New Technology in the Garment Industry

David Kaplan

> The whole object of introducing these new machines is to replace operators and to deskill the operation as much as you can
>
> \- production manager, Cape Town clothing firm

The manufacture of garments has, until very recently, defied any significant attempts at automation. The industry is highly labour intensive and reliant upon the ubiquitous sewing machine which has undergone only modifications since its invention in 1830. As a result, labour processes in garment making, whether in a large or small plant, whether in advanced capitalist countries or in the Third World, are very similar.

However, under the impact of "microelectronic related innovations" (MRIs), (1) the industry is presently undergoing significant changes. Moreover, there are indications of far more fundamental changes in the near future. This article briefly outlines how microelectronics is affecting changes within the garment industry internationally and, in more detail, the South African garment industry and suggests some likely future developments. The central concern is with the factors affecting the diffusion of microelectronic technology and the implications of this technology for employment and job content.

I Microelectronics and the production process in garment manufacturing

The production process in garment manufacturing can be divided into the following stages: (2)

the design and engineering stage includes the preparation of working drawings; the choosing of designs; costing and specification of how the cloth is to be cut and the garment manufactured. A variety of MRIs are available to aid these activities. Pattern design systems (PDS) allow designing to take place on a computer screen. This can be integrated with "product costing" packages which generate immediate costings for all the different design configurations. Other packages generate optimum "cut order planning" and "production scheduling";

the pre-assembly stage entails generating a set of graded patterns corresponding to the different sizes and fits from the master pattern (pattern grading); arranging the pattern parts on the material so as to minimise cloth usage (marker making); laying out the material on a cutting table (spreading) and finally cutting. Computerised processes are available for all these different activities. Moreover, computer aided grading and marking have been successfully integrated with computerised cutting. MRIs have had their most significant impact upon the labour process in this stage;

the assembly stage includes the transporting of cut cloth to the operator; the joining together of the different cut pieces and small parts assembly (eg. pockets, belt loops); and finally pressing, inspection and packaging. There are computerised processes available for all these different activities. Given the concentration of employment in sewing activities (typically two-thirds of total factory employment), there is a correspondingly strong incentive to computerise.

II The international garment industry and the diffusion of MRIs

There has been a pronounced relocation of garment making internationally. The industry has experienced steady, and in some cases, spectacular declines within the OECD (Organisation for Economic Cooperation and Development) countries and a concomitant rise within some LDCs (Less Developed Countries) - notably the Asian NICs (Newly Industrialised Countries), especially Hong Kong and South Korea. (3) The comparative advantage enjoyed by the latter countries is, of course, almost wholly a result of cheaper wage rates. MRIs, since they economise on labour and utilise skills and capital in short supply in LDCs, have been seen by many to be the panacea for developed country garment manufacturers, reversing the comparative advantage presently enjoyed by the lower-wage countries.

Since the bulk of wage costs occur in the sewing operations, microelectronic automation here is seen to be vital if large parts of the clothing industry are to be viable within the developed countries. Automated sewing machines are being aggressively marketed as ensuring substantial labour savings. Yet MRIs, now fairly widespread in the design and engineering and pre-assembly stages, are only diffusing slowly within the assembly stage. Microelectronic equipment in the assembly stage is still exceptional - in 1980, surveys showed that the percentage of firms using or planning to use MRIs in the US garment industry were below 10% (4)

Why, especially in the context of sharpening international competition, has the garment industry in the developed countries shown such reluctance to adopt the new microelectronic technology? A number of reasons have been advanced, the most important of which are:

(i) the clothing industry is dominated by a very large number of small firms. These firms are often undercapitalised and possess a paternalistic and conservative management which cannot easily assimilate the new technology. There is a problem therefore of affordability and of management assimilation. *It is the smaller firms which are particularly slow to adopt* new technologies;

(ii) this is an extremely risk-averse industry given pattern and style changes. This is particularly true for small firms, many of whom are sub-contractors to larger firms and who have contracts which are renegotiated every season. They are therefore generally averse to investment with long payback periods and inclined to adopt the conventional sewing machine which is extremely versatile and cheap. The costs of changeover on a microelectronic sewing machine are high since, unlike with metal cutting and forming machines, for example, mechanical changes are also necessary given fabric differences. Short runs, particularly true in fashions, render such changeovers uneconomic;

(iii) there are, of course, technical problems with many of the new innovations. The major problem is in material handling which accounts for a large part of the productive process and determines the labour intensity of the industry. The problems revolve around the use of "limp" fabrics which have hitherto been resistant to mechanical handling methods. Thus, the human operator cannot be easily dispensed with and their continued use sets limits to the productivity of any new machine;

