is also easier to survey by the state as regards to its expectable effect. It is not possible to calculate precisely beforehand the net amount remaining for the profit of the enterprise, from its pure income, thus the enterprise cannot know in advance whether the efforts made in the interest of export will also be reflected in the same extent in its own clear profit. The tax refund, on the other hand, means a clear profit. It is more clear-cut encouraging instrument for the state because it is not probable that the enterprise will try to counteract its effect by increasing its prices in the domestic marketing. /Apart from rare exceptions namely, it has not any change to have such a price increase accepted in the market, which has the same effect on its pure income as the tax refund./

As this method assures a considerable advantage for the enterprises, it is justified to stipulate stricter conditions for the tax-refund than for the state reimbursement. Therefore a double condition is stipulated for this state allotment:

- increase of the proportion of export marketing within the total marketing of the enterprises;
- increase of the export level.

The fulfilment of this double condition requires efforts of a different degree from the different enterprises, that is why the most practical method for determining the extent of all allotment /subsidy/ seems to be the elaboration of some kind of progressive tax-refund schedule /table/.

Example for the tax-refund schedule In Ft/$

Change of proportion of export x/	Increase of level of export in percentage 1	2	3	4	5	6	7	8	9	10
-2	-	o,5	o,75	1,o	1,25	1,5	1,75	2,o	2,25	2,5
-1	-	o,5	o,8	1,1	1,4	1,7	2,o	2,3	2,6	3,o
o	o,5	o,75	o,9	1,2	1,5	1,8	2,1	2,4	2,7	3,1
1	o,75	o,9	1,2	1,5	1,8	2,1	2,4	2,7	3,1	3,5
2	1,o	1,2	1,5	1,8	2,1	2,4	2,7	3,1	3,5	3,9
3	1,2	1,5	1,8	2,1	2,4	2,7	3,1	3,5	4,o	4,5
4	1,5	1,8	2,1	2,4	2,7	3,1	3,5	4,o	4,5	5,o
5	1,8	2,1	2,4	2,7	3,1	3,5	4,o	4,5	5,o	6,o
6	2,1	2,4	2,7	3,1	3,5	4,o	4,5	5,o	6,o	7,5

x/ The numbers given vertically indicate the decrease or increase of the share of exports.

This form of tax refund, too, can be connected with a concrete export development programme so that the export considered as useful by the state shuld be promoted not only in the phase of the realization of the investment, but also in the realization of the products manufactured.

The significance of this kind of export subsidy lies, however, mainly in the fact that the enterprises will probably make intensive efforts to develop their exports not only by making use of the existing capacities, but also by the expansion of their production. At the same time it is also possible to influence the commodity pattern of exports on a long-term basis by deciding which branches of industry will obtain first of all the facility of tax refund.

2.

Further methods of state support of the machine export development programme and promotion of machine export

Besides the establishment of the interestedness in exports concentrated in general or specific fields of economy /e.g. branches of industry/, other forms and methods of state support may become necessary, too, for the implementation of export development programmes of great importance. Here we have in mind first of all those cases when certain enterprises wish to increase their exports as a result of a general interestedness in exporting, but they do not have sufficient capital at their disposal, and they need the profit attainable by the development to be paid in advance in order to be able to carry out the necessary expansion of their production.

Credit preferences

Preferences can be granted for investments with a view to export machinery through credit policy, in a direct or indirect way. Giving support by state investments is a general method of preference. They can compromise the following:

- In enterprisal investments aiming the development of export, the related infrastructure facilities /e.g. road construction, branch railway connection, house-building, etc./ are given by the state free of charge, from state resources, or the state grants to the enterprise concerned a long-term loan without any interest or with a low interest.
- The state can also participate directly in establishing the production capacity designed for export purposes. The necessary financial resources for the development can be made available by the state free of charge, or in the form of a long-term loan.

- Finally, the state can also decide to realize some big investment without the participation of enterprises, by using means assigned for investment purposes from the budget, if the investment serves essentially the development of export or the appropriate change of the export structure. /Here first of all the setting up of new complete plants or integrated factories can be considered./ It should be taken into account, however, that such a solution can not be chosen frequently, because the state is compelled to use its investment means predominatly for developments not destined for production.
- In countries where there are important producing plants or big enterprise units in state ownership, it also occurs that, in order to promote the central development targets /for instance to develop exports/, the state owned enterprises are obliged to spend a fixed proportion of their investments for the promotion of centrally determined objectives.

