

COMMISSION OF THE EUROPEAN COMMUNITIES

Directorate-General for Industrial and
Technological Affairs

TOWARDS A EUROPEAN POLICY ON THE EDP INDUSTRY

November 1973

AVERTISSEMENT

L'étude "Towards a European Policy on the EDP Industry" a été réalisée à la demande de la Commission des Communautés Européennes par Monsieur Yao-Su HU de l'Université de Manchester.

La Commission attire l'attention du lecteur sur le caractère d'information générale de ce document qui ne l'engage en aucune manière.

Summary

- I. The problem of scale : can the European-owned industry survive ?
 - The R&D threshold
 - Strategic options for Europe
 - The marketing threshold
 - The experience curve and the importance of market share
 - The problem of scale : summary
- II. Technological developments
 - Evolution or revolution ?
 - The declining importance of the CPU
- III. European cooperation and the problem of IBM compatibility
 - Statement of the problem
 - How real is the problem ?
 - The real problem
- IV. The policy measures available to Europe
 - Subsidy versus procurement
 - General aid to R & D
 - Development contracts and public procurement
 - Form of preference
 - Time
- V. Conclusions

A EUROPEAN POLICY ON THE E.D.P. INDUSTRY

1. The propose of this is not to deal with the rationale for Europe of having an independent, European-based E.P.D. industry. This has been done in the Council of Europe report⁽¹⁾ and in the E.E.C. Commission's Working Paper of 29th November, 1972.
2. It will concentrate on what Europe can do should do, analysing current realities insofar as they bear on this, and discussing the various options open to Europe.
3. The word "option" is deliberately used because, as will become clear, there is no uniquely-determined strategy which Europe must adopt.

I

The Problem of Size : Can the European-owned Industry Survive?

4. It is useful to analyse the problem of size in terms of R & D, marketing (including servicing), and the experience curve. It is the interaction between these 3 factors that determines the minimum size required for survival and competitiveness. This minimum size is not unique, but varies according to individual circumstances.

The R & D Threshold

5. The R & D threshold is a concept that is frequently used, but not well understood.
6. A threshold is a minimum absolute level of resources that is required to attain a certain objective or set of objectives. Below the threshold, it is often possible to undertake the activity in question, but the objective will not be achieved.
7. In the computer industry, the objective will be, for a new firm, the development of a computer or a range of computers. For an established firm, the objectives include the development of a new range every 5 to 7 years, the introduction of a continuous flow of improvements, keeping abreast of

(1) The Computer Industry in Europe, hardware manufacturing, Strasbourg Jan. 1971, Document 2893.

technological progress in components and peripherals, and the development of software and applications for users.

8. The R & D threshold can be expressed as an annual expenditure, or as a cumulative sum. Naturally, the cumulative sum divided by a greater number of years, will produce mathematically a smaller annual budget. But the cumulative sum itself is likely to be raised if one tries to compress the lead-time, because one then foregoes the benefits of learning-by-doing of a sequential approach.

9. On the other hand, the lead-time must not be allowed to stretch so long that competitive edge is lost or the product is obsolete when it reaches the market.

10. The R & D threshold is not uniquely given, but depends, inter alia, on the following circumstances :

- whether the firm accepts the given state-of-the-art as regards electronic components and peripherals, or tries to develop new devices;
- whether the firm buys out the components or devices, or develops and manufactures its own;
- the degree of novelty in the design system;
- the possibility of buying licenses and technical assistance from other companies. Thus Siemens and C.I.I. used technology from R.C.A. and S.D.S. respectively. Licenses do not obliterate the need for in-house R & D effort, which is required for effective application and adaptation of bought-in technology, and sometimes it may be cheaper and quicker to start afresh with one's own design. Much also depends on the terms of the license, which are more favourable, the stronger the licensee's bargaining position and technological strength.
- the possibility of co-operation with universities (I.C.T. and Manchester University);
- the range of applications for which software is developed; I.B.M. blankets virtually all applications.

