COMMISSION OF THE EUROPEAN COMMUNITIES

SEC(83) 151 final. Brussels, 8 February 1983.

THE EUROPEAN MACHINE TOOL INDUSTRY

COMMISSION STATEMENT

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I. REASONS AND OBJECTIVES

1. The machine tool industry holds a key position in the production systems of the developed countries. As the essential springboard for the spread of innovation in all industrial processes, it must currently tackle the changes associated with the integration of electronics and meet growing international competition, all in a climate of slack investment.

   The importance of this industry for the Community has now gained wide acceptance: the rapid development of automated production is seen as one of the chief means of ensuring the vitality and continued growth of Europe's industrial machine.

   The Community can hold its position as the world's foremost producer of machine tools (1) only by an aggressive strategy that will quickly overcome its present handicap in relation to Japan in the field of advanced production equipment (notably machining centres and numerically controlled lathes) (2) and by resolutely exploiting its technological capabilities to win a sizeable share of the market for automated production systems.

   The machine tool industry, which, of course, is the one directly concerned and primarily responsible, has clearly demonstrated its willingness to embark on this course. The organization representing it at Community level (3) has so informed the Commission, which it asked, in a statement published in December 1981, to assist the sector in its efforts to improve its competitiveness.

   The trade union organizations (4) have likewise expressed anxiety with regard to the industry's future and urged that it receive special attention at Community level.

   Lastly, some of the Member States have formed and implemented measures to further the development of their own industries, notably through sector development programmes and within the more general framework of policies to stimulate investment.

2. The Commission has noted the readiness shown by the industry to launch an aggressive recovery strategy. It realizes that this is of vital importance to the Community and ought to be accorded priority both by the Member States and at European level.

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(1) The Community's share of world machine tool production is close to 30%.
(2) Between 1976 and 1980, European production of machining centres and numerically controlled lathes rose from 1 952 to 6 319 units; in Japan it rose from 2 599 to 17 267 units (see attached study).
(3) CECIMO: European Committee for Cooperation in the Machine Tool Industries.
(4) EMF: European Metalworkers' Federation.

It is up to all economic operators to do everything they can to further the development of this branch of industry for the following reasons:

- The demand for machine tools, which by their very nature will form an integral part of the production system, is particularly sensitive to the general trend of investment, on which national macro-economic policies exert a decisive influence;

- The sweeping changes in production systems now in progress affect not only the manufacturers of capital equipment, but also its users and, of course, the labour force which produces and operates it;

- Trade in this type of equipment, both inside and outside the Community (1), is on such a scale that it is truly essential to preserve free competition;

- The machine tool industry, which is largely made up of small and medium-sized firms, is an extremely important component of Europe's industrial fabric;

- What is at stake is the maintenance and improvement of the competitive position of a large part of European manufacturing industry.

The Community dimension will be a decisive factor for the success of efforts by the European machine tool industry to strengthen its competitiveness, because:

- the main problems are on a Community scale, notably in terms of the size of markets; the technological changes now in progress require an increase in the length of production runs over an increasing range of products;

- the development of distortions or a return to market compartmentalization within the Community would counteract any adjustments made.

The Commission intends to give active and concrete assistance with the definition and implementation of the necessary action. It has made a study of the problems that need to be tackled by the machine tool sector in close collaboration with the trade associations and unions and with due regard for measures either adopted or envisaged by the Member States. The industry has already put forward specific and constructive proposals; this statement is the first response to them.

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(1) The Community exports 40% of its machine tool production.

The Commission's analysis of the situation and the way it intends to exercise its own responsibilities are set out in the document entitled "The European machine tool industry - Situation and prospects", which it puts forward in support of its statement with the threefold objective of:

- meeting the industry's wishes and the anxieties voiced by the trade unions with a detailed response to the views they have expressed. The Commission's report is not an exhaustive study. Further reflection on the automation of production systems would embrace the whole spectrum of industries producing industrial capital goods, of which the machine tool industry is only one segment;

- providing a point of reference in discussions centering on the various support measures being introduced by some of the Member States (e.g. as part of sector development plans or actions to promote investment) in order to avoid situations that might adversely affect the adaptation process in the machine tool sector by upsetting the smooth functioning of the internal market and interfering with free competition;

- helping to relieve commercial tensions by following the guidelines adopted by the Council for the definition of a strategy in relation to the Community's main partners.

The method used by the Commission to achieve these objectives relates the aims in view, the responsibilities of those concerned and the procedures to be used.

This kind of multilateral approach together with the guidelines for an industrial strategy which it has recently drawn up (1) will be the basis on which the Commission will handle action within its own sphere of responsibility while relating it to the responsibilities of the firms, the Member States, the other authorities and the economic and social operators.

All these facts lead to the conclusion:

- that the European machine tool industry is faced with the necessity to increase its efficiency by making the most of the Community dimension and by making its own efforts to rationalize its structures;

- that it must face up to the permanent changes arising from technological development;

- that these adjustments are again made more difficult because of the continuing adverse economic climate.

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(1) See COM(81)639 "A Community strategy to develop Europe's industry".

II. COMMUNITY ACTION: AN OPERATIONAL PROGRAMME OF WORK

Actions which the Commission has decided to undertake can be grouped under six headings:

1. Revival of investment: an essential framework

Although the situation varies considerably between Member States, the general trend over the past few years has been for Community production facilities - the capital equipment of European firms - to age in comparison with that of Japanese and American competitors. (1)

This trend is disturbing all round, but particularly so in the case of the machine tool stock, which, on all the available evidence, is becoming rapidly obsolescent in relation to that of Japan and the United States. The level of numerically controlled machine tools is symptomatic of the situation: in 1980, Japan was using almost as many of these as France, the Federal Republic of Germany and Italy put together, although in terms of production by the mechanical and electrical engineering industries Japan's output in that year was barely 65% of the combined output of those three Member States.

If the decline in investment which is at the root of this phenomenon became a permanent feature, there would be reason to fear a gradual erosion of the Community's industrial base and an increasing loss of competitiveness by its manufacturing industry.

In March 1982, the European Council expressed concern at the weakness of productive investment in Europe. Action to revive industrial investment is justified both by the need to react to the depressed state of the economy and by the grave risk of deterioration in the capital goods-producing industries which are caught between weaker demand and keener international competition and can no longer muster the resources needed for technical and structural adaptation.

The Commission has already sent the Council two communications with a set of proposal and guidelines on the action needed to promote investment. (2)

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(1) Commission working paper II/III(82) 387 "The competitiveness of the Community industries".

(2) COM(82) 365: Commission Communication to the Council on the problem of investment; and
COM(82) 641: Commission Communication to the Council on initiatives for promoting investment.

It takes the view that the machine tool industry should be recognized as having strategic importance. Its general approach as outlined in its communications is therefore that the methods of support and the type of action to be taken must be designed in a manner that is consistent throughout the Community. This is an essential requirement for success, firstly because measures adopted nationally exert a decisive influence, secondly because the overall and sectoral approach should complement each other.

With a view to showing how the existing measures can be improved and coordinated, the Commission, in collaboration with representatives of the industry, has completed an initial study on the effectiveness of the schemes already in operation, as perceived by those they are designed to help. The Commission is to carry out more detailed analyses on this subject, after which it may propose to the Member States that they harmonize their procedures, by adopting appropriate legal instruments, in order to achieve maximum efficiency and compatibility.

The Commission has of now approved the following actions and guidelines on the objectives to be pursued, the methods to be employed and the beneficiaries:

- as regards the objectives, it is essential to remove short-term disincentives to investment and to promote the development and the rapid diffusion of new technologies throughout production processes, in the context of boosting the demand for industrial equipment;

- as to the methods:

  . as far as national mechanisms for promoting investment are concerned (of which the weakness is due to the difficulties being experienced by the users of production equipment because of high interest rates, the lack of capital and cash flow of a number of firms and sluggishness in demand) it will be proposed to the Member States that they harmonize their laws on lines that favour the most effective procedures, i.e., according to the operators concerned, systems such as tax allowances for investment and the more novel mechanisms introduced in some of the Member States (e.g. the MECA system in France, the Sabatini Law in Italy, and the United Kingdom's aid scheme for flexible manufacturing processes).

  . The Commission for its part will endeavour to ensure that companies have adequate access to the resources that can be mobilized by the Community's financial instruments. Even now productive investments by small and medium-scale undertakings

can be financed by loans from NCI funds or from the EIB itself. Recently, moreover, (1) the Commission suggested that projects eligible for NCI aid should include those that help to strengthen the Community's economy, e.g. by the diffusion of new technologies and innovations. Thus the machine tool industry has a twofold claim to loans from Community financial instruments: (a) it is largely composed of small or medium-sized firms and (b) it is a vehicle for advanced technologies. The Commission therefore intends to draw the attention of the financial intermediaries who distribute EIB or NCI global loans to the importance it attaches to this sector.

. Beneficiaries: Simultaneous action must be taken to assist both the producers and the users of machine tools in order to promote the best possible correlativity between supply and demand so that the manufacturers' ability to use their own products is maintained (it is particularly important for the manufacturers themselves to be able to use the most advanced equipment).

2. Matching supply to demand

The efficiency of the Community's industrial production system is closely dependent upon the quality of its production equipment. The process of automating manufacturing industries which started a few years ago is rapidly gaining momentum and will have a major impact on the future composition of demand for machine tools. It adds to the uncertainty of any assumptions that might be made by industrial undertakings and could entail far-reaching changes in the organization of production and in relations between the parties concerned.

In commenting on the situation, the European machine tool industry has called for an exploratory study of the market with a view to analysing the future composition of demand for machine tools and determining how the supply can be matched to it.

Clearly the industry itself will have to accept full responsibility for any such study. In view of the paramount importance of the market side of the problem and of the constraints imposed by the structure of the sector (many small and medium-sized firms), the Commission has:

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(1) COM(82) 601 final: Proposal for a Council decision on the New Community Instrument.

- agreed to the principle of providing logistic and financial support for this exploratory survey of the market, provided that the industry takes over the actual running of it - including its implementation;

- undertaken a methodological study, the results of which will be known by the end of 1982: its purpose is to define the scope of the survey, the terms of reference and the operational methods and work patterns to ensure that the means fit the ends. In view of the scale of the project it will be impossible to come to a decision on all points until thought has been given to shaping the terms of reference;

- requested the Council and the European Parliament to take account of the special budgetary requirements which the decision will entail. Since they share the Commission's view of the importance of the matter, the Council and Parliament have made a token entry against the budget item requested for 1983. In order to carry out its responsibilities, the Commission will undertake the required actions to the extent that the necessary funds may become available in the course of implementing the budget as adopted. (Estimated amount: 1.2 Million EUA).

3. Compatibility of the structural adjustments

The technological evolution now under way will bring structural changes with it. Along with questions relating to the size and organization of firms, problems will arise increasingly in connection with their financial structure, a factor that crucially affects their ability to adapt and grow. In these fields - amalgamations and government aids - the Commission has special responsibilities resulting from its powers in relation to competition, in the exercise of which it will be guided by the outcome of the exploratory survey mentioned above.

Some of the Member States have introduced sector schemes concerned with the restructuring of the machine tool industry; incentives are offered for inter-company cooperation, usually with support from public funds.

In view of the need to strengthen the competitiveness of the European machine tool industry, which is an objective common to all the Member States despite the industry's very disparate performance and level of development in them, the Commission will endeavour to create conditions under which an adjustment of the productive apparatus can take place by carrying out its responsibilities along the following lines:

- With regard to state aid, in the present situation the machine tool industry is receiving assistance from public funds under various headings. The Commission will satisfy itself, when

assessing measures to aid the machine tool industry notified pursuant to Article 93, that they provide a compensating Community interest in that they respect in principle the prohibition in regard to operating aids as provided for in the Treaty. It will re-assess the effects and transparency of general or regional systems, which may also have considerable impact on industries such as machine tools, in order to avoid disparities resulting from support procedures rather than the nature of actual aid.

- As regards measures to meet the need for closer cooperation upstream and downstream of the sector owing to technological evolution and the constraints of the competitive situation, * there are likely to be major adjustments which only the most competitive and best adapted undertakings will be able to cope with.

For these the changes now under way will mostly entail an increase in scale - economic, industrial and financial - for reasons that are partly technical (products becoming more complex in design and costlier to produce) and partly commercial (expansion of the sale of production systems and standardization of products). The Commission will not oppose the resultant structural changes. It will assess measures affecting the structure of the sector according to their conformity with Articles 85 and 86 of the EEC Treaty. The machine tool industry comprising over 2.800 firms within the Community is confronted with the adaptation of its structures to the conditions required by the research of competitiveness within a Community market which must of necessity be kept open. In this respect the Commission stresses its positive attitude towards small and medium size firms in regard to certain forms of co-operation and/or specialization which give favourable results in research, production or distribution (1).

On the third point - improvement of the financial structure of the undertakings - it should be noted that most machine tool builders in the Community are small or medium-sized firms with two pronounced weaknesses: inadequate capital resources and a disproportionate amount of short-term debt in their balance-sheets.

These weaknesses testify to one of the characteristic shortcomings of the financial environment of European firms compared with that of their Japanese competitors: the difficulty the Community financial systems have in procuring long-term, high-risk capital for a sector

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* See sections I/A/3 and II.C.1 of the attached document.

(1) Commission notice of 27.5.1970 concerning agreements of minor importance, modified by notice of 19.12.1977, O.J. C 313 of 29.12.1977, p, 3. Commission notice of 1968 concerning cooperation between firms, O.J. C 75 of 29.7.1968 p. 3 corrigendum: O.J. C 84 of 28.8.1968, p. 14. Regulation (EEC) No 2779/72 concerning the application of Article 85, paragraph 3 of the Treaty on specialization agreements, modified by Regulation No ...../82 O.J. L ... of ..... (to be published shortly).

whose current profitability does not permit it to generate sufficient funds of its own, while the small scale of the undertakings limits their ability to come to the stock market.

To help find a solution to these problems, the Commission is giving thought to the kind of framework within which the whole problem of finance for industry could be dealt with, since clearly it is one that far exceeds the immediate financing capacity of the Community institutions. Only by broad reflection on all the available mechanisms for financing businesses in the Community will it be possible to define schemes to counterbalance the advantage apparently enjoyed by foreign companies in this respect.

At this juncture, the Commission can say that:

- it is preparing a set of proposals on the means of easing the approach to the financing of innovation in small and medium-sized undertakings. The Commission plans to submit to the Council a Communication and draft Decision in the spring of 1983.
  A pilot scheme for cooperation between European venture capital companies is already available and proposals designed to encourage the establishment of an association of these specialized financial institutions are now being presented to the Council; (1)

- companies will find it easier to organize themselves on the required economic scale if the European Cooperation Grouping comes into being: it is to be hoped that a decision will emerge from the Council's examination of this Commission proposal (2) before the end of 1983.

4. Social aspects of the industrial transformation

The impact of automated production on employment and working conditions will, of course, extend far beyond the machine tool sector: it belongs to a set of wider social problems raised by the introduction of new technologies, and should be examined in that context.

Whether or not the automation of production is a success is obviously directly dependent on its social acceptability and on the willingness of all the industrial operators concerned to carry it further. It will, however, largely determine the future competitive ability of the European economy and thus the level of employment which the Community will be able to maintain in the years ahead, not only in industry itself but also in the services linked with, or dependent on, industrial production.

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(1) COM(82)251 final, 15.6.1982.
(2) Amended proposal for a Council Regulation (EEC) on the European Cooperation Grouping, OJ No C 103 of 28 April 1978.

