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UNIDO'S SUPPORT TO THE IRON AND STEEL
SECTOR IN DEVELOPING COUNTRIES*

Prepared by the

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1. IRON AND STEEL INDUSTRY IN THE WORLD - THE GROWING ROLE OF DEVELOPING COUNTRIES

The structural crisis of the iron and steel industry in the world has only incompletely and hesitantly been overcome. The level of world steel production in 1985 (720 million tons) was still far below the 1979 level (746 million tons) and almost at the same level as 1974 (704 million tons). The drops in world steel production were absorbed mainly by the industrialized countries. Developing countries, on the other hand, increased their production from 57 to 104 million tons between 1975 and 1984, equalling an increase in the share of world production from 9.3 to 16.9 per cent (see attached chart).

Consumption of steel has undergone similar changes. Steel consumption has steadily increased in developing countries and generally declined in industrialized countries. Apparent consumption in developing countries increased from 102 million tons in 1975 to 171 million tons in 1984. Their share in the world steel consumption during this period increased from 15.9 to 23.7 per cent (as shown in the attached chart).

Also in international steel trade the producers from developing countries have increased their share of exports considerably at the expense of the traditional exporting countries. The share of developing countries in world export of steel products increased from 2.4 to 11.7 per cent between 1975 and 1984.

In spite of the increase of their steel production, the developing countries still cover the bulk of their steel requirements through imports. As can be seen from the attached chart their share of world steel import continues to grow (31.7 per cent in 1975 and 33.6 per cent in 1984), although at a slower rate than their total consumption. On the other hand the share of imports in total steel consumption of the developing countries fell from 55 to 47 per cent between 1975 and 1984.

Note: All statistics in this paper are taken or derived from IISI statistics. Country groups in conformity with UNSO groupings.

The production capacity in developing countries practically doubled between 1975 and 1984 (86 to 166 million tons). Capacity utilization fell from 75 to 72 per cent between 1975 and 1984.

Substantial and continuous changes have taken place in the field of steel making technology. These changes are characterized by a decline in steel production by the open hearth furnaces process and an extension of the electric arc furnaces process and direct reduction. Greater use of secondary metallurgy, plasma and electroslag melting, a stable increase of continuous casting, further introduction of automation and computer controls and a wider use of mini steel plants are also among technological changes that have characterized this period.

The above facts show that the world iron and steel industry has undergone profound structural changes with respect to production, consumption, trade and technology. The process of restructuring is still continuing. It is still too early to make a complete evaluation of this process but it is fully clear that most of the changes have brought about larger shares and more participation in the industry of developing countries.

The following sections outline the main problems which the developing countries have to face in building up their iron and steel industry, UNIDO's main approach in support of this process and a resume of the means available to the organization as well as a description of recent achievements.

2. MAIN PROBLEMS FACING THE DEVELOPING COUNTRIES

For many developing countries the iron and steel industry is extremely vital in the industrialization process, not only as a supplier of steel products, but also as a means to reach a self-sustained and comprehensive economic and social development. This requires an economic and industrial planning that must include many other industries than the iron and steel industry itself, with special emphasis on the capital goods and related sectors.

In many developing countries the domestic markets for metal products are, however, too small for the establishment of large scale integrated iron and steel works. Such countries could satisfy their steel requirements through mini-steel plants based on the electric arc furnace process. This process, which can be used on a relatively small scale, is attractive to developing countries and particularly to those countries which want to satisfy their demands in long and light products. On the other hand, the ideal raw material for electric arc furnace steel-making is scrap, which as a rule is not sufficiently available in developing countries. In this connection an alternative to the scrap based process - the technology of direct reduction/electric arc furnace steelmaking has lately been receiving widespread attention.

Newcomers to the steel sector may face problems of small domestic demand which cannot support economies of scale, lack of indigenous technical and managerial expertise, inadequate infrastructure and shortage of capital for the required investments. Some of these problems can be solved through co-operation among producers at national, sub-regional and regional level. Problems with a too-small domestic market might be overcome through regional or subregional co-operation.