- the development lead-time (see paragraph 8 above);
- the previous experience of the firm : the greater this is the lower the development costs;
- whether R & D is done in Europe or the U.S., being cheaper in Europe.

11. Assuming : (i) a new entrant firm to the industry,
 (ii) experienced people,
 (iii) a range from small to medium-large computers
 (iv) standard or general software applications,
 and (v) a lead-time of 3 years,

then the total development threshold is about £100 million (£150 - 250 million or an annual expenditure of £60 million.

12. We can further assume that R & D should not exceed 10% of turnover, since 10% is normally considered the upper limit to the tolerable burden of R & D costs.

13. On the basis of the assumptions in paragraphs 11 and 12, a company must have an annual turnover of £600 million if there is no outside support (from the State or other divisions of the corporate group) for R & D.

14. If, however, there is government support to the tune of, say, £25 million per year (the first French Plan Calcul), the R & D threshold only requires a turnover of £350 million.

15. In 1971, the European-owned companies had the following turnover:

I.C.L.	£370 million
Siemens (computer production)	£230 million
C.I.I.	£130 million
Hixdorf	£110 "

16. Thus, none of them had reached the £600 million turnover. All of them, except perhaps Hixdorf, were obtaining government support for R & D.

17. Through a policy of specialisation, buying out of components and

peripherals, and relative conservatism in design, a small firm may have a much lower R & D threshold. This appears to have been the case with Data-Saab, Computer Technology Ltd., and Nixdorf.

18. Olivetti, too, by specialising in terminals, office computers, and data-input devices, has probably managed to achieve a lower R & D threshold.

19. Even in the general-purpose market, no company can hope to blanket the market like IBM, covering all applications, sizes, industries and geographical areas. For this reason, I.C.L. has recently announced its decision to concentrate on selected applications areas (manufacturing, retail, finance, local and central governments, and public utilities).

20. It would seem that Siemens and C.I.I. are still concentrating on hardware development problems. For this reason, they are relatively strong in real-time work, but have not yet reached the stage where the choice of applications areas arises.

Strategic Options for Europe

21. A number of strategic options clearly emerge for Europe. First, does Europe want to have a European-based capability in the general purpose EDP market rather than specialise in some segment of the overall market? Secondly, does Europe want to have an industry capable of competing without any government R & D assistance?

22. If the answer to both questions is yes, the implication is unambiguous. None of the European-owned manufacturers is big enough. Even a merger between C.I.I. and Siemens is not sufficient.

23. It can, however, be argued that Europe should specialise in fast-growing segments of the market such as :

- POS market (point-of-sale terminals),
- data-entry systems,
- or mini-computers (25-30% growth p.a.)

24. It can also be argued that the justification for giving State assistance to the industry is a distortion in competition due to the support that the U.S. government gives, directly or indirectly, to its industry, and that, therefore, so long as this distortion continues to exist, European industry should be assisted. If this is the case, depending on the level of government support, the R & D threshold no longer dictates a given size of the firm.

25. There is another strategic option. If Europe wants to adopt an aggressive (rather than defensive) R & D policy, i.e. if Europe wants to be a technological leader (in some fields at least) rather than a follower or imitator, the R & D threshold is raised by a lot, perhaps by a factor of 2 or 3 at least.

26. The benefits of being the first in a field in a commercially successful way are high : high exports, high value-added, high profits, licensing revenues etc. Foreign subsidiaries cannot be relied upon for these benefits because R & D, and first production and commercialisation, tend to take place in the home country which represents more than 60% of the total assets of the firm. Moreover, profits accrue to the parent company. The costs, and risks involved, of an aggressive R & D policy are, however, very great.

27. A possible scenario for Europe is for the European-owned firms to opt out of the general-purpose EDP market, as I have said. Maximum benefit could be derived if each firm or group were to specialise in different market segments or to adopt parallel, but different, approaches to the same problems.

28. There would, however, probably be no scope for parallel approaches (and, a fortiori, for duplication) if Europe wants to stay in the general market without continuous public support.