(iv) the industry has traditionally done very little inhouse research on development - averaging about 0.05% of sales. Thus, very few innovations specifically developed within an operating environment are made available and few resources exist to adapt innovations embodied in new equipment supplied by equipment suppliers to the industry. Also few technical personnel are available to clothing industries who might adequately evaluate the potential of new technologies;

(v) the equipment suppliers who have generated most of the technical changes in the industry in the form of new machinery have, given the overall structure of demand, been slow to introduce fundamental innovations. They have also been slow to incorporate the new microelectronic technology in the equipment they supply since their expertise is primarily in mechanical engineering. They have tended to favour incremental changes in existing models. This is compounded by the fact that parts and servicing represent a large part of sales and would be threatened by complete obsolescence of product lines.

But there are definite indications that the situation is beginning to change. Firstly, there is evidence of a growing importance within the industry of large firms - this for a variety of reasons, but also linked precisely to their more rapid take-up of the new technologies which offer substantial productivity improvements. The growing importance of large firms thus both reflects and encourages the diffusion of MRIs. Secondly, the technical problems of material handling are not insuperable. A large number of private and some semi-governmental research efforts are now being directed at resolving this problem and important incremental changes are already reducing material handling costs substantially. Although there are many technical problems in handling limp fabrics, as opposed to metals, these are not seen to be insuperable and robotic handling is seen to be likely in the very near future. (5) Thirdly, as the pace of change quickens, there are indications that more in-house R & D is being done, more personnel with technical expertise are being brought into the clothing industry and MRIs which grow out of an operating environment within the industry are becoming more widely available. Finally, a number of firms with experience of MRIs in other sectors are now directing attention at the clothing industry while the traditional equipment suppliers to the industry are rapidly acquiring expertise in the area of microelectronics.

III The South African garment industry and the diffusion of MRIs

In 1981, there were 1,141 firms in the clothing industry employing 127,124 persons - 8.66% of employment in all South African manufacturing industry. The ethnic composition of the labour force was 5% White, 23% Asian, 33% African and 38% Coloured. (6)

The industry is, as elsewhere in the world, highly labour intensive - involving an investment of R6,000 - R7,000 per job. Thus it is a haven for the small employer and concentration ratios are generally far higher here than in other sectors of manufacturing industry. However, there are a number of larger firms within the industry and their importance within the industry seems to be growing. In 1976 there were 34 firms out of a total of 1,220 which employed more than 500 workers (2,7% of the total firms in the industry) - they accounted for 32,3% of total industry employment. In 1979 there were 42 firms out of 1,304 which employed more than 500 workers (3,22% of the total firms in the industry) - they accounted for 37% of total industry employment. Similarly, the number of firms whose gross output exceeded R4m has increased in importance within the industry.

According to the National Productivity Institute, labour productivity has been improving - in cutting by 15% since 1977, sewing of bulk products such as shirts by 31% since 1976, ladies fashions 18%, men's trousers 8% and men's jackets only 1%. (8) Much of the improvement in productivity is probably due to better capacity utilisation and better application of existent techniques. However, it is also likely that MRIs have already had a significant effect on productivity, even though their diffusion has been limited, particularly in the assembly stage. (9)

The evidence on MRIs within the South African garment industry presented below is drawn from interviews. (10) With the exception of MRIs in the pre-assembly stage, where it was possible to obtain exact information, (11) the data below should be seen as indicative of trends rather than a precise tabulation.

(1) Design and engineering

Pattern Design Systems (PDS) allow the designer to utilise a database of patterns and/or instantly modify any existent pattern. PDS uses the same equipment as required for computerised grading and marking. Although 13 South African firms now have computerised grading and marking (see below), none utilises PDS. Utilising the computer as an aid in product costing is more widespread, but computerised cut order planning and production scheduling are still not universal, even among the medium and larger firms. The prime incentive to adopt PDS is to improve the productivity of pattern designers. The principal advantages of PDS are:

(a) saves cardboard piece cutting
(b) instant modification of designs
(c) storage of designs
(d) can be linked to an automatic costing of patterns.

The greater speed with which new patterns can be generated and existent patterns modified allows for a substantial reduction in lead times - extremely important in fashion.

However, there are two major problems. First, technical problems with the software which is very complex and second as a result of the unwillingness of designers to work on PDS. A production manager explained:

> The problem is deeper than the software. There has always been resistance from the design side. These designers have, or should I say create, their own mysteries. They're a bunch of arty crafty people and they simply don't get on well with computers. In the UK where I worked, we had bloody sabotage there.

