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Jörg Meyer-Stamer*

Old Structures versus New Logic in the Electronics Industry

Electronics is a branch of industry in which the competitive position of European firms is relatively weak, compared to the chemical, motor vehicle and mechanical engineering industries. This fact appears to some observers – in view of the electronic industry's high rates of growth and its technologically "strategic" importance – to represent a threat to Europe's future industrial development. This has led to intensive political discussions in recent years and to a multitude of initiatives for the revitalisation of the European electronics industry. This paper analyses the extent to which the discussions and initiatives have in fact dealt with the problems in hand.

Electronics is an industry in which production locations are distributed worldwide, with globally oriented firms and both public and private international research operations. But above all – and this is the difference between electronics and most other branches – it is an industry which sells homogeneous products throughout the world. Whereas, for example, the "universal car" strategy was less successful, PCs and Walkmans, televisions and mobile telephones look the same the world over. The basis for this is the separation of hardware and software: identical hardware can be adapted by means of specific software to fit specific local culture and demand. This is true of computers and consumer electronics, the largest market segments with 41.5% and 13.5% respectively, but it also applies to communications equipment (13%) and industrial electronics (8%).¹ Firms have to be present on all major markets – the ability to launch new products on all the large markets simultaneously is a precondition, in view of today's increasingly shorter product cycles and strong product differentiation, for amortising R&D investments and realising the advantages of mass production.

The actors in the electronics industry and the logic which they follow began in the 1980s to go through a fundamental change – particularly, but not exclusively, in the computer industry. This is true both for relationships between the producers of final products and their customers, the users, and for relationships between component producers and the producers of final products.

The interaction between producer and user until recently corresponded to the usual structure in the

marketing of capital goods. It was dominated by the close collusion between information technology (IT) experts in the user firms and the IT producers' salespeople, which contrasted strongly with the communication problems and conflicts between IT experts and IT users within a given firm. For a long time, the organisation of IT in the user firms was highly centralised because the organisational structures established in the early phase of "batch processing" and centralised data input had survived; and many IT producers (especially the largest, IBM) had organised their firm's structure accordingly.

This structure has long since been breached by "wild PCs", i.e. the non-managed, non-controlled introduction of computers by employees; and today, with the almost unlimited possibilities of interoperability among widely differing computers with different operating systems, the technical necessity for centralised procurement decisions regarding hardware is disappearing; (*nota bene*: this does not apply to software!) IT procurement decisions have been decentralised and the logic is often one of costs: who can supply the computer capacity I need at the lowest price? A logic between producers and users is thus gaining prevalence which does not exist even on the market for consumer durables (where there is generally such a thing as brand loyalty): if the products are largely interchangeable because there are hardly any differences in quality and performance, the price alone is decisive.²

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¹ Microelectronics account for 10%, other components 13%; calculated according to the figures published in the specialist magazine "Electronics", January 1990. This magazine has not published any detailed figures on the structure of the market since then, and such data are not available anywhere else (except from market research organisations at corresponding prices).

This phenomenon is further strengthened in the IT industry by two tendencies.³ Firstly, universal architectures are supplanting individually tailored solutions – dedicated word processing systems and CAD hardware have been replaced by normal PCs and workstations. Secondly, low end systems are supplanting high end systems. At the end of the 1980s the prognosis that PC networks would one day be capable of competing with mainframes caused far more amusement than headaches. That prognosis is today's reality, and IBM – regarded a few years ago as having the most secure future among the large enterprises – finds itself in a deep crisis, to which it is reacting with radical structural adjustments.

The upheaval in the electronics industry is – in Freeman's terminology⁴ – a case of radical technical change as a result of radical innovations which are changing the direction of development of the entire branch; it is not easy – in view of the fact that the branch as a whole is relatively young – for the participants to accept this.

There are two possible ways for firms to adapt to the new logic: either by submitting to it, or by evading it via product differentiation.

Submission

Submission to the new logic means: venturing into the race with regard to the innovation and prices of standardised goods, making production leaner via the reduction of vertical integration of manufacture and the improvement of response time via debureaucratisation and de-hierarchisation. Submission, however, not infrequently ends in a downward spiral: in order to meet the requirements of lean production, downsizing programmes are designed. These demoralise employees; the best skilled workers often leave the company. Commitment and thus productivity and innovativeness decline; competitive strength is reduced.⁵ At the end of the spiral is a firm with fewer

workers, less turnover, a lower profit margin and fewer (particularly non-material) assets. In this way a major enterprise can turn into a marginal supplier in the space of a few years.

Submission to the new logic is particularly fatal if it is not combined with a clear improvement in communication with the firm's customers. The Japanese example (especially in consumer electronics) is very instructive here: when time-based competition became the paradigm of the 1980s, virtually every firm implemented optimising strategies in this direction – and in doing so lost sight of the customer and his/her needs. The result was shorter and shorter innovation cycles for products which were increasingly difficult to operate. The firms increased their efforts continuously and appeared at first glance to be adapting optimally to the new pattern of competition, but their products became more and more difficult to sell.⁶

Evading via Differentiation

The alternative of evading the new logic by means of product differentiation appears to hold more promise of success, although it is more difficult. It is a precondition for this alternative that trends must be recognised early and that the producer must always have an ear close to the user.