A development towards an integrated production system, at national or subregional level, will require that developing countries succeed in the mastering of the corresponding technologies.

The final decision concerning the establishment of an iron and steel plant and its type must be based on a thorough examination of many factors, such as:

- (a) Availability of raw materials and energy;
- (b) Demand for iron and steel products (quantity, quality and types of products);
- (c) Possible technological routes and equipment;
- (d) Status of infrastructure;
- (e) Manpower and training requirements;
- (f) Financial aspects;
- (g) Possibility and scope of regional/sub-regional co-operation.

Issues relating to these factors must also be addressed by the international organizations which support the industrialization of developing countries.

3. UNIDO STRATEGY FOR SUPPORTING THE IRON AND STEEL INDUSTRY IN DEVELOPING COUNTRIES

Within its general goal of accelerating the industrialization of developing countries UNIDO assists these countries in the promotion, establishment and rehabilitation of the iron and steel industry. UNIDO's basic role in the development of the iron and steel industry in the developing countries is of a promotional character. UNIDO does not engage directly in the construction and running of industrial plants except for pilot plants and training centres for demonstration purposes. The key elements of UNIDO's strategy in this field are:

(a) An integrated approach to the development of the industry. The planning of the establishment and development of the iron and steel industry of developing countries should be carried out in close relation with metal-using sectors of the economy and particularly with the capital goods industries.

(b) A careful selection of suitable technologies. The technology selected should match the size of a country/region, the products to be produced and available national raw materials and energy. The mini-steel technology assumes a special importance, as being particularly suited for a large number of developing countries which have no iron and steel industry or only an embryonic one.

(c) Special emphasis on the mastering of technology including meeting manpower, training and financing requirements.

(d) The promotion and development of economic co-operation among developing countries. The importance of such a co-operation for the acceleration of industrialization in general and the development of the iron and steel industry in particular is evident.

4. MEANS AND ACHIEVEMENTS

UNIDO has many possibilities to assist developing countries towards self-sufficiency and self-reliance in the iron and steel industry.

UNIDO's activities are centered around the technical assistance programme. In addition to this direct technical support UNIDO can also provide assistance in the review of policies and strategies, preparation of sectoral studies of the iron and steel industry to help countries define critical areas for action and the establishment of new forms of international co-operation through discussions within the System of Consultations. A number of special programmes such as investment promotion, ECDC, advanced technologies etc. also contribute to these efforts.

4.1 The System of Consultations

Through the System of Consultations UNIDO offers a forum for contacts and consultations aimed at finding new forms of international co-operation to further the industrialization process. The objective is to achieve the goals set forth in the Lima Declaration through consultations between industrialized and developing countries and among developing countries themselves.

The System of Consultations gives great focus to practical and well-defined issues directly related to stimulate progress in industrialization. Three consultations on the iron and steel sector have been held in 1977, 1979 and 1982 respectively. Each consultation makes recommendations on issues affecting the iron and steel industry and proposes follow-up action for the next consultation meeting. The recommendations range from basic to fairly complicated issues, such as those related to the development and feasibility of the mini steel plant technology, its relevance for the entry of newcomers to the iron and steel sector as well as the difficulties of training and financing its development.

The Third Consultation meeting discussed, against the background of alternative scenarios for the long-term development of the industry, the following specific topics: (1) Training of manpower; (2) financing of iron

and steel projects in the developing countries; and (3) entry of newcomers into the steel sector. The Fourth Consultation meeting to be held in June 1986 in Vienna will discuss three major items: (1) Present situation, prospects and the need for more integrated development of the iron and steel and capital goods sectors and other sectors; (2) the mastering of the technology and development of the iron and steel industry in developing countries; and (3) the financial situation and perspectives of the iron and steel industry.