A great importance should be attached, as a whole, to the above forms of state supports, as the bigger export development programmes, in general, exceeds the possibilities of even great enterprises better off with capital, and they require the harmonized and coordinated development of the production of several enterprises. In addition to this, however, the preference to be granted for export development purposes to be realized by the enterprises, without the participation of the state, is also very important.

This preference can be given thorough the terms and conditions of the credits available for the enterprises. The greater the influence that the state has on the bank system, the more efficient this form of preference will be. Obviously it is the most efficient if the development credits, or at least a predominant part of them, are granted to the enterprises by the state bank or banks. /In Hungary, for instance, it is the Government that approves the directives of credit policy which - among others - stipulate also the preferences applicable for the development credits/. Let us examine the various types of these preferences.

- Most probably the most important preference can be the stipulation of the credit period, i.e. the period of repayment of the credit. Thus it is possible to reserve a certain credit period for investments serving the development of export, i.e. from the long-term /e.g. 12 years/ credits all other kinds of investments can be excluded.
- The timing of the credit repayment may also be a form of preference. If a long-term credit is granted, the first instalment can be envisaged a year or two later, or an obligation of a minimal instalment can be stipulated for the first years repayment in order to give more time to the enterprise for developing the export of the new production capacity and for organizing gradually the increasing marketing.

- Preference can be given also by the rate of interest to be fixed. Similarly to the credit period, certain preferences of interest may be reserved exclusively for investments serving export purposes, but it is also possible not to charge any bank expenses and thereby the interest is reduced relatively.

We have pointed out in connection with the state investments that the bigger export development programmes generally exceed the possibilities of individual enterprises, because the modernization and expansion of the capacity necessary for manufacturing a certain end product cannot be solved without the proper development of the production of the enterprises cooperating in this manufacture. This is important especially in the machine industry, where the enterprise producing the end product works generally with a great number of cooperating partners. Therefore it is necessary for this enterprise to coordinate and harmonize its development concepts with its partners supplying parts and component units. If the enterprise exporting the end product is willing to share the profit on export with the cooperating partners, it can expect of them to take part in the risk of development, to support its credit demand presented to the bank and also to take up the necessary credits for facilitating their own developments. In such a case it is reasonable to extend the credit preferences also to the cooperating partners and to determine these preferences in such a way that it should facilitate the association of enterprises /capital merger/ with the aim of export development.

Support of the machine export by credit policy

Under this heading there aretwo groups of questions to be discussed. First: the domestic financing of export marketing, second: credits to be granted for marketing abroad.

In connection with the domestic financing of export marketing, two main problems arise:

- The enterprises can get the countervalue of the goods supplied much later when it is exported than when sold in the internal market and this can make it necessary to apply for considerable credits in some cases also for financing the current production. This increases the costs of production for export even if the bank is ready to discount the negotiable documents representing the countervalue of the goods. The greater distances of transport and the keener competition in the export markets require shorter delivery terms and this makes it necessary for the enterprises to maintain bigger stocks of finished and semi-finished goods than the ones they would need for domestic marketing. For this purpose either a part of the resources of the enterprise is taken, which could otherwise be used for the development of production, or involves the use of credit. In each case the enterprise considers the export marketing as less advantegous.

If we want to stimulate the increase of exports, these problems should be solved by a flexible application of the credit and financing policy. As a matter of fact, in this respect not preferences are needed, but such measures which compensate the disadvantageous position of export. Such measures can be: the reduction of discount rate, for the export stocks granting of credits for operating funds at a low rate of interest.

The export of certain products of the machine industry can be effected only on credit. If the product is a newly developed one, its economy rarely makes this possible, not to mention the fact, that many enterprises have not the necessary conditions enabling them to grant long-term credits, both as regards their risk and the required capital. Therefore the support of the state may be necessary in this field as well, in order to promote the export and to ensure the markets.

In this field the following forms of state support can be considered:

- In general, the long-term trade agreements concluded by the state envisage government credits to be granted by one of the parties or by both of them. These government credits provide a general framework, or cover the supply of given commodities or groups of commodities according to the terms and conditions approved by both parties.

Deliveries under government credit mean cash receipts for the enterprises, as the credit obligation is assumed by the state. By assuring the participation in government credits the state renders considerable assistance for the implementation of certain export development programmes and for increasing the export of the enterprises concerned.