The "solution" advanced presently is for the designer to remain designing on a screen, with a newly created "post", viz. a pattern engineeer entering the designs on the system. South Africa has hitherto lacked pattern engineers. Moreover, to a considerable extent, South African firms have simply copied overseas designs. Thus, those firms which have computerised grading and marker making systems (see below) have found it more beneficial to utilise their systems solely to produce markers. However, as pattern engineers are trained and as the software improves, PDS is very likely to "take-off" in the South African clothing industry. Of the firms interviewed, three said that they were seriously thinking of introducing PDS within the next year.

Since, in South Africa, information regarding the garment is not generated in digital format at the design phase - which would allow automatic costing of the different design configurations - where the computer is utilised in costing, it simply performs the role of a sophisticated calculator. Computer analysis of orders, and the translation of these orders into an optimal cutting programme, is now undertaken by a number of the larger firms. Computerised production scheduling is more widespread. According to one of the principal firms which designs in-house programmes, production scheduling, of varying degrees of sophistication, has become commonplace with large and medium sized firms and is now utilised by a number of smaller firms. Computers here function primarily as managerial aids altering cutting and production schedules rather than affecting the labour process per se.

(2) Pre-assembly

Computerised grading and marker making systems have been purchased by 13 firms in the South African garment industry. The information generated in grading and marker making is in digital format and can therefore be linked directly to the cutting operation. However, only two South African firms have integrated their grading and marker making systems with a microelectronic cutter. Automated spreading machines are far more widespread and are now utilised by most of the medium and large sized companies.

The prime incentive to adopt a computerised grading and marker making system is fabric saving. Fabric saving comes about for a number of reasons including:

(a) greater accuracy and a lighter and neater marker
(b) ease of manipulation of the marker on a screen rather than on a long table
(c) easier adjustment for variations in material width and imperfections
(d) only one cut line required.

The extent of the fabric saving varies considerably according to a number of factors but particularly according to the type of product and the system in operation prior to the introduction of computerised grading and marker making. The responses of firms interviewed are summarised in column 1 of Table I. For a firm with a fabric turnover in excess of say R10m per annum, a saving of 2% will allow for a payback period of one year on an initial investment of some R200,000. (12) (Of course, the issue is much more complicated than this, there being, on the one side, many additional costs - of maintenance, servicing, updates, retraining of staff and a lengthy learning period, to name only the most important (13) - and, on the other side, other potential benefits - principally reductions in labour costs.)

Labour saving - see column 2 of Table I - is certainly an important factor. In every case interviewed, the number of markers and graders had been substantially reduced after computerisation. However, for the manufacturer, this is a secondary motivation and of less significance than the saving in fabric. Wage rates in South Africa, by comparison with those prevailing in the advanced countries, are low, while, again by comparison, material costs are high. In the proportions of labour to material costs, South African garment manufacturers lie somewhere between the developed countries and the Asian NICs. (14) Whereas the primary motivation overseas is often said to be labour displacement, in South Africa it is fabric saving. In each of the firms interviewed, purchase of the grading and marker making system had been cost-justified in terms of potential fabric savings.

Reductions in sewing costs through greater efficiency of the marker and the rapid turnaround time, given that modifications to existent patterns can be automatically regraded on the system, are important additional advantages secured. The large clothing firms in South Africa tend to produce for a wide spectrum of the market, largely as a consequence of the restricted size of the market overall. The greater variety of the final product and hence the greater variety of grading and marker making required, places a particular premium on rapid turnaround time in these operations. In every case the grading and marker making system was producing a very wide variety of output, and thus some of the diseconomies of non-specialisation were reduced.

Purchase of the computerised grading and marker making system is strongly correlated therefore with firm size and especially

TABLE I: BENEFITS OF THE MICROELECTRONIC GRADING AND MARKER MAKING SYSTEM: RESPONSES OF SIX FIRMS INTERVIEWED

Company Specified by Principal Product	(1) Extent of Fabric Saving	(2) Extent of Labour Saving	(3) Time Taken to Make a Marker	(4) Other Advantages
1. Ladies' Outerwear	3-4%	20 graders, now reduced to 6 15 markers, now reduced to 4	Varies - but generally less than one-quarter of the time required previously	Accuracy. Rapid turnaround time essential
2. Men's Outerwear	2%	56 markers, now reduced to 8	Suit markers reduced to less than one-seventh of the time taken previously	Rapid turnaround time. Introduced a night shift so reducing overtime
3. Fashion Shirts Briefs T Shirts	2-3% 10% ,8%	Markers and Graders reduced by four-fifths	-	Abolition of the skill factor: markers and graders in short supply in border area where located
4. Men's Trousers	2,5%	Markers and Graders reduced by one-third	Average reduced from 4 hours to half-an-hour	Reduction in turnaround time especially important in modifying designs
5. Men's and Women's Outerwear	2-4%	Markers reduced from 20 to 2. Saving on graders cannot be assessed since they run a "bureau" for a number of factories in the group	-	-
6. Full range of outerwear	1-3%	Markers and graders reduced by one-half and volume of production doubled	-	2 shift working Savings on the factory floor