As well as the initiatives it has already taken in matters relating to the introduction of new technologies, (1) (on which the Council is urged to decide without delay), the Commission, noting that "automated production systems" seem to diffuse and develop more easily where dialogue between the two sides of industry is most effectively organized, will lend support to efforts to improve it. The EMF and CECIMO will shortly be consulted on the expediency of organizing contacts on the subject.

It will give special attention to solving training problems in certain areas of the machine tool industry clearly defined by the industry itself.

In the more general context of assistance from the Social Fund: the Commission's proposals for the reorientation of the Fund provide in particular for the grant of assistance to persons employed in small and medium-sized firms who need training in new skills as a result of the introduction of new technologies that substantially alter the production or management methods used in them.

As regards training, the steps that need to be taken to meet requirements not at present covered (e.g. the training of systems engineers) will be examined in an appropriate setting in the first half of 1983.

5. Diffusion of advanced technologies

The competitive weakness that threatens the supremacy of the European capital goods industry lies mainly in the integration of advanced technologies and of electronics in particular. The problems in this field are not confined to the technological aspects, but take their place in the wider context of the market situation and its assessment, and the ability of the industries concerned to adapt to the new intersectoral relations required and come up with a satisfactory supply of products; the problem is one of selection by manufacturers.

Since there is no possibility of legislating at Community level - as has been done in Japan - to promote integration of the mechanical engineering and electronics industries, the selection process must be helped along by assisting the development of a suitable environment.

The real question is whether the European machine tool industry can count on a domestic supply of standardized numerical controls

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(1) See in particular "The new technologies and vocational training: new Community initiatives for 1983-87".

matching its requirements: the European market for numerical controls has been estimated at 100 000 units a year a few years from now compared with 12 000 at the present time.

To find the answer to this question, close concentration will be required between the machine tool industry and the manufacturers of numerical controls, so that the necessary investment decisions can be taken and agreement reached on the standardization of interfaces between the machines, the control systems and the operators. The implications of this choice for imports of numerical controls and the machine tools incorporating them will be considerable.

To facilitate decision-making, the Commission proposes to:

- place the topic of investment in the production of numerical controls and related questions on the agenda for a forthcoming meeting with the manufacturers concerned;

- begin immediately on a coordination and consultation exercise on interface standardization;

- approach the major machine tool users (motor and aerospace industries, etc.) with a view to their harmonizing their specifications.

In the field of research:

- it is now examining how the needs of the sector can be integrated in the 1984-87 outline programme of Community scientific and technical projects and in the various action programmes in the field of advanced technologies (data processing, micro-electronics, basic technological research and ESPRIT). (1) In this connection:

  . it has called on the undertakings in the sector to submit proposals, jointly with the electronics manufacturers, for ESPRIT pilot projects; (2)

  . action to meet the specific requirements of the machine tool industry will be proposed in the context of the Community support scheme under the data processing programme;

- the Commission will continue to promote active coordination of research support policies in the Member States along the lines recently proposed. (3) The Commission will take the initiative in arranging talks at Community level between the leading public and private sector heads of research in the machine tool field.

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(1) Towards a European strategic programme for research and development in information technologies (COM(82)287 and 486).
(2) Especially the projects "Design rules for computer-integrated manufacturing systems" and "Integrated microelectronic subsystems for plant automation".
(3) COM(81)574 final "Scientific and technical research and the European Community - Proposals for the 1980's".

6. The external aspects

The European machine tool industry is the world's leading exporter: hence its very survival depends on its ability to compete internationally. The industry's net exports are such that to isolate it from international competition would be (1) catastrophic.

The trend in the pattern of trade over the last two years shows a decline in its ability to face up to external competition and has given rise to commercial tensions in certain vulnerable segments of the market. (2)

The success of the recovery strategy which the European companies have embarked on will depend very much on a favourable environment which the authorities will help to create at home and abroad.

The need for more cohesion between the strengthening of industrial competitiveness and external strategy was stressed by the Council of the European Communities when, in March 1982, it asked for the setting up of a high-level working party to study questions relating to the interrelations between structural adjustment and commercial policy, having regard to the implications of Japanese export strategy for European industry. Along with the motor vehicle industry and the manufacture of television sets, the machine tool sector was one of the first subjects discussed by the working party.

For an external strategy to be effective it must be based on the Community's ability to reconcile its industrial objectives with the maintenance of satisfactory commercial relations from the point of view of safeguarding free trade.

At this stage, the Commission considers that the following points should be borne in mind:

- in the first place, the machine tool industry and, more generally, the robotics industry are strategic sectors in which the development of technico-economic relations that would place the Community in a position of dependence must be ruled out in advance. The only possible response to the risk that it may happen is to have productive capacity with a sufficient degree of self-sufficiency and competitiveness. The question still unanswered is, of course, the time required for the necessary adjustment process to come to fruition;

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(1) 2 411 million dollars in 1982.

(2) The rate of Japanese penetration in the Community market for machining centres is estimated by CECIMO at over 35% in unit terms for 1980 and about 30% for numerically controlled lathes, compared with 4.2% and 17.9% respectively in 1976.

- from this point of view, the most striking factor is the disparity of situations and attitudes within the Community, especially from the standpoint of the strategies and policy lines adopted by the authorities. We should avoid any measures that would endanger the advantage the Community industry now derives from the variety and fluidity of its internal market or would jeopardize its chances of recovery, for which solidarity within the Community is vital. This applies both to actions which tend, either overtly or in effect, to close off the internal market and also to those that re-open the question of the Community's integrity by favouring external alliances to the detriment of its industrial solidarity. Often these breakaway actions are motivated and justified by the intolerable delays in the Community's decision-making process. The Commission will do its utmost to avoid that happening in the case of the machine tool industry.

The Commission will use to the full all the means at its disposal to bring into operation a commercial policy at Community level, especially vis-à-vis Japan, on the basis of the guidelines adopted by the Council in this regard.

The European machine tool industry can only maintain its position as the leading world producer by adopting a positive attitude to counter the general weakness in investment, the increasing international competition and the changes brought about by the integration of electronics into industrial equipment.

The Commission, having taken note of the willingness of the manufacturers to take this course and their hope in making that effort to get assistance at Community level, intends to go along with that standpoint and the introduction of such an approach.

It is in this spirit that it will develop, in the coming months, its discussions with the other Community institutions and groups, the governments, professional organizations, trade unions and its principal trading partners.

THE EUROPEAN MACHINE TOOL INDUSTRY

SITUATION AND PROSPECTS

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I. THE COMMUNITY MACHINE TOOL INDUSTRY IN THE WORLD CONTEXT

A. PRODUCTION AUTOMATION: A MAJOR PHENOMENON

1. Far-reaching technological change

The rapid spread of automated production systems is undoubtedly the industrial change that will most mark the years to come. The rapid development and progress of microprocessor manufacture open up prospects for automated production processes that have so far been out of reach: electronic systems, first applied to continous production processes and then to mass production, can now be applied to batch processes with small production runs.

This means that an increasing proportion of manufacturing industry can now be automated, and the impact of this development on the Community's economy will be particularly great because manufacturing industry accounts for about 30% of its GDP. (1)

The generalizing of automation is thus a process which now seems irreversible, which is already well under way in some countries (Japan, USA and Sweden, in particular) and is bound to have a decisive influence on the economic competitiveness of industrialized countries.

It permits the optimum reconciliation of objectives which previously were often contradictory, namely:

- Higher productivity through the reduction of the time needed for all production processes, coordinated operation of machines and an improvement in their rate of utilization. The salient feature of automation will thus be the integration and interconnection of the product design and manufacturing stages;

(1) The competitiveness of Community industries (COM(82)387).

- Greater flexibility of production facilities, i.e., the ability to produce medium-sized and small runs of a variety of articles with the same set of machinery;

- Enhanced reliability and safety of equipment;

- Improved product quality and standardization.

The stakes are high, but the competing economic regions are in markedly different positions in terms of their production facilities.

2. Status of production facilities

The foregoing raises the question of the capacity of production systems to absorb the spread of automation which can, of course, swiftly make existing equipment obsolete. While its rapid replacement might have been expected, given the prospects that automated production appears to offer, there has been nothing of the sort, especially in the Community, where industrial investment over the last ten years has gone into sharp decline in a context of the stagnation of total investment, in relative or absolute terms.

This development is particularly disquieting since it poses for the European economy the serious threat of progressive erosion of its industrial base. Furthermore, it reflects a consistent deterioration in the Community's production facilities compared with the position in Japan and, to some extent, the USA.

Although information on the capital stock of different countries is very limited, it is striking to note that:

- in general, the rate of growth in manufacturing capital stock since 1969 has been far more rapid in Japan than in the Community, and hence the average age of machines is lower in Japan (see table below);

- Japan and the USA have gained a significant lead in recent years over most European countries in numerically controlled machine tools, industrial robots and flexible manufacturing systems. Thus, most of the estimates available show Japan and the USA with the largest stocks of these three types of equipment.

MACHINE TOOLS IN USE IN 1980 (1)

(NCMT (2); Advanced robots; Flexible manufacturing systems)

Estimates

in units	NCMT	% *	Advanced robots	Flexible manufacturing systems	Average age of machinery (% < 10 years)
JAPAN	50 000	7.1	14 250	33	46%
UNITED STATES	70 000	2.7	4 100	19	31%
GERMANY	25 000	2.0	1 420	13	34%
ITALY	20 000	4.4	353		49%
FRANCE	10 500	1.2	600	2	35%
UNITED KINGDOM	7 000	0.8	371		39%

* Percentage of total.

(1) See annex 1.
(2) Numerically controlled machine tools.

This leeway can obviously be made up since, as matters now stand, these three types of equipment together account for only a small fraction of production facilities. However, this leeway, combined with the relative aging of the Community's productive capital stock, might develop into a gap that would be all the more difficult to close since the gap for being likely to widen rapidly, and for having a considerable impact on the development of industrial structures.

3. Development of industrial structures

The trend is increasingly towards integrated production systems, automated flexible manufacturing systems being their most advanced form at present. As is underlined in a recent report (1), this development brings changes in industrial structures. It will lead, for example, to occasionally contradictory effects on subcontracting and on relations between large and small undertakings, with the development of "skilled" subcontracting, the possibility of rapid expansion of small and medium-sized undertakings, and, at the same time, more rigorous control of suppliers by large undertakings. It will also bring about major changes in the structure of employment.

Although analyses of these phenomena are still at an early stage most of the studies available indicate radical changes in the pattern of demand for capital goods, which will be reflected in the coming years in a marked increase in automatic plant (machining centres, automated flexible manufacturing units, and, programmable robots). Thus, annual growth rates of the order of 30% are anticipated in the market for these types of equipment between 1980 and 1990.

By the same token, the share of NC machine tools in the total demand for machine tools should continue to increase rapidly (2) (between 1976 and 1980 this market increased by more than 40% a year and the share of NC machine tools rose from 10 to 20% of world demand for machine tools).

(1) Economic and Social Committee (FR) report on robotics in production and its prospects for the future - 24.2.1982.
(2) Based on current dollar value - see annex 2(a).

B. THE MACHINE TOOL INDUSTRY: A STRATEGIC SECTOR

A study now being prepared by the OECD on "competitiveness and technology in the machine tool industry" illustrates the strategic nature of this sector, which brings together a major part of the manufacture of automated capital goods. (1) An examination of its role in the production system of industrialized countries and of the changes currently affecting it will bring out this fact.

1. Key function

The machine tool industry produces equipment designed to work metal and, consequently, to produce other machines or components for them. It is thus at the centre of the capital goods, transport equipment and arms industries - and it is one of its own customers. (2)

The importance of the sector must therefore be seen more in terms of quality than quantity: its size is relatively modest in terms of output and employment, since its contribution to the national product and its share in the numbers employed in manufacturing industry is at most 1.5% (in Germany, the second producer country) and even less in other industrialized countries.

(1) For convenience the definition of the sector to which this document refers embraces both machines working by metal removal (about 80% of output) and those shaping metal by deformation in the traditional sense. Needless to say, the comments in this paper are far broader in their scope, in that the machine tool industry has no hard and fast frontiers (some countries include industrial robots, for example) and the changes that affect it also affect other capital goods (e.g. woodworking machines).

(2) Estimated at 30% of its production.

On the other hand, its function within industrial structures makes its role crucial for at least two reasons, these being its link with the armaments industries and its capacity to transfer technological progress through an essential section of the apparatus of production. Technological progress must pass through the machine tool industry in order to spread through the rest of manufacturing industry.

This suggests that countries mastering the technology in this sector hold an advantage and will thus be able to exert direct influence on the international division of labour and that, conversely, countries in a dependent position are at a disadvantage since it takes time and effort to obtain the most sophisticated and efficient production machinery.

Machine tools are therefore an essential factor in industrial competitiveness on account of their influence on the productivity of their users. Accordingly, to stay in the front rank in this sector is the aim of many producing countries.

2. Radical changes

The machine tool industry is highly diverse owing to the many functions of its products and the great disparity in their level of technical sophistication. Its diversity is reflected both in the large number of models in production (over 400) and the wide price range (according to figures published by CECIMO the most sophisticated machine sold in 1979 was almost 100 times dearer than the simplest. (1)

This explains why the sector has traditionally been marked by a high level of specialization and why so far it has seemed unsuited to mass production.

(1) 6 000 Swiss francs for a non-NC drill and 560 000 Swiss francs for an NC machine-boring centre.

The structure of the sector reflects this: predominance of small and medium-sized undertakings, and a lesser degree of concentration than in most other industries. According to available statistics the average size of an undertaking in Germany is of the order of 225 persons; only 12 plants in Germany have more than 1 000 employees, 10 in the USA, 7 in the United Kingdom and 2 in France. (1) In contrast, the Japanese industry, as examined below, is far more concentrated.

A brief examination of changes now taking place, however, raises the question of how these structures will develop.

The possibilities offered by recent progress in micro-processors are obviously the driving force behind these changes and have led to a brand-new concept in machine tools, one form of this being the machining centre which can be equipped with an automatic tool-changing system with as many as 100 types of tool. Compared with conventional machine tools this is a revolution, since the workpieces do not move from one machine to another; instead the machine adapts itself to the various operations.

Three additional aspects of this development show to what extent it is likely to influence the structure of the industry, these being relations between the machine tool industry and upstream industries, its relations with down-stream industries, and its ability to use its own products.

. relations with upstream industries

Given its position in the production system, the machine tool industry is dependent on other industries - particularly, at present, for supplies of electronic components. In this the Community faces a real industrial problem, namely, its capacity to institute production of numerical control systems on a satisfactory scale and on competitive terms. More generally, it raises the problem of strategic decisions undertakings will have to take if they are to hold their positions in the market.

(1) See annex 3.

Although experts are divided on this point most of them agree that vertical integration, which has been a major success in the electronics and data-processing industries, could also prove essential for the machine tool industry's competitiveness. The fact that many new competitors, especially the Japanese, have made a successful impact on the market with their expertise in electronics, obviously lends support to this suggestion. If undertakings with these integrated structures are able to bring out their own developments in electronics more rapidly and more efficiently than others, traditional manufacturers of machine tools will be faced with extremely tough competition.

. relations with downstream industries

The development and strategy of user industries also constitute a major factor of structural change. There are many examples of cases where the machine tool industry had been greatly influenced by changes in demand, and one of the main reasons for the development of numerical control, for example, stems from the specifications of the aerospace industry. In addition, the main machine-tool-using sectors, where undertakings are often far more powerful than the machine-tool builders, often produce their own machines to fit their own needs, or situations of very close dependence arise.

The problem that emerges from this ties up with the problem of concentration. The financial and business base needed for the manufacturers of machine tools to adapt to these developments will probably give the edge to those which are already integrated into big groups.