Many IT producers – and especially brand-name suppliers – are, however, very weak in this regard. IBM's attempts to sell underdimensioned, feeble PCs to private households when the latter were already stocking up on high-performance computers from cheap chain outlets were only the tip of the iceberg. The current activities of a number of brand-name companies are very instructive: in a phase in which ergonomics (e.g. flickerfree screens) are becoming financeable, these firms are still operating in their advertisements with the argument of a low radiation factor. The brand-name producer who, in the present situation, put a quiet PC, with a monitor which did not flicker even if the user did not have intimate VGA programming knowledge, at a good price onto the market, could score a brilliant success. Instead, these firms apparently suspect that now *only* the price is decisive, and they run after the cheap chains without any great hope of overtaking. It is a typical case of the hare and the tortoise.

It is doubtful whether two other approaches offer a way out:

□ Leading-edge products, which are developed and produced specifically for particular applications. One example are those products which are presently being

² Cf. M. Borrus: The Regional Architecture of Global Electronics: trajectories, linkages and access to technology, in: P. Gourevitch, P. Guerreri (eds.): *New Challenges to International Cooperation: Adjustments of Firms, Policies and Organizations*, San Diego 1993.

³ Cf. C.R. Morris and C.H. Ferguson: How Architecture Wins Technology Wars, in: *Harvard Business Review*, Vol. 71, 1993, No.2, p.92.

⁴ Cf. C. Freeman: *Technology Policy and Economic Performance. Lessons from Japan*, London, New York 1987, pp. 60 ff.

⁵ Cf. G. Hamel and C. K. Prahalad: *Strategy as Stretch and Leverage*, in: *Harvard Business Review*, Vol. 71, 1993, No.3.

⁶ Cf. G. Stalk and A. M. Webber: *Japan's Dark Side of Time*, in: *Harvard Business Review*, Vol.71, 1993, No.4.

created by the fusion of different areas of electronics (e.g. CD and PC) or which are being developed specifically with multimedia in mind. But time-to-market, production efficiency and close communication with the user/customer are decisive for success on the market here, too; and since a large number of firms see the greatest chances of growth in this field, the wrangling is also greatest here. Japanese firms are strong in this segment, and a number of US firms have considerably improved their performance in this regard. Moreover, US high-tech start-ups are strong here. European companies are present in certain niches, e.g. industrial automation, but as a whole they tend to show a deficit in this sector.

□ Problem solutions. This idea has long been present in the IT industry; it represents a promise, however, which until now has not been kept. It remains an ambitious objective to this day to get back to the status-quo-ante level of productivity following the introduction of computers. True quantum leaps are possible here:

- in the development of user interfaces which allow the operation of complex applications without knowledge of computer science or lengthy training courses;
- in the development of programming tools which are operable by IT laymen;
- in the reorganisation of software development.

It is in this field that the weaknesses of Japanese firms appear to lie;⁷ even European firms appear to perform better here. The latter therefore have the greatest chances here of strengthening their competitive position, provided they succeed in reducing their excessively hierarchical structures and thus improving their innovative capacities, customer orientation and reaction speed. One gauge of this will be whether they succeed in establishing themselves on the US market, which is still the most demanding. European firms must react quickly, however, for their Japanese rivals have recognised their disadvantage and are working hard to eliminate it.

One thing in particular is presently under discussion as the magic spell for all the disadvantages of the new logic: the capacity of a firm to create a new market

segment, to integrate other firms into this segment, but at the same time to keep the technological control of this segment in its own hands, i.e. to control the technical standards. The new magic formula is: proprietary architectures in open systems.⁸ The paradigm has been created by firms such as Sun – the workstation producer which began early on to disclose the basic architecture of its microprocessors and subcontracted to other producers. Other examples are Intel, Microsoft, Novell and Adobe. An example of the opposite behaviour is a firm such as Apple, which has limited its potential for growth by retaining a completely closed system until recently.

This pattern is to be found in every segment of the electronics industry, not just in information technology. This becomes apparent if, for example, the situation in consumer electronics is considered. The VHS standard for video recorders established itself although it was technically inferior; decisive was the generous licensing policy of Victor, the firm which had developed the standard.⁹ The future success of firms with a new technology, e.g. digital audio-recorders, will also depend on how they are able to plan their system as an open system and at the same time to keep control over the standard; and the days of the overriding success of the Japanese game-console producer, Nintendo, could be numbered because it failed to open its system in time.

Horizontal Networks

In the new electronics industry, those firms are most competitive which are not too large and are integrated into networks. Not too large means: low overhead costs, little bureaucracy, a high degree of flexibility and reaction speed. The disadvantages of smallness – surviving in the recession, the funding of R&D etc. – are compensated for by the integration into networks (with other firms, with universities, with research institutes). Here lies a major advantage of the Taiwanese PC and periphery industry, which is one of those shaping the pattern of competition today in this field. However, Japanese firms also realise network advantages, for the *Keiretsu* are a type of corporate network (which differs from others mainly in that it is safeguarded by interlocking capital arrangements, that it is intended to be permanent and that the individual firm is very large).

⁷ The thesis by M. Cusumano (Shifting economies: From craft production to flexible systems and software factories, in: Research Policy, Vol. 3, 1992, No.4) that Japanese firms have achieved quantum leaps in the organisation of software development remains an unproved claim and is still awaiting verification. Meanwhile, the impression has gained the upper hand that Japanese software firms are struggling with serious structural problems (cf. "Japan's Soft Spot", in: Far Eastern Economic Review, 5. 8. 1993).

