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Does New Technology Bode Well for Working Women?: An Evaluation and Analysis

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Does new technology bode well for working women?: an evaluation and analysis

Professor Swasti Mitter

1. The Focus

I became especially aware of the pervasiveness of new technologies in the lives of working women, even of poorer countries', in the autumn of 1993. This was the time when I was visiting New Delhi to attend a workshop organised by UNIFEM, to explore its future programme in Asia in the context of trade, liberalisation and technology. There, in the workshop, among the participants was Kiran Bbatia, the key organiser of Udogini, an NGO in New Delhi which assists and trains petty vendors and small self-employed manufacturers -mostly women - in business skills and marketing. Udogini literally means 'entrepreneurship' or 'initiative'. Indeed, for these poor women and their families, any slowing down in initiative means virtual disappearance of their whole livelihood. In their intense struggle for survival, these women now make use of computer-assisted financial accounting, through the efforts of Udogini. The organisation is by no means at the cutting edge of technological change. Cheaper and older vintages of computer-aided systems, bought and supported by funds from donor agencies, are enough for its present needs. Yet the progression highlights the way in which the efforts of different actors, including NG0s, donor agencies, middle class organisers and women themselves, can make it possible to use new technologies, in a cost effective way, to improve the economic position of those women, who are generally excluded from the benefits of information technology. As Kiran 13hatia pointed out, none of the members had either the resources or the expertise to use the system and yet, on a co-operative basis, it was possible to use some amount of new technology towards improving the business efficiency of the organisation and of its membership.

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It is in the context of an ever-increasing role of new technologies in the lives of women and men in poorer countries that this paper aims to achieve four main objectives:

a) to highlight the relevance of new technologies in promoting the quality and quantity of women's employment in the modem sector;

b) to identify the differential impacts of these technologies on women and men;

c) to explore the reasons, social and economic, that lead to such differential impacts; and
d) to assist national and international policy makers to locate effective points of

intervention for redressing gender imbalances in the structure of paid employment, in collaboration with the corporate sector and women workers' organisations.

2. Relevance and definition of new technologies

Such an exercise, I am aware, needs some explanations and justifications. To start with, one needs to define the exact connotations of 'new technologies' in the context of modernisation. In current literature, the term 'new technologies' refers to recent developments in computer-aided technologies and to some types of bio-technologies. In the long and wide spectrum of technological developments, new technologies encompass mainly those areas where mode of production depends on storing, retrieving and applying knowledge and information. Whereas some modern technologies are labour-intensive and some capital- intensive, new technologies happen to be primarily knowledge-intensive ones. The effects of these technologies are, in many ways, similar to those experienced in the wake of previous types of modern methods of production. Yet, unlike other technologies, these new technologies assume and demand a certain amount of cognitive skills from the workers. Women's exclusion from scientific, technical and business training thus limits their opportunity to partake in paid productive activities in all societies, including the poorer ones, where the spread of these technologies has been or is likely to be wide.
One may pose the question whether women, especially women from developing countries, need to bother about the possible impact of new technologies, or, for that matter, of all modern western technologies that support and are supported by western capital and patriarchy, which exploit nature, women and the poor (Shiva, 1989, p.xiv-xx). There is an understandable scepticism from many quarters - ecofeminists, post-modernists and advocates

of indigenous knowledge systems - towards modern technologies that are male oriented, Eurocentric and anti-poor.

Given the havoc modern technologies in many ways have played in the developing and developed world, many concerned people understandably plead for a due appreciation of indigenous technologies that have had organic developments, are embedded in a country's cultural traditions and, as a result, are more appropriate to the needs of women and the poor.

The focus on the impact of new technologies in this paper does not aim to belittle well argued critiques of modern western technologies. But it does make a case against an uncritical rejection of knowledge systems that could, with vision and tenacity, be made compatible with the values and needs of different interest groups in human societies (Mitter, 1994). It is only with an increased cross-fertilisation between indigenous knowledge systems and formal science, that we could produce a paradigm of science and technology that is geared to the needs of men and women alike.
It would be unwise to deny that modem science and technology historically have benefited women immensely, even in developing countries. They have, for example, opened up new career paths for women, lowered the mortality rates of children and adults, allowed women to control, albeit to an imperfect extent, their own fertility. Advancement in formal technologies, on the other hand, has also made women's traditional skills redundant in the workplace and brought unforeseen health hazards into the productive and reproductive spheres of their lives. Faced with such complex and contradictory outcomes of modem technologies on women's lives, it is not easy to prescribe or formulate strategies that are universal or ahistoric. Yet, one can safely predict that it is only women's' increased autonomy and choice, in the workplace as in the domestic sphere, that is likely to redress male bias in the current technological trajectories.

The employment implications of new technologies assume a special importance in the context of augmenting women's autonomy and choice. Women's limited access to paid employment and corporate networks explains the current gender bias in the adoption of technology.
It is at this point that I should like to argue that it would be rather unwise to promote a universal utopian feminine vision of science and technology. Women, even in a single given society, do not form a homogeneous category. Instead of assuming a generalised, unhistorical concept of a feminine vision of technology, the needs and experiences of

different groups of women require serious study, especially in relation to policy making.

In their dual role as mothers and workers however, the majority of women in this world, despite their differences, do face certain common difficulties. It is the reproductive role of women which, to a large extent, explains differential impacts of technological changes on women and men.

3. Trade Flows, Technology Transfer and Women

The adoption and diffusion of technologies depend primarily on the decisions taken at the firm level, but macroeconomic policies, that are national and international, to a very large extent, define the external environment in which the choice of technologies is made by firms. In the context of new technologies, the most important policies, by far, are the ones which determine the flow of trade, particularly between the developed and developing countries. Almost all R & D's related to new technologies are undertaken in the developed world, and the transfer of technology takes place through trading, which encompasses buying and selling of machinery and knowledge through licensing, patenting and foreign direct investments. Technology transfer also takes place through the sale of 'turnkey' projects in which software is embedded in the equipment bought. The linkage effects of technology transfer are complex and depend much on the quality of workers and of the necessary infrastructure in the countries concerned. In some countries, particulary in East Asia, the driving force behind the adoption and adaptation of new technologies was, at least in the initial stage, to move up along the 'learning curve' through what is known as 'reverse engineering' or 'unpackaging the black box'. Given the complexity of new technologies, at the current state of the genetic and telecommunications revolutions, the prospect of moving up the learning curve through reverse engineering may not be so easy for countries that have only very recently embraced knowledge-intensive modes of production.

Trade in technology, in turn, depends on the national and international legal framework that generally determines the pattern and volume of exports and imports. In some countries, restrictions imposed on foreign hardware, partly to protect the domestic industrial base, have affected the rate at which new technologies are implemented in the process of modernisation. The pattern of industrialisation, and of women's employment in the urban

industrial sector, alters when an economy opens up to international competition. The international legal framework relating to trading, incorporating issues such as intellectual property rights, determines the extent to which the developing countries may be able to adopt the technological breakthroughs experienced and implemented in the more affluent parts of the world.