. ability of the industry to use its own products

This is probably the most important point. To what extent and in what manner will progress in products be accompanied by progress in production processes? As already stated, a feature of the machine tool industry is that it uses the equipment which it produces. The speed with which it can integrate the machines it can now manufacture into its own production line will have a large bearing on its future competitiveness. The success of the Japanese in markets for certain types of highly sophisticated equipment would seem to be directly connected with their ability to apply the most advanced methods to produce them.

These prompt an examination of the situation of Community industry as it faces international competition.

C. EUROPEAN PREEMINENCE: A WEAKENED POSITION

The European machine tool industry is still the world leader. Recent developments in its competitiveness, however, suggest that this position might be in danger.

1. The situation of the Community industry

The Community machine tool industry currently accounts for 28% of world output in the sector, which makes it the world market leader.(1) It is closely linked with the industry of other European countries, CECIMO (2) representing thirteen countries. (3) The area covered by CECIMO accounts for almost 40% of world output.

(1) See annex 4 (1981 figures).
(2) European Committee for Cooperation of the Machine Tool Industries.
(3) Member States: Belgium, Germany, Denmark, France, United Kingdom, Italy and the Netherlands.
EFTA countries: Austria, Switzerland, Spain, Norway, Portugal and Sweden.

The Community is also the world's biggest consumer of machine tools (20.4%), along with the United States (20.7%). (1) The Community industry is thus a net exporter, to the extent of 40% of its production. (2)

However, the machine tool industry has not achieved the same development or the same performance levels in all Member States.

Thus, the German industry, which accounts for more than half of European production, is first in Europe and second in the world, while the Italian industry accounts for only 6% of world production, followed by the British (5%) and French (4%) industries.

Germany's leading position is even more evident in exports: it alone accounts for 26% of world exports in the sector (including intra-Community trade where Germany's exports amount to 50%). (3)

An examination of industrial specialization confirms the diversity of the situation in the Community. Two indicators will serve to illustrate this point: the relationship between the average unit value of a product imported and that of a product exported, and the balance of trade. (4) Although, given the great variety in the product range, these indicators only give a rough assessment, they do show certain trends.
For example, the German and Italian industries seem to be highly competitive and to specialize in the top of the range, whereas the industry in Britain specializes more in the middle and bottom of the range.

Recent developments tend to accentuate this rift between Germany and Italy, which have maintained their competitive position, and France and Britain, whose share of the world market has decreased.

(1) See annex 5.
(2) See annex 2(a).
(3) See annex 6.
(4) See annex 7.

This diversity has a number of closely connected causes:

- The level of development achieved by the country in question: the Italian machine tool industry, which has developed more recently, shows higher growth rates;

- The degree of specialization: the German industry, with its wide product range, is highly competitive on external markets;

- The weight of structures (German undertakings - with more concentration and vertical integration - contrast with the Italian, which are smaller and make more use of subcontracting);

- Attitudes and behaviour (the standardization that has contributed to the competitiveness of German industry began in the machine tool sector) and traditional trading links (the fact that France and the United Kingdom had captive markets for a long time in overseas territories for which they were responsible may have been a major adverse factor affecting their adjustment to world competition).

Most of the Community industry is concentrated in four Member States which account for 96% of output (Germany, France, Italy and the United Kingdom) although this does not mean that technologically and economically top-level undertakings are not to be found in certain other countries (Belgium, Denmark and the Netherlands). (1)

The other, non-member, European countries are even less important, in that the two main ones, Switzerland and Sweden, account for less than 5% of world production. The competitiveness of these countries, however, is due less to the size of their output and market than to their successful specialization in the top of the range.

(1) See annex 4.

2. Reduced trade advantage

A cursory examination of developments in the relative positions of the Community in the world production and consumption of machine tools and, more especially, the NC machine tool market, shows some worrying trends.

- Taking the machine tool market as a whole, between 1976 and 1980, when it doubled in value, the relative position of the Community dropped while the shares of the United States and especially Japan increased considerably, as can be seen in the table below.

DEVELOPMENT OF THE MACHINE TOOL MARKET (1)

(by value)

	PRODUCTION		CONSUMPTION	
	1976	1980	1976	1980
EEC	35%	33%	22%	23%
USA	16%	18%	15%	20%
JAPAN	7%	14%	6%	10%
OTHERS	42%	35%	57%	47%
TOTAL	100%	100%	100%	100%

This trend is doubly disquieting in that it shows that the Community is behind in terms of investment in this type of product (which will have its effect on competitiveness) and that its ability to meet demand, especially for export, has deteriorated. Whereas the Community exported 48% of its production in 1975, the figure was down to 41% in 1980, net Community exports dropping from 38 to 27% of output (the

(1) Source: Consultronique. See annex 2(a).

corresponding figures for Japan are 22% in 1975 and 34% in 1980, and for the United States 10% in 1975 and - 11% in 1980, the USA having therefore become a net importer). (1)

Region	% of production exported		% of consumption imported	
	1975	1980	1975	1980
EEC*	48	41	17	20
USA	23	16	14	24
JAPAN	34	40	15	7

*Non-EEC

Source: American Machinist

This is the result of three complementary factors: the investment crisis, (particularly acute in the Community), the growth of exports by numerous countries on the market for conventional machines and, finally, Japan's sales breakthrough in the NC machine tool market.

This third point is without doubt the most salient.

- In recent years the NC machine tool market has developed as follows:

(1) See annex 4(a).

DEVELOPMENT OF THE NC MACHINE TOOL MARKET (1)

(by value)

(USA-EEC-JAPAN) (1)

	PRODUCTION		CONSUMPTION	
	1976	1980	1976	1980
EEC	41%	35%	25%	30%
USA	38%	24%	32%	28%
JAPAN	13%	30%	20%	15%
OTHERS	8%	11%	23%	27%
TOTAL	100%	100%	100%	100%

(1) Source: Consultronique

SHARE OF NC MACHINE TOOLS IN PRODUCTION AND CONSUMPTION IN 1980 (1)

(by value)

	PRODUCTION	CONSUMPTION
EEC	21%	25%
USA	26%	27%
JAPAN	41%	30%

(1) See annex 2(a).

These tables point up the fact that, on the rapidly expanding market for NC machine tools (with an annual increase of 40% by value between 1976 and 1980), Japan is the only country to achieve the status of a net exporter, the EEC being an exporter in value but not in unit terms, and the United States being a major importer (its consumption exceeding production by more than 39% in unit terms). It must also be stressed that the share of NC machine tools in total production and consumption is lowest in the EEC. (1)

These few figures show that it is Japan which is developing most favourably compared with the Community, whose position as premier world exporter has weakened, and with the United States, whose trade balance has worsened considerably in recent years.

D. DEVELOPMENT OF THE JAPANESE INDUSTRY: EXAMPLE OR THREAT

The rapid development of Japanese machine tools production is due to the adoption of an extremely purposive industrial policy which has given the industry a completely different structure from that of its competitors and made it outstandingly successful in the export field.

1. Purposive industrial policy

After a serious crisis in 1975 and 1976, when its share of world production slumped to 7.8% (against almost 12% in 1981), the Japanese machine tool industry began a phase of extremely rapid growth, with output increasing in value to an average rate of +30% a year between 1976 and 1981. This was due to a large extent to brisk growth in the production of numerically controlled machines, whose share of total production increased from 19% in 1976 to almost 41% in 1980.

(1) See annex 2(a).

Production of some products, such as numerically controlled lathes and machining centres, rocketed (multiplying by a factor of six for the former and ten for the latter between 1976 and 1980). (1)

The industry was backed by a highly interventionist policy on the part of the Japanese authorities, in the form of a host of measures to promote demand, regulate supply and reform production structures.

Information published by the American industry when filing applications with the US administration (2) shows that over the past 10 years the Japanese Ministry of International Trade and Industry (MITI) has taken numerous steps in aid of its machine tool industry:

- promoting concentration in the sector and cooperation between firms;
- stimulating product standardization;
- furthering the manufacture of NC machine tools;
- permitting the establishment of an export cartel;
- fixing production and price targets;
- granting a host of financial aids (tax exemptions, accelerated depreciation rates, tax allowances for exports, aid for research and development, etc.);
- supporting domestic demand (allowances for the purchase of automated equipment).

(1) See annex 2(b).
(2) See point 2.

A more detailed examination shows that several factors have combined with this purposive policy to bring industrial success:

- A strong electronics industry, already in existence, from which the machine tool industry could derive new products. The Japanese industry thus benefited more extensively than its European counterpart from the advantages of harnessing electronic technologies to an original industrial and trade concept;

- A long-term strategy covering the widest market possible and geared to average user demand rather than to individual needs. Accordingly, the Japanese manufacturer produces a moderately priced standardized machine with built-in electronics enabling it to perform several functions, both in machining and turning. This strategy is completely different from that of the European industry, which develops custom-built products with better performance in terms of specific capacity but costing more for similar functions;

- Manufacture organized in a way reflecting the transition from the production of small runs to the production of long runs of identical machines for all customers, with the traditional buyer's market replaced by a new seller's market.

This concept was developed with the aid of a structural advantage consisting of three elements:

- The juxtaposition of large undertakings integrated into industrial concerns and small subcontractors producing the standardized components;

- The equating of large firms with mass production. Unlike the European industry, where the small number of large undertakings have wide product ranges, Japanese producers manufacture a limited number of products on a large scale;

- Industrial relations which promote the spread of new technologies. The introduction of new technologies is often sought by the labour force itself, especially in large concerns where the practice of life-long employment eliminates fears about the possible adverse effects of these technologies on the numbers employed. Furthermore, the benefits of the resultant improved productivity directly influence the six-monthly bonuses linked with profitability levels, thus providing a further incentive. It must be stressed, however, that these points are of little relevance to small and medium-sized undertakings, where jobs are generally not guaranteed, but which play a very important part in the Japanese economy.

The measure of the Japanese advantage is the average difference in price of 30-40% between European and Japanese products.

2. An original production system

A study undertaken by the Italian industry (1) has brought out the structural implications of the Japanese development strategy. The most interesting factor to emerge from this comparison between the sector in Japan and in other countries is the degree of industrial concentration. (2) From this angle Japan would be far above the average, with undertakings employing more than 1 000 persons accounting for more than 50% of the Japanese industry's labour force, compared with only 20% in the USA, 24% in Germany and 16% in Italy. (3) In addition, many Japanese undertakings form part of very large groups.

(1) Japanese competition: problems and proposals for the Italian machine tool industry - Ufficio Studi Economici - UCIMO - June 1981.
(2) See annex 8.
(3) Particularly high for some products such as lathes. See annex 9.

UCIMO found that this special structure gave the Japanese industry the following advantages:

- easier access to credit;
- ability to influence industrial policy making;
- greater research capabilities;
- availability of extensive funds.

Combined with highly efficient and standardized organization of subcontracting, this structure has enabled an extremely effective export policy to be developed.

3. Outstanding export success

In 1971 Japan imported 15% of its domestic consumption of machine tools and exported 12% of its output.

By 1981 foreign penetration of the Japanese market was down to 6% and exports exceeded 35% of production.

These figures reflect the highly creditable performance of the Japanese industry on both the home market and export markets where it is now the world's Number Two (1 128 million ECU in 1980) after the EEC (3 059 million) but ahead of the United States (899 million). (1)

(1) See annex 10.

The tremendous growth of Japanese exports (37% a year between 1976 and 1980) was based mainly on sales of numerically controlled machines (as outlined above); indeed Japan is the only net exporter of these (in unit terms). Japan alone produces more NC machine tools than the EEC and the United States put together.

This export growth has resulted in a rapid increase in Japanese penetration of third markets, which has been felt all the more strongly because Japanese exports are highly concentrated - both geographically and structurally:

- geographically, more than 50% of Japanese exports in 1980 went to North America and EEC countries (37.4% to North America and 13.3% to the EEC), whereas the corresponding rates were only 18% for the EEC (to Japan and North America) and 29% for the United States (to the EEC and Japan);(1)

- structurally, more than 60% of Japanese exports (by value) in 1980 were NC machines (mainly lathes and machining centres) against 16.2% for the EEC and 17.3% for the USA. (2)

The combination of these two factors has meant that despite fairly small overall market shares in the USA and the EEC (9% and 4.5% respectively) Japanese penetration reached very high levels in the two areas of the market on which exports were concentrated: numerically controlled lathes and machining centres.

Accordingly, Japan's share of this market in these two products is estimated at close to 50% in the USA, and almost 19% in NC lathes and more than 13% in machining centres in the Community. (3)

(1) See annex 11 (concentration of exports of NC machine tools is even greater - see annex 14).
(2) See annex 12.
(3) These percentages are by value. In unit terms they would be nearly 30% (lathes) and 36% (machining centres) in the Community. See annex 13.

In 1981, Japanese exports of numerically controlled lathes rose by 15% by value and exports of machining centres by almost 60%.(1)

This overall rise includes geographically differing trends which reflect some moderation of Japanese exports to the Community. Sales of NC lathes in EEC countries, for example, dropped by 33% in 1981 while increasing by 52% in the United States, the respective rates for machining centres being + 22.4% and + 86.1%. In 1981 both products were brought within the scope of the Community statistical surveillance system. (2)

Furthermore, this rapid and concentrated growth in Japanese exports has caused serious commercial pressure in the United States; the NMTBA (3), whose members account for 90% of American production, recently published its views on the matter, underlining the fact that the American machine tool industry had lost its competitive edge and asking the authorities to adopt a package of measures designed to promote its recovery by:

- lowering the barriers to exports resulting from antitrust laws (restrictions on joint export ventures);
- amending rules for allocating tax allowances on investment (10%) so that they would no longer be granted in respect of purchases of foreign machine tools;
- action to reduce the financial aid for exports in certain Community countries.

This is the background to the likely development of Japanese competition on the machine tool market and, more generally, on the market for automated plant and machinery as a whole.

(1) See annex 12.
(2) OJ No L 361, 16.12.1981. See Annex 15.
(3) NMTBA: National Machine Tool Builders Association.

4. Ambitious plans

Projects announced and decisions already taken in Japan bring out that country's determination to press on with the general development of automated production as quickly as possible.

This determination is expressed through a policy of demand promotion and supply-side intervention and could soon lead to an increase in Japan's export capacity and competitiveness on "mechatronic" capital goods markets.

- The most striking point with regard to demand is the increasing percentage of small and medium-sized undertakings among customers for these products, aided by tax reliefs (e.g. 13% for the purchase of "mechatronic equipment") and by special financing procedures. For example, a joint leasing company from which small and medium-sized undertakings can obtain industrial robots on very favourable terms has been set up by more than 30 robot manufacturers with aid from the MITI.

- As regards the supply side, the development of robots (the term being used in a far wider sense in Japan than in Europe) (1) is a national priority under the industrial strategy of increased productivity pursued by the Japanese authorities. The JIRA, (2) an association founded with government support, coordinates activities to this end and helps in particular to organize:

  - the production and sales policies of the 41 chief manufacturers;

  - research in 70 laboratories, public and private. It must be stressed that research is backed to the hilt, the MITI having recently launched a seven-year programme (1983-89) with a budget of 17 000 million Yen to develop robots for industry and a whole range of activities such as space exploration and nuclear research.

(1) See annex 16.
(2) Japan Industrial Robot Association.

In short, these measures are intended to create a dynamic home market which will enable a particularly competitive product range to be developed and hence open the way for vast export potential. They could lead to an increase in the percentage of production earmarked for foreign sales both in machine tools, where Japanese production, according to some forecasts, will double between 1980 and 1985, and industrial robots, where production will increase fourfold over the same period. Japanese exports of industrial robots have so far been very small (3% of production in 1980), but growth in sales abroad could be especially rapid.

