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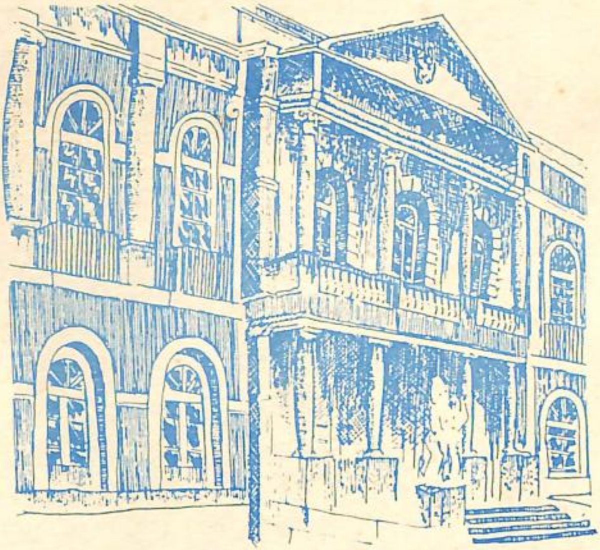

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MANUFACTURING STRATEGIES AND GOVERNMENT POLICIES

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Manufacturing Strategies and Government Policies*

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Pan-European technology-related programmes certainly have an important role to play in the movements towards continental integration in the coming decade. Of particular importance, according to those evaluation reports which are currently available (1), has been the experience of undertaking collaborative R&D between what in many cases has been up to five or six firms, research institutes and universities in two or more countries on any single project. The already high and increasing costs of R&D in high technology industries has forced European countries into the realisation that they cannot compete internationally on their own. These experiences in collaboration, and contacts made between firms that previously were little more than brand-names to each other, are now recognised as being as, if not more, important than any of the actual products which might be forthcoming from such joint ventures. So successful have these experiences been that they are now being reproduced outside the institutional framework of EEC programmes.

But these programmes, in spite of their heavy resource allocation, address the problems of only a small number of firms in a narrow range of industries throughout Europe. Without wishing to denigrate the economic and political importance of such initiatives, their primary contribution is to strengthen the high-technology supplying firms. They cannot solve the problems faced by the vast majority of companies in Europe that arise from the changing nature of international competition.

The competitive situation in which the majority of manufacturing firms now find themselves is by now well documented. Regardless of the source of the intensification of competition, customers increasingly require (and are in a position to insist upon) high quality, more consistently reliable, products and better delivery performance. These and other non-price factors listed in Table 1 add to the constant pressure on firms to produce to a suitably low price in order to capture and defend market share (2).

Table 1: Pressures on Firms

- strong pressure on price to reduce or at least maintain at low levels
- increasing emphasis on non-price factors, such as design and quality
- increasing demand for customer service before, during and after sales
- greater customisation of products, more variety and differentiation
- shorter product life cycles to cater for markets with an increasing 'fashion' orientation
- increasing pressure on short delivery response times

Source: Bessant J, and Rush H, (1987) "Integrated Manufacturing", Centre for Business Research, Brighton Polytechnic, a report to UNIDO, to be published in the Technology Trends series.

These pressures compound the normal problems of rising costs of input such as labour, materials and energy. As a means of providing greater variety in products with more frequent modifications or to meet the demands for customer specific service, firms are finding it necessary to become more flexible. This flexibility also extends to the need to cope with fluctuations in demand, as well as being able to offer a wider range of products and the capability to use the same item of capital equipment for more than one product (3).

Increased flexibility requires manufacturers to solve problems ranging from high inventory levels, long lead times and high overhead costs. The list of such problems, shown in Table 2, will be familiar to any manufacturer and are not restricted to those working in batch-production sectors. Similar pressures have spread across the manufacturing spectrum to mass-assembly and high-volume process industries. These problems are the legacy of the previous industrial paradigm where economies of scale, heavy

capital-investment in dedicated equipment, and employment practices based on the theories of Ford, Taylor and Sloan dominated manufacturing strategies. With these strategies, there has traditionally been a trade-off between productive efficiency and flexibility. They have become increasingly inappropriate in conditions where market pressures are forcing firms to find alternative ways of producing with both high flexibility and high productivity.