fabric turnover. The key lies in the relationship between fabric price and the price of the system. While fabric prices are unlikely to fall, the systems are certainly coming down in price. The reduction in system prices will continue for two major reasons. Firstly, the growing sophistication of the "chip" is leading to a constant reduction in the prices of electronic components. Secondly, specific to this product, up to fairly recently a single company, Gerber Garment Technology, (GGT) a subsidiary of Gerber, has had something of a world-wide monopoly after buying out their major rivals, CAMSCO, some years ago. A number of new firms are now entering the market, and this is forcing a reduction in price.

Thus far, marker-grader systems have only been purchased by firms with large fabric turnovers and few of the 1,300 plus garment manufacturers are in this category. However, as the price of the systems fall, demand will increase substantially as the much more numerous clothing producers, located in the medium fabric turnover spectrum of the market, will be able to justify the purchase.

The electronic cutter is similarly a product of GGT. The cutter was invented in 1968 and is said to be between 3 and 8 times as fast as a manual. The key advantages of the cutter are:

(a) saving in labour costs. This is the key factor. Comes about through a substantial reduction in the number of cutters required - typically 3 were said to do what a dozen were doing previously - and a deskilling of the cutter's job which is now largely reduced to that of monitoring;

(b) quality of cutting. The cutter has a sensor and a self-correct to the angle of the knife so that all pieces are exactly cut. This is not so with manual cutting. The greater accuracy of the cut product results in productivity savings in the sewing operations since cutting accuracy leaves no doubt as to the sewing path required. Productivity rises for sewing operatives has been considerable;

(c) cloth saving. Comes about through greater cutting accuracy as the seam allowance can be exactly specified whereas with manual cutting a "margin" had to be left for manual cutting error. Likely to be 1% or less.

The cutter is extremely expensive and not all operations can be electronically cut. Initial costs are well in excess of

R500,000. With relatively few cutters being employed in a plant (although cutters have always been amongst the highest paid operatives in a factory) and with low wages prevailing for sewing labour, there are few South African firms that can justify expenditure on a cutter. The limited number of long-runs makes for less heavy lays and this reduces the advantages of electronic cutting. Production for a wide spectrum of the market means that there are a number of very short-runs which are more economically cut by hand.

However, once again, the price of the cutter is likely to fall substantially in the near future. GGT have ensured their monopoly with a series of patents. The most crucial of these - covering the vacuum compressor system coupled with the bristled cutting table surface - expires in 1986, and all the indications are that a large number of suppliers are waiting to enter the market. In any case, GGT has only registered patents in 5 key countries and a competitor has emerged - a Spanish company which is selling locally a similar product including the vacuum compressor and bristled cutting table surface (since GGT patents do not cover South Africa) at a lower price. Again, the net effect must be to increase market penetration very substantially.

Automatic spreading machines are now widely used in the larger factories. The advantages are fabric saving, due to exact positioning and tensing of the fabric, and particularly labour saving since, even with aids such as flotation tables, manual spreading is labour intensive. However, they are confined to the larger factories with large fabric turnovers and even here manual spreading is still frequently resorted to particularly where short-runs make manual spreading more economic. Manual spreading also has the advantage of allowing simultaneous fault detection in the material and the consequent reorganisation of the marker. The development of computerised fault detection systems integrated with computerised spreading systems is now under way and their successful development should do much to facilitate future diffusion of automated spreading. (15)

(iii) Assembly

While MRIs in the South African garment industry are utilised in only limited numbers in sewing and pressing, and not at all in transport and handling, the potential significance here is enormous. Firstly, unlike design and engineering where systemisation is the key incentive to use MRIs in the assembly stage it is overwhelmingly a reduction in unit labour costs. Secondly, it is with respect to the assembly operations, especially sewing, that the major efforts are now being made to advance microelectronic automation.