⁸ Cf. C. R. Morris and C. H. Ferguson, op.cit., p. 87.

⁹ Cf. Y. Baba and K. Imai: A network view of innovation and entrepreneurship: The case of the evolution of the VCR systems, in: International Social Science Journal, Vol. 35, 1993, No.135.

The advantages of horizontally structured corporate networks are

- ☐ a more rapid flow of information,
- ☐ shorter decision paths and therefore time advantages,
- ☐ specialisation advantages,
- ☐ flexibility, because under changed conditions new corporate networks can easily be formed,
- ☐ low overhead costs due to the smaller size of firms and thus a more favourable cost pattern.¹⁰

The firms which are successfully integrated into these networks are able to find a balance between competition and cooperation; in this way they are able to avoid the numbing effect which otherwise often accompanies too close cooperation between firms.

Networks differ from the traditional organisational and interactional patterns of large firms, which still continue to dominate the picture, particularly in the European electronics industry. These firms

- ☐ are large and thus have high overhead costs,
- ☐ succeed only with great difficulty in dismantling centralised decision structures and hierarchies and in overcoming decision-avoidance mentality,
- ☐ often have conflict relationships with their suppliers (or at least do not enjoy the trust of other, smaller firms due to past sins).

The logic behind the actions of buyers within the network is completely different to that of buyers on the final product market: "brand loyalty" is high (at least as long as it is apparent that the supplier is not persistently weaker than other potential suppliers, i.e. competitive pressure is always present in the background), supplier relationships are planned to last a long time and the price is less significant than criteria such as quality or reliability and speed of supplies.¹¹ Since in an innovative network the dense

flow of information in both directions is of elementary importance, trust is a key element of network relationships; predatory behaviour destroys trust and leads to the predator's being rapidly expelled from the network (and also to his not being able to get into other networks easily, precisely because the flow of information is rapid and dense).

The US Semiconductor Industry

Because of its superiority in the development of new products, the US electronics industry dominated the world electronics market for a long time. Weaknesses in production efficiency have, however, undermined its position since the 1970s and the Japanese semiconductor programme meant that the US industry no longer went unchallenged even in the case of innovative products.¹²

In the US electronics industry, and especially in the semiconductor industry, two types of reaction to the Japanese challenge could be observed in the 1980s – a defensive one and an offensive one. The defensive reaction was to be found among the "old" firms of the branch as well as among individual systems producers; the offensive reaction was connected with a rapid, network-oriented, structural change in Silicon Valley.

The old firms – in many cases spin-offs from the pioneer companies Fairchild and Texas Instruments – changed their behaviour from the 1970s onwards. As their turnover grew, they distanced themselves increasingly from the existing networks (especially in Silicon Valley). Where they had once cultivated close contact to suppliers and customers, they now turned to the arms-length relationships which are typical for the USA.¹³ They verticalised their production and many of them relocated certain production stages to Mexico or Southeast Asia – a strategy which was intensified as competition stiffened although it undermined competitiveness, since it reduced the capacity to react to innovation thrusts. Furthermore, they concentrated on standardised mass products, which they sold on the free market (hence the label "merchant producers"). In addition, they introduced an institutional innovation: they founded a branch association, the virtually exclusive aim of which was political lobbying – the Semiconductor Industry Association (SIA).¹⁴

The offensive reaction was shown mainly by new firms established in the late seventies and eighties, the great majority of which are located in Silicon Valley.¹⁵ More than 85 semiconductor firms were

¹⁰ Cf. OECD: *Technology and the Economy. The Key Relationships*, Paris 1992, p.79; and A. Saxenian: *Regional Advantage. Culture and Competition in Silicon Valley and Route 128*, Cambridge, London 1994.

¹¹ Cf. A. Saxenian, *op. cit.*, p.147.

¹² Cf. M. Fransman: *The market and beyond. Information technology in Japan*, Cambridge 1990.

¹³ Cf. A. Saxenian: *Regional Networks and the Resurgence of Silicon Valley*, in: *California Management Review*, Fall 1990, p. 99.

¹⁴ Cf. D. B. Yoffie: *How an industry builds political advantage. Silicon Valley goes to Capitol Hill*, in: *Harvard Business Review*, Vol. 66, 1988, No. 3.

¹⁵ On the following, cf. A. Saxenian: *Regional Networks ...*, *op. cit.*

established there during the 1980s, and they had a high rate of survival: 90% of these firms survived the first six years. Their turnover reached a volume of US \$ 2,000 million in 1988. With them, an organisational model for semiconductor production was created which an observer once compared to the industrial districts to be found in Europe:¹⁶ a flexible network of highly specialised and efficient small and medium-sized enterprises, cultivating an intensive, usually informal, exchange of information among themselves as well as with larger firms (e.g. Hewlett-Packard, Apple) – an organisational pattern which minimises the transaction costs usually associated with communication between firms. Supplier relationships are created between firms along the vertical chain of production which are intended to last for a longer period – in contrast to the situation with regard to the merchant firms, which in periods of recession force not a few of their suppliers into bankruptcy.

The product range of these firms includes all those articles which show high rates of growth, but especially application-specific integrated circuits (ASICs). Their specific advantages – specialist know-how, tight information network, high degree of flexibility – can be fully brought to bear here. Many firms specialise on a limited phase of production and development – chip design, the translation of design into production, manufacture (silicon foundries) etc.