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This might suggest that the rapid expansion of Japan's "mechatronic" industry will soon be a threat to its American and European competitors, which are now in a weak position although they do have their own specific advantages:

- The American industry exports the least and its market has suffered the highest level of foreign penetration. However, it can derive support from a very strong electronics industry and already has firms on an international scale in the automatic plant "robotics" sector;

- The European industry has a sound engineering tradition and has the benefit of a highly diversified supply and demand structure, both for exports and on the internal market, but its electronics sector is weak and finds it hard to satisfy the special needs brought on by the switch to electronically controlled machinery.

But rather than being a threat, the determination of the Japanese industrial policy of pressing on with the inescapable trend towards automated production above all provides a challenge by exemplifying an aggressive and orderly response to a major technical and industrial change.

There is no doubt that this change will provide the firms with most drive with countless growth opportunities but it requires radical changes in the organization of production in all respects - technical, economic, social and financial. Full advantage therefore cannot be taken of these opportunities by the European industry unless the Community's available forces are mobilized for an aggressive recovery strategy.

The ways and means and conditions for the success of a strategy of this kind are discussed in Part Two of this document.

II. AN AGGRESSIVE RECOVERY STRATEGY

From the analysis in the previous section it is clear that a series of coordinated initiatives will have to be taken at various levels if the efforts being made by the Community machine tool industry to improve its competitiveness are to succeed.

This part II of the paper is intended to contribute to the definition of the action required and to indicate the measures the Commission itself proposes to take on its own responsibility.

After an initial examination of the adjustment problems to be faced, the three broad topics suggested by the analysis will be dealt with in the following order:

- the market synergies;
- the adaptation of industrial and social structures;
- the definition of an external strategy.

A. ADJUSTMENT PROBLEMS

In 1982, the Commission prepared an exploratory document which raised a number of questions - suggested by a preliminary analysis - with regard to the working hypotheses that should underlie an effective approach to the problems of the machine tool industry. Subsequent comments from the parties mainly concerned - in particular CECIMO and the EMF - it would seem that the problem area as there defined is regarded as a satisfactory basis. The document can now be presented in the form of a summary confirming the field of analysis and the main options.

1. The field of analysis

Under the pressure of change, Community manufacturers are compelled to make strategic choices. Indeed, in a market economy it is up to them to make whatever adjustments are necessary, the role of the public authorities being mainly to facilitate the process and in particular to create a favourable environment. The choice the undertakings have to make, however, is rendered difficult by the fragmentation of the industry. Owing to the many economic operators and the diversity of their specialized fields, there can be no unanimity concerning the constraints imposed by change or the definition of clear guidelines for development. The distance separating them, moreover, are a hindrance to any satisfactory dissemination of information relating to change. This lack of information works to the disadvantage of undertakings less well prepared for coping with a rapidly changing environment.

The example of Japanese industry confirms this view by contrast: it was by a general process of joint consultation by the parties interested in adjustment that the policy lines from which the present performances spring were drawn(1) up from 1971 onwards. To meet the crisis in the sector, which hit Japan harder than any other industrialized country, a thorough review of development strategies was undertaken at that time. The outcome of the consultation process, which helped create a vast flow of information, was the development by the Japanese industry of products that strike a balance between technology, cost and requirements and have had a resounding success both at home and in the export markets.

From this kind of analysis it would seem that an effective adjustment process is an operational synthesis between the variables of demand, supply and, of course, the constraints of external competition.

(1) See Part 1, Chapter D.

2. The main options

. the trend of demand

The development of the market can be viewed from two angles - growth and structure. Although it is apparent from the foregoing analyses that its structure will be greatly altered by the general adoption of automated systems, the rate of overall market growth is much more difficult to forecast. There are a number of variables, often operating in opposite directions, that lend uncertainty to any assumptions concerning the development of the two major components of demand, namely the replacement of productive facilities in the industrialized countries and the first-time equipment purchases in the developing countries.

Without prejudging the rate at which integrated production systems will be introduced, it can be said that they provide the answer to two sets of problems:

- the improvement of productive efficiency and in particular the reduction of unit cost;
- better organization of work and its environment (job enrichment).

Hence any measures that tend to promote automation and the conditions under which it can develop must be carefully examined. Their effectiveness - and thus the rate at which the new processes can be introduced - will be closely bound up with the relative importance of certain variables that will either speed up or slow down the movement: in the industrialized countries it will be the foresight of the operators that will determine the evolution of demand, especially the replacement market; in the developing countries their solvency and development policy will be decisive factors.

. the trend of production structures

With regard to the capital factor, changes in structures could be influenced by two things:

- the effort to standardize production and the large-scale mass production of products so far produced in small quantities or even on a one-off basis. The Japanese industry, with the advantage of a special structure, was the first to put into practice this type of organization of production. Standardization relates to both the component and the finished product. It is made possible by the principle of the universal nature of the electronic system and by the systems approach to problems;

- the increasingly important role played by upstream component manufacturers as a result of standardization, and by maintenance and after-sales services as a result of the growing tendency to contract out certain activities (e.g. the role of software). As a result, the manufacturer must find his role as a total system designer.

The adaptation of structures is mainly a matter for manufacturers themselves. The pace at which it proceeds, on the other hand, depends on the way the market develops and the support given by the authorities.

As far as the labour factor is concerned, the introduction of new technologies should not at first sight - unless there is a very substantial reduction in the volumes produced - bring about any substantial change in the level of employment. On the other hand, the skills required could well change. Two possible developments must be considered:

- in the production process proper, the skills of operators and engineers must be widened, to include for the former a knowledge of electronics and for the latter, primarily a systems approach to problems; on the functional side monitoring and maintenance operations will take precedence over machining proper, either in the workshop or at more centralized locations;

- in the company as a whole, redistribution of the work force amongst departments will probably be significant as a result of the importance attached to programming activities and after-sales service.

Lastly, the industry will have to tackle the innovation processes, an area in which Japanese companies have displayed remarkable efficiency owing to their capacity to apply the results of research and development at competitive prices. Here the advantage of the Japanese seems to be structural - in both the firm and its environment. It does not apply to the technology, which is of an equivalent, if not a higher, standard in Europe.

The problem, therefore, is that of improving the dissemination of information between the parties concerned by adjustment - the two sides of industry, the research institutes, the users and the authorities - and increasing the efficiency of the research effort. Two areas merit special attention:

- the ability of small and medium-scale firms to undertake the necessary research. Here the problem centres on the financing of research and the setting up of cooperative structures to facilitate sharing;

- the dissemination of the results of R&D and their availability to all potential users.

Concerning the first aspect, poor operating results in Europe and their declining trend raise the question of research financing in a rapidly changing technological context. In view of the growing urgency of the research requirement, however, consideration should be given to the sharing of the research effort between producers or between producers and outside research bodies (public or private institutes, technical centres, etc.).

. the trend of foreign competition

In this connection, the main question that arises is that of defining an external strategy: so far no definite course of action has been agreed upon as it is only fairly recently that the tensions in the machine tool market have become manifest (see part 1).

x

x x

(4)

This brief survey of the field and of the main options that have to be considered leads us to reflect on the initiatives that might provide the basis for an aggressive recovery strategy for the Community machine tool industry, taking account of the three complementary aspects: market, production and commercial policy.

B. MARKET SYNERGIES

It is undoubtedly for those industries that are central to the production processes - such as the machine tool sector - that the term "market synergies" is most meaningful.

More than in any other sector, their operations are affected by the various components of the market, and above all by those involving:

- the producers and their customers (joint planning at this level is a traditional and crucial factor in the machine tool industry);

- the producers and their suppliers (see the questions raised by the integration of electronics);

- the workforce operating the machines and, in a more general way, all users of them.

Furthermore, the links between macro-economic variables and the situation in these sectors are particularly strong, which makes the industries highly sensitive to macro-economic policy.

For all these reasons the design and implementation of an effective strategy for the machine tool industry are closely dependent on the interlinking of the component elements of that strategy and the size of the likely multiplier effect of concerted action.

With these facts in mind, there are two main aspects to be investigated: the revival of investment and the matching of supply to demand.

1. The revival of investment

Although the national situations vary considerably (1), the trend in recent years has been towards a relative aging of the equipment of European companies compared with that of their Japanese and American competitors. If the decline in investment which is at the root of this phenomenon became a permanent feature, there would be reason to fear a progressive erosion of the Community's industrial base and an increasing loss of competitiveness by its manufacturing industry.

This trend is especially disturbing in the area of numerically controlled machine tools, with which European industry seems at the present time to be particularly poorly equipped (1).

Under these circumstances, the revival of investment seems to have a twofold urgency:

- for manufacturing industry, whose future competitiveness will depend on it; and

- for the machine tool sector, which will be able to cope with its structural problems only in the context of a development of its activities.

In March 1982, the European Council expressed concern at the low level of productive investment in Europe, and most of the Member States are taking action to remedy the situation, in some cases through sectoral programmes (2).

(1) See annex 1.
(2) The structural aspects of these measures are examined in the next chapter.

By way of example:

. In France, a development programme for the machine tool industry adopted in November 1981 has as one of the objectives the expansion and modernization of the machine tool stock. This aim is to be achieved by a number of mechanisms to sustain demand, in particular the MECA system (Machines et Equipements de Conception Avancée), which provides for the grant of operating subsidies to undertakings purchasing new equipment and for an increase in public orders for the nationalized industries, education and research.

. In the Federal Republic of Germany a subsidy of 10% of the purchase price for capital equipment is under discussion.

. In Italy, the Sabatini Law provides for reduced-interest credit for the purchase of production equipment. The Law is likely to be extended to include leasing, and the introduction of tax relief for investments is also under consideration.

. In the United Kingdom, under a programme of aid for industrial development, some financial assistance is granted to small and medium-scale firms for the purchase of industrial equipment (Small Engineering Firms Investment Scheme) and a programme of aid for the spread of flexible manufacturing systems has recently been set up.

The problem of investment revival must be tackled from both the macro-economic and the sectoral angles:

- From the macro-economic standpoint, the Commission is drawing up, within the framework of discussions initiated by the Council, a set of proposals for action which are set out in a specific document (1);

(1) COM(82)641 final: Communication from the Commission to the Council on initiatives to promote investment.

- From the sectoral standpoint, the Commission believes that consistency within the Community in selecting the means of sustaining demand and directing whatever actions are taken is an essential condition for success. It is therefore necessary for Member States to take steps to align their support mechanisms, both existing and in preparation. Through CECIMO, the industry has several times pointed out the need to ensure that the sector support programmes that exist in some Member States are not discriminatory, and has drawn attention to the privileged position enjoyed by Japanese manufacturers owing to the highly favourable financial and tax treatment accorded to them (1).

To draw attention to ways of improving and coordinating existing measures, the Commission, together with representatives of the industry, has carried out a preliminary study of their efficiency as perceived by their final beneficiaries.

The Commission is to launch more detailed studies on this subject, which may be followed up by initiatives to induce the Member States to harmonize their procedures, by means of suitable legal instruments, on lines conducive to efficiency and compatibility. From the discussions with CECIMO, however, a number of preliminary guidelines can already be laid down:

. The use of anti-cyclical instruments to support demand is of special importance for the machine tool industry. Companies in this sector are often faced with cyclical contractions of demand that influence their medium-term policies through the liquidity problems they engender and the resulting changes in company investment plans. The "smoothing" of investment cycles - i.e. levelling them off at the most critical points - would thus remove some of the short-term obstacles to investment decisions.

Among the various forms of aid accorded by the Member States along these lines, the most effective seem to be those that take the form of tax relief for investments. In all cases, substantial relief for a short period has been found preferable to a lower level of tax relief over a longer period (the cost to the State being equal). Arrangements for accelerated

(1) See part 1.

depreciation of the machines purchased over a given period - these are widely used in Japan and in the final analysis amount to a deferment of revenue for the State - were also very well thought of.

. With regard to support for the introduction of new technologies, with which the Commission is actively concerned in its work on the promotion of innovation, the instrument rated the most worthwhile was support for purchases of high-technology machines, especially by the smaller users (1). As well as stimulating demand, this makes it possible to:

- open up the market for new equipment by overcoming reluctance due to the users' unpreparedness;

- increase automation and productivity in small and medium-scale firms;

- help to channel the supply side towards the most sophisticated machines.

A study of the experimental schemes in France (MECA) and the United Kingdom (Small Engineering Firms Investment Scheme and the Aid Scheme for Flexible Manufacturing Systems) has led to the conclusion that there must be no uncertainty among potential recipients of financial aid as to their obtaining it. The sense of insecurity caused by vagueness is felt to militate against effectiveness. The rules governing these schemes must therefore be clear, fairly straightforward and conducive to rapid decision-making.

To this basic point, four comments can be added:

- the measures adopted must be applicable first and foremost to the small and medium-sized firms, since they are the ones most in need of a reduction of costs in order to overcome their misgivings concerning the introduction of new technologies;

(1) An instrument widely used in Japan (see part 1, D).

- the cost reduction must be commensurate with the cost of adapting to the use of new equipment;

- the financial aid must be linked with assistance to the user in the choice of machines;

- lastly, the types of equipment that qualify for aid must be clearly specified. In this connection, CECIMO proposes that the following should be included, in particular: numerically controlled machine tools, machines for working with or without stock-removal and fitted with special tools, special-purpose machines, measuring machines and industrial robots.

. The third category of measures examined is that of financial aid for the purchase of machine tools in general. The Italian experiment (Sabatini Law, No 1329 of 1965) is an example that has been found particularly effective. Under this law it is possible to purchase machine tools by a system of deferred payment (up to five years). The seller for his part can discount the bills in the medium-term credit establishments. Moreover, financing may attract an interest rebate.

Although the operation of the system leaves room for improvement, e.g. by extending its scope to include leasing and by ensuring that the banking institutions have an interest in using it, it still appears to be a basic scheme that might well be applied in other Member States.

Moreover, there are certain Community financial instruments such as the NCI and the EIB loans that might make a specific contribution in this area of financing. Exploratory contacts have already been made between the industrial organizations concerned (notably the Italian ones) and the Commission with this in view.

2. Matching supply to demand

The European organization representing the machine tool industry (CECIMO) has suggested to the Commission that an exploratory market study be carried out with a view to analysing the future composition of demand for machine tools and assessing how the supply can best be matched to it.

The industry, which regards a study of this kind as essential, is willing to participate directly in its implementation, though it points out that the task would be beyond the means and the interest of individual companies.

Furthermore, the European Metalworkers' Federation (FEM) has asked the Commission to study the economic and industrial problems of the machine tool sector with special reference to the social aspects of automation.

In view of these requests and bearing in mind the foregoing analyses, the Commission's viewpoint can be summed up as follows:

- The efficiency of the Community's industrial production system is closely dependent on the quality of its manufacturing equipment. The rapid development of automated systems adds to the unreliability of any attempt to forecast demand and will no doubt entail far-reaching changes in the organization of production and in relations between the various groups involved.

- Under these circumstances, a broad-based study of forthcoming developments in the machine tool market and of strategies aimed at bringing the Community's offer into line with market trends is essential. Clearly, failure to recognize current and future requirements in this field will slow down the Community industry's adjustment.

. The survey should by no means be merely an academic exercise, however, and the industry must therefore take an active part and assume primary responsibility for it. Nor must its scope be limited in advance, since both opportunities and hazards arise very often without regard for the present segmentation of markets and technologies.

. Lastly, the work required will have to be coordinated, in its initial phase, with that of other organizations, in particular with the work of the OECD on the relationship between technology and competitiveness (1). Needless to say, in view of the importance for competitors of the data that will be collected, the exchange of information obtained from the exploratory study will have to be restricted.

. The Commission for its part can provide logistic and financial support for the execution of the project.