29. It seems that a pooling of I.C.L., C.I.I. and Siemens would allow Europe's computer industry to cross the R & D threshold. A point of primordial importance, however, is that a merger will not automatically produce the

benefits of scale. What is absolutely essential is that there should be rationalisation of activities and resources after the merger. But rationalisation is possible even outside the framework of a merger.

30. A major and real difficulty, which cannot be dismissed, is that by now I.C.L. is well advanced in the development of its New Range, which will be its main product line in the 1970's and on which all its hopes are pinned. If there were to be a merger now between I.C.L. and C.I.I.-Siemens, it would be utterly unreasonable to expect I.C.L. to write-off its development investment of more than £70 million (£150 M) and to disappoint its existing and potential customers. Moreover, the cancellation of New Range would have disastrous effects on the company's R & D personnel and on general morale, perhaps more destructive than a cancellation of Concorde or TSR 2.

31. At first sight, it would be more reasonable to expect C.I.I. and Siemens, who are still discussing the details of their future common range scheduled for 1977-8, to accept New Range if there was a merger. This is to forget, however, that C.I.I. and Siemens are smaller, individually and perhaps even combined, than I.C.L., and have a valid reason for worrying about I.C.L. predominance. Adherence to New Range would greatly accentuate I.C.L.'s predominance.

32. Moreover, as we shall discuss later, the commercial strategies of I.C.L. and C.I.I.-Siemens may be, at present, so different as to preclude common R & D effort on the C.P.U. of an EDP system.

33. What about the prospect of a merger around 1980? One possible scenario which would make this possible would be if either I.C.L. or C.I.I.-Siemens failed, so that the other could proceed with a simple take-over. If this does not happen, pushing the date back to 1980 does not improve the prospect of a merger. By 1980, I.C.L.'s new range would be approaching the end of its useful life, whereas the common range of C.I.I.-Siemens, to be launched around 1978, would be at the peak of its career.

34. The impasse into which we are now led may be due, however, to the wrong questions being asked rather than the non-existence of any acceptable solution. Granted that Europe must have an independent capability in the general-purpose EDP market, this does not necessarily imply that co-operation must centre on the C.P.U. or mainframe. We shall turn to this later.

35. Since R & D is only a necessary, but not sufficient, condition for successful innovation (the other elements being production and marketing), attaining the R & D threshold does not guarantee a firm either survival or commercial success.

The Marketing Threshold

36. In a market situation in which rival suppliers can offer similar prices, quality and delivery dates, and in which, because of technical complexity and continuous innovation, customers require assistance in the selection, application and maintenance of their equipment, marketing/servicing is the determining factor in success or failure.

37. In a given distinct and homogenous market (a country in Europe), a supplier must maintain a marketing and servicing organisation to provide a variety of services and technical assistance, even when he does not aim at blanketing the market.

38. Moreover, given the geographical distribution of the offices and factories of individual large users, the computer supplier must maintain a national servicing network. If he attempts to appeal to international companies, he must maintain a continental or world-wide apparatus.

39. The nature of the market aimed at by the firm and the intensity of competition thus determine a threshold level of marketing and servicing below which efforts to penetrate a market are ineffective.

40. To be economically justified, this marketing threshold⁽²⁾ requires a minimum sales volume. In major Western European countries and in the

(2) Y.S. HU, The Marketing threshold, Center for Business Research, Manchester Business School.

general purpose GDP market, this can be 5-8% of the market.

41. A company that specialises in some market segment or specialised product may, however, have a lower marketing threshold which requires a lower market share.

42. The minimum size of the firm dictated by the marketing threshold depends on the market strategy of the firm.

43. A firm that aims at supplying the entire West European market must have 8% of the W. European market to sustain its sales and servicing efforts.

44. The European-owned manufacturers' share of the European market are as follows:

I.C.L.	9%
Siemens	3 1/2%
C.I.I.	2%

45. Siemens and C.I.I. definitely have not reached the European dimension, even if combined. It may be thought that I.C.L. has, but this is not so yet. I.C.L. does not have 8% of the market or more in any country except its home country, the U.K. The 9% overall market share is due to its 40% share of the U.K. market. To be viable as a Europe-wide supplier, with such a share of the home market, requires 15% of the total European market.