Technological Trends

Two technological trends make this model possible. Firstly, a few years ago computer supported design tools for ASICs became available, which has multiplied designer productivity. Lead times for new chips were thus shortened from several years to a few months or even weeks. The computer design of ASICs has achieved a degree of maturity which has led to its becoming widespread; especially larger ASIC users in a wide range of branches are thus able to develop chip designs themselves. In order, beyond this, to open up the promising market of the small and medium-sized enterprises, ASIC producers are founding geographically scattered development

centres, which maintain close contact with users. Secondly, the production of ASICs takes place mainly in relatively small, highly flexible factories (*minifabs*), which can be built within six months with an investment of US \$ 20-50 billion; for a *megafab* for standard chips two to three years are needed and (at the end of the 1980s) US \$ 250 million. In the mid-1980s small Silicon Valley firms were producing 100 to 200 different types of chips in lots of between ten and ten thousand.

Because of the pressure of time under which ASIC users find themselves, the disadvantages of the higher production costs (compared to Southeast Asian locations) are more than compensated for by shorter assembly cycles. Whereas an assembly cycle for standard chips in an offshore assembly plant takes about six weeks, Cypress (one of the leading ASIC producers who assembles in Silicon Valley) takes only four days.

The changes in Silicon Valley show that it is not a law of nature that the US electronics industry has to lose one market segment after another to the Japanese. This is true of microprocessors, where e.g. Motorola has completely turned its production lines upside down since the mid-eighties, tried out new organisational concepts, systematically trained its workers (Motorola University) and based itself less on offshore production. It is also true of ASICs being produced in small to medium-sized numbers, where Japanese firms only have one substantial advantage over US enterprises (namely the *Keiretsu* structure, i.e. the possibility of cross-subsidisation as well as more room for manoeuvre for long-term strategies). In the other fields in which US firms otherwise usually lose out, Silicon Valley is strong: flexible corporate networks, supplier relationships which are reminiscent of Japanese structures, and a high degree of competence and efficiency in manufacturing.

Competitive Weakness in Europe

Whereas the US electronics industry has been able since the end of the 1980s to regain lost ground from its Japanese competitors, the position of European enterprises, which was never particularly good,¹⁷ has deteriorated further; this could be seen, for example, in the continuously growing deficit in the electronics balance of trade.¹⁸ The causes of the fundamental weakness of the West European electronics industry are to be found essentially on two levels: the microlevel of the firms themselves and the metalevel of societal strategic capacity.¹⁹

¹⁶ Ibid., p.91.

¹⁷ "Europe's problems in electronics cannot be realistically termed a decline. In fields such as consumer electronics, computing, software and semiconductors, Europe had never achieved a strong international position from which to decline." (M. H o b d a y: The European electronics industry: technology and structural change, in: Technovation, Vol.12, 1992, No. 2, p. 81).

¹⁸ Cf. EC Commission: The European Electronics and Informatics Industry: Situation, Chances and Risks, Proposals for Action, Brussels 1991, p. 37.

Microlevel

European electronics firms are strong in markets which have a monopolistic structure or are characterised to a high degree by systematic partitioning: telecommunications, military electronics. In the past, the state had a monopoly of demand, and price formation often took the form of cost-plus pricing. This – and not the lack of public demand for high-tech products²⁰ – is the problem.

These are segments of the electronics industry which until now have not functioned according to the new logic. One thing is now becoming clear, however: even in the telecommunications industry the times of close cooperation between the public telephony monopolist and the official manufacturing contractors are over. The end of the monopolies is at hand – for services in any case, but also for networks, where cellular technology is establishing itself as a cheaper alternative to the expensive underground cables (quite apart from the fact that, for example, in the United Kingdom competing suppliers are busy digging holes for parallel cables). An unusual dynamic is thus entering into this branch, which until now has tended to be rather easy-going.

The reasons for the competitive weakness of European electronics firms at the microlevel can be summarised under five headings:²¹

□ *The wrong products are being developed.* Research and development are usually supply-driven: the development departments develop products which they expect to be marketable (or which they know are also being developed by competitors). This is occasionally supported by the production of visions, i.e. convincing concepts (e.g. for office automatisations) which are intended to motivate potential users to make the corresponding purchases. This is all far removed from the close interaction with users cultivated by Japanese firms, which leads to products tailored to the user's problems and which are therefore easy to sell. This is the reason why the Japanese electrical and electronics industry achieves

a much better performance with far fewer engineers (1985: Europe 109,000; Japan 69,399).²² Furthermore, it explains why the productivity of European development engineers is so low, for according to a McKinsey study, "...in turnover of new – i.e. less than 36 months old – products, the Americans and Asians at US \$ 3.1 and 4.1 million per development engineer respectively achieve a much better figure than the Europeans, who only achieve US \$ 1.2 million".²³

□ *Time-to-market is too long.* The large electronics concerns (like other large European enterprises, too, but in contrast to small and medium-sized firms) are characterised by rigid organisational patterns, an inflexible division of labour between departments and weak forms of communication among the different departments.²⁴ Therefore not only are the wrong products developed, but these are also developed too slowly – the organisation of research in European firms still has more in common with the traditional cascade model than with the simultaneous engineering practised by the Japanese.