At the same time the government credit makes it possible for the receiving country to assure the import of such investment goods which promote the realization of its own export development objectives. This is a widely used method.

- In international relations between the big banks it is also common to grant financial credits for different periods of time.

According to these arrangements, the banks settle by immediate payment the orders for payment received from the other bank. This renders possible the conclusion of contracts between the importer and exporter also in cases when otherwise the supplier would not be in a position to extend credit.

- If it is necessary for the realization of export to grant enterprise credit, the state can directly contribute to it in the case of industries enjoying preferences.

Furthermore, the state can diminish the risk of the enterprise by giving export credit guarantees under favourable terms for fixed transactions or for a scope of transactions.

Naturally in countries where a special permission is necessary for the enterprises to grant credits, the direction of export by state can be effected in such a form that priority is given to certain important branches of industry when considering the applications for credit permissions.

Customs

Besides the solutions mentioned above, the support of the export oriented industries - at least so far as they can be competitive - requires to protect these industries in the internal market against the competition of the identical finished goods imported. This protection against the competition of import is, however, a double-edged weapon, because it may result in the leisureliness of the industry to be developed. In spite of this danger protectionism cannot be fully avoided, since the commodities produced by the new capacities cannot be marketed immidiately and completely in foreign markets. If the competition of imported goods endangers the utilization of the capacities, it may have a detrimental effect on the initial rentability of the entire export developing activity.

The most suitable and generally applied means of protection against the competition of imports are the customs tariffs as well as other financial measures / deposition system, etc. /. The fixing of the degree and the application of the customs procedure regulations provides a rather flexible means of protecting industries and production branches receiving state priority.

Furthermore, the tariff system can be used for supporting in a more direct form the export oriented production. For economic reasons, the case of the import of certain raw materials, semi-manufactures and productive parts, high tariffs are charged, or tariffs considered as high from the point of view of utilization and in these cases the production costs can be diminished by means of tariff concessions or tariff exemption. Thus, if the state regards it necessary to assist the export activity of an enterprise, this can be made in the form of customs refund or by tax exemption.

Long-term government-to-government agreements.

Medium-developed and developing countries are in need of increasing their outer economic resources and for them make use of the possibilities for export development as well as the financial assistance /credits, etc./ of more developed countries. Obviously, if they do not succeed in fulfilling their export targets, their demand for foreign assistance perhaps their dependence also will increase moreover, it renders the repayment of the credits received earlier more difficult and thereby aggravates their balance of payment problems in the long run.

In view ot this, the countries in question have a vital interest in raising the means necessary for their development from their own resources to an increasing extent. In the initial period they have to make use of foreign financial resources to a greater extent, but this can be only a temporary solution and cannot replace such an economic policy whichcan accelerate the general development of their economy and increases appropriately their export capacities and general exporting potential.

> In support of this it is worth mentioning that in recent years the role of foreign financial resources has decreased in the economic relations between developing and industrially developed countries. In 1961 the so-called "aid and assistance" represented 0,87 % of the gross national product of developed countries, whereas its share in 1964 was only 0,66 % and apparently they show a decreasing tendency since then, as their absolute amount stagnates around 8 million dollars. Under these circumstances the developing countries can only finance their imports from developed countries increasingly from their export receipts.

The development ot the export potential requires more and more the realization of firm export developing programmes and the assistance of export marketing by the state, as well as a determined economic policy resulting in the <u>long-term government-to government agreements</u> on which we have laid great emphasis before.

According to the present practice the long-term government agreements are generally concluded for 3 to 5 years. Agreements concluded for an even longer period are especially advantageous for developing countries. As a rule, the agreements regulate on a bilateral basis the contents /e.g. volume, commodity structure/ of the exchange of goods between the participating partners, the mode of payments connected with the exchange of goods, the granting of credit related to this trade, the scientific and technical cooperation, rendering of assistance, etc.

It is rightful, however, to ask, why the bilateral long-term agreements are considered useful at a time when the development of world trade advances toward multilateralism.

No doubt, multilaterality is perhaps the most common and comparatively most efficient form of the trade relations between countries having a developed market economy. But the partners taking part in multilaterality are countries where there is no big difference in economic development and competitiveness in the world market. For a medium-developed or developing country the participation in this multilaterality would cause considerable problems, as it would be necessary that the commodity stocks to be exported by this country should be convertible from the point of view of the market /in other words, it shoukd be marketable anywhere uhdèr the given conditions of the world market competition/.