Once the material pieces have been cut, like pieces are tied together and manually transported to the required operator. However, a computerised overhead rail system is now available which moves the individual pieces, placed in baskets or on a hanger, automatically, to the most appropriate location. The computer simultaneously monitors the performance of each operator so that it is able to ensure that the operator only receives material pieces which require the operation at which he /she is most proficient. Similarly, the operator receives only pieces that accord with the colour thread being utilised at the time. Finally, the computer can provide an immediate statement of an operator's efficiency relative to some standard allowance and the corresponding running total of an operator's output.

Thus, utilisation of a computerised rail enormously facilitates a piece wages system. Almost every employer interviewed spoke of the introduction of a piece wages system in the South African garment industry as a prerequisite for any substantial increase in productivity on the factory floor. Secondly, the overhead rail will generate substantial savings in work-in-progress - throughput time may be reduced by as much as 85%.

A number of such systems are now employed in Europe and the USA. (16) As yet, as far as could be ascertained, only one South African company - a producer of lingerie - has an overhead rail on order. A medium sized manufacturer of ladies outerwear is seriously considering installation and is being encouraged to do so by its overseas parent which has a number already in operation. According to one of the suppliers, a number of South African companies have made enquiries and are considering purchase. The system is, however, currently expensive - approximately $5,000 per work station.

There are a wide range of automatic and semi-automatic pressing machines - many of which are computer controlled. Some of the most sophisticated handle several garments simultaneously and pressing is done against an air balloon representing the human shape. The operator selects a number of process variables which are generally specified on the production ticket.

The job is thus almost completely deskilled. Labour saving has been assessed at about 50%. (17) A number of factories visited had automatic pressing equipment. This was especially true of the large factories and of those producing men's trousers. Not all pressing is automated - particular garments and touch-ups are still performed manually and the old hand-held iron is to be seen alongside the most modern presses. The key motivation is labour saving and, to a lesser extent, quality improvements. Most of the pressers are men earning higher wages, whereas sewing is exclusively a female preserve. The presses are expensive - upward of R25,000 each, but demand is definitely increasing.

Assessment of the potential impact of the MRIs on the sewing operation necessitates a brief summary of the position that has prevailed hitherto. (18) Up to now, technical change has been primarily incremental - modifications of the sewing machine rather than any fundamental technical transformation. Sewing speeds have been greatly increased; work aids have been developed to facilitate material handling and some small parts assembly has been mechanised by the development of dedicated machines performing more than one operation. MRIs have generally tended to follow the same path of incremental change.

There are three types of microelectronic applications in sewing. First, dedicated machines utilising dedicated microprocessors to control operations such as small parts assembly or repetitive sewing, eg. belt loop attachers or pocket welters. Second, preprogrammable convertible machines which convert conventional machines to different sewing tasks by use of preprogrammable data input devices. Third, operator programmable machines whereby the operator undertakes the required operation manually and at the same time programmes the machine functions required to perform the operation, eg. raise presser foot, back tack, etc. These instructions are converted into an optimum sewing programme that can be exactly repeated.

The productivity gains through using MRIs in sewing are substantial - of the order of 45% on average. (19) However, MRIs are more inflexible than conventional machines. Thus, productivity gains are often offset by the need for greater flexibil- ity. In addition, MRIs are far more expensive than their con- ventional equivalents, of the order of magnitude of 5-7 times. Moreover, the total range of activities for which MRIs are currently available is still very limited. A recent survey of firms in Europe and the US found that the largest number of electronically controlled machines in any individual firm amounted to only 6% of the total number of machines. (20)

In South Africa MRIs for sewing operations are to be seen in all of the medium and large sized factories but, as yet, in relatively small quantities. They are to be found where firms have high volumes and repetitive styles and in certain basic lines such as men's shirts and trousers. For example, at a clothing factory in Tongaat which produces a wide variety of mens' and womens' wear, and is in the trade recognised as the most automated and modern in South Africa, a number of such machines were in evidence but mostly in mens' trousers and shirts. In some cases there was only one operator feeding up to three machines. The company is planning to set up their own R and D department to examine new automation techniques and how they could be applied within the factory. One of the largest clothing firms in the Cape, producing primarily mens' outerwear, has automatic embroidery machines, a few electron- ic machines for stitching sleeves and automatic pocket flap attaching machines on every jacket production line. Another large Cape factory, producing a wide range of clothing, has most of its automated machines on the trouser floor which is now quite highly automated. Elsewhere they have pre-program- med machines to stretch a sleeve and a number on order, and a small number of dedicated MRIs to do pocket setting and some other functions. The middle sized companies tend to have fewer MRIs. One Cape company making ladies' outerwear has two new machines which can be programmed to do operations such as tacking. Another Cape company making work and leisure wear had only very recently acquired its first MRI - an automatic pocket setter.