It is in this externally constrained environment that the spread of technological diffusion, through trade flows, alters both the comparative advantage of countries and the gender structure of employment. In the short run, the major impact on developing countries is expected to arise from agricultural biotechnology. For example, tropical export crops could be genetically re-engineered so that they can be grown in temperate climates; or genetic engineering could produce lower cost substitutes. For example, oil palm exports may be threatened by the development of canola. There. may also be shifts of comparative advantage within developing countries, as those with more advanced capabilities in agricultural biotechnology improve their speciality or commodity crops at a faster rate than others, or displace imports from other countries. For example, genetic engineering may be used to shift coffee production from Africa to South East Asia, whilst virus-free clones in cardamom are likely to have a significant effect on the relative competitiveness between the international lead producers, India and Guatemala.

A focus on the differential impact of trade flows on gender and on different regions will thus be a necessary condition for ensuring an equitable distribution of the costs and benefits of technological changes. A methodological framework for such an evaluation should be part of the future research agenda. Such an evaluation will be pertinent also for making a case for 'managed trade' (i.e. trade that is not quite 'free', but subject to careful planning), on the grounds of distributive justice, in all spheres including that in the field of employment (Beneria, 1993).

4.0 The 1m12act of Technological Changes

Advanced technologies alter the position of women in the world of paid work through

a) the replacement of direct labour,
b) changes in skills requirements, and
c) innovative work organisations.

It will be useful to assess the impact of bio-technologies and computer-aided technologies in

relation to these three areas.

4.1 Biotechnology: Friend or Enemy of Women?

I use the term 'biotechnology' to refer exclusively to the 'new' techniques of genetic and plant engineering, i.e. recombinant DNA and cell fusion. These new techniques are often known as third generation biotechnology and have special implications for women's employment in developing countries. Women's work, in the near future, will be affected indirectly, by the changing nature of the comparative advantages of different countries in the global economy; women's employment will also take on a different pattern with the emerging challenges and opportunities within each national economy.

Biotechnology, although often described as a recent scientific breakthrough, has a long history. It refers essentially to a set of process technologies which involve the use of biological organisms. In first generation biotechnology, this generally means the use of biological organisms in the processes of fermentation. Second generation biotechnology emerged around the 1930s with the advent of petrochemicals and later of antibiotics. Third generation biotechnology (which 1 shall discuss in what follows) is based on the systematic manipulation of material at the level of the genetic code. This biotechnology is expected not only to have wide applications covering a variety of industrial sectors and markets but to open up a range of new (and currently unforeseen) possibilities in the future.

Biotechnology applications could be divided into seven broad groupings: pharmaceuticals, plant and animal agriculture, speciality chemicals and food additives, environmental applications, commodity chemicals and energy production, and finally, bio-electronics. Changes in the first three areas are going to have the greatest impact on the structure of women's employment, in developed as well as in developing countries.

Studies on the employment implications of agricultural biotechnology have often focused on the differential impact on small farms and large scale plantations. Potential or actual impacts on men and women have generally not been discussed (Ahmed, 1992) despite the current economic importance and potential vulnerability of women in bio-technology related industries. Even radical feminist literature (Mies and Shiva, 1993) has yet to systematically examine the gender implications of biotechnology.

There is a crucial need to undertake gender focused research on the impacts of, and opportunities for, biotechnology in developing countries in order to inform policy making. The pharmaceutical and food processing sectors may be the most appropriate initial foci for two reasons. Firstly, technological and market developments are the most advanced in these

sectors and therefore impacts are likely to become apparent soonest. Secondly, their impacts will particularly affect women, who form a large proportion of the workforce in these sectors in developing countries. To date, their use of new techniques of biotechnology has been small. However, the technology is relatively cheap and is already spreading.

Food processing, pharmaceutical and many other chemical industries, some of the major sources of employment for women in the developing countries, are already undergoing visible changes. One can safely assert that the impact of biotechnology is likely to be even more deeply felt than that of computer technology in the late twentieth century, as it will bring revolutionary and low-cost changes in modes of production to both developed and developing countries.

Improved and new methods of agricultural and industrial production in the industrialised countries, by displacing more traditional products from the world market, will adversely affect the volume of employment in the developing countries. In the sugar industry, the application of biotechnology, for example, is displacing workers already. Fructose made from maize grown in industrialised countries is emerging as an economically viable and widely-used substitute for cane sugar. This has spelled disaster for cane sugar exporting countries, as they can no longer control the price of exports or compete in quality. They are losing an export crop and the industrial workforce involved in the sugar production and processing industries faces redundancy.

The application of tissue culture technology within a national economy may cause further displacement of women from the manufacturing workforce in developing countries. This technology has distinct advantages over the traditional technique of extracting chemicals from plants. Tissue culture yields products that are more easily purified and ensures that both the quality and the quantity are predictable and planned. Given these advantages, it seems likely that there will be an increasing shift towards tissue culture production, even in some of the developing countries. This shift, however, will imply the replacement of direct labour, as the number of workers needed for tissue culture production tends to be much lower than that for traditional industries that produce chemicals from plants. Moreover, the tissue culture factories themselves are unlikely to generate significant employment, since these factories are highly automated through the use of computer-guided production techniques.

It is too early to assess the full implications of the introduction of biotechnology on

the **structure of** industrial employment, yet the emerging evidence indicates that new jobs, in the age of biotechnology, are going to be those that demand a high level of technical skills and managerial competence. Consequently, women's prospects for retaining their share of employment in industries such as food processing or chemicals will depend on the following factors:

a) the ability of developing countries to create an institutional and educational infrastructure that will promote the necessary skills;

b) the success of the developing countries in resisting recent moves towards imposing an intellectual property law on the fruits of the research undertaken in the developed countries;

c) the willingness and support of national governments and intergovernmental organisations in extending opportunities to acquire relevant skills to women as well as men.

Biotechnology's impact on agriculture is also going to be far-reaching. The rapid commercialisation and world-wide distribution of the genetically engineered herbicide-resistant plant varieties will lead to an ever-increasing use of chemical herbicides in place of the manual weeding performed by the female waged labour force. Iftiker Ahmed's book, Biotechnology: A Hope or a Threat? (1992) offers important insights into possible consequences of such a shift (Ahmed, 1992).

Displacement of female labour from paid work is likely to take place with an increased use of unpaid female family labour. The demand for such unpaid labour may particularly increase as scale-neutral biotechnology, unlike Green Revolution technology, will be much more accessible to smaller farms, which depend on unpaid family members for the extra farm work.