□ *A too strong orientation towards the national market.* European electronics firms are strong above all in Europe, and some of them even only on their own national market (examples of this were, or are, mainframe suppliers such as ICL, Bull and Compares) which is also a result of their close connections with government purchasers. In some cases it is also the undesired result of support for national champions, which have become fat on their protected market instead of using it as a spring-board to regional markets or even the world market. Altogether, the presence of European firms on the world market is weak – only 45% of their exports leave the European Community. Worse: in France, for example, in the mid-eighties 85% of the exports of IT and office machinery came from the factories of foreign firms. Demands by large European electronics concerns for protection and for a European industrial and technology policy make it seem doubtful that they seriously intend to expose themselves to the strenuous business of selling on non-European markets.

□ *Disadvantageous company structures.* European

¹⁹ For definitions cf. K. Esser et al.: Systemic Competitiveness. Concept and Key Policy Issues, Berlin 1993.

²⁰ Cf. for example D. Samland: Strategien zur Stärkung der Wettbewerbsfähigkeit der europäischen Informationsindustrie, in: Jahrbuch Arbeit + Technik, 1992, p. 279.

²¹ Cf. G. Vickery: European Electronics at the Crossroads, in: OECD Observer, 1991, No.172; G. Vickery: The European Experience in Advanced Electronics, in: STI Review, 1992, No.10; H. Drüke: PCs 'made in Europe' – ein Auslaufmodell?, Berlin 1992; H. Drüke: Restructuring in the PC Industry: New Challenges, New Actors, New Strategies. A Study in Labor and Industrial Policy, Berlin 1993.

²² Cf. G. Vickery: The European Experience ..., op. cit., p.63. The widespread observation that Europe has a deficit here (cf. D. Samland, op. cit., p. 278) is wrong.

²³ Handelsblatt, 11.10.1993, p. 20 (our translation); cf. also H. Kluge, J. Kluge and L. Stein: Europe's structural weakness, in: The McKinsey Quarterly, 1994, No.1.

²⁴ H. Drüke: Restructuring..., op. cit.

electronics companies are inadequately integrated into networks and are often large, inflexible and top-heavy. Communication beyond departmental borders is often complicated. The establishment of networks is often made difficult by the fact that – despite all the attempts (some of which have indeed been successful) to set up technology incubators – there is in Europe, as opposed to the USA, no large sector of dynamic, innovative small enterprises (some of which become Fortune-500 firms within a few years). On the contrary, the sector is dominated by old firms, which were often established in the 19th century. New firms, which temporarily replicated the success story of the HPs and DEC's, often fell victim with their increasing size to the same ossification as the old firms (and not infrequently perished – as did Nixdorf and Norsk Data – as a result).

□ *Efficiency versus the securing of corporate power structures.* The sudden commotion which broke out following the publication of the MIT automobile study²⁵ speaks volumes. A broad discussion has been going on in Germany and other North and West European countries since the mid-1980s on the question as to whether the key to a firm's efficiency, flexibility and innovativeness lies in the human sphere rather than in the application of new technologies. A similar discussion has been going on for longer in the USA, started off by the experiences of the GM-Toyota joint venture NUMMI and the Japanese transplants. This discussion was, however, largely confined to academic circles. Within the enterprises, the proponents of human-centred production concepts seemed to be fighting a lost cause. The study mentioned above was necessary in order to set off a wide-ranging rethinking in the minds of decision-makers.

Inferior Philosophies

It is undisputed today that the competitive disadvantages of the European industry are in particular a result of inferior organisational philosophies. The McKinsey study states for Germany, "Compared to Japanese producers, the cost disadvantage is on average roughly 50%. Factor costs, i.e. the wage level, capital and material costs, make up only about a fifth of this. The rest is caused, in the final analysis, by the productivity lag, and this

can be attributed directly to product design which inadequately meets the requirements of production and to inefficient production processes."²⁶

It would, however, be illusory to assume that the firms will rapidly change their organisational structure because profit maximisation is their dominant objective and they are prepared to use any means to achieve it. In practice this goal often collides with other goals; the alternative for many firms is the consolidation of corporate power structures versus quality, flexibility, efficiency and reaction speed; for the consistent application of "lean" concepts would render entire management levels superfluous and would necessarily lead to a clear shift of competences downwards. Differences in the perception of the challenge posed by Japanese production concepts become obvious here: whereas the trade unions lay the emphasis on the broadening of qualification profiles and the decentralisation of corporate decision-making structures, the employers tend to hope that it will be possible to reduce the power of the workers' representatives, to intensify work and to increase wage differentials (especially – and this time in precise analogy to Japan – along the component suppliers chain).

Metalevel

In Europe the strict adherence to the ideology of the free market is no longer a German peculiarity but is complemented, for example, by the consistent application of neoliberal ideology by the British government. This makes it more difficult to support the process of structural adjustment in individual firms by activities on the mesolevel.

In practice, exceptionally fruitful interactions between firms, intermediate organisations and government institutions (e.g. in research) have emerged. In Germany, for example – due to exceedingly urgent problems – a functioning industrial policy network at and below the level of the *Länder* has developed, in which structural change is planned, negotiated and organised so that it is socially acceptable.²⁷ At the macrolevel – in trade policy, competition policy etc. – a pragmatic line is taken. At the metalevel on the contrary – in social discourse as well as in the ruling economic theory – these

²⁵ J. P. Womack, D. T. Jones and D. Roos: *The Machine that Changed the World*, New York 1990. On its reception in Germany cf. P. Cooke: *The experiences of German engineering firms in applying lean production methods*, in: *Lean production and beyond. Labour aspects of a new production concept*, Geneva 1993.

