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The impact on women of the introduction of new technologies in the textile and clothing industries:

Emerging trends and implications for labour and skill requirements

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P r e f a c e

This study is to provide the basis for a series of country-level analyses of the changing role of women in the textile and clothing industry of selected Asian countries (Bangladesh, Indonesia and Thailand in a first round of studies). It will identify and asses those relevant technology-induced innovations and structural changes in the textile and clothing industry (including in particular changing production and investment patterns at the international level) that will in turn determine the future skill and gender distribution of the industry' predominantly female labour force. Due to opposing trends, the precise impact on the skill requirements in the industry is not yet clear. However, it appears safe to assume that whereas new supervisory, data control and programming activities tend to increase the skill requirements, the generally higher degree of automation would tend to decrease the required skill level in other activities. For the female labour force in developing countries, it will therefore be particularly important to meet these challenges in order not to be replaced by both new equipment and differently qualified male labour.

The issues are

- to identify the functions which are affected by technological innovations,
- to asses future application of new technologies,
- to elaborate the influence on production costs,
- to asses the impact on labour absorption,
- to outline global location pattern of production (relocation tendencies).

The authors

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A. Textile Industries

I. Technological Developments and Characteristics of Employment in the Textile Industries

1. Technological Developments

The traditional classification of the textile production system consists of three major parts:[1]

(1) the manufacture of yarn from either staple or filament,
(2) the fabric formation (weaving, knitting, production of non-wovens) and finishing,
(3) the assembly of finished products for end-uses (hosiery and knitwear, carpets, apparel, and other made-up articles).

1.1 Basic Trends of the Technological Development

Most of the technological changes of the past consisted of improvements of the conventional production methods, in particular greater speeds, more universal application, and progress in automation. This led i.a. to higher output (cf. Table 1), productivity gains, and the integration of different stages of production in order to reduce transportation and handling costs[2]. Integration of the production processes

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[1] See General Agreement on Tariffs and Trade, Textiles and Clothing in the World Economy, Apendices I-IV, Geneva, July 1984, p. 39.

[2] See Organisation for Economic Co-operation and Development, Application of New Technologies in Mature Industries - Case Study on the Textile Industry, Paris, June 1987, p. 15.

Table 1: Performance Data of Various Textile Machines

Textile machines	1950	1985	Increase %
Card (kg/h)	8-12	50-80	700
Cotton drawing frame (m/min)	30	600-800	2000
Ring spinning frame (min^{-1})	6000-10000	16000-18000	200
Flat-knitting machine (R/min)	15-20	60-80	420
Cotton weaving machine (Sm/min)			
shuttle	300-400	1200	300
air jet	-	1800	500
wave weaving machine	-	2200	600
Circular knitting machine (course/min)	300-400	2500-3000	750
Stenter frame	25-30	200	1000

Source: H. Wohlfart, G. Egbers, Die Textilindustrie im Jahre 2000, Manuscript, 1986, p. 2.

in spinning appears to have been realized to a higher degree than in weaving. Besides improvements of known technologies, completely new technologies of textile production were developed. Examples of such true innovations are rotor spinning and shuttleless weaving.

Technological progress in the textile industry was stimulated to a significant extent by innovations in fibres, especially by an improved technology for synthetic fibres. In this context mention must be made of the higher speeds of spinning and weaving, the progress made in yarn texturing, and in the production of non-woven fabrics, as well as the progess achieved in dyeing, printing, and finishing.

During coming years changes in textile technology will lead to further automation and flexibilization, but also increasingly to the integration of different stages of production. This evolution is closely related to the use of micro-chips. Beyond production planning and controlling, these permit utilization of all divisions of the enterprise, also including suppliers and clients. This will also make possible a reduction of inventories of materials, intermediate, and finished goods to a minimum and a much more efficient system of handling transportation. It must be emphasized, however, that - based on today's state of knowledge - leaps or shifts in textile technology are not likely in coming years. Over the medium term there should therefore be some difference to the future evolution of clothing technology, where, in the area of sewing, revolutionary developments may be expected in the following 10 to 15 years (cf. Section B).