Table 2: Problems Restricting Flexibility

- low machine utilisation (due to set-up times for different batches)
- queueing problems at key bottleneck operations through which all products must pass
- low machine utilisation due to queueing upstream and waiting downstream of bottleneck operations
- high inventory levels of naw materials, work-in-progress and finished goods
- long production lead times
- poor production monitoring and control
- high overheads in indirect staff engaged in trying to monitor and expedite orders
- poor delivery performance
- poor quality
- inefficient use of space
- overloaded paperwork systems

Source: Bessant J, and Rush H, (1987), "Integrated Manufacturing", paper prepared for the UNIDO Technological Trends series.

Technological Approach

For a growing number of companies the central feature of their new manufacturing strategies has been the introduction of a powerful range of new technologies based on programmable automation which have become available during the last decade. These new technologies range from simple microelectronic controls to rather more complex systems for computer-aided design, flexible manufacturing systems, robotics, automated handling, test and warehousing facilities and the like. Their rate of diffusion has been breath-taking. A three-country comparative survey conducted in 1983 indicated that process applications of microelectronics in industry had reached 43% of manufacturing firms in West Germany, 43% in Britain and 35% in France (4). In the UK, a country not noted in recent times as having the most innovative industries, the diffusion of microelectronic process applications has grown from 18% in 1981 to 49% in 1985 (5).

Studies of the diffusion of discrete pieces of automated technologies show that the installed base of 10,000 CAD systems in 1982 grew to 42,000 in 1985 (6). In the UK alone, 32% of those firms which had adopted some form of microelectronic-based equipment were using CAD by 1985 (7). For FMS's, which represent only 2-3% of the global machine tool market (8), sales more than doubled between 1982 and 1984; over 1000 FMS systems are now installed worldwide (9). The diffusion of industrial robots in nine OECD countries increased at a rate of 44% per annum between 1974 and 1984 (10). Within individual countries the stock of robots grew at varying rates. In Japan, for example, a stock of 65,000 robots in 1984 increased to 93,000 in 1986, a rate of 52%. In the UK and the USA the growth rates were lower at 8,5% and 27% respectively.

Rates of diffusion alone do not, however, tell us anything about the benefits of the technologies to individual firms or the problems that arise in their application. For this we must rely on case-studies of individual firms and sectoral studies: only a small number of the latter are presently available. Data from case-studies show that it isn't unusual for firms with CAD to report increases in productivity of nearly 300%; a study of the clothing sector found more modest but

none-the-less significant improvements of 4-6% in material savings and an average of 50% reductions in lead time (11). An in-depth study of fifty FMS user firms in Britain reported reductions in lead time by an average of 74% and in work-in-progress by 68%, and an increase in machine utilisation by 63% (12).

It would be possible to continue quoting this type of statistic at some length, but it is not my intention here to sing the praises of any particular technology. Indeed, it is widely accepted that regardless of how powerful each discrete automated technology may be, their 'real' benefits only appear with the converge of the technologies and the subsequent integration of activities within the plant. Nevertheless, studies clearly indicate that these technologies - even at the individual level- can address some of the problems currently facing manufacturers. Sufficient examples have now been recorded of programmable technologies permitting more rapid changeover of plant, reducing lead times, producing higher quality, etc. The fact that these technologies can help does not, however, mean that they always do. Just as a selective presentation of either anecdotal evidence or the more systematically collected data can imply that these technologies are a panacea for industrial woes, they can also be employed to argue the opposite. Significant difficulties exists, which intensify as higher levels of integration are attempted. A recent study of 250 firms in the UK sounds an important note of caution (13). It reports, as illustrated in Table 3, that of those plants which have invested in FMS over two-thirds have experienced low paybaks while nearly half of the CAD users found returns less than initially expected.

Table 3: Payoffs from Advanced Manufacturing Technologies (sample: 250 firms)

Technology	Zero-Low Payoff (%)	Moderate - High Payoff (%)
CAD	46	54
CAM	46	54
MRP	19	81
FMS	67	33
Robots	76	24

Source: New C, (1986), Manufacturing Operations in the UK, British Institute of Management/Cranfield University.