Biotechnology opens up fresh challenges in the generation as much as in the application of technology. Women currently are far more visible in the field of biotechnology than in other new-tech sectors. While women are generally under-represented in tertiary education, they traditionally tend to be best represented in the biological sciences. Women dominate the micro-propagation laboratories in both the Philippines and Mexico. For instance, women constitute 80 per cent, 74 per cent and 85 per cent of the Philippine Societies for Microbiology, Cell/Molecular Biology and Biotechnology respectively (Halos,

1992). One reason for such a concentration of women scientists in this profession, is that hitherto it has been considered a low-paid job, concerned with basic science, with limited linkage to industry (and hence has been shunned by male scientists). Another reason why these were not interested was that the work in the tissue culture laboratories was generally tedious, requiring patience and perseverance. But the picture may alter quite drastically.

If the rapid commercialisation of patented bio-technologies brings large profits to the corporate sector, it may lead to a raising of the remuneration levels of poorly paid women scientists. But the raising of remuneration itself may attract competition from male scientists, who will find these occupations carrying high status and financially lucrative.

New biotechnology firms tend to be small and knowledge-intensive. They thus offer new potentials of upward mobility to women in smaller scale entrepreneurship. Yet there are also constraints in this connection, both for developing countries and for women. The production of knowledge as well as of goods, in many spheres, could be undertaken in small firms in a cost effective way, but the marketing of products, an essential condition of success in business, is not so easy. Access to venture capital or to bank loans determines the viability of small companies; women's exclusion from such access, especially in developing countries, limits their opportunity to make a breakthrough in this new-tech area. In order to make this possible for women, therefore, education should go beyond purely technical training. An understanding of the so-called 'soft side' of technology - encompassing expertise of marketing, finance and quality control - will ultimately determine women's visibility in the biotechnology business as entrepreneurs.

Retaining and expanding the role of women in this area will increase a nation's endogenous capacity building. This may also lead to a change in the direction of scientific research and its application to biotechnology. The scientific capacity in this field is currently being channelled to cover the needs of the commercial world, and it may not be a coincidence that the most vocal arguments against commercially profitable yet socially and environmentally irresponsible uses of genetic engineering come from women natural and social scientists.

4.2 Computer-aided technologies: manufacturing

Implementation of biotechnology is still at the early stage in the developing countries. Computer-aided technologies, in contrast, have already made their impact on the structure of employment felt. These technologies, combined with telecommunications and satellite technologies, have changed the skills requirements, the nature and quantity of jobs available to women employees. Digital automation and robotic technologies, by replacing the importance of feminised labour-intensive work, reduce the scope of employment opportunities for women.

Computer technology gradually erodes the developing countries' comparative advantages that were based on the cheap labour of their women blue collar employees. As computer-aided machines make the role of labour-intensive work less significant, multinational companies do not locate work in developing countries for the sake of cheap labour. The current flow of foreign direct investment highlights that it is the countries which offer the promise of cheap but skilled labour that receive sizeable direct investments from abroad. ASEAN countries have been, significantly, recipients of such investments: there, women have a relatively better chance to obtain the requisite training and skills.

The domestic companies also look for new kinds of expertise in the wake of new technologies. Manufacturing companies, even in a labour surplus country, now adopt a certain amount of labour-replacing methods of manufacturing to achieve speed, flexibility and quality control. As a result, even in the midst of diverse patterns and directions of manufacturing employment in all parts of the world, one can identify certain trends in the corporate sector, in that:

- the cost of capital is rising;
- the input of labour is falling;
- the demand for multi-skilled operators is increasing;
- new skills requiring hardware and software development are becoming important;
- expertise in material resources planning and total quality management is proving crucial;
- marketing skills are becoming significant;
- skills in the management of organisation as well as of technologies are becoming essential.

The changing nature of skill requirements often means displacement of women workers even

in an expanding industry. In Malaysia, for example, the introduction of modem management systems, in response to technology, in the semiconductor sector increased the demand for expertise in material control systems such as Materials Requirement Planning (MRP) and Materials Resource Planning (MRP 11). The result of new management techniques has been impressive. Most firms in Penang have reduced machine set-up time, ideal time and manufacturing lead time.

The increased overall productivity, however, has meant a reduction in the share of female employment in the electronics industry of Malaysia. Whereas up to 80 per cent of the workers were women in the first phase of the industry, a 1986 survey showed that female representation had fallen to 67 per cent (Narayan and Rajah, 1990). The percentage is even lower in the 1990s. Computer technologies have affected the quality of women's employment as well. By lowering the number of highly repetitive manual operations, computer-aided technologies, for example, have reduced the physical strain of assembly line work. Yet, the increasing productivity rates, achieved by the technological progress, have also reduced employees' opportunities to regulate their work rhythm (Mitter, 1992). Workers have frequently had to pace their work within ever narrower limits set by the ever-quicker machines, to which they feed parts of whole products they have to test. In these situations, job rotations and group technologies were at times viewed by women employees as managerial strategies to mitigate the work intensification, following from the introduction of CAD technologies.

With the implementation of CAD/CAM technologies, assembly workers' tasks are becoming more versatile and changing qualitatively, from manual assembly line to machine feeding, machine minding, quality control and routine maintenance. The implementation of computer technologies has thus altered the required skills at the enterprise level. In the production process of semiconductors, for instance, cheap labour alone does not guarantee a foothold in the internationally competitive market. Thus in the pioneer days of Thailand's electronics industry the employers needed the nimble fingers of women workers for connecting tiny wires to a semiconductor. The same task is now being done by a machine, with as many as ten machines under the charge of just one woman. It is not only the labour content that is decreasing; the quality of labour that is being demanded of the electronics workers is rising at the same time (Financial Times, 5 December, 1990, p.5).
The nature, volume and conditions of women's employment have been influenced also

by changes in the organisation at enterprise level. In fact, innovations in work organisation have been prompted precisely by the need to have a continuous workflow, that the expensive technologies require to be cost effective. The trend at the corporate level has been generally to adopt a lean and quality-conscious management, in order to remain competitive.

The core of lean management has been the Just-in-time or JIT method, based on a Japanese management philosophy, that stresses the benefits of reducing inventories and waste, both of materials and of final goods and services.

The success of JIT relies on being able to deliver, on the part of the companies, an assured quality and quantity of goods without delay. The main thrust of JIT is a 'Quick Response Strategy' to a swiftly changing market through organisational flexibility. JIT thus advocates:

- organisational ability to deliver high quality products;
- organisational ability to respond rapidly to changes in demand;
- organisational ability to be more cost-competitive.

Companies that have embraced the JIT philosophy basically follow two-pronged policies of:

a) eliminating inefficiency and waste, in defective work and waiting time, through streamlining of work organisation and diversification of employees' skills;
b) establishing an effective network of subcontractors, that ensures a fail-safe delivery
of quality goods, services or materials at all times.