4.2 Studies

UNIDO's Industrial Studies are conducted at the global, regional, country and sectoral level for the promotion of the industrial development of the developing countries. The role of the industry in the context of industrialization and economic development is treated in the Global Report 1985. The sector is also given emphasis in regional and country studies issued on a regular basis.

Studies on the iron and steel industry at the sectoral level are done continuously by the Sectoral Studies following an established three-stage approach: analytical appraisals of current and future trends in the industry, elaboration of alternative sectoral strategies for the sector and practical application of research findings.

The research publications serve many different users inside and outside UNIDO. The first stage provides a source of information and reference for member countries and also serves as background to the sectoral consultations. Recently, special studies on the iron and steel industry in the ESCAP as well as the ESCWA region have been undertaken. Studies on Africa and Latin America will be issued in 1986.

The second stage provides inter alia input to the System of Consultations. Examples are: 1990 scenarios for the iron and steel industry for the Third Consultation meeting and a study on manpower and training requirements in different routes of iron and steel production for the Fourth Consultation meeting.

The third stage of the research approach, is composed of practical testing or field application of research finding or proposed solutions to specific problems. These studies are undertaken in close co-operation with the Department of Industrial Operations. For the time being a method for determining manpower and training requirements is being tested in Mongolia and Zimbabwe.

4.3 Technical assistance

Technical assistance to developing countries is one of main priorities of UNIDO. This assistance is provided by UNIDG's Department of Industrial Operations.

The bulk of technical assistance relates to planning the establishment of new metallurgical plants or the expansion of existing ones. Another priority area is the provision of expertise to improve plant operations and performance as well as quality of output. Projects aimed at the establishment and/or expansion of metallurgical R and D units also receive high priority. A number of projects focus on improving local capabilities to master the evaluation, concentration and beneficiation of ores and minerals. This involves metallurgical investigations and testing on laboratory and pilot plant scale to establish the characteristics of raw materials and their processing into added value agglomerates and metal products for home use and export. Another priority area is the introduction of scrap collection and processing systems. If properly collected and processed it provides valuable raw material for use in foundry and steel plants.

During 1985 special emphasis was placed on projects related to the development of the iron and steel industry and about 40 projects in this field were under implementation. Examples of projects may be provided as follows:

A project covering a comprehensive techno-economic evaluation for the establishment of a mini steel plant in the Republic of Mongolia has opened a wide door for the transfer of technology for small-scale steel production in the remote country. The project report has recommended the establishment of a

100,000 tpy steel plant, based on domestic scrap, limestone and power utilization to feed the growing steel market in Mongolia. The formulation of technological process routes for iron and steel production in Bolivia based on local iron ores and natural gas has been completed and is expected to lead to significant capital investment by the country in the near future for the establishment of sponge iron/steel industry.

Laboratory bench-scale investigations on the production of sponge iron for steelmaking based on iron ores and coals of Viet Nam have been completed with encouraging results and pilot plant tonnage scale tests are now being implemented at the UNDP/UNIDO established Pilot and Demonstration Plant for the Production of Sponge Iron in Paloncha, Kothagudem, India, through a regional sponge iron project which should lead to the establishment of a sponge iron plant in Viet Nam. Under the same regional project, pilot plant tonnage scale investigations on Nepalese ores and coals will be taken up in the near future. Iron ores and coals from Niger will also be tested in India during 1986.

The Iron and Steel Institute in Argentina, which has received significant assistance from UNIDO, has now come to a stage of total self-reliance and technological self-sufficiency. In Paraguay the industrial sector is participating dynamically with the UNIDO executed project related to technological strengthening of the metallurgical industry and with the counterpart institute. TCDC contacts are being set up with Brazil and Argentina.