To some extent, the more disappointing figures are a result of firms not being sufficiently far along on the learning curve. Many users of CAD, for example, suggest that it takes up to two years before they are experienced enough to use the equipment to anything approaching its full potential (14). In other cases, the choice of technologies have been inappropriate because of lack of information or understanding on the part of management. Sometimes the machines have performed as intended but antiquated accountancy procedures, which expect short-term returns on investiment, are inadequate since they fail to take into account the full long-term benefits of the technologies. Few of the more traditional accountancy systems, for example, take into consideration the ability to enter new markets, or an increase in market share which might result from reduced lead times or more customised production. Simple return-on-investment techniques are only just now being replaced by more complex alternatives which incorporate the strategic issues facing firms.

It is not possible here to discuss all of the difficulties facing firms in adopting advanced automated technologies. In addition to those already discussed, these difficulties also include technological problems related to integrating different elements, and a lack of in-house skills and resources. Elsewhere we have outlined a long-term strategic approach for the adoption of automated technologies which argues for an incremental, step-by-step progression towards higher levels of integration of manufacturing activities (15). The approach we favour allows for organisational learning and the acquisition of skills while keeping investment and risk at an acceptable level during the early stages. But in our research we have found that in nearly every case, successful technological change cannot be accomplished without some degree of organisational change as well - what in the innovation literature is referred to as the 'compatibility' between the innovation and the context into which it is being placed. In some cases we have even found that organisational changes introduced as a prelude to the introduction of advanced automation has resulted in such significant reductions in inventories, shorter lead times and higher quality that the adoption of the technologies has become unnecessary (16).

Organisational Approach

As one manager in a recent study succiently put it "computer integration into a chaotic situation results in computerised chaos". The elements of organisational innovation required can range from the need for functional integration to reduce the traditional problems of inter-departmental boundaries through to vertical integration with shorter and flatter hierarchies resulting in a devolution of decision-making. But perhaps most significant, has been the changing nature of work organisation - the greater reliance on small autonomous groups of workers and managers, which reduces task fragmentation, highly specified division of labour, and external control and regulation (17).

One of the most powerful arguments in support of the need for organisational change has been the success of many Japanese firms, and the subsequent adoption by an increasing number of non-Japanese enterprises, of a range of organisational/managerial techniques. These include 'just-in-time' production, total quality control, closer user-supplier relationships. Central to these techniques (some would say philosophies) is the better use of existing resources - the workforce itself - to generate and implement solutions to a firm's problems within a context of long-term continous improvements.

Just as with advanced automated technologies, the selection of appropriate organisational techniques is not subject to a universal formula but is dependent on the needs and resources of the individual firm. The direct benefits have been clearly demonstrated in the area of inventory saving, reduction of work-in-progress, increased quality, faster through-put, space savings, reduced scrap, and arguably, improved worker motivation (18).

The route to successful use of such techniques is not, however, a simple matter. While we categorically reject the often-repeated argument that Japanese success in applying these organisational techniques is culturally determined, we also do not accept the alternative extreme - that they are 'plug-in' solutions. As with the advanced automated technologies, successful use of any of the forementioned techniques must be part of an overall strategy which aims at streamlining, simplication of operations, and the integration the design and manufacturing process. Fundamental to this approach is the acceptance of the importance of human rather than technological capital (19). Those firms - Japanese or otherwise - which have successful adopted these methods have done so over a long period of time. But to receive the full benefits which they have to offer requires both management and the workforce having to pay more than mere 'lip-service' to the concepts of participation and consultation. Use of these techniques as a means of furthering management control of the rate of work or as a means of circumnavigating the legitimate rights of worker representatives will lead to increased resistence to their diffusion (20). For their part unions must also accept the changing face of manufacturing and re-think traditional approaches to securing worker benefits.

The Role of Governments

Whether one adopts the organisational techniques for the benefits they provide or as a necessary prelude to the introduction of advanced automated technologies, there is the need for planning within a framework that links the business strategy to the resources available to the firm, with an understanding of the technological and organisational options, and the requirements of implementation. Clearly, many large organisational already have the resources to undertake the strategic planning necessary for future success. But just as clearly, many firms do not. With the proliferation of choice of new technologies and techniques, many firms are at a loss as to which would be the most appropriate, considering the combination of resources available and problems faced. A question that is increasingly posed is what role, if any, can governments realistically play in assisting firms in making the transition between the old and new industrial paradigms.