The network between the subcontractors and the main company is generally described as the 'external' side of JIT. The emphasis on organisational efficiency, quality control and re-skilling of workers, in contrast, is seen as the essence of 'internal' JIT. Both sides of JIT affect the structure and nature of employment, with markedly different impact on women and men.

Innovative Work Organisation: Total Quality Management

Crucial to the 'internal' JIT policy is the Total Quality Control philosophy - which demands that organisations should be geared to all aspects of quality, that include 'zero' defects, aftercare servicing and guaranteed standards of products, aspects that are of key concern to the customers and thereby to the competitiveness of the companies. Total Quality Control (TQC) is often referred to as Total Quality Management (TQM), precisely to emphasise the significance of an integrated quality approach in an emerging management policy (Roldan, 1994).

The TQM or the 'internal' JIT offers contradictory possibilities to women employees. At the organisational level, the approach entails a transition from the traditional division of labour between different sections and categories of employment, to a more integrated approach linking functions, skills and experiences within a company. The key to success is viewed in terms of Interfunctionality' between different sections of the company, so that efficient communications among employees can be established in order to improve the quality and timing of products and service deliveries. This paradigm shift in management practices demands of employees:

- complex and multiple business and technical skills;
- professionalism;
- high educational levels;
- flexibility/ability to change.

As women are generally in the lower occupational categories and have limited access to relevant education and training, it is understandable why the introduction of TQM is likely to lead to displacement of women workers in core enterprises. The TQM, at least in principle, holds promises as well. The move away from the 'Fordist' approach of the division of labour implies new flexibilities in existing bureaucracies. The democratic approach requires employee involvement. TQM companies consider that the alienation of employees, a feature of 'Fordist' organisations, can be lessened by opportunities and training for self-development through resource centres, discussion groups, action learning sets and suchlike. The activities around TQM thus have the potential of giving women confidence and polyvalent skills.

There has been insufficient research in exploring the impact of TQM and JIT on women at shop-floor level. The paucity of knowledge is even more marked in the context of

developing countries.

In some cases, a universal and undifferentiated application of TQM simply accentuates the intensification of work and thereby health hazards for women employees. Increased expectations from employees lead to increased physical stress. Applications of JIT/TQM have been known to contribute also to emotional stress. TQM expects employees to think of continuous improvement or Kaizen in quality circle groups. The innovative, challenging ideas that women give in the quality circles make them feel important or involved; yet it leads to fear that management gains experience from blue-collar women workers without any compensation for redundancy, tensions and added responsibilities. The research in Argentina shows that when Temporary Technology Groups (TTGs) are formed, they give rise to stomach ulcers and nervous ailments among women. While juggling with the demands of family and working life, women find it more difficult than men to cope with the expectations of quality circles (Roldan, 1994).

The internal JIT and the TQM philosophy thus lead to a reduction in the number of women's jobs in the core enterprises. The external JIT exacerbates this trend by transferring some of the feminised jobs to smaller subcontracting units.

Service industries and information technology

Robotic technologies, combined with new management practices, pose threats of redundancy for blue-collar women workers on the assembly line. In contrast, the application of telecommunications and computer technology opens up new avenues of employment for women in service industries. The stereotype images of women having nimble fingers have made them a preferred workforce in all kinds of office work. The Qwerty keyboard of the computers allowed women to use typists' skills in many information processing jobs. In the banking, insurance and telecommunication industries, the entry of women has been impressive both in the richer and the poorer parts of the world. In India, in some of the major foreign banks, 70 per cent of the workforce is comprised of women (Gothoskar, 1995). In the 1970s, the comparable figure was 5 per cent. A similar rise in women's jobs in the telecommunication sector has also been documented in Malaysia (Ng, 1995).

In the printing and publishing industry, the proportion of female employment increased in both the United States and Denmark on account of the introduction of microelectronics. In the United States the share of women workers in this industry increased from 25 per cent in the 1960s to 33 per cent in the 1980s. In absolute terms the increase was 56 per cent. The gain in women's employment was accompanied by a fall in male employment, arising from the replacement of traditional male craft skilled jobs such as linotype setting by office-type skills possessed by women, such as input of text on phototypesetting visual display units. Similar increases in the proportion of women's employment in composing and printing work have been observed in Denmark (ILO, 1990). Fatima Alloo's work likewise exemplifies how women, even in poorer countries like Tanzania, have made successful entry into the printing, publishing and media industries, with effective use of computer technology (Haddon and Silverstone, 1993).

There is, indeed, a dire need for aggressive training programmes for women in these new occupations in poorer countries, not only for the benefit of women but also for that of the countries. The shortage of skills, in the field of computer literacy, is now acutely being felt in transitional economies like those of Vietnam or Romania, which have just recently embraced computer-aided technologies. African countries too are facing similar problems, with shortage of necessary cognitive skills. In one financial firm in Kenya, for example, nearly a third of the openings in the data processing department had to remain unfilled (Mureithi and Ndiritu, 1991).

It is not enough to give women workers a once-and-for-all access to computer literacy. In the context of rapid changes in technology, it is important to upgrade their basic skills continually. Women's entry into these new occupations so far has been mainly in clerical and data-entry types of jobs. These are precisely the jobs that are likely to be automated in the next phase of technology.

Women employed in these new occupations generally come from a background that is different from that of blue collar workers in manufacturing. Moreover, the new white collar women workers belong to a younger age group; whereas the redundant manufacturing female workforce generally belongs to an age group over 35. In formulating appropriate policies, therefore, it becomes important to take note of the emerging polarisation among women themselves on the basis of class background and age groups.

Against the background of such new polarisation, it is necessary to make a distinction between the enabling and enticing strategies - in order to make the most effective use of women's potential cognitive skills. The field of software programming has opened up new opportunities, but for women from relatively privileged backgrounds. The proportion of women in this field is quite significant in some developing countries, such as Brazil and India. At a rough estimate, it is nearly 15 per cent in India and 25 per cent in Brazil (Gaio, 1995). The reasons for not having an even higher proportion is that women often make a compromise, by not accepting a challenging career, in order to improve the overall quality of their life. In order to entice women with relevant education to enter into these emerging fields, policy makers need to have a dialogue with the corporate bodies to experiment with flexihours and flexitime. The cognitive skills of women are going to be crucial in upgrading human resources both at the enterprise and at the national levels. Enticing strategies would make business sense and contribute to the competitiveness of countries in the international economy.