1.2 Technological Change in Individual Areas of Manufacturing[1]

Man-made fibres (yarn and monofilaments): Here automation and integration of the indidvidual stages of manufacturing has progressed quite far. The monitoring and controlling of the manufacturing process and quality as well as the winding onto spools and the sorting by quality are done automatically.

Spinning: Despite the development of novel spinning processes, the long-known ring-spinning process has retained its dominance. Its advantages lie primarily in its universal applicability, especially in the production of fine and very fine yarns. OE-rotorspinnng, which is used for the production of coarser yarns, follows in second place, whereas the high-speed spinning processes, like jet and friction spinning (Table 2), have not spread as fast as expected.

The individual spinning processes have been subject to continuous improvement during past years. Mention may be made of ring and runners as well as rotors and spindles, but also of automatic feeding and stripping of spools. There are ring-spinneries today whose spinning process runs in three integrated stages, with each of the stages having its own closed transport system. Efforts are being made to automate the remaining manual work.

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[1] Cf. H. Wohlfart, G. Egbers, Von der Automation zur Integration - Trends in der Textiltechnik, in : Jahrbuch der Textilindustrie 1985, ed. by Gesamttextil, Frankfurt 1985, pp. 52 ff.

Table 2: Performance Data of Various Spinning Processes

Spinning processes	Twist level/ min	Limits of the process	
		Twist level	Distortion
Ring spinning	15000- 18000	yes	no
Wrap spinning	25000- 35000	yes	no
Rotor spinning	80000-100000	yes	partly
Jet spinning	150000-250000	no	yes
Friction spinning	200000-300000	no	yes

Source: H. Wohlfart, G. Egbers, Die Textilindustrie im Jahre 2000, Manuscript, 1986, p. 4.

In rotorspinning full automation has almost been achieved. Only the donning of the tows is not yet fully automatic, but solutions are in sight. In the year 2000 spinning, no matter which kind, is expected to be fully integrated.

Further developments in spinning are directed at the realization of monitoring, numerical control, and regulation systems at all levels. This will permit a considerable reduction of monitoring costs and the optimization of inventories.

Weaving: In weaving the shuttle-less looms gained considerable importance during the past three decades, compared to the less efficient shuttle systems (cf. Table 3). Still higher speeds are expected for rapier and projectile looms in the future. Air jet looms will probably also gain ground, not only because of higher efficiency, but also because of less noise pollution.

Table 3: Performance Data of Various Weaving Processes

Weaving processes	t/min	m/min
Shuttle	260	400
Projectile	400	1100
Rapier	300/500	930/1200
Air jet	520/720	1600/2000
Water jet	800	1650
Wave weaving		2200

Source: H. Wohfart, G. Egbers, Die Textilindustrie im Jahr 2000, manuscript, 1986, p. 5.

Besides further performance improvements, future technological progress in weaving will focus on increased automation and integration of the individual stages of processing. In this - like in spinning - numerical control will play an important role. Threading up the warp will pose the greatest problem for automation. Although the fully automatic fasten

ing of a warp appears realizable, automatic threading-up of a warp (including the harness) may not be realized during the coming decade. In contrast, based on today's state of the art, the automatic removal of grey fabric, grey fabric display, and automatic packing and storing may become possible in the near future.

Knitting: In knitting, too, first attempts have been made to integrate individual processing steps. This is true, for example, of automatically equipping the knitting machine creels with cross-wound bobbins as well as of automatic removal of the goods. First steps have also been taken in the direction of automatic discovery of mistakes in the layout and cutting of the goods. The greatest problem for the time being is caused by the manufacture of knitwear. Although first attempts at automating the sewing process have been made, the road to fully automated manufacturing of knitwear is - as mentioned - likely to be a long one.