In every case where MRIs have been introduced, the principle motivation has been labour saving. This accords with findings abroad. The extent of saving clearly varies with the operation in question. The automatic pocket setter, acquired by the Cape company making work and leisure wear in the example above, will be replacing six pocket setters. This appears to be the average for the dedicated machines which combine more than one operation. Labour saving on other MRIs is more difficult to calculate for the one machine/one operator configuration is generally retained.

Apart from labour displacement, the introduction of MRIs is generally accompanied by a process of deskilling. The operator's role is confined to starting the operation and feeding in the material. According to the Chief Mechanic at one of the largest Cape factories: "On our electronic machines the girl only introduces the material and switches on. As far as craft goes, it does not come into it anymore". The authoritative Bobbin Magazine, surveying mechanised sewing machines, stipulates the category of operator required and in the vast majority of cases, this is "low skilled". (21) The lower level of skill required and the consequently shorter training period involved is seen by employers here as a considerable advantage for labour turnover rates are very high - on the factory floor, as much as 100% per annum in some cases.

The presence of MRIs in the sewing process is likely to increase. Firstly, more machines are being developed covering more operations. Secondly, these machines are becoming more proficient as new advances are made in microelectronics and, very importantly, more flexible, necessitating less expensive changeovers. Thirdly, and most significantly, there are indications that microelectronics will generate radical technological changes which will fundamentally alter the process of material handling and sewing. Robotic feeding and single machines which combine more and more operations for example, are increasingly being introduced. But, even more radical breakthroughs are possible in the near future. There are a number of important research projects currently under way which aim at the development of far more mechanised plants where human labour plays a minimal role in direct production. (22) South African garment manufacturers will not remain unaffected by these developments. Most companies interviewed stated that they were planning to increase their use of MRIs on the factory floor in the near future and many had new machines on order. According to suppliers, demand for MRIs was increasing steadily - mostly on the part of the larger factories.

IV Factors affecting the further diffusion of MRIs in the South African garment industry

There are a number of factors, local and international, affecting the rate at which microelectronic technology will diffuse within the South African garment industry in the near future.

Firstly, there is the question of labour costs. Although, with respect to applications in design and engineering and pre-assembly, labour saving is not the key motivation, it is still significant - especially in pre-assembly. In assembly, labour saving is the overwhelming motive. Microelectronic automation is increasingly being referred to as the employers' answer to rising wages and/or worker militancy. However, microelectronic automation has advanced in the clothing industry in a situation in which strikes have been virtually non-existent and where, in many cases, real wages have been falling. In fact, with respect to pre-assembly where MRIs have advanced most rapidly, markers, graders and cutters have, over the last decade, experienced reductions in real wages of between 16 and 18% - the highest for any of the categories covered by Industrial Council determinations for the clothing industry. Any substantial increase in wages for sewing operatives will speed the pace of microelectronic automation in the assembly stage.

In one respect though, microelectronic automation may indirectly preserve some existent jobs, since it makes it less likely that clothing firms will relocate to the border areas/Bantustans. According to manufacturers interviewed, the new computerised grading and marking systems place a premium on skills which are virtually non-existent in these areas. This is particularly true of maintenance for delays in service or breakdowns can be enormously costly. Moreover, MRIs generally, and in the assembly operations in particular, reduce the overall labour input which is the primary attraction of these areas, as far as clothing manufacturers are concerned. This will strengthen the attraction of the established urban areas overall, or alternatively lead, as already has occurred in a number of cases, (24) to a situation where the less labour intensive operations in design and engineering and pre-assembly are located in the "white" urban areas and the more labour intensive processes of assembly, in which heavy reliance upon sewing operatives will continue for some time, are located in the border areas/Bantustans. Just as microelectronics will decisively affect the international location of industry, so too will it affect the location of industrial activity within South Africa.

Secondly, the factor which has both impeded the introduction of microelectronics generally into manufacturing industry in the advanced countries and simultaneously shaped its final configuration and application, is the reaction of workers whose jobs are affected. In South Africa, MRIs have, thus far, affected relatively few workers in the clothing industry and often those who possess skills which are in short supply and who can therefore find alternative employment. Resistance has thus been muted and where it has surfaced, it has generally been individualised. If, as is being suggested here, succeeding stages of microelectronic automation affect a much larger number of operatives, this might elicit a very different and more organised response. In the clothing industry specifically a number of managerial persons interviewed reported some unhappiness with the introduction of microelectronic grading and marker making systems and cutters, but not on any serious scale that might have delayed implementation. This lack of resistance is partly to be explained by the absence of any combative organised union presence throughout the industry, but also that since all of those introducing such systems were dynamic and growing companies, they were able to relocate any displaced workers to other functions in the factory. "Nobody will lose their jobs" is the persistent message given to workers affected prior to the system's introduction.