4.3 The telecommunication revolution and distant working: woman friendly?

Modularisation and miniaturisation of products, with the electronic revolution, have made it possible for a large part of manufacturing to be moved away from core enterprises to smaller companies. Externalisation of parts or the whole of the production process is not however limited to manufacturing. It is spreading in the services sector - most notably in office work. Innovations in computers and office equipment, changes in telecommunications technology and in regulation of telecommunication services have resulted in a virtual fusion between the office machinery, computer and telecommunication sectors. These new developments have affected volume of employment and structure of work organisation. The increased flexibility offered by the new hybrid technologies has enabled major users of information processing to decentralise parts of their work. Large companies are able to utilise the flexibility offered by innovations in telecommunications, computers and office technology to separate the physical location of labour and space-intensive operations - such as invoicing, payrolling, stock control, sales records, market analysis and routine accounting procedures - away from the headquarters of the company to a location where the cost of appropriate labour and office accommodation is considerably lower. The decentralisation of office work has in fact taken a variety of forms, which are often described, interchangeably, as 'teleworking'; 'telecommuting; 'distant working'; 'remote working'. These terms refer to a range of organisational strategies which have evolved to take advantage of the flexibility and cost savings inherent in geographically separating various tasks connected with data preparation and information processing.

It is not too uncommon to define a teleworker as one who regularly works from home, using some form of telecommunications link to the outside world. But such a narrow definition excludes a number of other interesting new forms of work organisation, such as telecottages (neighbourhood work centres where a small group of self employed or employees share an office space), satellite offices and teleservice centres. The emerging locational pattern extends beyond simple electronic homeworking. It is difficult to gauge accurately the extent of different forms of telework in advanced countries, and it is almost impossible to give any quantitative estimate of such work in poorer parts of the world. Scant information in this area confirms the view that-the spread of electronic homework has been rather limited in the developing countries. There, homes, even of white collar workers, are

not often suitable for installing the equipment that is essential for electronic home-working. Nonetheless, the prevalence and spread of such work has already been identified in Malaysia, Singapore, South Korea and the Philippines (Kelkar and Nathan, 1992).

Decentralisation of white collar work, thus, is likely to take place, in poorer parts of the world, more frequently in satellite offices and in telecentres. The trend is already discernible and the implications of such work patterns are particularly significant for women. The experience of women in the more affluent parts of the world in this respect is fruitful for women of the developing world, where distant working in the information processing jobs is rather a new phenomenon.

The extensive work conducted in this field by such scholars as Ursula Huws in the UK (Huws, 1991), Judy WaJcman in Australia (WaJcman, 1988) or, more recently, Leslie Haddon and Roger Silverstone in the UK (Haddon and Silverstone, 1993) shows in detail why it is difficult not to have a gender dimension in the analysis of the social implications of telework. A technology that allows women to combine childcare and homemaking with a reasonable career is, of course, a welcome possibility - the more so as, in addition to spatial flexibility, teleworking, at least potentially, also offers the prospect of flexibility in working hours. In practice, the evidence gathered so far suggests that women's gain in this direction, contrary to the dream of many futurologists like Alvin Toffler, has not been substantial. As Ursula Huws has pointed out, in employer-led teleworking schemes, it was usually the employer who had the control and power to define how the employee should fit into a new set of flexible impositions. Employees often end up working at unsocial times and for longer hours. In Teleworking in the 1990s: A View from the House, Leslie Haddon and Roger Silverstone confirm the previous observations of Huws and WaJcman, that telework, especially if conducted from home, reinforces the traditional gender division of labour rather than liberates. The freedom from domestic duties that women often enjoy while going out to work gets lost. The duties and the tools of work conflict with the demands and the design of the home, causing stress both within work and the family domain. Men work 'from' home, women work 'at' home: in evaluating the impact of teleworking, one should bear this in mind.

Some of these problems become less relevant when work is done in small-scale satellite offices or in neighbourhood centres. The problem of isolation is also less acute in this form of distant work. Yet there are warning signs, especially when the skills content

of these jobs is low and workers have little bargaining power.

In Brazil, workers employed at a decentralised (branch) office of a large public administration agency found, for example, that lack of contact with the head office meant they had no say on questions of skills, training decisions and job content, in spite of the flexibility required from them in carrying out their tasks. They experienced increased control over task performance, both by supervisors and by electronic surveillance. There was little scope for communication among workers, as a result of the physical fragmentation of the workplace into individual workstations. Data entry clerks were forbidden to talk during working hours; were allowed only limited rest periods; and were further discouraged from sentiments of group solidarity by the payment-by-results system, which encouraged an individual rather than a collective work ethic.

A survey carried out in Japan on the effect of working with computer terminals in banking and other sectors tends to confirm the pessimistic experience of the workers in the Brazilian study. The Japanese office workers were convinced that their working conditions had deteriorated as a result of computerisation. They complained of intensive electronic surveillance; restrictions on their physical mobility; high levels of exhaustion; and dissatisfaction with the monotonous and repetitive nature of the work (Pearson and Mitter, 1993).

It is bargaining power, or the lack of it, at home and at work, that determines women's capacity to enjoy the advantages of flexibility, which the telecommunications revolution has made attainable. In the absence of such power, telework becomes an extension of traditional part-time or piece-rate work - with similar insecurity and with a marked absence of career progression. It is thus hardly surprising to find out that the occupational distribution of telework is not very different from that found in traditional jobs. The recent report written by Ursula Huws for the Department of Employment in the UK, entitled Teleworking in Britain (1993) reveals such a phenomenon. A survey conducted in 1992 by Huws in preparation for this report showed that:

> Women make up nearly nine out of ten teleworking secretarial and administrative workers, three quarters of writers and journalists and nearly two-thirds of training and education staff. They make up over half the home-based managers and sales and marketing staff, and half the researchers, but otherwise they are in a minority. In the case of engineers, this is quite a large minority, at 48 %, but in other cases it is very

small. Only 16% of home-based consultants are, on average, female, while women make up a mere 14 % of home-based computer professionals. Among accountants and financial services workers the male majority is even more overwhelming, at 96%.

Even for professional women and men, telework often poses problems in terms of employment contracts. It is often difficult to establish whether a teleworker is a freelance consultant or distant employee of an established business organisation. The security and the benefits that an average employee derives from employment often eludes the teleworker, who in many cases gets reclassified as a freelance worker by employers.

4.4 Relocation of data entry jobs

The creation of distant work is related also to the internationalisation of the market and of production of information processing work. Swasti Mitter's and Ruth Pearson's report, written for ILO, Global Information Processing: the Emergence of Software and Data Entry Jobs in Selected Developing Countries (1992), shows that there has been marked differentiation in the quantity and quality of relocated in formation-in ten sive jobs by region as well as by gender. Despite a dramatic growth of international subcontracting of software programming work to a number of poorer countries, the overall share of poorer countries in the production of software has been small. Women's role in this sector has been minuscule. In contrast, women in developing countries have gained a major share of semiskilled data entry jobs - especially when they have been relocated from high-wage countries.

Offshore data entry or data processing is the term applied to such relocation of new technology clerical work to low wage countries. The article written by Ruth Pearson and Swasti Mitter in the International Labour Review (Vol. 132, 1993, No. 1) gives a comprehensive picture of the working conditions of women workers in offshore data entry jobs.