But this is not generally assured and therefore the developing countries would be handicapped in the multilaterality of the competition of the world market, their export would go back and their payment problems would grow. The goods exchanged mutually within the frame of bilateral trade agreements are predominantly such goods which could not be placed only be marketed with excessive secrifies on behalf of the exporter, due to the conditions of multilateral trade. Therefore the less developed countries are particularly interested in carrying out their trade or parts of it whithin the frame of agreements aiming at the bilaterally balanced settlements of payments. The long-term agreements are concluded precisely to assure these conditions of bilateral trade by permanent instruments thus creating a certain long-term security for the development of export. Whether the ageements comprice lists of goods of an indicative character or with fixed quotas, the contracting parties guarantee that they will facilitate and promote by suitable governmental instruments the import covered by the agreement, during its validity, in accordance with the valid licencing and payment system. This bilateral stability lasting several years is particularly important for countries whose payment position shows a lasting disequilibrium and the unfroeseeable changes of the world market. The bilateral stability of foreign trade policy is advantageous also for the conclusion of long-term contracts between enterprises, the purpose of which is to facilitate the realization of export development programmes. It can be recommended mainly for the promotion of the export of machines and equipments requiring a longer period of time for the production, transaction and crediting.

x x
x

In the opinion of the authors of this study, the planing and organization of machine industry development and machine export oriented development can be carried out most efficiently by the joint and harmonized application of the methods described in the there chapters. In this respect we can safely say that completing thing task depends not only on the methods of planning of the sector, but also on the economic and financial policy and on politics as well.

Appendix No.1.

Checking and evaluating questions prepared for the long-term development programs of engineering x/

I. Product development

1. Do the technological parameters of the product attain the world level?

2. Relying on the existing research and development basis, is there a possibility to maintain the product on the desired world level?

3. If the existing research and development basis is inadaquate to maintain the product on the desired level, is there a realistic chance to create such basis?

4. If the domestic research and development basis necessary to maintain the product on world level cannot be created, do conditions exist for production on world level if documentation is taken over or licences are bought?

5. Is it necessary to expand the range of products?

6. Justification of the choice of the product from the point of view of usability.

II. Conditions for up-to-date production

1. Order of magnitude of the rational scale of production in terms of annual output.

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x/ The answer had to be given in the form of yes - no, or by giving the required data.

2. The same in the plant determining the world level.

3. Proportion of domestic demand and the rational scale of annual production in 196o and 198o.

4. Ratio of the rational annual output to the world production /in lack of such data, to the production in some leading country/.

5. Proportion of output in 196o to the rational scale of annual production.

6. Does the production technology actually used conform to world level or can it be raised to that level?

7. Do the plants determining the world level perform only fitting and procure the spare parts from the specialized enterprises or - apart from standard parts - produce all vertical stages?

III. The situtation in respect of specialization within the Council for Mutual Economic Assistence

1. According to the principles accepted in respect of the specialization in engineering products is it expedient that Hungary specializes in the product in question?

2. Has been a decision taken on the specialization of the product within the CMEA?

3. Is the specialization allocated to Hungary?

4. Has there been any proposal prepared on specialization by a working panel or section within the CMEA?

5. According to 4, is Hungary proposed to specialize in the product?

IV. <u>Capital intensity</u>

1. Direct and total capital intensity of the industry.

2. Investment requirements of the product /the Committee determined in each case how far the "consequential investments" should be taken into account/.

V. <u>Material intensity</u>

1. Material and labour intensity of the product.

2. Does the product require any materials in short supply?

VI. <u>Indicators of economic efficiency</u>

VII. <u>Results of the long-term plan collating discussions</u>

1. Exports /roubles or quantity/

2. Imports /roubles or quantity/

VIII. Export possibilities for the product

1. To developed countries
   - relatively rapid development may be expected
   - relatively slow development may be expected
   - stagnation may be expected
   - there is no export possibility.

2. To less developed countries
   - relatively rapid development may be expected
   - relatively slow development may be expected
   - stagnation may be expected
   - there is no export possibility.

IX. Special wishes in respect of vertical development connected with the product to be developed /short summary/.

X. Proposal of the Committee on development

1. Domestic production of the product is expedient.
2. Domestic production of the product is expedient only with considerable exports.
3. Proposed quantity for 1970 and 1980 according to the study.