With these considerations in mind, the Commission has started on a study of the possible content and methods of such a survey, based on an expert report and in cooperation with CECIMO and the national organizations affiliated to it.

This preliminary feasibility study, the results of which will be known by the end of 1982, will deal in particular with the following points:

- an analysis of the machine tool sector both within its own environment and in relation to the upstream and downstream industries in order to pinpoint the various factors by which it is influenced, and an evaluation of the competitiveness of the Community industry. This first topic will make it possible to define the proper scope for the general exploratory survey;

- the design, in collaboration with the industry, of methods and working arrangements to ensure that the means are appropriate to the objectives and that the results are utilized as efficiently as possible;

- terms of reference for the work in view (plan of work, schedules, budget, etc.).

(1) See part 1, Chapter A.

Whilst the Commission can already express agreement in principle on the essential value of the exploratory market survey envisaged by CECIMO, the feasibility study will very shortly provide all the information on which to base a final decision. Its implementation will require a special financial effort, which the Commission asks the Council and Parliament to keep in view from the budgetary standpoint.

It is essential that there should be no delay in creating the right conditions for defining the strategic options on which the success of the Community's machine tool industry will depend in the years ahead.

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C. ADAPTATION OF THE INDUSTRIAL AND SOCIAL STRUCTURES

The analyses conducted in the first part of this document showed that technical changes affecting the production and use of capital equipment would have far-reaching structural implications from the point of view of:

- the organization of the production of capital equipment, which brings into sharp focus questions relating to the amalgamation of companies and financial support for their adaptation;

- intersectoral relations and the implementation of the necessary R&D effort, especially at the interface of mechanical and electronic engineering;

- the social consequences (in their qualitative and quantitative aspects) and the repercussions on industrial relations within the sector.

With these three points in mind, we go on to consider ways and means of rationalizing the reorganization of structures, launching an industrial research drive and facilitating social adaptation and concertation.

1. Ensuring cohesion of structural adjustments

Major elements of the sectoral measures adopted or in preparation in some Member States concern the restructuring of the machine tool industry by means of incentives to inter-company cooperation, sometimes with support from public funds.

This is particularly the case in France, where, under the 1981 Plan for the machine tool industry, provision has been made to promote the formation of "poles of development" by linking up a number of companies (about twenty such projects are being studied and one is already being implemented in the field of heavy machine tools) and to provide financial aid of FF 2 300 million for the sector. France, of course, is not the only example: measures likely to have structural effects have also been taken in Italy and the United Kingdom, and even the more general systems of support for the industry in force in Germany might have a similar effect of this kind.

It should also be mentioned that, along with questions relating to the size and organization of the undertakings, there is the aspect of their financial structure, a decisive factor in their ability to adapt and grow.

In the first two areas referred to above (amalgamations and public aid), the Commission exercises special responsibilities deriving from its powers in the competition field.

In view of the need to improve the competitiveness of the European machine tool industry, which is an objective shared by all Member States despite the great variations between them in the industry's performance and level of development, the Commission will do all it can, when assessing aid measures notified pursuant to Article 93 EEC, to safeguard the conditions necessary for the adjustment of the productive facilities, bearing in mind:

- the competitive situation that the European industry has to face internationally and the necessarily open nature of the Community market;

- the need for closer cooperation upstream and downstream of the industry required by the technological and economic developments. The Commission will, of course, ensure that measures taken in this area have regard to Articles 85 and 86 EEC.

With regard to the third point - the improvement of the financial structure of the companies - the Community machine tool industry, consisting largely of small and medium-sized firms, has two main weaknesses:

- insufficient equity, resulting in excessive borrowing;

- a disproportionate amount of short-term debt in its total indebtedness.

These two weaknesses are due especially to the technological changes in the sector, since numerically controlled machine tools are costlier to produce than conventional machines and take longer to manufacture; there is reason to believe, however, that costs will fall as manufacturing know-how is accumulated. The resulting change in the ratio between work in progress and turnover gives rise to an increase in short-term requirements as a fraction of total requirements.

This imbalance is in itself a source of financial problems and it adversely affects the firm's ability to raise long-term finance which they need to develop new products.

Here again we see one of the characteristic weaknesses of the financial environment of European companies compared with that of their Japanese competitors: the difficulty experienced by the Community banking system in providing long-term credit on the basis of considerations of corporate strategy and production techniques rather than on conventional criteria of financial analysis.

This is a matter of vital importance, since the development of new products is central to the renewal strategy that is absolutely essential for the European machine tool industry. That strategy requires the investment of long-term, high-risk capital, but with its present level of profitability the industry cannot generate sufficient funds for the purpose internally; hence the need for outside sources of risk capital.

The limited size of many firms in the sector makes it unlikely that direct recourse to the stockmarket could provide sufficient capital.

The Commission is considering how Community financial instruments could help solve these problems, especially for financing innovation: it is preparing a set of specific proposals on the financing of innovation in small and medium-sized firms.

Companies will be better able to organize their activities on the required economic scale when the European Cooperation Grouping (ECG) comes into being (1).

With regard to risk capital, a pilot scheme for cooperation between European venture capital companies has been drafted, and proposals designed to promote the establishment of a European association of venture capital houses are now before the Council.

It is clear, however, that the questions raised are on a scale far beyond the Commission's powers of action; only broad reflection on all the available mechanisms for financing businesses in the Community can come up with ways of compensating for the advantage enjoyed by their foreign competitors in this respect.

2. Mobilizing an industrial research drive

The competitive weakness that threatens the supremacy of the European capital goods industry lies mainly in the integration of advanced technologies, especially electronics. Problems in this field are merely technological but take their place in the wider context of the market situation and the capacity of the industries concerned to adapt to the new intersectoral relationships required and offer a satisfactory product range: it is really a matter of selection by manufacturers.

Since there is politically no possibility of introducing Community legislation such as the measures adopted in Japan to promote the amalgamation of the mechanical engineering and electronics industries, the selection process must be helped along by assisting the development of a suitable environment.

(1) OJ No C 103 of 28 April 1978.

The specific question is whether the European machine tool industry can count on a domestic supply of standardized numerical controls matching its requirements: the European market for numerical controls has been estimated at 100 000 units annually a few years from now compared with 12 000 at present.

To find the answer to this question will require closely concerted action by the machine tool industry and the numerical controls manufacturers, so that the necessary investment decisions can be taken and agreement reached on the standardization of interfaces between machines, control systems and operators.(1)The implications of this for imports of numerical controls and machine tools incorporating them will obviously be considerable.

To facilitate decision-making, the Commission proposes to:

- place the topic of investment in the production of numerical controls and related questions on the agenda for a forthcoming round-table conference on telematics;

- make an immediate start on the work of coordination and consultation in preparation for the harmonization of mechanical/electronic interfaces;

- approach the major machine tool users (motor and aerospace industries, etc.) to induce them to harmonize their specifications;

- devise forthwith ways to bring industry's needs within the scope of the Community action programmes on advanced technologies (data processing, micro-electronics, basic technological research and ESPRIT (2)). In this connection:

  . certain pilot projects of the ESPRIT programme (integrated micro-electronic sub-systems for plant automation) and the concerned action machinery set up for it will be utilized for the benefit of the machine tool industry;

(1) One task that needs to be tackled urgently, therefore, is that of defining which interfaces it is expedient to standardize in the present state of the art in order to reduce the costs of adaptation and programming and to increase reliability. In August 1982, the machine tool industry sent the Commission a document detailing the units which in its view ought to be standardized in order to provide a limited number of standardized numerical controls for the various uses in question. (See annex 21.)

(2) European Strategic Programme for Research on Information Technology.

- matters relating to non-electronics basic research (e.g. research on machine components, on the effects of using new materials, etc.) will be examined in the context of the programme on basic technological research;

- projects designed to meet the specific requirements of the sector may be proposed under the "Community support scheme" forming part of the data processing programme to complement existing projects directly concerned with the production and use of machine tools (e.g. the feasibility study on robot programming languages and the project on microprocessors for the control of production systems);

- topics for long-term study can be suggested by the machine tool industry - in association with the electronics industry and the Commission - within the framework of the micro-electronics programme.

What the Commission wants to promote is ultimately a real dynamic of industrial research that will enable European companies to make better use of their technological capabilities in the production process and the product.

In addition, various initiatives have been taken by governments to stimulate research in the machine tool industry. For instance:

- in France, a research plan for the industry was adopted in December 1981. It is built around three key fields (national technology poles): machine tool design, manufacturing processes and automation. For its implementation it relies on the use of existing research facilities (1) and on public financing, and a special committee is responsible for the selection of research topics, follow-up of research and the evaluation of results;

- in Italy, much the same methods are being applied through the agency for a centre similar to CERMO;

(1) In particular, CERMO (Centre d'Etude et de Recherche de la Machine-Outil) and CETIM (Centre Technique des Industries Mécaniques).

- in the United Kingdom, there are two organizations concerned with research in connection with machine tools: the first deals with product research and is partly financed from public funds; the second studies production processes (Production Engineering Research Association);

- in the Federal Republic of Germany, where there is no research institute specializing in machine tools, the industry's trade association allocates about DM 2 million for the financing of university research. Moreover, the all-industries micro-electronics programme coordinated by the Ministry for Research, includes sections that directly or indirectly affect the machine tool sector.

These few examples show that better coordination of projects and research would do much to increase their efficiency. During the talks between the industry and the Commission on this topic, it was found that some duplication of work could be avoided and that there was plenty of scope for improving the situation by closer cooperation (between the various research bodies and between Member States) and by more effective transfer of research results to the industry.

The Commission will therefore continue its efforts to harmonize the research-funding policies of the various Member States on the lines it has recently proposed (1).

3. The social aspects

The spread of automated production will, of course, have an impact on employment and working conditions extending far beyond the issues specific to the machine tool industry.

(1) See COM(81)574 final.

Hence the scope of analysis must extend to all problems raised by the introduction of new technologies. It must also be realized that those problems are not merely social: they have great economic importance as well. The success of automation is obviously bound up with its social acceptability and with the willingness of all the operators concerned to extend it. At the same time it will largely determine the future competitive ability of the European economy and thus the level of employment that the Community will manage to sustain in the future.

Under these circumstances, it is essential that the extension of the new technologies should proceed in a favourable social climate. The preponderance of SMEs in this sector is in itself conducive to close contacts between the interested parties, but it cannot be too strongly emphasized that information and consultation will play a crucial role in enabling the operators to appreciate all the social and economic implications of adopting the new technologies.

Although studies on the social consequences of innovation have so far produced only fragmentary results, a number of aspects - whether general or specific to the machine tool industry - are already emerging: they explain the attitudes of the trade unions and trade associations and enable fairly definite courses of action to be worked out.

According to the report by the French Economic and Social Committee already referred to (1), although the impact of robotics on total employment is still impossible to determine, it is already clear that it will be a decisive factor in changing the functions, conditions and content of work as well as the skills and vocational training required. The Economic and Social Committee estimates that the work of 4.6 million industrial employees in France is, or eventually will be, affected by robotics.

Although it is hard to predict the exact nature and extent of the adaptations that will ensue, most of the available studies reach the conclusion that the introduction of automated systems and the general adoption of flexible manufacturing systems could lead both to a new demand for highly skilled staff (e.g. specialists

(1) "The use of robotics in production and its future prospects": Economic and Social Committee (24 February 1982).

in industrial automation and operating personnel) and to deskilling for part of the workforce (e.g. tradesmen in the traditional sense disappear; operator/minders appear). As the (French) Economic and Social Committee points out, these developments will not necessarily result in one ubiquitous system of organization and with it a standard pattern of skills. It will, however, undoubtedly increase the training requirements.

It is worth noting the experience gained elsewhere in the advanced application of numerically controlled robots and sequence robots. In Japan, for instance, the implementation of this type of technology is already enabling factories to operate almost automatically with a workforce about 20%, or even 10%, of the traditional size. At the same time, the figures show that in Japan, despite a general decline in employment in manufacturing industry, 48% of companies that have introduced automation have recorded rises in employment, 68% due to an increase in orders, 32% to an expansion of the company and 30% to the need for new skills (1).

The general growth of computerized systems has had major repercussions on the control hierarchy within the company. It has been found that, with the introduction of numerically controlled machines, the work monitoring traditionally done by the operator has been reduced - to the advantage of management - by the possibility of centralized programming. Numerically controlled machines require only a semi-skilled, or even an unskilled, operator. But with the introduction of computer numerically controlled machines the decision centre can be moved back to the workshop, where the operators (more highly skilled ones, of course) can also exercise control over the operation (2).

Increased use of these machines will thus have a crucial influence on industrial relations and general harmony in companies using the new technologies. The reaction of management to these trends will determine the extent to which they are willing to place orders for this level of technology.

(1) Testimony of Japan Productivity Centre to the US House of Representatives Committee on Science and Technology (Subcommittee on Investigations and Oversights), June 1982.
(2) Microelectronics and Manpower in Manufacturing: Applications of CNC in Great Britain and West Germany. Wissenchaftszentrum Berlin, October 1981.

With the expanding use of numerically controlled machine tools (*), the type of operation begins to affect where the programming is done and the level of skill required. A survey in Germany revealed that 78% of the machines were (1) programmed in a planning office and only 22% in the workshop. Workshop programming reached 48% for drilling and milling operations, whilst for more complex operations the percentage was relatively low, e.g. barely 10% with machining centres.

The link between workshop programming and operator skills is clear enough. The same survey showed that with workshop programming, 78% of the operators were skilled; only 42% were skilled where programming was done centrally.

The level of skill required for numerically controlled machine tools also depends on the type and volume of production. Experience shows that the degree of skill is bound up with batch size: large batches call for skilled setters and semi-skilled operators; small batches need only qualified operators combining both functions.

All the parties concerned are agreed that training in the Community is decidedly inadequate, not only in the field of computerization and automation, but also in such areas as hydraulics and precision engineering.

This background explains why the European Metalworkers' Federation (EMF) has several times pointed out to the Commission that the facilities for personnel training and retraining need to be improved and that the problem of training and retraining workers should be tackled in good time.

The EMF has also impressed on the Commission that the introduction of new technologies with their concomitant effects on employment, skills and working conditions would gain readier acceptance if the Commission were to:

(1) Microelectronics and Manpower in Manufacturing: Applications of CNC in Great Britain and West Germany. Wissenchaftzentrum Berlin, October 1981.
(*) by computer.

- help with the analysis of forecast changes in employment, both quantitative and qualitative, and with the definition at European level of general principles governing information, consultation and negotiation between management and workers' representatives prior to the introduction of new technologies;

- propose a change in the possibilities of aid from the European Social Fund, which should also contribute to the training and retraining required by future activities.

Speaking from the sectoral standpoint, the machine tool industry (CECIMO) has pointed out that although, in terms of numbers, the trend of employment in the sector ought not to raise any special problems in the years ahead (CECIMO expects a progressive cut-back in the workforce which it puts at around 5%, spread over several years), major qualitative problems will have to be resolved in the field of training.

On the first point, it should be noted that the machine tool sector employs around 210 000 persons in the Community compared with about 96 500 in the USA and 34 000 in Japan (1). Relating these figures to output data, the Japanese industry's productivity is seen to be better than that of its competitors, subject to the statistics being comparable, and allowing for differences in the organization of production (2) (e.g. the importance of subcontracting for the Japanese industry). This raises the question of the consequences of any approximation of industrial structures such as might result from the technological developments discussed in Part One.

With regard to training, CECIMO has surveyed the estimated annual requirements of the European machine tool industry. All these are set out in the following table:

(1) See annex 17(a) (1981 figures).
(2) The value of output per employee in 1980 was $54 000 in Japan against $23 000 in the Community and $27 000 in the USA. It is still more striking to see that this "apparent productivity" (at 1975 prices) scarcely changed between 1975 and 1980 in the Community and the United States, but nearly tripled in Japan - see annex 18.