46. To operate as a world-wide supplier, the required size is even larger. Unless this threshold is attained, there is no hope of reaching the class of world-wide users (e.g. the airlines and the petroleum companies).

The experience curve and the importance of market share

47. The experience curve refers to the decline in unit costs with increases in the cumulative volume (in units) of the firm or industry. Potentially it encompasses all costs. In the computer industry, this is a more appropriate tool of analysis than classical economiew of scale, which refer to the decrease in production costs with step jumps in the rate of output.
48. With the experience phenomenon, and in a fast-growing industry, competitive relationships are fundamentally unstable. If a firm increases its market share, the greater increase in its cumulative volume relative to its competitors results in lower costs, which can be converted into further increases in market share, through price cuts or greater investment in marketing. Competitive stability is only reached when one producer clearly dominates the market. Conversely, if a firm falls behind competition, a vicious circle will set in.
49. In the general-purpose computer industry, unit costs go down potentially by some 15% every time cumulative volume double. The increase in volume can be achieved either by internal growth, or by a merger provided the merger is successful. This has obvious implications for a European policy, which we shall explore soon.
50. If IBM's cost index is taken as 100, and if we refer to the effect of cumulative volume on the costs of the same bundle of production, R&D and marketing activities, we obtain the curve depicted in Diagram 1.
51. Two important and interesting conclusions emerge. The first is that the region where the curve begins to flatten out (ie where costs begin to decline less rapidly) corresponds to the stretch around 10% of the world market. None of the US firms other than IBM has yet reached this point, but they are now in the 5-8% region. With the mergers involving GE and Honeywell, and RCA and Univac, and the cooperation between CDC and NCR, the resulting three groups have virtually doubled their market shares, made a step jump towards the 10% mark, narrowed their differential with IBM, and increased their lead over other companies, including the European-owned ones.

52. The second conclusion concerns the unfavourable position of the European-owned manufacturers. The cost indices are:

IBM=100

2nd league US companies=175

ICL=220

Siemens=290

CII=300

53. A merger of all three European-owned firms, if the merger is complete and successful, would give a cost index of about 200.

54. What are the implications for the required size of the European-owned industry? If Europe wants to remain competitive with the second-league US firms, then none of the European-owned firms is large enough, and even a merger of ICL, CII and Siemens would not be sufficient. This is a much higher scale than that determined by the R&D or marketing thresholds.

55. Alternatively, Europe may decide to content itself with staying in the third league, or to specialise in certain market segments.

56. The philosophy of the experience curve differs considerably from the implications of the R&D and marketing thresholds. Any cooperation is beneficial, regardless of optimum levels. These benefits do not end with the threshold being reached, but go on for ever as long as the experience phenomenon applies. There is no once-and-for-all effort which will enable the optimum to be reached and maintained simply because, in the absence of restraints, IBM could theoretically wipe out all competition.

57. The benefits of any measure of real cooperation and any merger come out from our analysis very clearly. No amount of feasible internal growth can permit the European-owned industry to lower its cost as much or as fast.

58. These benefits are so considerable that even a certain amount of inefficiency can be absorbed. Let us take a numerical example. Firm A and firm B both have a turnover of X and are growing at 20% p.a. After a merger, C (=A+B) grows at only 15% p.a. It will take 16.3 years before the turnover of A or B overtakes that of C, assuming that the respective growth rates are and can be maintained. It may, of course, be that A or B will have been eliminated before that time.

The problem of scale: summary

59. Depending on Europe's competitive objective, the experience curve dictates a larger size and a bigger market share than the R&D or the marketing threshold. Given the objective of competing in the second league in the general-purpose market, we need only retain the notion of the experience curve, which subsumes the two thresholds.

60. The required size depends very much on what are the objectives for which the size is required. An aggressive or defensive R&D policy, the extent of specialisation, the number of markets to be penetrated, and the overall competitive aim, all these are crucial considerations on which Europe has to make strategic choices.