However, as microelectronic technology advances in the South African clothing industry into more labour intensive activities and spheres, particularly as this starts to alter labour requirements and job content on the factory floor, and also as this technology is diffused to smaller and less rapidly expanding firms, such relocation becomes much less likely. Might technological change be at least one element in advancing a more combative worker organisation in the industry?

Thirdly, as noted earlier, large garment manufacturers are tending to become more predominant in the South African garment industry. (25) This may well accelerate with the more widespread diffusion of microelectronic technology and also a consequence of tie-ups between manufacturing firms and large retail outlets. Since it is overwhelmingly the larger firms who adopt MRIs this will facilitate their further diffusion.

- new technology -

The fourth factor is the effect that the new technology will have upon the competitiveness of the South African garment industry in its existent markets. Presently the industry is primarily directed at the local market where it is overwhelmingly predominant, imports averaging about 5% of local sales. (See Table II) Unlike the NICs, South Africa has not succeeded, except in a few cases, in building up a substantial export market in garments.

TABLE II: SALES, IMPORTS AND EXPORTS OF WEARING APPAREL

Rm Sales*	Imports**	Exports**	Year
1 378,6	74,5	27,0	1981
1 441,0	69,8	28,0	1982

* Figures for Wearing Apparel except footwear

** Figures for Chapter 61 viz. Articles of Apparel and Clothing Accessories of Textile, Fabric excluding knitted or crocheted goods.

SOURCES: Bulletin of Statistics. Quarter ended March, 1984; Foreign Trade Statistics for Calender Year 1982.

The preservation of the domestic market for local manufacturers has, since the industry's inception, been heavily dependent on tariff protection. There are indications that the government may be preparing to reduce tariffs - and indeed this has already occurred, in some cases. Were there to be a substantial reduction in tariffs and a corresponding increase in imports from the NICs, this might further encourage local manufacturers to invest more heavily in the new technology. The lower wages of the NICs and especially the newer entrants to clothing exports such as mainland China, as compared to South Africa, might be offset by reliance locally on more capital intensive labour processes.

A final local factor of significance is that virtually all machinery related to the garment industry is imported. There is very little local production of conventional equipment and none at all of microelectronic equipment. The size of the South African market does not warrant local production and, as a consequence, diffusion of MRIs will depend upon the availability of foreign exchange and the Rand exchange rate.

But, it is likely to be the international factors which ultimately exercise the determining influence upon the process of technical change in the South African garment industry. The vastly more productive potential of microelectronic automated factories may leave little cost-effective choice of technique.

It is already clear that the pace of technical change is rapidly picking up momentum in the industry. This is resulting in a wider field of application for microelectronics in the clothing industry in addition to lower prices, more powerful and flexible products and products specifically developed in an operating environment. All this must exercise a profound effect and accelerate the diffusion of microelectronic technology. While the factors limiting diffusion remain powerful and predictions as to the precise rate of diffusion are necessarily questimates, (26) the advance of microelectronics within the South African garment industry is certain, bearing with it major implications for employment and job content.(27)

Footnotes:

1 This is a broad term encompassing all computerised applications in industry: K Hoffman and H Rush, Microelectronics and clothing. The impact of technical change on a global industry, MS April 1984, forthcoming
2 Hoffman and Rush, Microelectronics: I have leant heavily on this very recent study, particularly as regards developments within the clothing industry abroad
3 Developing country exports of clothing increased from \$1,362m in 1970 to \$14,674m in 1980. About 60% originated from Hong Kong and South Korea whose per annum increase in clothing exports in the 1970s was 21% and 30% respectively: Hoffman and Rush, Microelectronics, p2-8
4 American Apparel Manufacturers Association, Using the computer in apparel manufacturing, AAMA TAC Report, Arlington VA, 1980: quoted in Hoffman and Rush, Microelectronics, p5-45
5 "The next breakthrough will be in robotics ... and it will certainly come within the next two to ten years", John Hurrell, technical executive, Marks and Spencer in Apparel International 6.1, July 1984, p36. In a recent talk in Cape Town entitled "Automating the Clothing Factory - Why, How and When", the President of Gerber Garment Technology,