ESTIMATED ANNUAL REQUIREMENTS OF THE EUROPEAN MACHINE TOOL INDUSTRY

Source: CECIMO	L E V E L				
	Engineers	Professional	Supervisers, foremen	Assembly workers; Staff employees	Machine workers
Design and research	790	495	215	1 285	770
Manufacture	340	205	945	3 360	4 595
Marketing (market research, sales, after-sales service)	225	320	390	Staff employees: 1 285	

In view of these requirements, CECIMO wishes to see action taken at European level on the training of engineers and, as regards other employees, assistance granted to firms to promote the gradual transfer of workshop personnel to assembly tasks and retraining in the use of numerically controlled machine tools (programming and operation). In this connection, it has put forward detailed proposals which are currently under examination by the Commission.

On the basis of these analyses and the proposals submitted by the trade unions and trade associations, the Commission is of the opinion that:

- a more thorough study should be made of the impact of automated production processes on employment, and recalls the various initiatives already taken or in preparation as part of activities relating to the introduction of new technologies; and

- that the resources assigned to training in the Community should be increased in order to speed up automation by making it more socially acceptable and enabling the workforce to master it.

Accordingly, the Commission:

- has already undertaken a number of studies: for instance, the European Centre for the Development of Vocational Training - a Community body associated with the Commission - is at present carrying out a comparative study on the introduction of the numerical control of machines in various types of industrial undertaking and its socio-economic consequences, especially in the field of training. (This study is initially restricted to Germany and the United Kingdom, but will later be extended to France, Denmark and Italy) (1). These investigations will be coordinated with those undertaken or envisaged by other institutions, especially the OECD, which is currently considering whether studies should be carried out on applied information technologies in manufacturing industry;

- will give special attention to solving training problems in the machine tool industry which, though on a small scale, are of strategic importance. In connection with the reorganization of the European Social Fund, the Commission is proposing that assistance be granted to persons employed in the smaller firms who need retraining following the introduction of new technologies that substantially modify the production or management techniques of their companies;

- recalls the proposals it submitted in connection with "New information technologies and vocational training: new Community initiatives for the period 1983-87", which suggest that one of the priorities should be small and medium-sized undertakings endeavouring to modernize their production process by applying new technologies;

- points out that the spread of "automated production systems" seems easiest to handle in countries where the dialogue between the two sides of industry is most effectively organized, and will lend its support to the efforts being made to intensify that dialogue.

(1) The European Institute of Engineering Education has also carried out numerous studies on the training of engineers.

D. DEFINITION OF EXTERNAL STRATEGY

The European machine tool industry is the world's leading exporter (1), and hence its very survival depends on its ability to compete internationally. The trend in the pattern of trade these past two years has shown the Community less able than it was to meet foreign competition and has given rise to tension in certain vulnerable areas of the market (2).

The success of the recovery strategy that European undertakings must formulate and carry out will depend very much on cohesion between internal and external measures. Although the producers themselves will have to assume basic responsibility for industrial reorganization in an environment made as favourable as possible by all the other parties concerned, the role of the authorities is absolutely vital as regards the external aspect.

A brief examination of the interconnections between industrial reorganization and commercial policy will highlight the requirements for the success of such a strategy.

1. Industrial reorganization and commercial policy

The need for more cohesion between the strengthening of industrial competitiveness and external strategy was underlined by the Council of Ministers of the European Communities when, in March 1982, it called for a high-level working party to examine the links between structural reorganization and trade policy in the light of the implications of Japan's export strategy for European industry.

(1) See annex 4(a).
(2) See Part 1, Chapter C.

The machine tool industry, along with the motor and TV set industries, was one of the first subjects discussed by the working party.

As things stand, the points to be borne in mind can be summarized as follows:

- First of all, the machine tool industry and, more generally, the automatic plant industries ("robotics") are strategic sectors in which the development of technical and economic relations which would put the Community in a situation of dependence must be ruled out from the outset. The points made in the first part of this document illustrate that a risk of this exists. It goes without saying that countries advanced in automatic plant, such as the United States and Japan, exert external pressure on the other economies which is starting to be reflected in trade balances. The problems of Community supplies in numerical controls at competitive prices are a prime example. The only possible response to such a risk is to develop productive capacities with an adequate degree of self-sufficiency and competitiveness. The question still unanswered is, of course, the time required for the reorganization process to come to fruition;

- From this angle the most striking feature is the disparity in situations and attitudes within the Community, especially as regards strategies adopted. Although the solutions to the different situations will obviously vary, measures must nonetheless be avoided which might jeopardize both the advantages currently enjoyed by the Community industry in the variety and fluidity of its internal market and its chances of recovery, for which solidarity within the Community is vital. This applies both to measures which "repartition" the internal market, either openly or in effect, and to those that call into question the Community's integrity by favouring external alliances to the detriment of its industrial cohesion;

- Finally, the general principles of balance in trade relations must be taken into account, and obviously the trade balances of areas producing this type of equipment must reflect their know-how and actual competitiveness.

It is fair to say at this point that although the Community's situation satisfies this criterion in terms of its current imports, the same cannot be said of its exports, especially to Japan. The Community has proved to be wide open to imports of products where Japan has gained an undeniable competitive advantage in manufacture, as is evident in the rates of penetration achieved in certain segments of the market (1). On the other hand, the Community might have expected its sales of high-performance machinery, the quality of which is recognized world-wide, to reach far higher levels in Japan than is actually the case in a country with Japan's level of industrial development.

From these points flow the requirements for an effective external strategy.

2. Requirements for success

Apart from these aspects of industrial strategy and the need to muster all available forces to bolster the competitiveness of the European machine tool industry, the requirements for recovery in this sector depend on the Community's ability to bring its industrial objectives into harmony with two other aims: the preservation of free trade and the maintaining of satisfactory commercial relations.

Reconciling these constraints will depend on three major elements: strengthening of the common commercial policy, concerted action by the Community and its main trading partners, and the development of industrial cooperation.

. If it is to produce mutually acceptable trends in the pattern of trade, the strengthening of the common commercial policy is the only way of avoiding the risk of differences in national attitudes when faced with pressure from outside competition.

(1) See Part 1 - Chapter C (annex 13).

This places the Community in a delicate position in respect of its machine tool industry. Either it will be able to strengthen and put into effect its common commercial policy, or it will succumb to the latent protectionism emerging in certain Member States. In the latter case, the chances of restoring the Community industry's competitiveness would be lessened since compartmentalization of the internal market would inevitably return.
This policy should strike a balance between the inherent constraints of industrial reorganization, which vary from one Member State to another, and the defence of the Community's trading positions on its territory and in external markets. This would mean that Community interests were defended from a united front with the support provided by the open-market principle and the assurance of no national restrictive measures, and it would be reflected by increased cooperation with the Community's trading partners.

. Greater cooperation is urgently needed, firstly because the rapid and concentrated development of Japan's exports to the Community has created pressures which must be absorbed or at least contained, and secondly because of the discussions now taking place in the United States on selective measures requested by the American machine tool industry (1). In general, the basic terms of these discussions will be the causes and consequences of trading imbalances. The Commission's position on this point is that the development of such imbalances is unacceptable if they are not the result of free competition and hence of differences in competitiveness between the producer areas in question, and if they jeopardize the continued survival of the Community industry.
Given Europe's capabilities in machine tool production, the variety of products made under this heading and the exporting tradition of the Community industry, it is inconceivable that a general situation of severe imbalance between the Community and a country with the same level of industrial development should arise and persist. Accordingly, the system of statistical surveillance of imports of certain types of machine tool set up by the Commission must be maintained to provide regular monitoring of developments (2).

(1) See Part 1.
(2) From a more general point of view it would be better if the Member States' statistical departments could arrange as soon as possible for their national statistics to incorporate, on a uniform basis throughout the Community (see page 1 of the statistical annex), a classification modified to reflect changes in the products and permitting a more realistic assessment of situations.

. Ultimately, the bases for sound economic and trade relations must be sought in increased industrial cooperation between the main producer countries.
Recent agreements between European and Japanese companies show that this is already beginning to materialize. However, if these agreements are to give effective support to the industrial development of the parties concerned they must not undermine opportunities for cooperation presented by the Community market nor result in undesirable dependence.

THE EUROPEAN MACHINE TOOL INDUSTRY

SITUATION AND PROSPECTS

STATISTICAL ANALYSIS

Statistical annex — List of annexes

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2b	NC lathes and machining centres in the machine tool industry 1976-80
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Notes on the statistical annex

1. SITC and NIMEXE

It will be noticed that the figures for total Community exports in Tables 6 and 10 are not the same as those in Tables 11 and 12. This is because since 1978 SITC heading 736, which used to be 715.10 under revision 1, no longer corresponds with NIMEXE heading 84.45 as the latter now excludes parts.

We have therefore used the SITC figures (3 059 million ECU in 1980) in comparing the Community with Japan and the United States, where the figures are available under the same nomenclature (Table 6), but have opted for the NIMEXE figures for Table 12 as they give a breakdown for NC machine tools.

2. Statistics on the structure of the industry

The note accompanying Annex 8 explains the problem of Japan. The data for Annex 3 came from various sources: the figures for Germany, France and Belgium were supplied by the industry; for the United Kingdom and Italy industry censuses were used. It is therefore quite possible that the number of small firms in UK and Italy may be exaggerated. Moreover the censuses in UK and Italy related to establishments rather than firms.

In Annex 8 we have endeavoured to summarize the data and make them comparable, at least for the Community; we then go on to the problems of Japan.

3. Statistics on production and consumption

We have used two sources: American Machinist and Consultronique. The former provides a very detailed breakdown of production and consumption by country for the entire industry. Consultronique, on the other hand, provides figures on both by broad regions (EEC, USA, Japan and rest of the world), with a breakdown by type of NC machine. Naturally, there are some slight differences between the figures given by the two, and Consultroniques' figures only go up to 1980, whereas American Machinist had produced provisional figures for 1981.

Here we have tried to use the most appropriate source for the purpose.

Principal sources of statistics on the machine tool industry

1. Official statistics

(a) International

SITC - Trade statistics (OECD)

(b) Community

NIMEXE - Trade statistics

Common Customs Tariff - Customs duties

(c) National

United Kingdom	Dept. of Employment	Employment
	Census of production	Size for firms etc.
Italy	Size of firms etc.	
Japan	MITI Production Census	- Size of firms etc.
	Customs Tariff Schedule	- Customs duties
USA	Bureau of Labour Statistics	- Labour costs
	Dept. of Commerce	Size of firms etc.
	Customs Tariff Schedule	Customs duties

2. Industry statistics

(a) International

CECIMO (European Committee for Cooperation of the Machine Tool Industries)
- Production and consumption of and trade in machine tools in Europe

(b) National

(i) EEC

France	Syndicat de constructeurs français de machines-outils
Germany	Verband Deutsche Maschinen- und Anlagenbau e.V.
United Kingdom	Machine Tool Trade Association
Italy	Unione Construttori Italiani delle Macchine Utensili
Belgium	Syndicat des constructeurs belges de machines-outils pour le travail des métaux

(ii) USA National Machine Tool Builders' Association

(iii) Japan Japan Machine Tool Builders' Association
Japan Machinery Exporters' Association (Belgium)
Japan Industrial Robot Association

Statistics on employment, the size of firms, the machine-tool stock and, as regards Japan, the breakdown of exports.

(c) Specialist publications

(i) American Machinist Annual statistics on machine tool production, consumption and trade (all countries)

(ii) Japan Economic Yearbook (Oriental Economist)
Information on the Japanese machine tool industry

(iii) Japan Economic Journal

(d) Research bureaux

(i) Consultronique (France) Study on the importance of NC machines in Community, American and Japanese industry

(ii) DAFSA (France)

ANNEX I

Breakdown of the machine-tool stocks of the EEC, the USA and Japan

	Machines tools in USE				AGE STRUCTURE OF MACHINE TOOLS IN USE		
	TOTAL	Numerically controlled	Ind. Robots (1)	Flexible manufacturing	0 - 9	10 - 15	15 +
West Germany	1.250.000	25.000 (2%)	1.420	13	34	18	45
France	847.600	10.500 (1,2%)	600	2	35	20	45
Italy	541.200	20.000 (4,4%)	353		49	17	34
UK	891.400	7.000 (0,8%)	371		39	19	42
USA	2.631.000	70.000 (2,7%)	4.100	19	31	18	51
Japan	706.922	50.000 (7,1%)	14.250	33	46	24	30

Sources: National Machine Tool Builders' Associations

(1) Based on a Japanese definition (JIRA). Includes intelligent,NC, playback and variable sequence robots, but not manual manipulation and fixed sequence robots.

ANNEX 2

Summary of markets for all machine tools and NC machine-tools

		Value in million dollars (current)					% share of world total			
		EC 10	USA	JAPAN	OTHERS	WORLD	EC10	USA	JAPAN	OTHER
(1) All machine tools										
Consumption	1971	2.478	824	973	3.568	7.843	32	10	12	46
	1976	2.948	2.010	804	7.638	13.400	22	15	6	57
	1980	6.300	5.300	2.600	12.300	26.500	23	20	10	47
Production	1971	3.153	996	933	2.761	7.843	40	13	12	35
	1976	4.690	2.144	938	5.628	13.400	35	16	7	42
	1980	8.800	4.800	3.800	9.100	26.500	33	18	14	35
% Production exported	1980	40	15	37	10	25				
% Consumption imported	1980	16	23	8	31	25				
Net balance (million dollars)	1980	+ 2.500	- 500	+ 1.200	- 3.200	-				
(2) NC machine tools										
Consumption	1976	338	432	270	310	1.350	25	32	20	23
	1980	1.560	1.456	780	1.404	5.200	30	28	15	27
Production	1976	554	513	175	108	1.350	41	38	13	8
	1980	1.820	1.248	1.560	572	5.200	35	24	30	11
% Production exported	1980	28	10	51	2	28				
% Consumption imported	1980	16	24	3	58	28				
Net balance (million dollars)	1980	+ 260	- 208	+ 780	- 832	-				

Summary of markets for all machine tools and NC machine tools

ANNEX 2a

		EC 10	USA	JAPAN	OTHERS	WORLD
(3) NC machine tools as a % of all machine tools						
Consumption	1976	11	21	34	4	10
	1980	25	27	30	11	20
Production	1976	12	24	19	2	10
	1980	21	26	41	6	20
(4) Annual Growth rates 1976-1980						
i) Consumption:						
All machine tools		21	27	34	13	19
NC machine tools		47	35	30	46	40
ii) Production:						
All machine tools		17	22	42	13	19
NC machine tools		35	25	73	52	40
(Based on current dollar value)						

Sources: American Machinist
Consultronique
CECIMO

ANNEX 2b

NC lathes and machining centres in the machine tool industry 1976-80

Machine Type	Country	Year	Production		Exports	
			Units	Value	Units	Value
(1) NC Lathes	EC	1976	1.397	183,9	864	102,1
		1980	4.860	715,8	847	144,6
	USA	1976	1.301	204,9		
		1980	2.739	481	181	23,0
	JAPAN	1976	2.073	88,9	847	40,9
		1980	12.036	751,6	6.593	442,8
(2) Machining Centres	EC	1976	555	101,8	256	33,5
		1980	1.459	531,1	559	146,0
	USA	1976	1.225	178,4		35,5
		1980	2.129	413	313	56,6
	JAPAN	1976	526	46	133	14,6
		1980	5.231	491,4	2.920	270,0
(1)+(2) As % of all NC Machine Tools	EC	1976		51,6		40,7
		1980		68,5		57,0
	USA	1976		74,7		
		1980		71,6		63,8
	JAPAN	1976		77,1		90,7
		1980		79,7		89,6
(1)+(2) As % of all machine tools	EC	1976		6,1		6,5
		1980		14,2		8,2
	USA	1976		17,8		
		1980		18,6		11,0
	JAPAN	1976		14,4		15,1
		1980		32,7		50,7