The major location of such activities has been in the Caribbean, principally in Barbados and Jamaica and more recently in the Dominican Republic, with a handful of facilities in the smaller Caribbean islands, such as St Lucia, St Christopher, Nevis and St Vincent. Other facilities are known to operate in India, China, Singapore, the Philippines and Ireland.

Most of the foreign-owned subsidiaries in the Caribbean region and elsewhere are located in the Free Trade Zones, which provide incentives to foreign investors parallel to those offered to offshore manufacturing. Incentives available to foreign-owned data entry firms in Jamaica's Montego Bay Free Zone include low cost space, tax benefits and full repatriation of profits and dividends to the home countries.

There are similarities between the working conditions of offshore data workers and those of electronic distance workers (teleworkers) in industrialised countries. This is particularly true of the insecurity of their contractual and earnings situation. In Jamaica it is frequently the case that workers are hired only after a lengthy period of selection and training, during which they are paid no more than a training allowance, though they are already processing data for commercial contracts.

In spite of the precariousness of employment contracts and low basic wage rates, total remuneration for offshore data entry clerks often compares well with earnings in other local employment (this was found to be case in Jamaica, for instance, vis-a-vis manufacturing employment). An American-owned data-processing company in the Philippines advertised to potential clients that wages were pegged to the US dollar and were adjusted to compensate for any devaluation of the local currency. Minimum wage rates cited were compared not with industrial but with white collar and professional wages. Even so, in comparison with prevailing rates in the developed countries, the cost advantage for employers is very clear. The OTA study estimated that wage costs in the early 1980s (calculated on the basis of hourly wage rates) were between six and twelve times higher in the United States than in Third World offshore locations (Pearson and Mitter, 1993).

The situation regarding data entry employees' rights to organise in labour unions is also unclear. Employment in Free Trade Zones often precludes the right to organise. It was clear that in Jamaica there was no unionisation among data entry workers; in both Jamaica and Barbados keyboard operators were encouraged to think of themselves as white collar employees, in order to pre-empt the development of militancy characteristic of organised industrial workers. Management styles were often based on notions of responsibility for the employees' welfare, highlighting caring rather than conflictual relationships between workers and management. In the Philippines, managers stressed the benefits granted to their employees, including bonuses, medical care and profit-sharing plans, while confirming these employees' non-union status.

Women's net benefits from the new jobs and novel work practices need careful evaluation. Most of the research in the field of technology has so far been geared to manufacturing, and that too without an appropriate focus on gender. A limited amount of research, undertaken by committed women academics, nonetheless provides some basis for undertaking a more ambitious evaluation of the advantages and disadvantages of flexible services work.

5. Women in the Decision Making Process

Even in those sectors where women have gained quantitatively in terms of jobs, they have remained invisible in the decision making process. Women's virtual absence from top management positions is a feature both of the developing and the developed world**.** Women's under- or non-representation in the decision-making process is particularly striking in the new information technology (IT) industries, which are relatively free of the historic gendered division of labour, and where, as a consequence, one expects women to fare better. The picture that emerges from a recent survey of the large telecommunications companies in Europe, characteristically, reveals that the gender structure of occupation in IT companies is very similar to that in the traditional sector. In an occupational pyramid, women are mostly visible at the base, where jobs require less skill, little formal training, and are repetitive and tedious. Women's presence becomes less visible near the apex of the pyramid (Shapiro, Levy, and Mitter, 1995).

The reasons are complex. I do not think it valid to ascribe women's invisibility in management jobs only to their relative exclusion from formal technical and managerial education. In an in-depth analysis of career progress of women managers in two large IT-based companies in the UK, Gillian Shapiro of the University of Brighton, UK, found that there is not much difference in the level of formal qualification of men and women junior and middle managers. The reasons for the differential rate of progression can be understood better in the context of informal promotion procedures: women generally have less understanding and grasp of these than men in predominantly male-oriented organisations. Until a critical number of women reach a senior management position, it becomes difficult to bring a change into the organisational culture.

Difficulties of reconciling family and working lives likewise pose problems for women in accepting senior management posts when they are offered. A demanding management job puts strain on family life; it is thus not too uncommon for women in all societies to opt for a compromise in their careers in order to improve the overall quality of their lives. By creating flexibilities in the location and time of work, new technologies themselves could be used as instruments for reconciling the family and working lives of women. Because of their under-representation, however, women fail to negotiate flexibilities on their own terms.

The emerging management philosophies in the era of new technologies, however, may lend support to creating patterns and practices of work that would entice trained women to

enter and progress in the senior technical and management jobs. Qualities that are normally considered feminine are now being highly prized in IT-based companies, as they move away from Tayloristic assembly-line activities to group technology and team work. In some IT-based companies, management explicitly stresses the need for a feminine style of leadership for ensuring total quality management (TQM) in processes and products. 1 personally am sceptical of such essentialism, but an open acknowledgement of women's potential contributions to management style may bring about a certain amount of woman-friendly orientation in the pattern of work.

6. New Technologies and Small and Medium Scale Enterprises

The introduction of information and knowledge-intensive industries has contributed to the importance and growth of small and medium scale enterprises (SME's), both in the poorer and richer parts of the world. It is the small firms that have often taken the lead at the innovatory stages in generating knowledge and in marketing of products; the role of small firms in these aspects has been acknowledged in the field of biotechnology as well as that of computer-aided technology in general.

The knowledge-intensive small firms are more commonly found in the affluent parts of the world. But even there, SME's find it difficult to make an entry into, or sustain their share of, the markets that are dominated by larger companies, who have greater access to capital and knowledge of the preferences of buyers. The knowledge-intensive small firms, as a result, frequently end up as subcontractors, supplying goods and services not directly to the market but to large companies that dominate the market. In the field of biotechnology, this phenomenon explains why there is an apparent contradiction in the conventional wisdom in the US: on the one hand arguing that a large part of the vitality and competitive strength of US biotechnology is derived from the efforts of relatively small biotechnological firms, while on the other fearing competition, not from small new biotechnology firms but from the established Japanese giants.

New technology SME's strive to find an outlet for their products as subcontractors of large companies, in services as well as in the manufacturing sector. Or else they carve out a niche for themselves in a market where flexibility in response is of paramount importance for business survival. In electronic and information technologies, for example, activities related to microelectronic components (Integrated Circuits - Ics) are undertaken by large scale multinationals operating in global markets. In some areas, where barriers to entry are low, this globalisation has allowed large as well as SME producers in developing countries, particularly in East Asia, to make an entry as subcontractors of the multinationals. Production of electronic modules - the hardware subsystems to be used in systems of higher complexity - offer, in contrast, a niche market to SMEs in both developed and developing countries, especially in the areas of peripheral equipment or consumer electronics. In certain segments of the high-tech service sector, there are now new opportunities for SMEs in developing countries. Software is the prime example.