David R Pearl, said that he foresaw that robotics for positioning and placing of materials will be possible for a wide variety of processes in the very near future and that the fully automated factory would be possible even before the end of this decade: Apparel Machinery and Technology Exhibition, Cape Town, 13 June 1984

6 Report of the Committee of Inquiry into the Textile and Clothing Industries, <u>The policy of protection in regard to textiles and clothing</u>, GP No.3/1983, p21

7 Calculated from Industrial Census data

8 Cited in Report of the Committee of Inquiry into the Textile and Clothing Industries (1983), p23

9 Recording a significant increase in productivity in the South African clothing industry, the National Productivity Institute noted that "In the Cape Town area, the introduction of computer technology and the investment in sophisticated capital equipment played a significant role": <u>Cape Argus</u> 12 January 1982

10 Interviews were carried out with 10 firms in the clothing industry - 7 in the Western Cape and 3 in Natal and Transvaal - which were known to have utilised MRIs. Seven of the firms had computerised grading and marker making systems and two of these had the computerised cutter. All firms were large or medium sized - the smallest had 750 workers. Interviews were in-depth and partially structured and, where possible, combined with a tour of the plant. In addition, 5 of the principal equipment suppliers were interviewed as well as one computer consultant specialising in the industry. All interviewed were unanimous that it was the larger firms that were the principal users of MRIs

11 Data was obtained from suppliers

12 The approximate starting price of a single system of one work station including the costs of installation

13 The learning period is particularly crucial since it can take up to 6 months before any usable output is generated and 2 - 2,5 years before the system is fully operational and the operators have truly mastered it: interviews

14 <u>Breakdown of Variable Costs of US, Asian and South African Garment Producers</u> (%)

	US	Asian NICs	South Africa
Material	60	85	70
Labour	40	15	30

SOURCES: Figures for US and Asian NICs are for "typical US and Asian producers 1980", Hoffman and Rush, Microelectronics, p3-20. Figures for South Africa are an average for the apparel industry as a whole, derived from the industrial census data for 1979

15 Hoffman and Rush, Microelectronics, 4.44-4.51

16 At least two large clothing manufacturers - Eton Shirts in the US and Indyco in Spain - have developed their own rail systems. The writer visited the Indyco factory in Madrid. The sewing operatives on the overhead rail complained of the greater isolation since the descending rail largely cuts them off from the other operatives, and the pressure of work. On the other hand, as a result of their greater output on a piece wage system, most had higher earnings

17 Hoffman and Rush, Microelectronics, p5-51

18 Drawn from Hoffman and Rush, Microelectronics, chapter 5

19 ibid p5-24

20 ibid p5-29

21 Bobbin Magazine May 1982, p186

22 One of the most significant of these is under way in Japan. The Japanese government has committed more than $53m to a project in which 27 Japanese companies, including the largest clothing, textile and equipment manufacturers are cooperating to build a highly automated clothing plant. At the centre will be a machining/sewing centre incorporating a dummy model against which the pieces of cloth will be clamped by a robot and where sewing operations will be done by a computer-controlled three-dimensional sewing head

23 The data for the Cape Clothing industry show Head Cutter (-18.1%), Pattern Maker (-18.1%), Pattern Grader (-17%) and Cutter/Laymaker (-16.3%) as the four operative grades with the greatest percentage decreases over the decade: D Budlender, D Hendry & G Young, Industrial council wage rates: a comprehensive analysis of minimum wage rates set by South Africa's industrial councils, SALDRU, 1984, p83-5

24 Information obtained from interviews. Some of the companies had factories in the border areas/Bantustans

25 A very large number of factories in the industry are extremely small CMT (cut, make and trim) operations, making up garments for the larger firms or retailers. For a variety of reasons, related to production and marketing, the larger factories have been finding it increasingly advantageous to produce more within the firm and to contract

out less work

26 The most detailed study of the international garment industry, concludes that the rate of diffusion of MRIs over the next decade will slowly pick up speed. By the mid-1990s, the type of technology coming on to the market will change towards more total manufacturing systems and these will diffuse rapidly: Hoffman and Rush, Microelectronics, pp7-46

27 The Chairman's Report presented at the Annual General Meeting of the Textile and Clothing Advisory Council held in Cape Town on September 5th 1984 provides strong confirmation of the growing trend towards automated processes in the garment industry:
'Regrettably for our country, I do not see our industries postured for the 90s and the 21st century as making a significant contribution to the provision of new jobs. Those of us who will remain in business in clothing and textiles will be high technology, highly sophisticated and automated industries moving into the capital rather than labour intensive sector".