Interestingly, a wide range of politically disparate governments in Europe have come to remarkably similar conclusions during the 1980s. By this I am not referring to the high profile

pan-European programmes. Potentially more important have been a series of national programmes aimed at increasing the awareness of individual firms to the capabilities of new technologies, providing financial assistance to user firms who wish to develop their own applications, and building a national infraestructure for technical assistence.

The focus of most of these programmes is to increase the rate of diffusion of microelectronic-based applications in both manufacturing processes and products. They go under names such as the Microelectronics Applications Programme (MAP) in the UK, the Special Programme on the Application of Microelectronics (SAM) in West Germany, the Technological Development Programme (TDP) in Denmark, Products Using Electronic Components (PUCE) and Application of Computer-controlled and Automated Production Equipment (ADEPA) in France, and the National Microelectronic Programme (MNP) in Sweden.

Naturally, each programme has its own distinctive administrative arrangements and differing degrees of financial assistance that are tailored to its perceived strengths and weaknesses, to market requirements, industrial structures, and laws regulating competition in each country (21). I have selected the UK's MAP scheme for illustration; it was one of the first, the longest running, and one of the most successful, programmes. Initiated in 1978 by the then Labour government, the scheme was extended under the Conservative administration. Divided into three separately-administered parts, the scheme had a strong bias towards educating firms on the potential of microelectronics, allowing them (many of which had never undertaken any form of R&D) to engage in learning-by-doing, and developing a network of experienced consultants to undertake fleasibility studies for firms.

Part A of MAP covered awareness and training and included materials (videos, published literature, etc.) and speakers for in-firm presentations, subsidised by the Department of Trade and Industry. Short-courses for managers were organised through existing educational and training institutions with equipment and course-development paid for by the government (firms paid the fees for their managers). One of the most creative parts of this scheme was a train rented from British Rail which travelled the country filled with demonstration applications for commuters to see (22).

The second part of the scheme, entitled MAPCON, provided financial support to meet the cost of hiring consultants to assist the firms in undertaking short feasibility studies. Consultants who qualified for the scheme were listed in a booklet which specified their industrial and technical expertise. The government paid for up to ten days of the consultants time. This was sufficient for a study of potential applications (process or product) and an outline of the resources which would be required if the firm chose to procede into development. At the height of the scheme's popularity, over 100 applications for assistance were being received monthly and 800 consultants were participating. Between 1979 and 1985, nearly 7,000 applications had been received and over 4000 studies completed, costing the government 9.5 million pounds sterling. The programme was aimed at small to medium sized firms. Of those receiving support, nearly one-third employed less than 50 people and only 8% employed more than 1000. Consultants registered under the scheme came from a wide variety of institutions, ranging from private consultancy companies through to university and polytechnic engineering departments. While a large number had little previous experience with microelectronic applications in industry, the scheme provided a low-risk means of providing experience (ie. at little or no cost to the client firm). Administratively, the scheme was unemcumbered by bureaucracy. Application to the scheme was simple (a two page form) and rejection criteria almost non-existent. In the period during which the scheme was in heaviest demand, only six civil servants were require to process applications and assess whether the terms of the contract between clients and consultants had been fulfilled. In our evaluation of the scheme, we concluded that it had been a nearly unqualified success in both educating firms and contributing to a national capability for technical assistence (23).

The third, and largest, part of the scheme (Part C) was for development support in the form of grants of between 25% and 33% towards the costs of R&D. Entry into the scheme was somewhat

more demanding, with applicants required to provide details of financial and human resources, a business plan, the expected time schedule and costs of development. Naturally, since more public monies were being spent, closer attention was paid to the ability of firms to complete the projects (24). Nearly 250 civil servants were required to process and act as project officers for the nearly 2,500 firms which applied (of which 55% received support) during the period of our evaluation (1979-1985). The composition of firms participating were again biased towards the small and medium sized, and the majority of projects cost less than 250,000 pounds sterling.

We were not able to evaluate MAP in terms of financial returns since many projects were still underway or not on the market for a sufficient period of time to reach firm conclusions. However, when compared to a sample of firms who had undertaken projects outside of MAP, we found that only 11% of MAP projects were eventually abandoned, compared to 23% of those outside of MAP. Over 50% of MAP projects proceeded into commercial production, against 33% for non-MAP projects. 82% of the firms participating in MAP considered that they had successfully met the necessary technical specifications (against 60% for non-MAP firms). More MAP-participating firms reported a greater degree of increase in market share, spin-off products, and the acquisition of in-house expertise (25). At a cost of only 5-10 million pounds sterling a year (26), MAP helped a significant number of firms to take their first steps up the learning curve of efficient use of microelectronics.