High level technical assistance has been given to the Zimbabwe Iron and Steel Company (ZISCO), which is the leading iron and steel plant in this sub-region of Africa. Improved electrical maintenance of ironmaking, steelmaking and rolling mill equipment led to increased productivity of the plant. Zimbabwe has requested further UNIDO assistance in the automation of the bar rod rolling mill at ZISCO. In turn, a team of experts from ZISCO assessed the existing metallurgical industries in Angola, Ethiopia and Mozambique and offered concrete technical operation assistance as well as recommendations to be implemented in the future.

Technical assistance was provided to Mozambique to strengthen the national capabilities in steel industry development, particularly in the evaluation of bilaterally prepared reports for the establishment of a large scale iron and steel industry. In Angola, the first scrap collection and processing plant was commissioned under a UNIDO project during 1985 and is now providing necessary raw material for the local steelmaking industry, saving foreign currency hitherto spent on imported scrap or billets.

After completion of projects related to the introduction of managed maintenance in the East Slovakian Steelworks at Kosice in Czechoslovakia, the follow-up project, a National Technical Consultancy and Training Centre, has become a basis for regional and interregional activities, inter alia a preliminary assessment of the needs for establishing computerized maintenance systems in Mexican iron and steel plants. Other projects in this field are considered for India and for the ASEAN countries. The Intercountry Programme for Managed Maintenance System in metallurgy and foundry industry at the Egyptian Iron and Steel Company in Helwan carried out a number of regional activities in diagnostic missions to Ethiopia, Kenya, Sudan and Zimbabwe and a number of regional activities including the provision of training to Ethiopia, Kenya, Sudan and Zimbabwe.

Under a regional programme for the Arab iron and steel industry seminars have been held relating to computer application, personnel management and maintenance management in the steel industry, respectively.

4.4 Industrial training

Training in the iron and steel industry is one of the central components of the UNIDO technical assistance programmes. The UNIDO training activities, as in other industrial sectors, are grouped in three main categories. These are:

- (a) Field operations;
- (b) Group training activities;
- (c) Individual fellowships and study tours.

(a) Field operations

The field operations have become the priority preoccupation of UNIDO for the establishment or strengthening of the training capacities of the developing countries for the achievement of self-reliance and self-sufficiency. The establishment or strengthening of training capacities through the training of trainers, the assignment of industrial training experts and the provision of equipment is preceded by a training needs assessment.

In 1981 UNIDO surveyed the needs of selected countries in Africa and Asia to establish training capacities in small-scale foundry operations. In 1984 a detailed study was carried out on the training needs of Turkey for establishing a Training and Technological Manpower Development Centre for its own needs and for those of other developing countries. A similar project was implemented in Africa for the Preferential Trade Area (PTA) for strengthening the training capacity of the Zimbabwe Iron and Steel Company (ZISCO) and for establishing training units in PTA member countries. Parallel to this a project for establishing a training capacity at ZISCO in planned maintenance for the PTA was implemented in 1985.

A computerized maintenance capacity in the iron and steel industry in Egypt providing training both at national and regional levels for the Arab region and Africa is also established.

Training of trainers

In recent years a strong emphasis has been put on the training of trainers. This activity is done either in developing countries through training experts or through overseas training. The key element for establishing a training capacity of the above-mentioned projects for Turkey and the PTA is the training of trainers, which already started through overseas training.

A pilot project for the training of trainers was initiated in Poland in 1985 in foundry technology following the programmes in modern foundry technologies organized since 1977. This programme follows the 1981 UNIDO survey in selected countries in Africa and Asia.

Co-operation with universities and industry as well as industrial training experts plays a fundamental role in UNIDO's activities for training of trainers and other training activities.

(b) Group training activities

The group training activities are aimed at upgrading the skills and know-how of the technical and supervisory personnel already employed in industry or at providing the basic skills and technical know-how of personnel with an employment commitment. The first group training of UNIDO was organized in 1965 in iron and steel in USSR and is repeated twice annually. About 800 engineers from about 60 developing countries have been trained since then.