61. Moreover, the question whether the European-owned industry can survive depends on what survival means: survival without any support (including procurement), with the present level of support, or with more support.

62. European-owned firms have survived until now with the degree of support that they have had. The only major reason why they may not be able to do so in the future is radical technological developments calling for resources and expertise which they cannot muster.

II. Technological developmentsEvolution or revolution?

63. One can conceive of a number of radical technological developments in the next 10 to 15 years: LSI which reduces costs and/or increases speeds by a factor of 10 to 100, new computer memory techniques such as bubbles and laser, and new architectural designs such as paralld processors (the ILLIAC IV), pipeline processing, and associative memory. Will these developments not impose a big jump in scale?

64. It should be noted that, in the USA, many companies outside the computer mainframe manufacturing industry are involved in, or pioneering, these developments. Should these developments take-off commercially, there is no reason why the European-owned computer manufacturers cannot cooperate

with and buy from them. Cooperation may also be extended to the European electronics, scientific instruments, photographic glass, and software industries. Such cooperation should reduce considerably the burdens of meeting the technological challenge.

65. It seems likely, however, that future technological developments will be evolutionary rather than revolutionary, with emphasis shifting from hardware features to total systems efficiency.

66. The present co-existence of 3rd and 4th generation machines indicates that the revolutionary displacement of the 1st by the 2nd and of the 2nd by the 3rd generations is not likely to be repeated.

67. There is a strong feeling that even current technology is ahead of users' ability to use it fully. According to Dr H. Grosch of the US Bureau of Standards, few installations in the US operate at better than 10% of reasonable effectiveness. Users will be less inclined to rush out to buy new machines simply because of the incorporation of new technical features. They will be concerned mainly with the effectiveness and cost of the system as a whole.

The declining importance of the CPU

68. Not only are users less interested in the technical features of the CPU, but, because of technical progress leading to cost reductions, the importance of the CPU is declining in relation to the value of systems and of industry-wide deliveries. Reliable figures are impossible to obtain, but it seems likely that, in a few years time, the value of CPUs will be overtaken by two faster-growing sectors, individually: (1) peripherals, terminals, input-output devices, and (2) systems design and layout work.

69. It also happens that it is much easier for different firms to cooperate in these two fields than in the architecture of the CPUs. The important implication of this fact for European cooperation will be explored in the next section.

70. Moreover, Europe is weakest in the fields of components and peripherals, and of large systems. All the European-owned firms rely, to some extent, on Texas Instruments or Motorola for their electronic components, on CDC and Memorex for their

memory control devices, etc. There is no European-owned manufacturer of LSI. There is in Europe not a single airline reservation system that was delivered by a European-owned firm or group. Both the French and the British railways rely on US suppliers for their traffic-control real-time systems.

III. European cooperation,
and the problem of IBM-compatibility

Statement of the problem

71. The reason why ICL has not been able to come together with CII or Siemens is said to center on the question of compatibility with IBM. After the breakdown of its talks with CII, ICL said that "differences in philosophy" prevented agreement. More recently, Siemens said that ICL was welcome to join the continental group provided it was willing to adhere to the group's "Treaty of Rome". The "Treaty of Rome" is IBM compatibility.

How real is the problem?

72. At a technical level, incompatibility is no barrier to cooperation. The computers of GE and Honeywell were not compatible, but Honeywell has successfully taken over GE's EDP operations. After Univac's take-over of RCA's EDP division, RCA users were able to convert to the Univac 9700 Series through a conversion package, SMOOTH, and it is noteworthy that 90% of RCA users remained with Univac. ICL's New Range will be able to bridge programs from the 1900 and System 4 machines.

73. The Burroughs B1700 computer is a pointer of the shape of things to come. It is a soft or Protean machine, i.e. it does not have a fixed, built-in machine code and operating system. Through the use of microprogramming, it can emulate any high-level language. Theoretically, it can work on any program from any maker's computer.