As mentioned above, other European countries have addressed the same objectives with programmes differing more in terms of degree than substance. Perhaps the most significant difference was the decision in Denmark and Sweden to enhance their technological infrastructure through government support of networks of private, non-profit technological institutions which could carry out R&D, consultancy, training, testing, etc. Another important difference has to do with the way in which schemes were administered, with West Germany, for example, using its engineering association rather than a government department to run their programme.

Relevance for Developing Countries

Whether one refers to these sorts of programmes as interventionist or merely 'creating the environment' which allows the market to operate, is largely irrelevant outside of politically ideological considerations. More important is whether or not there are elements of these schemes that could be adopted universally or improved upon. With the assistance of UNIDO, a team of civil servants in Venezuela, clearly believe that this is the case (27). Having studied the different instruments and mechanisms employed in such programmes, the Venezuelan government is expected soon to embark on their own distinctive programme. Recognising that microelectronic-based applications alone will not solve the problems facing firms, they have developed a programme which spans the new technologies while encompassing the new organisational techniques.

Central to the Venezuelan modernisation programme is the concept of the "innovation consultant". These individuals, skilled in using the diagnostic tools for analysing firms main problem areas quickly and knowledgeable on the potential of the new technologies and techniques, will act as 'marriage brokers' between the firm and those individuals within the country with the expertise necessary to undertake a full feasibility study and the application of the chosen solution.

The skills required for such a program are, not surprisingly, in short supply. As a prelude to a full programme, training courses for innovation consultants are required as is an expansion of the in-country expertise on areas ranging from low-cost CAD systems to just-in-time production. The government, through established organisations such as COVEP (the productivity council), will train and help establish a registry of consultants, develop awareness programmes using successful local firms as demonstrators, and establish an information centre for interested cliente (28). Interest in this programme has quietly spread and a fund of one million dollars has been designated by the development bank CAF for the extension of similar programs throughout the Andean Pact member nations.

This type of programme suffers from the ineloir fact

that results can only be expected in the medium-to long- term. While the potential exists to reach a large number of previously-negleted firms which form the backbone of any economy (29), this type of step-by-step 'continuous improvement' programme will take years to make a significant impact. As a result, the political will to support such an effort is much more difficult to generate than the higher-profile types of technology policy. All too often it is the 'sexier' short-fix solutions which, while lacking any track-record of substantive achievements, provides greater political capital in the short-term. It is my view that the 'nuts and bolts' type of technological programmes, such as that currently under development in Venezuela, will make a longer-lasting impact on industrial restructuring, regardless of geographic location.

1. See for example, The Mid-Term Review of ESPRIT, submitted to the Commission of the European Communites by the ESPRIT review Board on October 15th 1985; or, Hare P, Lauchlan J, and Thompson M, (1988), An Assessment of Esprit in the UK, Technological Change Research Centre, Heriot-Watt University, Edinburgh, Scotland, June; or, Georghiou L, and Cameron H, (1987), The Esprit Programme and the UK PREST, University of Manchester.

2. Bessant and Rush (1987), Integrated Manufacturing, to be published as part of the Technological Trends Series, UNIDO.

3. Bessant, Haywood and Rush, (1987), "Integrated Automation in Batch Manufacturing", paper prepared for the OECD's Directorate for Science, Technology and Industry, Centre for Business Research, Brighton Polytechnic.

4. Northcott J, Knetch W, and de Lestapis B, (1985), Microelectronics In Industry: An International Comparision - Britain, Germany, France, Policy Studies Institute/Anglo-German Foundation, London.

5. Northcott J, (1986), Microelectronics In Industry: Promise and Performance, Research Report 657, Policy Studies Institute, London.

6. Edquist C, and Jacobsson S, (1988), Flexible Automation: The Global Diffusion of New Technology in the Engineering Industry, Basil Blackwell, Oxford.

7. Northcott J, (1986), op. cit.

8. Edquist C, and Jacobsson S, (1988), op. cit.

9. Bessant J, and Haywood B, (1986), The Introduction of Flexible Manufacturing Systems as an Example of Computer Integrated Manufacturing, Innovation Research Group Occasional Paper 1, Centre for Business Research, Brighton Polytechnic.