The number of group training activities organized in developing countries is increasing. The training provided in Egypt and Turkey since 1983 for the Pakistan Steel Mills Corporation are expected to continue in the future. The Egyptian Iron and Steel Company in co-operation with the Arab Iron and Steel Union is also hosting group training activities for Africa in planned maintenance. Interregional group training programmes have been regularly organized in Turkey since 1984. Turkey is also the host of the group training programme in small-scale foundry operations for LDCs repeated annually since 1979.

Other group training programmes organized by UNIDO are e.g. ad hoc programmes for ZISCO in Austria in 1983; steel standardization in Brazil in 1983; energy conservation in the United Kingdom in 1983 and a group training programme in rolling mill operations for CIFEL, Mozambique, organized in Bulgaria. The number of participants to be trained in 1986 is expected to increase to about 120.

(c) Individual fellowships and study tours

Individual fellowships are tailor-made training activities designed to meet the specific needs of the fellows. The individual fellowships are aimed either at solving specific technical problems in the industry, introducing a new technology or training of trainers. For countries like India, which already master the traditional technology, fellowships are more and more geared to the acquisition of new technology. This trend can be easily observed in the fellowships and study tours for 1983 to 1985 as an increasing

emphasis on fields such as carbonaceous raw materials characterization, sponge iron technology, extraction metallurgy, computerized process control system, combined blowing steelmaking process and electronics, etc.

The study tours which usually are for senior technical and managerial staff and for a shorter duration than the fellowships are primarily designed for exchanging views with colleagues in other countries, for obtaining information on technological developments or for studying solutions to technical problems or comparing results in research and development with other scientists in countries with more advanced technology.

Although the placement of individual fellows and the study tours traditionally take place in the developed countries in Europe and North America there is an increasing number of activities also in developing countries.

4.5 Special programmes

Special programmes of UNIDO on technology and industrial co-operation among developing countries have great potentials for stimulating the development of the iron and steel industry even if the activities of these programmes so far have been limited in this sector.

Technology programme

The programme is directed towards two interrelated goals:

(a) To encourage appropriate policy responses by developing countries to the changing technological scene and a strengthening of their technological capabilities; and

(b) To implement a broad-based programme to help developing countries in the selection, acquisition and development of technology.

The following activities relating to the iron and steel industry are being undertaken on a regular basis:

- The publication of Industrial Development Abstracts containing among other information references and abstracts of UNIDO documents on the iron and steel industry.

- The publication of a Directory of Industrial and Technological Research Institutes in the Metallurgy Sector.

Some other activities implemented under the technological programme that can be mentioned are:

- The preparation of standard project documents for the establishment of metal production development units for casting.

- The publication of an issue of Advances in Material Technology: Monitor devoted to high strength low alloy steel (Issue no. 1, November 1983).

Industrial co-operation among developing countries

The main goal of this programme is to promote economic and technical co-operation among developing countries. The objectives of this programme are primarily intended:

(a) To promote the spirit of solidarity and to increase the awareness of the necessity and possibility of economic and technical co-operation among developing countries;

(b) To encourage the developing countries to adopt policies and measures favourable to ECDC/TCDC in order to obtain maximum benefit for them;

(c) To promote co-operation in specific industrial projects as well as specific projects in order to strengthen the indigenous capabilities of the developing countries.

The activities of the last year as far as iron and steel is concerned included the organization of an expert group meeting on the preparation of guidelines for the establishment of mini-plants on iron and steel with special

emphasis on Africa, held in Vienna from 2 to 4 December 1985. This meeting determined, through bilateral discussions among the participants, the needs and capabilities of the participating countries as well as the joint production possibilities. The meeting also agreed on the main items to be included in the guidelines for newcomers to mini iron and steel plants and discussed the possibilities of establishing multinational production enterprises in the iron and steel sector in Africa.