74. The question of compatibility arises at three levels.
- (1) The most difficult to achieve is compatibility at the level of machine codes and operating systems, which requires identity of machine architecture. But the advent of the soft machine concept is making this preoccupation obsolete.
75. (2) At the level of applications programs, compatibility can be achieved through the use of compilers, which are software programs doing translation work. Alternatively, a program can be converted once-and-for-all into a different language, to suit a different computer, by the use of conversion programs.
76. (3) The level at which greatest possibilities exist for compatibility is that of the plug-to-plug interfaces between CPUs, add-on memories, peripherals, and data transmissions. IBM is experiencing great difficulties, for example, in preventing users of its computers from adding on non-IBM devices.
77. On the whole, therefore, compatibility is a non-problem. Either it does not matter, or it is perfectly feasible and, what is more, economic, because of the decreasing cost of hardware.

The real problem

78. We must therefore ask why is it that the European-owned manufacturers cannot come together, if compatibility turns out to be a non-problem.
79. One possible explanation, which does no credit to Europe, is that CII, Siemens, and Philips are several years behind the current state of the art, and are still obsessed with the "last war".
80. It seems, however, that the squabble about compatibility may reflect a fundamental difference in the approach to the market. What are the main growth prospects of CII and Siemens? - Their respective public sector markets, which are more than 60% in the hands of IBM at present. Compatibility with IBM minimises the costs of converting from IBM to CII-Siemens, and the posture of compatibility reassures the prospective customers who rely on IBM at present.
81. As for ICL, it already has a high share of the UK

government market. IBM-compatibility will not help it to increase market penetration, while exposing it to direct competition from IBM and depriving it of its technological initiative.

82. This difference in market position is the real stumbling block in the way of European cooperation. The primary aim of European policy must be to create the conditions for a common commercial strategy, which is the only basis on which the European-owned firms will willingly cooperate. No amount of talking or pressurising can take the place of this fundamental requirement.

83. In the light of this crucial point, we consider the alternative policy measures open to the Commission and European national governments.

IV. The policy measures available to Europe

Subsidy versus procurement

84. According to neo-classical economic theory, a subsidy intervenes on the supply side, whereas a tariff acts on both the supply and demand sides. A subsidy is therefore preferable, because it introduces only one "distortion" instead of two.

85. This simplistic view is quite irrelevant here. The theory of international trade leaves out economies of scale and market imperfections, and hence the need to assist infant-industries.

86. Moreover, the dichotomy between tariff and subsidy is not clear at all in the case of aid to R&D and preference in public procurement. Although general grants and loans to support the R&D budgets of companies is distinct from the purchase of standard, repeat-order products, there is little distinction in practice between development contracts and the procurement of one-off, custom-made, or large and complex systems, both of which involve some technical novelty and development work.

General aid to R&D

87. Theoretically, this offers the advantages of introducing the minimum amount of "distortion" and of penalising the users least. This instrument, however, acts only on a part, and a small part, of the total effort required for successful innovation and competition, which includes R&D, production, marketing, servicing, leasing, etc.
88. The main objection to exclusive reliance on this policy measure is that it does not satisfy our fundamental requirement, namely, that of creating conditions favourable to the emergence of a common commercial strategy between the European-owned firms.
89. At present, R&D funding is purely national. Even if there is a pooling of the national funds, there would still remain the well-known and intractable problem of how to allocate the funds between the different national companies, diverting time and energy away from more important issues.
90. Nevertheless, the companies are unlikely to survive if government R&D funds were suddenly cut off, and I recommend that this form of support be retained. What follows is additional to this support.

Development contracts and public procurement

91. These are the main instruments by which conditions for the emergence of a common commercial strategy between the European-owned firms can be created. There is the additional advantage that the actual, detailed forms of cooperation can be left to the companies themselves to decide, thus avoiding any error of judgement of those who are not directly concerned.
92. The public sector markets of the EEC countries (including central and local governments, universities and nationalised industries) amount to some 10% of the world market, the famous threshold. This is sufficiently large to sustain, without any private sector markets, a viable computer industry. If the industry derives half of its sales from private markets, it needs only half of the public sector market to reach the threshold.