Generally, software is divided into three categories: systems software, applications

software and tailored software. Systems software and, to a certain extent, applications software have high barriers to entry, and hence offer fewer opportunities for SMEs of the developing world. In tailored software services, by contrast, barriers are relatively low, which makes this area potentially attractive to small- and medium-sized firms. The extent of women's share in these new tech SMEs has not yet been documented.

The small- and medium-sized entrepreneurs in this area come, at present inevitably, from an elite educational background; for women of such a background it is not impossible to overcome some of the obstacles that poorer women generally face in having access to knowledge, credit and networks. A study of women new tech entrepreneurs is likely to reveal the kind of obstacles women face in occupations which are free of a historic tradition in the gender division of labour. Concomitantly, it may entail the need to re-evaluate the nature and organisation of a formal education that excludes women from vocation-specific technical and business training, at all levels.

To poorer women of the developing world, the arena of knowledge-intensive industries still remains, of necessity, closed. Nonetheless, they too face new structures in business and production. The introduction of new technology, as I have discussed, makes it possible for large companies to decentralise some segments of production to external small and medium-sized producers. With an effective use of telecommunications technology in management, large companies efficiently source goods and services from a nationally or globally dispersed network of subcontractors. The emergence of such networking in turn opens up possibilities of entrepreneurship among women even in traditional sectors such as clothing, consumer electronics or publishing.

Challenges that women face in achieving a sustainable existence in these fields are not necessarily in the sphere of production; the chief problem lies in their insufficient ability to respond to market demands. The OECD report on Small and Medium-sized Enterprises: Technology and Competitiveness (1993) stresses how, even in the richer part of the world, the survival of SME's depends as much on their 'tangible' assets, such as technologically suitable equipment, as on their 'intangible' investments in expertise to obtain technological and commercial information. Strategic capabilities of innovation and flexibility are also crucial. Women in any society, especially in the developing world, find it problematic to acquire such expertise and skills. An intervention by government and donor agencies to give women access to commercial knowledge and business skills would augment women's

opportunities in the SME sector.

The role of national and international policy makers assumes a special importance at this time, when in most countries there is a substantial shedding of female workers from the formal sectors, following world recession, technological changes and 'lean' management policies of the corporate sector. There is, understandably, a close correlation between a rising rate of unemployment in the formal sector and the growth of self employment in the SME sector. In Portugal, for example, between 1986 and 1990, during the peak period of recession, female entrepreneurship rose by a massive 48 per cent. Self-employment, in many cases, is an alternative to stark unemployment - especially in societies where the cushioning of a welfare state is absent.

The role of women in SME's is highly visible in ex-socialist countries. In their transition to a market economy, women are losing jobs in these countries at a much higher rate than men. This differential impact, on men and women, of a new economic orientation is visible in all regions: it is as pronounced in present-day Romania (Alatescu, 1993; Sandor, 1994), as it is in a socialist country such as Vietnam. In both these countries, as elsewhere, women compared with men generally possess less qualifications and training than are necessary for progression to new tech jobs. In the economic climate of shrinking state sectors, maternity leave and higher absenteeism among women make them a less preferred workforce than men in the corporate sector. A spread of basic computer literacy and of managerial competence, in this climate, would, to a certain extent, help women to sustain a career in SMEs in countries where the female literacy rate is reasonably high.

7. Labour standards and new technologies

In the context of new technology, the question of labour standards assumes an important dimension. The health and safety issues relating to the electronic industry have received some attention among, both the workers and the policy makers. Behind the Chill Proceedings of the Conference on Safety and Health in Electronics (1992), published by the Women's Development Collective and Sahabat Wanita, Malaysia, is an example of effective activities by NG0s in raising awareness among policy makers in this important area.

It is not only in the manufacturing sector, but also in the services sector, that VDU related health hazards assume special urgency. These hazards are particularly important for those working at the lower end of the office hierarchy, such as typists, telephone and data entry operators. Ruth Pearson's work in this field draws our attention to the way the work of women academics has brought the issue of health hazards of VDUs to the attention of policy makers (Pearson, 1993). The conference organised by the Women's Development Collective in Malaysia in 1993 provides a model of NG0s' effectiveness in giving these issues a high profile. By involving the Minister of Social Development and Unity, the conference paved the way for including health issues in the national policy dialogue on technology. The conference was attended mostly by workers, and there were also academics from Australia, India, Germany, Sweden, and the United States. The conference proceedings (Ng and Munro-Kua, 1994) are aimed at disseminating this information to other non-European countries.

The health hazards of production processes are worthy of attention. Yet, ultimately, it is the overall safety in the work environment that determines the quality of working lives. The difficulties of combining quality with the quantity of jobs is exemplified by China's recent experience. Whereas the increased flow of foreign investment has opened up employment opportunities, for many million women in South China alone, it has also led to much publicised safety hazards, such as fire in the factories leading to the death of young women workers. The incidence of fire has alerted the national policy makers, women's organisations, as well as trade unions, to the need to devise and monitor better safety legislation for firms in the private sector.

In industrialised countries, where the dissemination of new technology is more thoroughly monitored by government agencies and labour organisations, the existence of potential health risks arising from the intensive use of computers is well documented. But

such control is extremely rare in the developing world, especially with respect to health hazards related to VDUs. In some countries, such as Vietnam, where computers are a recent phenomenon, even the concerned government bodies and relevant labour federations have insufficient knowledge of the potential health hazards. A participatory involvement, of governments, NG0s and academic researchers, on this issue would help to disseminate such knowledge for formulating corrective policies.

8. Training in new skills for corporate jobs

The quality and quantity of women's employment depends on their ability to acquire relevant skills. Some of the skills are learnt on-the-job, some through in-house training, and some in the formal training institutes. The experiences of developed and developing countries show that women find it difficult to enrol in formal training institutes (Acero, 1995). The hours of training, the costs involved and the structure of the courses are the factors mentioned by older women that conspire against formal training. For young school leavers, it is the cost of training, especially relating to computer literacy, that proves the biggest deterrent (Banedee, 1995). Whereas an average family views the education of sons as an investment for the future, it perceives expenditure on daughters' education as a mere luxury. The trend, in most parts of the world, is gradually to withdraw state subsidies from post-primary school education. In this scenario it becomes extremely difficult for young women, without the support of the family, to continue with expensive vocation -specific education. In certain countries, such as South Korea, daughters are expected to earn and pay some amount of money to their parents before they get married. In fulfilling this traditional obligation, they enter the job market precisely in those years when their brothers are getting vocational training.