5. TOWARDS THE YEAR 2000

The iron and steel industry is undergoing substantial structural changes.

The decline in steel intensity in industrialized countries which was originally initiated by the energy crisis has further accelerated due to such factors as a reduced steel utilization caused by the slowdown of economic growth, a reduction of the share of metal used in the total output, a decreasing use of steel by such industries as shipbuilding, heavy machinery and automobile industry, the introduction of non- and low waste technologies, widespread utilization of high quality steels, substitution of steel by plastics, ceramics, non-ferrous metals etc.

Some of these factors already have started to influence the development of the iron and steel industry in developing countries, others will come into operation at the later stages of the industrialization of these countries. It could be expected in this connection that in 20 to 30 years time steel consumption in developing countries will decline or at least stabilize.

It can further be expected that in both industrialized and developing countries mini-plants will expand further, forcing large integrated iron and steel works to specialize further in more sophisticated products of high quality and high value in big quantities.

As far as the future of mini-plants is concerned it can be anticipated that they will undergo essential evolution. Mini-plants will produce a far wider range of products both long and flat ones, encouraging the development of such technologies as gas- and coal-based direct reduction and plasma furnace

technology, which hold potential for technological breakthroughs in further transforming steel making from a batch into a continuous process. Direct reduction based plants will include a strip or even a plate mill which will become possible due to the achievements in thin strip casting. The next 15 years may well bring technology innovations comparable to those of continuous casting and the BOF technology, which will remain one of the major processes in steelmaking for many years to come.

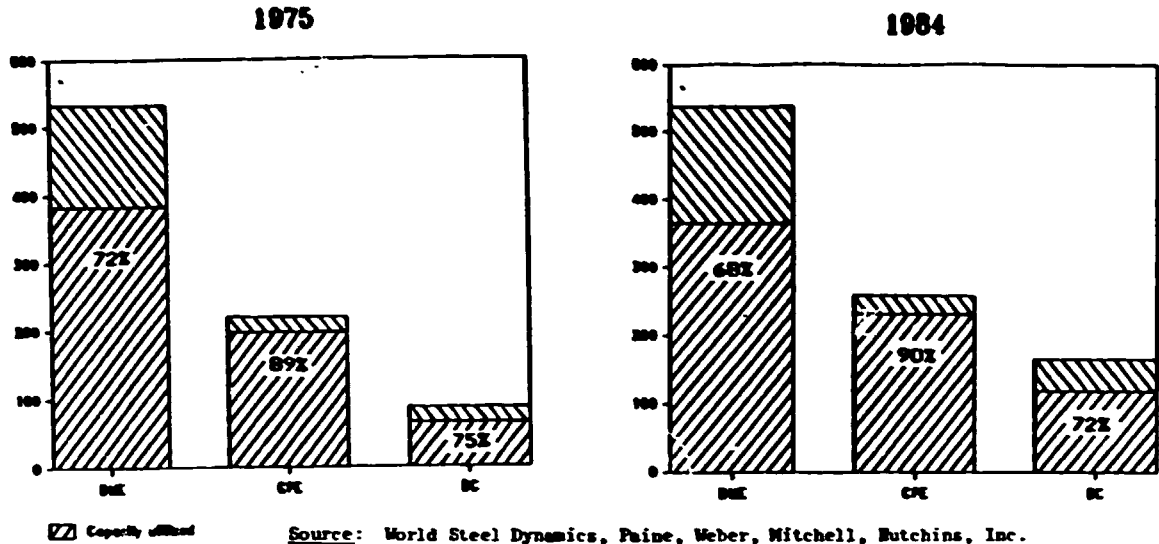
In developing countries, the spread of mini-plants could have a substantive impact on industrial development through the strong linkages between the steel industry and other parts of industry. However, developing countries face major obstacles in securing the funds to finance their infrastructure, in solving technological problems associated with expanding industrial output and usage of steel and in providing suitable training for steel industry personnel.