93. The ideal solution is a combination of two approaches.
- (1) Open up all public sector markets to all European-owned firms, without any discrimination by national authorities in favour of nationally-owned firms : this will create a common market for the European-owned firms, and hence the precondition for cooperation between them, ie common commercial interests.
 - (2) Use Community Development Contracts for their demonstration effects, to hasten the speed of cooperation and mergers.
94. Nevertheless, the opening up of public markets presents the most serious administrative and bureaucratic difficulties. There are already great difficulties in implementing and coordinating purchasing at the national level. These difficulties will be multiplied exponentially if the policy is applied at the European level, with traditional, nationalistic sentiments inevitably coming into play at the level of individual users, if not at the central government level.

Form of preference

95. If only to overcome these reluctances, it is essential that the users must not be made to bear the cost of a preferential procurement policy. Moreover, these costs may be considerable, not just in terms of expenditure, but in terms of reduced efficiency of the users, given the strategic role of the computer in management, research, production control, etc.
96. A price preference is also difficult, if not impossible, to apply, because, with all the technical complexities of an EDP system, the "product" is difficult to define clearly, and price/performance has no clear meaning. Price has many dimensions: credit terms, rental conditions, conditions of maintenance and technical support, software availability, cost of add-on units, running costs, etc. Performance may differ enormously according to the nature of problems to which the computer is applied and according to the training of the assessors.
97. The simplest solution, which is also that most acceptable to users, is to offer them inducements to buy European, in the

from of credit facilities, subsidies, and coverage of the costs of conversion.

98. Given the large number of users at present using IBM who could convert eventually to European sources, there is considerable scope for cost savings in the conversion process if a certain amount of standardisation can be imposed on the user departments, and if the European-owned companies, including the software firms, can share their experience.

Time

99. Given the fact that US companies have in general already developed advanced applications for the US government, they can meet an order in Europe for advanced systems more rapidly than their European competitors. It would be useful for the latter if they were given more time to develop the systems to meet these orders. One way of doing this would be to set up a planning bureau at the European level, which would inform the European companies of forthcoming needs. Another would be to extend longer delivery dates, with the user retaining existing equipment until the European-owned firm or group can deliver a satisfactory system which has been debugged.

V. Conclusions

I. With the world restructuration of the computer industry, and the lead acquired by three US groups, as a result of merger or cooperation, over the remaining companies, Europe must act fast.

II. The minimum size required depends on what the size is required for. Europe must make choices as to an aggressive or defensive R&D policy, the extent of specialisation, the number of markets to be penetrated, and whether to fight for a place in the 2nd or 3rd league of competitors.

19.
III. Compatibility is no barrier to cooperation, at the technical level.

IV. The real problem is to create the conditions for a common commercial strategy between the European-owned firms.

V. Cooperation should start where it is easiest and most important, in components, peripherals, and advanced systems work, before moving on the CPU, which matters less and less.

VI. Primary emphasis should be on the opening up of public markets in Europe together with Community Development Contracts.

VII. Instead of a price preference, users should be offered assistance in converting to European suppliers.

VIII. There is considerable scope for cost savings in the conversion process, given standardisation on the users side, and cooperation on the suppliers side.

Appendix
Size of the European owned firms

	ICL	Siemens	CIH	Nixdorf
Turnover 1971	£151m	DM 900m*	MF 655m	DM 344m
In US \$**	368	282	132	108
Cumulative installations, beginning 1972	3000	more than 1000	800	24,000
share of European market (n. of installations) beg. 1972	9%	3½%	2%	-
index of unit costs where IBM=100***	220	290	300	-
share of world market	2.3%	less than 1% each		-

Notes:

* value of production. Sales+ rentals may be smaller.

** converted at Sept 1972 exchange rates.

*** IBM has installed more than 90,000 units. The formula is derived from the experience curve, and is

$$X=1460 Y^{-0.235}$$