10. Edquist C, and Jacobsson S, (1988), op. cit.

11. Hoffman K, and Rush H, (1988), Micro-electronics and Clothing: The Impact of Technical Change on a Global Industry, Praeger, New York.

12. Bessant J, and Haywood B, (1985), op. cit.

13. New C, (1986), Managing Manufacturing Operations in the UK, British Institute of Management/Cranfield.

14. Arnold E, and Senker P, (1982), "Designing the Future: The Implications of CAD Interactive Graphics for Employment and Skills in the British Engineering Industry", Science Policy Research Unit, University of Sussex.

15. Bessant J, and Rush H, (1987) op. cit.

16. Bessant J, and Haywood B, (1985) op. cit.

17. Bessant J, Haywood B, and Rush H, (1987), op. cit.

18. Schonberger R, (1986), World Class Manufacturing, Free Press, New York. Case studies conducted by Lamming R, (1986) "For better or for worse? Technical change and buyer-supplier relationships in the UK automotive component industry", in Voss C (ed), Managing Advanced Manufacturing Technology, IFS Publications, UK, documents significant savings. For example, one firm making small pumps for use in diesel engines recorded reductions in lead times from 10 to 1 day, decreases in work-in-progress from 15,000 to 1000 units, and scrap down 3-1%. Payback was achieved within 9 months on the manufacture of 54,000 pumps per month. Another firm which manufactured shock absorbers increased labour productivity from 6.44 to 8.32 standard units/per hour while at the same time reducing scrap from 43% to 23%.

19. Bessant J, Haywood B, and Rush H, (1987), op. cit.

20.see, for example, Turnbull P, (1987), "The Limits to 'Japanisation' - Just-in-Time, labour relations and the UK Automotive Industry", New Technology, Work and Employment.

21.A comparision of these programmes has been undertaken by the OECD (1989 forthcoming) "National Programs to Promote Industrial Diffusion of New Technologies", Directorate for Science, Technology and Development, Paris.

22.The cost for Part A of the scheme was approximately 1 million pound sterling.

23.Northcott J, et. al. (1986), Promoting Innovation: Microelectronics Consultancy Support, Research Report 662, Policy Studies Institute, London. The assessment of the MAPCON scheme was conducted jointly by members of the PSI and the Centre for Business Research at Brighton Polytechnic.

24.Although the information required was necessary to determine whether the companies had been able to attract sufficent funds to pay for the rest of the work it also had an important secondary effect. Many of the participating firms had never undertaken R&D or written a business plan before. For the first time they were forced to consider what the potential impact within the firm of a process innovation might be, or the potential market for a new product. An assessment of the MAP scheme Part C was carried out jointly by the Policy Studies Instutite and the Centre for Business Research at Brighton Polytechnic, see Northcott J, et al. (1985), Promoting Innovation: Microelectronics Applications Projects, Research Report 645, PSI, London.

25.Northcott J et al. (1985) op. cit.

26.Approximately 65 million pounds sterling had been allocated for project development support between 1978 and 1986. During 1986 the MAP project was integrated into the 'Support for Innovation Programme' of the Department of Trade and Industry, which in 1988 was replaced by the 'Enterprise Scheme'.

27.Perez C, and Vivas L, (1988), "Creacion de Condiciones for ONUDI-FOMENTO, Caracas, Febrero. The team of civil servants working together in Venezuela included individuals seconded from various government and non-governmental institutions in Venezuela as well as Howard Rush and John Bessant from the Centre for Business Research, at Brighton Polytechnic UK.

28.Decisions on the financial arrangement for this scheme have yet to be finalised.Venezeulan law does not permit direct grants to firms but it is likely that some form of subsidy will be available to pay for the few days required of the innovation consultant per firm. Some degree of 'soft-loan' may also be possible for the full feasibility study although the implementation costs are likely to be bourn by the user firm.

29.In many countries modernisation programs have been directed solely at larger firms in the hopes of having the greatest impact. The results, while at times dramatic for the individual firms, is often similar to the early years of the 'green revolution' which was similarly biased towards larger establishments at the expanse of the small-holder.

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TEXTOS PARA DISCUSSÃO

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