UNIDO's future activities to the steel sector must reflect this changing industrial environment when supporting developing countries in building up a viable iron and steel industry.

This would involve strengthened support to mini-mill operations but with close attention also to the development of new technologies and products. An important function for UNIDO would further be to provide industries and policy-makers with information about long-term trends and tendencies in the international development. This could help to smooth the seemingly unavoidable international restructuring by reducing the uncertainty of the decision makers.

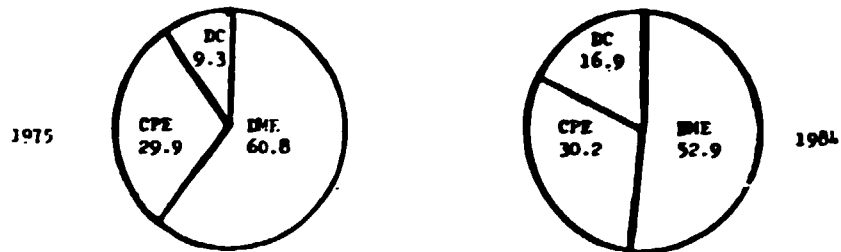
Further emphasis must also be put on problems related to financing and training. A sectoral approach would seem warranted and should be further pursued.

World capacity and capacity utilization (in million metric tons)

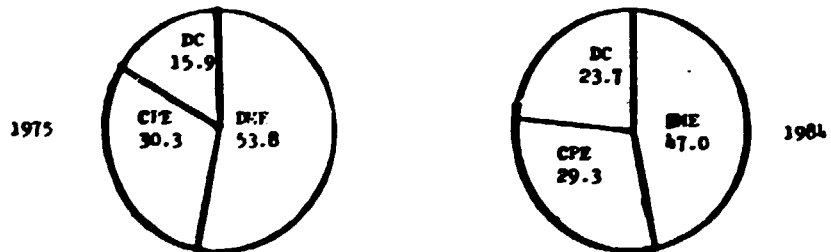


Source: World Steel Dynamics, Paine, Weber, Mitchell, Hutchins, Inc.

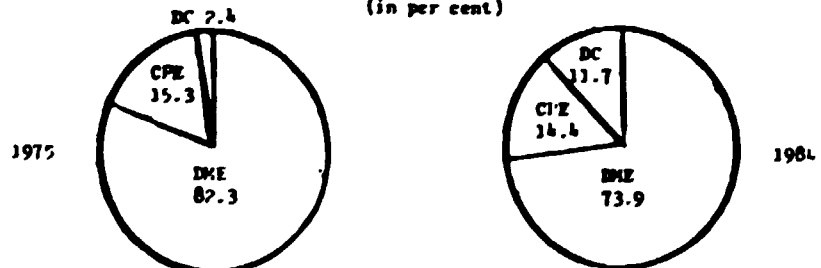
Geographical distribution of steel production (in per cent.)



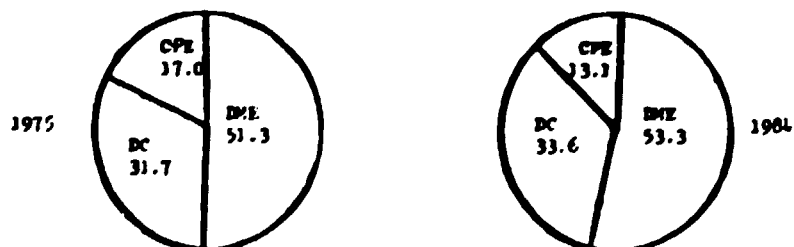
Geographical distribution of steel consumption (in per cent.)



Geographical distribution of steel exports (in per cent.)



Geographical distribution of steel imports (in per cent.)



DME - Developed market economies
 CPE - Centrally planned economies of Europe
 DC - Developing countries

Source: World Steel Figures, International Iron and Steel Institute