Appendix No.2.

The 27 factors taken into account in the Committee evaluation of the studies

No	Factors	Character of answer
1.	Do the technical parameters of the product attain the world level?	yes - no
2.	Is there a research and development basis available for keeping the product on world level?	"
3.	If there is no research and development basis available, is there a realistic possibility to bring it about?	"
4.	Is there documentation or licence necessary to create the research and development basis?	"
5.	Is it necessary to expand the range of products?	"
6.	Does the production technology attain the world level?	"
7.	Has production the character of fitting?	"
8.	Has production a vertical character?	"
9.	Is there an import content?	"

No	Factors	Character of answer
1o.	Are there export possibilities - to developed capitalist countries?	yes - no
11.	- to less developed capitalist countries?	"
12.	Is domestic production expedient?	"
13.	Is domestic production expedient only in case of substantial exports?	"
14.	Indicator of labour intensity: manpower necessary per one million forint of output /the highest value obtains first rank/	numerical data
15.	Investment volume /the lowest is best/	"
16.	Incremental investment indicator Ft/Ft /the smallest value is best/	"
17.	Incremental export investment Ft/Ft /the smallest is best/	"
18.	Production estimate /by order of magnitude/ billions	"
19.	Export estimate /by order of magnitude/ billions	"
2o.	Domestic requirements /by order of magnitude/ billions	"

No	Factors	Character of answer
21.	Export efficiency indicator in socialist relation $/$	numerical data
22.	Export efficiency in non-socialist relation $/$	"
23.	As 21, Ft/$	"
24.	As 22, Ft/$	"
25.	Demand on manpower /the biggest ranks first/	"
26.	of 25: engineers /the biggest ranks first/	"
27.	of 25: technicians /the biggest ranks first/	"

Appendix No. 3.

Specification of engineering products in the sector-model

Steel structures

Storage tanks

Piping

Hand tools for general use

Hand tools for special use

Special machine tools for industry use

Cutting machine tools for metal industry

Plastic moulding dies

Industrial fittings

Fittings for dairy plant and fire-fighting equipment

Fixtures for building industry

Pipe joints

Sanitary equipment

Fire-fighting equipment

Locks, fittings for furniture

Other fittings

Screws, bolts, nuts, rivets

Packaging materials /steel and metal/

Hand tools for agriculture

Engines, prime movers

Steam boilers

Equipment for air cooling, heating, conditioning

Pumps, compressors, fans, blowers

Elevators, conveyors

Metalcutting tool machines: lathes, planers and shapers, drilling machines, milling machines, grinding and finishing machines

Machines for forging and hot stamping

Machines for cold manufacturing of sheet and rod material

Special tool machines

Railway locomotives and motor waggons

Railway cars and waggons

Buses

Trucks and lorries, dumpers

Motor cycles

Ships

Mining machines

Machines and equipment for metallurgical works, rolling mills and foundries

Machines and equipment for building materials industry

Other machines for heavy industry

Machines for disintegrating, sizing, charging, mixing

Machines for chemical industry, petroleum refining, the textile, the leather, the rubber, the wood, the paper and the food industries

Tractors

Tillers

Seeding machines

Machines for chemical plant protection

Harvesters

Transmissions, gears, gear drives

Bearings

Couplings, clutches

Springs

Electrical motors and generators

Tranformers

Low-voltage electrical equipment

High-tension electrical equipment

Electrical heating equipment for industry

Rectifiers

Electrical driven hand tools

X-ray equipment

Equipment for electrical welding

Storage batteries, cells

Electrical conduit fittings

Electrical lighting fittings

Equipment for kitchen and catering trade

Household electrical appliances

Telegraph and telephone apparatus

Wire communication

Radio transmission and receiving sets, TV receiving sets

Radio receiving and electro-acoustic equipment

Electronic sets

Electrical equipment for remote indication and control

Industrial electronic equipment

Rectifiers for communication

Components for communication apparatus

Electrical sources of light

Electronic valves

Other products of vacuum-engineering

Mechanical instruments

Thermic instruments

Optical instruments

Physico-chemical instruments

Electrical instruments

Electronical instruments

Medical instruments

Therapeutic and test sets

Laboratory instruments

Photographic equipment

Apparatus for school demonstration

Office machinery

Gas generators for welding

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