²⁶ Handelsblatt, 11. 10. 1993, p. 20 (our translation).

²⁷ Cf. U. Jürgens and W. Krumbein (eds.): *Industriepolitische Strategien. Bundesländer im Vergleich*, Berlin 1991; H. Abromeit and U. Jürgens (eds.): *Die politische Logik wirtschaftlichen Handelns*, Berlin 1992.

phenomena are ignored, as are more recent perceptions as to the determinants of a firm's competitiveness, the structure of international trade rivalry and the determining factors of systemic competitiveness. Instead, discussions on wage costs are instigated indefatigably; and in the debate on industrial policy a war of faith is raging between liberal ideologists and nostalgic supporters of the "survival of the fittest". Not infrequently, this discussion sinks into polarisations which reflect the categories and the societal conflicts of the 19th century. It is not only that the really important questions – e.g. what is the future of the industrial system in view of the ecological crisis? – can hardly be posed. Even in trivial everyday politics the discussion remains ten years behind theoretical perceptions and also (and this is the true paradox) behind political practice below the national level.

Blind Alleys

Quite a few of the industrial policy initiatives to improve the competitiveness of the European electronics industry discussed in the recent past pointed completely in the wrong direction:

□ There was the idea of a German or European memory chip factory, i.e. concentration on an area in which the new logic of the electronic industry has not (yet) really gained ground. In this sphere the laws of mass production, of large investments in large production plants, are still valid; this segment has until now continued to follow the Fordist logic. That is the reason why this – strategically not so very important – segment has attracted such great attention in the discussion: for European companies this segment fits into the concept of the world with which they are familiar, into their firmly established logic of action. That is why they concentrate their strategic considerations and industrial policy demands so strongly on this segment.

□ In view of progressing globalisation it is absurd to aim for electronic autarchy.²⁸ The starting-point for an industrial policy for the electronics industry must, rather, be the identification of those segments in which the weakness of the electronics industry undermines the competitiveness of other branches; these are segments in which the interaction between producers and users is particularly intensive and the production base is weak. Such a segment is e.g. obviously not the production of standard DRAM chips. It is much more plausible to consider application-specific chips (ASICs) to be such a segment. In view of the high degree of differentiation

in the components industry, however, even this is a much too general statement; and we do not really know what the European industrial base in this area in fact looks like since most analyses concentrate on large enterprises, whereas the typical ASIC firm is medium-sized.

□ In view of the differentiation mentioned above it appears problematical for an industrial segment such as ASICs to aim for firm-oriented targeting in order to reduce a possibly existing gap. The political concept of promoting a single European chip production champion in order to counterbalance Japanese competition ignores the experience that champions in Europe always develop sclerosis very rapidly. Apart from that, such ideas are based on the thesis that every type of chip can only be manufactured efficiently in gigantic factories, which is obviously wrong.

□ The attempt, with a European HDTV policy to guarantee the future of the European consumer electronics industry (more precisely: of the companies Philips and Thomson), turned into a fiasco, which should be regarded as a warning to EU initiatives in completely new market segments to be careful.²⁹ Of course it is sensible not to leave the creation of new market segments to the anarchy of the market but, rather, to let it be actively fashioned by enterprises, the state and other social actors working together.³⁰ At the level of the EU, however, until now the mechanisms have not existed which could offer an opportunity for more than only a narrow circle of electronics companies, academics and research bureaucrats to enter into a dialogue. This type of narrow discussion circle has not stood the test in the past, however.

False Policies

It is meanwhile regarded as common sense that the competitive disadvantages of the European electronics industry are, in particular, a result of inferior organisational philosophies. This problem cannot be solved by an industrial and technology

²⁸ Cf. J. Zysman and M. Borrus: From Failure to Fortune? European Electronics in a Changing World Economy, in: *Annals of the American Academy of Political and Social Science*, 1994, No. 531.

²⁹ Cf. J. Meyer-Stamer: Steuerungsprobleme von Medien- und Technikentwicklung, in: O. Jarren (ed.): *Medienwandel – Gesellschaftswandel? 10 Jahre dualer Rundfunk in Deutschland. Eine Bilanz*, Berlin 1994.

³⁰ Cf. J. Meyer-Stamer: Suchprozesse – richtungslos. Zum Steuerungsbedarf in der Medientechnik, in: S. Holgersson, O. Jarren and H. Schatz (eds.): *Dualer Rundfunk in Deutschland. Beiträge zu einer Theorie der Rundfunkentwicklung*, Münster 1994.

policy of the old school. Traditional policy is aimed at firms which either come into existence in new branches, or find themselves principally on the right trajectory³¹ in growing industries or are active in mature branches and are in need of modernisation. The electronics industry cannot easily be classified as belonging to one of these three groups, however. It is a relatively young, growth industry, which nevertheless is in the process of structural change, and it is populated by firms with serious structural problems and adjustment deficits. Political intervention must tackle these problems. Many of the political initiatives under discussion at present do not do this.³²

□ Measures to provide insulation against non-European competition cause damage to trade without helping European companies. On the contrary, experience shows that phases of protection are often not used to conduct the necessary painful structural changes, but that instead they reduce the pressure on firms for change.

□ Increased investments in training do no damage but they ignore the problem: research and development are not characterised by an inadequate number of engineers but by inadequate organisation (i.e. the inadequate use of the existing engineer capacities).