Sources: CECIMO
Japan Ministry of Finance
NMTBA

Units: Current US Dollars

Size of firms in the EEC machine tool industry

Annex 3

Member State	Germany	France	Italy	U.K.	Belgium
1. All firms					
a) number of firms	440	163	1 233	982	36
b) number of employees	99 000	18 984	46 400	55 200	3 138
c) average size of firms	225	116	38	56	87
2. Firms with a workforce of over 500					
a) % firms	11,6	4,9	0,6	1,9	2,8
b) % employees	49,1	33,7	21,1	49,7	17,3
c) % turnover	50,0	34,7		49,9	

Source: National surveys

Machine tool production by country

Country	1971	1975	1980	1981
1. EC	40.2	35.8	33.8	27.9
of which: Germany	22.6	17.6	17.6	15.3
Italy	5.9	6.4	6.5	5.3
UK	5.9	5.3	5.2	3.5
France	4.7	5.0	3.6	3.1
Belgium	0.6	0.8	0.5	0.4
Netherlands	0.3	0.4	0.2	0.2
Denmark	0.2	0.3	0.2	0.2
2. USA	12.7	18.0	18.0	19.5
3. Japan	11.9	7.8	14.3	18.4
4. USSR	14.8	14.5	11.5	12.2
5. Switzerland	3.4	3.9	3.7	3.1
6. GDR	3.7	4.3	3.3	2.9
7. Roumania	0.3	0.8	2.2	2.3
8. China	0.7	2.2	1.6	1.7
9. Czechoslovakia	3.2	2.2	1.2	1.3
10. Spain	1.3	1.7	1.3	1.2
11. Brazil	0.5	1.0	1.2	1.2
12. Poland	2.2	3.1	1.5	1.2
13. Yugoslavia	0.5	0.5	0.9	1.0
14. Taiwan	0.2	0.2	0.9	0.9
15. Sweden	1.0	1.0	0.9	0.8
16. Canada	0.5	0.5	0.7	0.8
17. South Korea	-	-	0.5	0.8
18. India	0.6	0.7	0.6	0.7
19. Austria	0.4	0.5	0.6	0.5
20. Hungary	0.7	0.4	0.5	0.5
21. Others	1.4	0.9	0.8	1.0
Total (Million US dollars)	7 843	13 644	26 748	26 391

Annex 4 a

Net exports of machine tools

EC, USA, Japan

	EC		USA		JAPAN	
	1975	1980	1975	1980	1975	1980
a) Production	4 885	9 040	2 452	4 812	1 060	3 826
b) Exports	2 345	3 706	568	785	359	1 523
c) Imports	510	1 295	318	1 299	123	229
Trade balance b) - c) or net exports	1 835	2 411	250	- 514	236	1 294
Net exports as a % of production	37,6	26,7	10,2	- 10,7	22,2	33,8

Source: American Machinist
Eurostat

Units: Million US dollars

Machine tool consumption by country

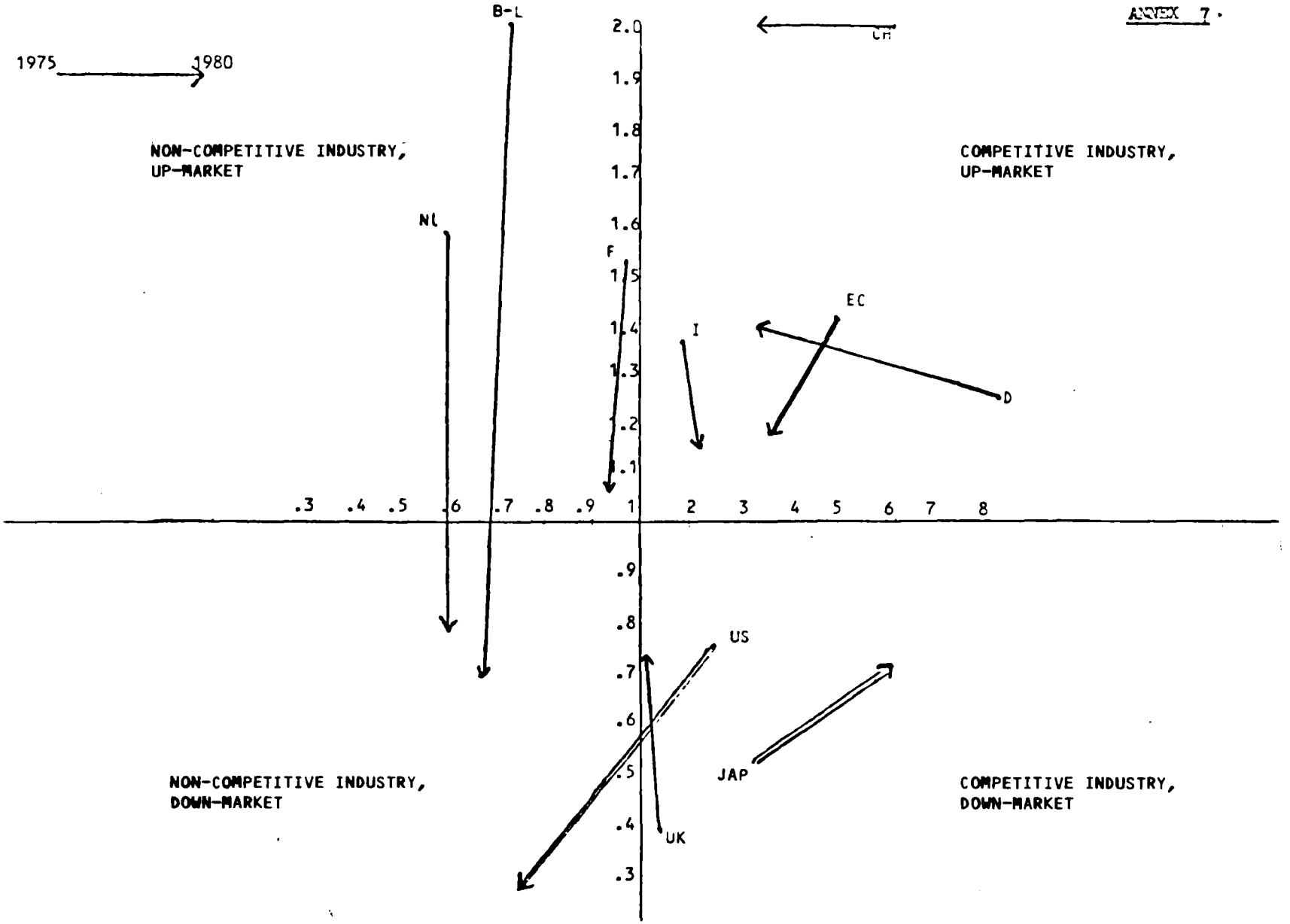
Country	1971	1975	1980	1981
1. EC	31.6	22.0	24.2	20.4
of which: Germany	14.2	5.9	9.5	8.3
France	6.0	5.1	3.7	4.0
Italy	5.6	4.8	4.7	3.9
UK	4.4	4.5	5.0	3.1
Belgium	0.8	0.8	0.5	0.5
Netherlands	0.6	0.5	0.5	0.4
Denmark	0.2	0.3	0.2	0.2
2. USA	10.5	16.1	19.9	20.7
3. USSR	16.6	16.8	14.0	14.9
4. Japan	12.4	6.0	9.5	12.8
5. Canada	1.3	1.9	2.0	2.9
6. China	1.5	2.6	2.0	2.0
7. Mexico	0.9	1.8	1.2	1.8
8. GDR	1.1	2.0	1.7	1.6
9. Brazil	1.0	1.5	1.6	1.4
10. Korea	-	-	1.7	1.4
11. Poland	2.4	5.1	2.0	1.3
12. Yugoslavia	0.6	1.0	1.3	1.2
13. Switzerland	1.5	1.6	1.3	1.1
14. Australia	0.9	0.8	0.6	1.0
15. India	0.8	0.9	0.8	0.9
16. South Africa	0.7	0.7	0.9	0.9
17. Sweden	1.4	1.6	0.9	0.9
18. Spain	1.5	2.3	0.9	0.8
19. Czechoslovakia	2.3	1.8	0.8	0.7
20. Hungary	0.6	0.4	0.6	0.7
Total (Million US dollars)	7 843	13 644	26 748	26 391

Breakdown of Community imports and exports of machine tools

Annex 6

	Year	EEC(the 9)of which % (million EUA)	Germany	France	Italy	Neth.	Belg/Lux	U K	Ireland	Denmark
Exports										
(i) Intra-EC	I976	650	58,I	8,I	I3,2	3,8	6,8	9,0	0,I	0,8
	I980	I.398	48,8	9,7	I7,2	4,3	5,9	I2,2	0,7	I,I
(ii) Extra-EC	I976	I.852	59,9	I0,3	I3,0	I,I	2,4	I2,2	-	I,I
	I980	3.059	55,2	II,I	I5,I	I,I	I,7	I4,8	0,I	0,9
Imports										
(i) Intra-EC	I976	595	I2,5	35,6	I3,6	7,7	8,0	I7,7	I,5	3,5
	I980	I.369	I8,0	24,6	I3,5	7,7	II,0	20,I	2,7	2,4
(ii) Extra-EC	I976	454	27,4	2I,8	I2,9	3,5	3,I	27,2	0,5	3,5
	I980	I.I75	38,8	I4,4	I0,8	4,3	4,4	24,4	0,7	2,3

Source: Eurostat



SPECIALIZATION IN THE MACHINE TOOL INDUSTRY 1975-1980

Note on the diagram (Annex 7)

The diagram is intended to illustrate the following two factors for the EEC countries, the US and Japan:

(i) The competitiveness of the machine tool industry;

(ii) The range of machine tools manufactured (up- or down-market).

These two factors were measured in terms of two indices:

(a) Vertical scale: $\frac{\text{unit value of machine tool exports}}{\text{unit value of machine tool imports}}$

(b) Horizontal scale: $\frac{\text{total value of machine tool exports}}{\text{total value of machine tool imports}}$

Arrows: The arrow indicates the position of each country in terms of these two factors. The tail of each arrow shows the position in 1975, the head the position in 1980.

Example: Japan. In 1975 the unit value of Japanese machine tool imports was twice the figure for exports, but Japan exported three times as much as it imported. Thus the Japanese industry was competitive and specialized in the bottom end of the market.

In 1980 Japan exported six times as much as it imported and the gap between the unit value of imports and exports narrowed. The Japanese industry has clearly become even more competitive and has shifted towards the top of the market.

ANNEX 8

CONCENTRATION IN THE MACHINE TOOL INDUSTRY IN THE EEC, THE USA AND JAPAN

FIRMS WITH A WORKFORCE OF OVER 1000

	% Firms	% Employees	% Production
JAPAN	23,0	50,7	53,1
USA	0,7	20,0	
GERMANY	3,6	23,6	22,0
ITALY	0,2	15,9	16,0
UNITED KINGDOM	1,7	25,8	25,5

Annex 9

Concentration of production of machine tools in Japan by product, 1980

Type of Machine	1°		2°		3°		First 3
	Firm	%	Firm	%	Firm	%	%
All NC machines	Mori Seiki	13	Hatachi Seiki	9	Makino Milling	8	30
NC lathes	Mori Seiki	20	Yamazaki	18	Okuma	14	52
Grinding machines	Nippei Ind.	12	Toyoda Mach.	7	Okamoto	7	26
Milling machines	Hatachi Seiki	15	Osaka Kiko	13	Makino Milling	13	41

Sources: Japan Economic Journal (Market Survey)
Yano Keizai Kenkyusho.

Sources: OECD
Eurostat

Geographical breakdown of trade in machine tools: EEC, USA and Japan

EC Imports				USA Imports				Japan Imports			
1976	%	1980	%	1976	%	1980	%	1976	%	1980	%
Million EUA		Million EUA		Million EUA		Million EUA		Million EUA		Million EUA	
Intra-EC 595		Intra-EC 1 369		Total 284		Total 1 199		Total 63		Total 186	
Extra-EC 454		Extra-EC 1 175		of which:		of which:		of which:		of which:	
of which:		of which:									
1. Switzerland	32	1. Switzerland	32	1. Germany	29	1. Japan	35	1. USA	44	1. USA	31
2. USA	22	2. USA	18	2. Japan	21	2. Germany	18	2. Germany	21	2. Germany	29
3. Sweden	8	3. Japan	18	3. UK	10	3. UK	10	3. Switzerland	15	3. Switzerland	17
4. Spain	6	4. Spain	7	4. Switzerland	8	4. Switzerland	6	4. USSR	4	4. South Korea	4
5. Japan	6	5. Sweden	6	5. Italy	5	5. Taiwan	6	5. UK	2	5. Italy	2
6. USSR	4	6. Austria	4	6. Canada	5	6. Canada	6	6. Singapour	2	6. Singapour	2
7. Czechoslovakia	4	7. Czechoslovakia	3	7. Taiwan	4	7. Italy	3	7. Poland	2	7. UK	2
8. Austria	3	8. GDR	2	8. France	3	8. Sweden	3	8. GDR	2	8. USSR	2
9. GDR	3	9. Poland	2	9. Sweden	3	9. France	2	9. Italy	1	9. GDR	1
10. Poland	2	10. Taiwan	2	10. Spain	2	10. Spain	2	10. Czechoslovakia	1	10. Czechoslovakia	1

EC Exports				USA Exports				Japan Exports			
1976	%	1980	%	1976	%	1980	%	1976	%	1980	%
Million EUA		Million EUA		Million EUA		Million EUA		Million EUA		Million EUA	
Intra-EC 650		Intra-EC 1 398		Total 491		Total 899		Total 324		Total 1 128	
Extra-EC 1 852		Extra-EC 3 059		of which:		of which:		of which:		of which:	
of which:		of which:									
1. USSR	19	1. USSR	14	1. Brazil	16	1. Canada	20	1. USA	19	1. USA	35
2. USA	8	2. USA	14	2. Canada	14	2. Mexico	14	2. South Korea	17	2. Germany	7
3. Poland	7	3. Switzerland	6	3. Mexico	10	3. UK	9	3. USSR	7	3. South Korea	7
4. Brazil	6	4. Brazil	4	4. USSR	7	4. Japan	6	4. China	6	4. Taiwan	5
5. Sweden	5	5. South Africa	4	5. UK	7	5. Germany	5	5. Taiwan	6	5. UK	5
6. Spain	4	6. Austria	4	6. Japan	5	6. France	3	6. Brazil	5	6. USSR	5
7. Austria	3	7. Sweden	4	7. Venezuela	4	7. Brazil	3	7. Poland	5	7. S. Africa	3
8. Rumania	3	8. Mexico	4	8. Germany	3	8. Venezuela	3	8. Australia	3	8. Singapour	3
9. Switzerland	3	9. Yugoslavia	3	9. France	3	9. Argentina	2	9. Germany	3	9. Australia	2
10. Iran	3	10. Rumania	3	10. Italy	3	10. S. Korea	2	10. UK	3	10. Belgium	2

Breakdown by destination of machine tool exports (by region)

ANNEX 11 - BREAKDOWN BY DESTINATION OF EXPORTS: COMMUNITY, USA AND JAPAN (in %)