Empirical evidence tends to confirm that there is a correlation between a rise in the requirements of skills and a fall in the female share of employment. The experience of export-oriented maquiladoras on the US-Mexico border is significant in this respect. These maquiladoras since 1965 have been mainly employing women who, with their primary schooling, were adequate for the jobs that were repetitive and unskilled, in the apparel and electronics industries. In the 1980s, however, the skills requirements of the companies changed, leading to an increased proportion of technical workers and engineers in the personnel. There was a concomitant fall in the women's share of total employment: from 77 per cent overall to less than 60 per cent. The downward trend continues (Hualde, 1994).

Women's relative exclusion from skilled new-tech jobs is a common occurrence almost everywhere. The difficulties of reconciling the demands of new technology jobs, which require continuous upgrading of skills, with women's commitment to running a home generally makes it difficult for them to make an entry into occupations which demand complex, polyvalent skills. Studies of interconnections between the productive and reproductive spheres of women workers' lives, set in their specific cultural context, will be

useful for the policy makers to identify appropriate points of intervention for ensuring women's access to tomorrow's skills.

It is not easy to locate a best practice model of training in the public sector, particularly in developing countries. But there are some good examples of promoting women-friendly training programmes in the private sectors in Europe for retraining women workers who are facing threats of technological redundancy (European Commission, 1994). It will be useful for the policy makers in developing countries to evaluate the relevance and efficacy of programmes which are now being collated by the Equal Opportunities Unit of the European Commission at the Directorate General of Employment, Education and Training.

10. Research Agenda for Policy Guidelines

In order to ensure that women receive adequate employment protection and the necessary skills, some research areas appear to deserve urgent priority. The mode of research should be fundamentally participative, involving governments, NG0s and federations of employers. It is better to have projects that are demand-led and that respond simultaneously to the needs of women and of employers. No positive action is going to be sustainable in the long run unless it proves commercially profitable.

To this end, the policy makers need to ensure, through participatory research:

1. that the new technology training and retraining programmes for women take note of the cultural and ideological constraints within their societies;
2. that the health and safety hazards facing women in new tech jobs are included in the programmes for national human resource development;
3. that the women get access to knowledge and training which are relevant for small- and medium-scale new tech enterprises;
4. that one can identify the cultural and organisational barriers which women face in entering managerial and technical occupations in high tech industries;
5. that the accumulated knowledge of the impact of technological changes on women's employment receives priority in world-wide dissemination.

11. The role and concerns of UN Agencies

For nearly a decade and a half, the United Nations has been alerting national policy makers to these issues. In various reports, the UN has drawn attention to two disturbing dimensions

in the current paradigm of technology:

1) it fails to elicit and appreciate what women could contribute to modem science and technology, and
2) it overlooks women's specific needs and thereby affects women's opportunities and career progression adversely.

Even as early as 1979, in the Vienna Programme of Action on Science and Technology for Development, the United Nations emphasized the importance of human resource development for the endogenous capacity building of developing countries. It encouraged the policy makers to 'facilitate constant training, development and upgrading of their labour force so that they may be better able to assimilate and benefit from the swift changes characteristic of the modern world' (UN, 1979, para.34). The Vienna Programme of Action also significantly stressed the need to tackle potential inequities in the distribution of the benefits of modern technology:

> Modern technological developments do not automatically beneflit all groups of society equally. Such developments, depending on the given economic, social and cultural context in which they take place, are often seen to affect various groups in society differently. They may have a negative impact on the conditions of women and their bases for their economic, social and cultural contributions to the development process (UN, 1979, para.5).

The UN documents subsequent to the Vienna Plan of Action Report have consistently acknowledged the need to evaluate the different impact of technological changes between the North and the South as well as between women and men. The report of the 1980 UN Copenhagen World Conference of Women, for example, was vocal about the need for a World-wide 'collaborative effort towards making science and technology a tool to eliminate rather than to amplify inequalities between women and men' (UN, 1980, Chapter 1, Section A). The report, in addition, stressed the need to recognize women as an important component of a country's human resources and a source of technological innovation. The report of the 1985 Nairobi World Conference of Women likewise made a case for women in the context of human resource development plans:

> their technological and managerial skills should be enhanced in order to increase self reliance in industrial production, and to promote innovations in productive design, product adaptation and production techniques (UN, 1985, para. 191).

In including women-specific issues in the policy dialogue, the reports did not view women themselves as passive agents. The emphasis has been to acknowledge women as agents of change; the plea has been to include women workers' organisations in the policy dialogue, and to pledge a commitment to disseminate information regarding technological changes to workers themselves, to improve their negotiating power. To this end, as the Report of the Ad hoc Panel on Science, Technology and Women, 1983, states:

> Concerned women scientists should establish linkages with women's groups to monitor and publicize the impact of new and emerging technologies on women's lives (UN, 1983, para. 96).
> The quoted reports of the UN have, over the years, enhanced the awareness of UN agencies of the importance of gender dimension in research and action related to science and technology. The results have been impressive, but not yet in the field of new technologies.

Two of the agencies that are most concerned with the role of women in the process of technological changes and industrialisation are ILO and UNIDO. ILO's contribution in this area, with the notable exception of the work of Iftiker Ahmed, has been concerned in the context of new technologies, only marginally with gender analysis. ILO's contribution to women's welfare in this area has been in highlighting the occupational safety and health hazards, and the implications of flexible employment for women, as epitomised by telework, in developed countries (ILO, 1989; ILO, 1990a; ILO, 1990b; ILO, 1991). In the field of training, UNIDO has not yet focused specifically on the needs and potential of women in new technology industries, but UNIDO's most important contribution has been in stressing the need to take seriously the role of new technologies in women's future employment, through its contribution to the 1989 World Survey on the Role of Women in Develo12ment.

In addition, UNIDO's study of 'Changing Techno-Economic Environment in the Textile and Clothing Industry: Implications for the Role of Women in Asian Developing Countries' also exemplifies the way gender awareness could enrich the analysis of industrial restructuring in response to computer-aided technologies (Unido, 1993).

12. New Initiative in Research

To redress the current gap in research and analysis in this field, we have initiated a number of projects at United Nations University Institute for New Technologies (INTECH) at Maastricht, The Netherlands. Between 1991 and 1993, the Gender and Technology Group at INTECH has collected preliminary data and sketched a conceptual framework of analysis of the employment implications of new technologies, in collaboration with 14 researchers from different regions of the world (Mitter, 1995). The latest phase of this work, that has begun in 1994, focuses not only on collecting more information but on adopting a novel mode of research, bringing together researchers, members of NG0s and of governmental bodies, in order to facilitate a policy dialogue centred upon endogenous capacity building. The primary goal of the project is to improve the advocacy skills of women workers' organisations, by giving them access to key knowledge. The project is partly funded by UNIFEM, is focused on Asia and is guided by the conviction that women who bear the consequences of technological and industrial policies should have an adequate voice in the formulation, implementation, diffusion and evaluation of those policies. Such a move would contribute towards ensuring that the countries, and women in them, benefit from the potential of new technologies.

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