□ In view of the structural problems of the European electronics industry, a technology policy oriented primarily towards the financial promotion of R&D is aiming in the wrong direction, and may even offer incentives for increases in structural problems. This is true, for example, for projects such as the development of a new generation of highly integrated circuits. Such projects are bound to fail if the basic problems outlined above are not tackled and the products therefore come onto the market too late and at too high a price. They have a false impetus: they are technology oriented instead of organisation oriented. The mastery of the design and manufacture of highly integrated circuits is without doubt an important objective. But if the organisational components are

ignored, a Siemens project will suffer the same problems as the GDR microelectronics project did.

Making cheap capital available may compensate for one of the advantages of the Japanese industry. But the European electronics industry is characterised, among other things, by inadequate capital productivity, which is more likely to be stimulated than corrected by making this factor of production cheaper.

□ Government procurement policy has in the past led to phenomena such as the creation of "Siemens civil servant look-alikes". In the current situation this policy is not necessarily harmful. It will, however, only have positive effects if it differentiates clearly between firms capable of change and those which are ossified (and only promotes the former).

The Course of Locational Policy

The present situation in the electronics industry is marked in many segments by overcapacity and ruinous competition. These are the result of two factors:

□ the widespread conviction that this is *the* key technology and industry of the future, which induces a number of politicians to throw themselves into industrial policy activism and causes many firms to accept short and medium term losses;

□ the low barriers to market entry in many, and especially in new, segments. Existing dominating positions in the market – particularly that of IBM – are subject to a steady process of erosion. Even in segments in which the high intensity of research and investment would lead one to expect a trend towards the formation of monopolies (the production of DRAM memory chips), the degree of concentration fell during the eighties.³³

In view of this constellation, it seems both plausible and the obvious thing to do to sweep the dependency scenarios aside (e.g. that of a threatened dependency in chip production which would undermine competitiveness and security). Some dependency apologists (e.g. Konrad Seitz, who is very influential in Germany³⁴) make it rather easy for critics: arguments which paint the gloomiest possible picture on the basis of a moderate level of differentiation are effective in achieving publicity, but for experts on the subject they are not very convincing.

Konrad Seitz is no doubt right when he states, "In the high-tech age, 'comparative advantage' is no longer given, but a parameter which itself has to be

³¹ On the definition of this cf. G. Dosi: Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change, in: Research Policy, Vol. 11, 1982, No.3.

³² On this cf. EC Commission, op. cit.; D. Samland, op. cit.

³³ Cf. D. T. Methé: The influence of technology and demand factors on firm size and industrial structure in the DRAM market – 1973-1988, in: Research Policy, Vol.21, 1992, No.1.

³⁴ Cf. K. Seitz: The Case for a Federal Government High Technology Policy, in: INTERECONOMICS, Vol. 27, 1992, No.3, pp. 103-107.

produced.”³⁵ From this, he comes in the next sentence to a conclusion which strikes like thunder, “Thus, once a certain party has established an advantage it is almost impossible for it to be taken away again.”³⁶ This is in essence a simplified depiction of the technology gap theory of trade; this approach postulates that it can take some time, often a number of years, before competitors catch up with an innovator.³⁷ The level to which this refers is, however, the sectoral or national innovation system, not the individual firm. The electronics industry in particular demonstrates that this rule only has limited application at the firm level: Fairchild does not today dominate the chip market, nor IBM the PC market, nor Toshiba the laptop/notebook market. The rapid technological change in the electronics industry means that an innovator must put in a great deal of effort to maintain his technological lead. Where there are leads which are incontestable, these are not based primarily, or not only, on technological breakthroughs but on specific marketing capabilities, on detailed knowledge of a market segment or on particularly close contacts to customers.³⁸ Thus, in the electronics industry the opposite of Seitz’ statement tends to be true: without continuous, intensive efforts to extend competitive advantages, a firm will rapidly lose the competitive lead it had once achieved.

Of course, the opposite position – all products are becoming commodities; let us therefore leave their production to the Japanese and concentrate on activities which are value-added intensive and demanding, such as design and software³⁹ – cannot be taken seriously in its generalised form because it ignores the importance of the close interaction between development and production (and, in addition, overestimates the employment potential in these segments).

In view of the way in which politics work in Europe, it is difficult to formulate an industrial policy which would make the electronics industry competitive. What must be done first and foremost is re-engineering⁴⁰ a fundamental change at the microlevel, in and between firms. European policy in the past was

hardly able to enforce this. It has always been a central problem of European industrial policy that it tended to be defensive and without criteria. Firms which did not make use of research subsidies or import protection to become more competitive were not punished, but received more subsidies and more protection because they employed large workforces and for this reason alone had a great deal of bargaining power.

This pattern preserved non-competitive structures and thus contributed to the reinforcement of the current crisis, which began as a cyclical one. This crisis makes the mistakes of the past clear and offers an opportunity for a reorientation of policy. European policy should primarily encourage and stimulate the necessary changes in corporate structures

- via a radical reduction in subsidies for large firms,
- via stricter control of the relationships between large firms and their suppliers as part of competition policy,
- via subsidies for programmes to assist the establishment of innovation-oriented firms and to support small and medium-sized enterprises, which should be formulated at the local and regional level.