Origin \ Destination	EEC		REST OF EUROPE		EASTERN EUROPE		NORTH AMERICA (USA + CANADA)		JAPAN		DEVELOPING COUNTRIES		TOTAL
	1976	1980	1976	1980	1976	1980	1976	1980	1976	1980	1976	1980	
EEC	-	-	22.8	22.8	32.2	24.9	9.0	15.8	1.0	2.3	35.5	33.2	100 %
USA	15.8	22.7	6.1	6.1	11.9	3.2	12.9	20.4	3.2	6.4	50.1	41.3	100 %
JAPAN	5.2	13.3	2.0	1.2	9.2	5.7	13.6	37.4	-	-	70.0	39.3	100 %

(calculated from SITC)

Breakdown of EEC machine tool exports by destination 1976-80

Destination	1976		1980	
	Value	%	Value	%
(1) Rest of W. Europe	423,3	22,9	586,8	22,8
of which: Switzerland	52,1	2,8	142,1	5,5
Austria	53,0	2,9	95,2	3,7
Sweden	94,4	5,1	84,8	3,3
(2) Eastern Europe	596,7	32,2	641,7	24,9
of which: USSR	350,0	18,9	396,6	15,4
Poland	120,6	6,5	61,8	2,4
(3) North America	167,2	9,0	408,2	15,8
of which: USA	145,6	7,9	354,4	13,8
(4) Latin America	195,1	10,5	302,2	11,7
of which: Brazil	105,6	5,7	105,4	4,1
Mexico	27,8	1,5	101,9	4,0
(5) Middle East	128,2	6,9	87,7	3,4
(6) Africa	150,2	8,1	223,1	8,7
of which: S. Africa	43,1	2,3	103,7	4,0
(7) Asia	165,1	8,9	261,3	10,1
(8) Oceania	25,1	1,4	61,5	2,4
(8a) (OPEC Countries)	(187,5)	(10,1)	(142,2)	(5,5)
Total Extra-EC	1.851.6	100	2.575,4	100
(Intra-EC)	(650,4)	(35,1)	1.075,4	(41,8)

Source: Eurostat
(Nimexe 84.45)

Units: Million ECU

Breakdown of Japanese machine tool exports by type of machine

Machine Type	1976		1980		1981	
	Value	%	Value	%	Value	%
Lathes	94,0	36,6	524,0	44,0	576,8	40,9
of which: NC Lathes	40,4	15,7	446,8	37,5	508,8	36,0
Machining Centres	14,4	5,6	273,4	22,9	431,2	30,6
Grinding			106,9	9,0	104,6	7,4
Milling	22,6	8,8	74,2	6,2	77,3	5,5
Drilling	14,8	5,8	54,1	4,5	58,9	4,2
Boring	19,3	7,5	28,5	2,4	27,7	2,0
Gear Cutting	6,0	2,3	13,8	1,2	10,9	0,8
Planing			4,8	0,4	3,6	0,3
All NC Machine Tools	61,2	23,8	766,3	64,3	994,1	70,5
Total Machine Tools (metal-cutting)	256,9	100	1.191,7	100	1.410,8	100
At 1976 prices	256,9		822,5		883,5	

Units: Millions of dollars

Source: Japan Machinery Exporters Association
(metal-cutting tools only)

This table shows the increasing percentage of Japan's MT exports taken up by NC machines and the concentration on lathes and machining centres.

Breakdown of Community machine tool exports by type of machine

ANNEX 12a

Source: Eurostat (Nimexe)

Units: Million ECU

Machine Type	1976		1980	
	Value	%	Value	%
Lathes	359,9	19,4	489,9	19,0
of which: NC	92,7	5,0	164,7	6,4
Milling machines	174,6	9,4	274,0	10,6
of which: NC	52,7	2,8	71,4	2,8
Grinding machines	271,4	14,7	403,1	15,7
of which: NC	38,1	2,1	27,3	1,1
Boring/Milling machines	65,3	3,5	115,9	4,5
of which: NC	26,0	1,4	52,6	2,0
Presses	235,6	12,7	240,1	9,3
of which: NC	4,4	0,2	5,2	0,2
All Numerically-Controlled Machine Tools (1)	304,6	16,5	416,1	16,2
Total	1.851,6	100	2.575,4	100

(1) Note: In fact, the % of NC machine tools is almost certainly higher (rising from about 18% in 1976 to 21-22% in 1980). However, the current NIMEXE codes do not provide an individual category for machining centres etc., which are therefore recorded under "others". (84.45.94).

Japanese and other foreign penetration of the Community machine tool market

Machine Type	Year	Foreign Penetration		Japanese Penetration	
		Quantity	Value*	Quantity	Value*
NC Lathes	1976	51.3	29.9	17.9	7.8
	1980	39.3	26.3	29.9	18.7
Machining Centres	1976	40.9	19.0	4.2	2.4
	1980	60.9	27.7	35.9	13.1
Other Machine Tools	1976	-	16.4	-	0.7
	1980	-	19.6	-	1.5
All Machine Tools	1976	-	16.7	-	1.0
	1980	-	21.6	-	4.5

Source: CECIMO

*Value figures based on current dollars

ANNEX 14

Breakdown of Japanese exports of NCMT by destination

Destination	1980		1981	
	Value	%	Value	%
United States	349,4	45,6	567,3	57,1
Canada	22,6	3,0	18,9	1,9
EC	220,8	28,8	197,4	19,9
of which: Germany	81,9	10,7	71,8	7,2
France	28,0	3,7	25,1	2,5
Italy	4,8	0,6	7,4	0,7
Netherlands	12,2	1,6	5,8	0,6
Belgium/Lux.	34,3	4,5	34,8	3,5
U.K.	56,1	7,3	48,4	4,9
Ireland	-	-	0,2	-
Denmark	3,5	0,5	3,9	0,4
Greece	0,1	-	-	-
Rest of Western Europe	53,7	7,0	57,5	5,8
Rest of world	119,8	15,6	153,1	15,4

Source: Japan Machinery Exporters' Association

Unit: Million Dollars

Breakdown of Japanese exports of machining centres by destination

Destination	1980		1981	
	Value	%	Value	%
United States	120,5	44,1	220,2	51,1
Canada	8,5	3,1	9,8	2,3
EC	87,0	31,8	105,3	24,4
of which: Germany	29,9	10,9	36,2	8,4
France	13,6	5,0	15,4	3,6
Italy	2,2	0,8	4,3	1,0
Netherlands	4,5	1,7	2,8	0,7
Belgium/Lux.	14,7	5,4	21,7	5,0
UK	20,9	7,6	23,4	5,4
Ireland	-	-	0,1	-
Denmark	1,3	0,5	1,3	0,3
Greece	-	-	-	-
Rest of Western Europe	21,2	7,8	29,5	6,8
Rest of world	44,6	16,3	66,5	15,4

Breakdown of Japanese exports of NC lathes by destination

Destination	1980		1981	
	Value	%	Value	%
United States	209,2	46,8	313,8	61,7
Canada	12,7	2,8	6,7	1,3
EC	129,6	29,0	86,9	17,1
of which: Germany	49,9	11,2	33,5	6,6
France	14,0	3,1	9,0	1,8
Italy	2,7	0,6	2,8	0,5
Netherlands	7,5	1,7	2,9	0,6
Belgium/Lux.	19,6	4,4	13,1	2,6
UK	33,7	7,5	23,0	4,5
Ireland	-	-	0,1	-
Denmark	2,1	0,5	2,7	0,5
Greece	0,1	-	-	-
Rest of Western Europe	31,4	7,0	27,2	5,3
Rest of world	63,9	14,3	74,1	14,6

Source: Japan Machiners Exporters Association Units: Million Dollars

Annex 16

Classification of robots in Japan

Category of robots	Stock	% Total
1. Manual manipulators	9 226	12
2. Fixed sequence	53 189	69
3. Varied sequence	7 347	10
4. Playback	4 306	6
5. Numerically-controlled	1 124	1
6. Intelligent	1 470	2
Total	76 661	100

Excluding manual manipulation and fixed sequence robots (1+2), the total stock of robots is 14 250, which represents 63% of the world total of industrial robots (19% in the USA and 13% in the EEC).

ANNEX 17a

Employment in the machine tool industry 1970-81

Country	1970	1975	1978	1979	1980	1981	Annual change 1975-80
Germany	120,0	102,0	97	97	97	99	- 1,0
France		26,9	20,7	20,2	19,7	19,0	- 6,0
Italy		36,5	36,8	37,5	37,2	36	+ 0,4
UK	70,1	53,0	51,9	61,2	58,9	48,1	+ 2,1
Belgium	4,0	4,7	3,3	3,2	3,1	2,9	- 8,0
EC Total		230	215	225	220	210	- 0,9
USA	100,2	88,8	89,5	96,1	99,7	96,5	+ 1,4
Japan	49,2	40,9	28,2	31,1	33,7	33,9	- 3,8

Source: National Associations

Unit = '000s of persons

ANNEX 17b

Structure of machine-tool industry workforce

Country	Total Emp.	Production workers	% Production workers	% other workers
France				
1980	19.650	11.597	59,0	41,0
1981	18.984	11.166	58,8	41,2
Germany				
1975	102.000	77.010	75,5	24,5
1981	99.000	65.043	65,7	34,3
USA				
1975	88.800	58.500	65,9	34,1
1980	99.700	66.000	66,2	33,8
JAPAN*				
1976	24.775	14.520	58,6	41,4
1981	22.079	12.921	58,5	41,5
UK				
1979	61.200	32.440 (1)	53,0	47,0
1981	48.100	27.370	56,9	43,1

Sources: National Associations

*A sample of 22 major companies, not including temporary workers.

(1) Craftsmen and operatives

Apparent productivity in the machine tool industry 1975/80

Country	Output		Employees		Output per employee	
	1975	1980	1975	1980	1975	1980
West Germany	2.404	2.669	102,0	97,0	23,6	27,5
France	679	528	26,9	19,7	25,2	26,8
Italy	873	1.113	36,5	37,2	23,9	30,0
United Kingdom	728	644	53,0	58,9	13,7	9,3
Belgium	104	75	4,7	3,2	22,1	23,4
EC Total	4.885	5.130	230	220	21,2	23,3
U.S.A.	2.452	2.731	88,8	100,7	27,6	27,1
Japan(1)	777	1.836	40,9	33,7	19,0	54,5

Sources: Production (output) American Machinist (revised figures)

Employment: NMTBA and other national trade associations

Units: Output: Million US Dollars (1975 prices)

Employment: '000s

Output per employee: '000s of dollars (1975 prices)

(1) Metal cutting MT industry only.

ANNEX 18

Rate of customs duty levied on machine tools - EC, USA, Japan

1. European Community

C.C.T. 84.45	Description of machine tool	Rate of Duty NC	Not NC
A.	Specially designed for the recycling of irradiated nuclear fuels	9.3	5
B.	Machines operating by electro-erosion etc.	5.4	2.8
C. (i)	Lathes	6.9	6.2
(ii)	Boring machines	5.4	3
(iii)	Planing machines	7	6.2
(iv)	Shaping, sawing, broaching and slotting machines	4.6	2.4
(v)	Milling machines and drilling machines	8.3	7
(vi)	Sharpening, trimming, grinding machines:		
	(a) fitted with micrometric adjusting system	6.9	6.2
	(b) others	2.8	2.4
(vii)	Jig-boring machines	4.6	2.4
(viii)	Gear cutting machines		
	(a) for cutting cylindrical gears	7	6.2
	(b) for cutting other gears	4.6	4.1
(ix)	Presses	8.3	6.9
(x)	Bending, folding, shearing etc. machines	5.3	2.8
(xi)	Forging and stamping machines	5.4	2.8
(xii)	Others	6.2	6.2

2. United States

Item	Description of machine tool	1	LOC	2
674.30	Machine Tools for cutting or hobbing gears	8,4	5,8	40
674.32	Boring, drilling and milling machines, including vertical turret lathes - machining centres	5,3	4,2	30
675.35	Other metal-working machine tools, including	6,3	4,4	30

3. Japan

NACCI	Description of machine tool	(1)	(2)
1	Machine tools - metal cutting		
(1)	Numerically Controlled	7,2-8	5,2-7,5
	NC Lathes	8	6,1
(2)	Not Numerically Controlled	5,2-7,2	4-5,8
2	Machine tools - metal forming		
(1)	Numerically controlled	5,2-8	4,6-3,5
(2)	Not numerically controlled	5,2	4-4,6

Notes on tables on customs duty on machine tools

EC: Conventional Rate quoted

USA: 1 = Normal Rate (Applicable to EC countries and Japan)

LDC = Least developed countries

2 = Rate for state-trading countries

Japan: (1) Temporary rate

(2) Special GATT rate

Source: Customs Tariffs

Hourly labour costs in the machine tool industry 1979

Country	Hourly rate	Additional costs	Total cost
EC			
Germany	7.32	4.63	11.95
Italy	3.96	3.80	7.76
United Kingdom	4.46	1.30	5.76
USA	7.56	2.44	10.00
JAPAN	5.36	0.99	6.35

Source: US Bureau of Labour Statistics
- Branch of International Comparisons.

Units: US Dollars

ANNEX 21

EUROPEAN COMMITTEE FOR CO-COPERATION OF THE MACHINE TOOL INDUSTRIES

COMMENTS BY CECIMO ON THE MACHINE TOOL-DP INTERFACE

NC will eventually be applied to all types of machine tools. To ensure that there are only a limited number of standard NCs for all types of use, standards should be defined for the following:

I. HARDWARE - physical link-ups - mechanical interfaces - electrical systems

Standard interfaces (mechanical and electrical parameters, and possibly the characteristics of the data-bus) for:

(a) connection to measuring systems (linear and circular);

(b) connection to controls (in practice this is already largely standardized, but the likely scope for digitalization in line with future development must be taken into account);

(c) connection to diagnostic screens equipped with appropriate NC software or to external diagnostic equipment (and for diagnostics via telephone or telex);

(d) connection to a superimposed computer system (for DNC, flexible manufacturing systems), data acquisition by the firm);

(e) connection to sensors (e.g. tool breakage sensors, measuring probes, cutting-force monitor);

(f) connection for selecting external subprograms interrupting programs for measuring cycles and externally introducing predetermined contouring corrections;

(g) connection for programming programmable robots;

(h) connection to operating consoles;

(i) adding supplementary control functions;

(k) connection to simple integrated manipulators.

II. SOFTWARE

(a) Standardized machining cycles and facility of extending them to sub-programs or parts-program modules, calling-up of sub-programs or parts-programs by code (the C functions are often inadequate);

(b) Uniform programming language for programmable NC robots;

(c) More sophisticated standard programming language for NCs;

(d) Provision for connecting an external accessory device for reading drawings automatically - Automatic programming from drawings;

(e) To make it possible to program movement limits (software limit switch). They must be able to allow for the initial position error.

III. STANDARD NUMERICAL CONTROL

In addition to standardizing the functions specified in sections I and II, thought should be given to a future numerical control system concept with the following possible features:

1. Four-axis control (linear and circular) with the possibility of extension to a further four axes.
2. Number of part inputs according to the number of axes.
3. Computing speed and memory capacity must be sufficient to avoid time or capacity problems during data processing in the NC.
4. Altering machine functions (signals between machine tool and NC system) to be done in the NC unit via the interface or by introducing the logic for the alteration into the NC unit's processor(s) (perhaps with programming by a software-controlled teach-in process). Arithmetic unit with data capture for calculating tool-related data or to take account of external data.
5. Provision for diagnosis via telex or telephone (possibly via punched tape) with corresponding data exchange without language problems.
6. The operating console should readily permit dialogue and should be better protected, to at least IP 54.
7. It must be possible to use any kind of measurement system (analog, digital-incremental, absolute digital). Resolution adjustment must be done in the NC unit.
8. There must be redundancy of the NC unit's central systems (central processor, operating system).