Lessons from Silicon Valley

What, in addition to the above, could represent a starting-point for industrial policy? The fact of globalisation must not be allowed to lead to the conclusion that in the electronics industry locations worldwide can be exchanged at will. The globalisation of corporate R&D, for example, is not indicative of a loss of importance of regional innovation networks but is, on the contrary, an expression of the fact that they are irreplaceable. It is extremely seldom the case that the multinational concerns’ globalisation of their R&D is an expression of their interest in exploiting low-wage locations in the style of footloose industries.⁴¹ They are more concerned to get a foot in the door of particularly promising networks and to be fully informed about technical innovations at an early date. This does not imply that regional innovation networks are being replaced by global research networks. The reason that, for example, most of the large electronics concerns have at least one “listening post” in Silicon Valley is because a particularly innovative milieu is to

³⁵ Ibid., p. 104.

³⁶ Ibid.

³⁷ Cf. OECD, op. cit., p. 250.

³⁸ This is argued correctly by A. S. Rappaport and S. Halevi: *The Computerless Company*, in: *Harvard Business Review*, Vol. 69, 1991, No.4.

³⁹ Ibid.

⁴⁰ Cf. M. Hammer: *Don’t automate, obliterate*, in: *Harvard Business Review*, Vol. 68, 1990, No. 4.

⁴¹ Cf. J. H. Dunning and J. Cantwell: *MNEs, Technology and Competitiveness of European Industries*, in: *Außenwirtschaft*, Vol. 46, 1991, No. 1, pp. 53-54; they speak of the “increasingly footloose nature of international production and of innovative activities”.

be found there.⁴² It is not only that in many product areas the technological limits are defined there. It is also the close networks and intensive interaction between firms, as a result of which relatively small firms can keep up with considerably larger and financially more powerful competitors at home and abroad in innovation competition.⁴³ These experiences set the parameters for political initiatives to vitalise the European electronics industry.

An active locational policy to improve industrial competitiveness should concentrate on the mesolevel so that entrepreneurial initiative can enfold and the traditional European structure of flexible specialisation can develop. In the chip industry, for example, this would mean specifically

- the strengthening of (already existing) initiatives for standardisation and training in chip design (as there seems in fact to be a bottleneck here);
- increased promotion of the application of ASICs by potential users (i.e. above all educational and information programmes) to flank existing firm-establishment programmes;
- increased control of the abuse of market power by component producers who compete with their customers in the markets for final products.

By placing the emphasis on these points, governmental/private research cooperation could contribute towards the improvement of competitive position. They should, however, be planned from the beginning to be that which the JESSI programme has become in the course of time: a stimulus for interaction, communication and networking.⁴⁴

In addition, financial incentives for firms of all sizes should be tied to clear criteria determined by benchmarking, i.e. continual improvements in quality, runthrough time, stock-keeping, the reduction of batch size etc. Attention must also be paid that performance improvements by the assemblers are not to the detriment of components suppliers. It might be worth considering organising suitable forums in which firms could exchange experiences – interaction and communication on the European level is apparently something which still requires to be stimulated.

An active locational policy can be supported by a more offensive foreign trade policy and a carefully

directed demand policy. The main instruments of EU policy towards Japan until now have been local content rulings, anti-dumping measures and pressure for voluntary export restraints. None of these measures has stood the test: voluntary export restraints let the protection rents fall to Japan; the anti-dumping measures took effect too late; and the local content regulations tended to lead to the establishment of screwdriver factories. In contrast, the US government has succeeded in recent years in forcing Japan to open its markets little by little. Preferences which Japan grants to the US economy often do not apply to EU firms. Changing this will be the most important challenge which EU foreign trade policy with regard to Japan will have to face in the coming period.

A carefully directed demand policy can strengthen European power in two areas: in telecommunications and in industrial electronics.⁴⁵ In telecommunications European firms have been able to retain their strong position or even to extend it, e.g. because it proved possible early on to establish a Europe-wide standard in the field of mobile communications and European producers were able to translate this into a lead in the development and marketing of appliances.⁴⁶ Further windows of opportunity are being opened by the fact that Japanese firms are being hindered by the backwardness of their national telecommunications market and the leading US company AT&T is having problems with the management of its internationalisation strategy.⁴⁷ The further deregulation and "supranationalisation" of European telecommunications, combined with a demand oriented expansion strategy, could provide important stimuli here. In industrial electronics there are points of departure arising from increasing environmental requirements, which force a dramatic increase in the efficiency of energy usage. This implies discriminating demand for advanced control electronics both in production and in the products (e.g. car electronics). Strict environmental requirements can start off a demand thrust in this field which the European electronics industry could translate into worldwide competitive advantages.

⁴² Cf. D.J. Teece: Foreign Investment and Technological Development in Silicon Valley, in: California Management Review, Vol. 34, 1992, No. 2, p. 100.

⁴³ Cf. A. Saxenian: Regional Networks ..., op. cit.

⁴⁴ Cf. J. Meyer-Stamer: Staatlich-private Forschungskoooperation in der Elektronik: Erfahrungen und Perspektiven, in: Vierteljahresberichte, 1993, No.131.

⁴⁵ Cf. J. Zysman and M. Borrus, op. cit.

⁴⁶ Cf. Handelsblatt, 22. 2. 1994, p. 18.

⁴⁷ Cf. R.H. Victor and D.B.Yoffie: Telecommunications: Deregulation and Globalization, in: D.B.Yoffie (ed.): Beyond free trade: firms, governments, and global competition, Boston 1993.