Textile finishing: In textile finishing computer-based systems have been used for a long time. From the firms' point of view, the future task will be to raise productivity with the help of computer-based process control. More than in other areas of the textile industry, in textile finishing the focus is on an increase in flexibility. That is why the development of finishing machines is directed toward universally applicable equipment, which also works economically for small batches, is largely computer-controlled and may be loaded and unloaded automatically. Examples are the computer-controlled automation of dye-mixes and the control of the dyeing processes.

2. Characteristics of Employment

The employment structure in the textile industry is characterized by a relatively large share of low-skilled workers. In 1985, for example, almost 60 % of the employees of the German textile industry[1] were low-skilled or unskilled (specially female workers), whereas this share was around 37 % for industry on average (Table 4). The characteristic ratio for the intensity of human capital, i.e. the training capital embodied in the work force, is relatively low in the textile sector, indicating a below-average level of training

Table 4: Factor Intensity of Clothing, Textiles and Total Industry in the Federal REpublic of Germany

	Clothing		Textiles		Total industry	
	1973	1985	1973	1985	1973	1985
Percentage share of:						
unskilled workers	67,7	64,5	61,9	58,9	44,3	36,6
craftsmen	15,2	16,3	20,1	20,6	32,3	34,8
highly skilled workers	17,2	19,3	18,1	20,2	23,5	28,7
Physical capital per employee (thousands of Deutschmarks)	23,4	42,8	90,4	150,3	83,5	127,9

Source: Statistisches Bundesamt (Wiesbaden), Fachserie 16, Arbeiter und Angestelltenverdienste, 1973, 1985; cited in: International Labour Organization, The Impact of Employment and Income of Structural and Technological Change in the Clothing Industry, p. 4.

[1] The skill structure in the German textile industry is of special interest here, as internationally it is leading in technological progress, so that developments in Germany can indicate possible changes in skill structure in other countries.

(Table 5). Low-skilled work in the textile industry is frequently performed by women, primarily in production. In the German textile industry women account for approximately half of the workforce. More detailed informations about the qualification of the workers and employees are given in tables 6 and 7.

Table 5: Human and Physical Capital Intensity Ranking in Selected Countries and Industries

Country or area (in ascending order of per capita income	Clothing H[a]	P[b]	Textiles H	P	Food H	P	Chemicals H	P	Electrical machinery H	P
India	4	4	3	3	5	5	1	1	2	2
Hong Kong	3	5	2	4	5	2	1	1	4	3
Spain	5	5	4	4	3	2	1	1	2	3
Japan	5	5	4	4	3	2	1	1	2	2
Fed.Republic of Germany	5	5	4	4	3	1	1	2	2	3
Unit.States	5	5	4	4	3	2	1	1	2	3

a) Human capital intensity. - b) Physical capital intensity

Source: United Nations: Year Book of Industrial Statistics, 1983; cited in: International Labour Organization, The Impact of Employment and Income of Structural and Technological Change in the Clothing Industry.

As mentioned above, progress in textile technology was quite pronounced in past years. Costs for the establishment of an additional work place have risen considerably, and nowadays DM one million and more must be expended on the most expensive work place, e.g. in a modern spinning or weaving mill. There are, however, also branches in the textile industry, in which investment per employee is much lower. This applies to manufacturing areas which focus on sewing, e.g. in certain subsectors of the knitting industry.

The increasing capital input per employee has made the textile industry as a whole one of the most capital-intensive sectors (in contrast to the labour-intensive clothing industry) (Table 8). This implies that the widely held opinion

Table 6 : Qualification of Workers in the Textile Industries
(Case of Germany F.R.as an example for indust.countries)
(figures in% of workers i.e.75 % of employment)

Qualification / Sex	1	2	3	together
male	43%	48%	9%	54%
female	8%	64%	28%	46%
all workers	27%	55%	18%	100%

explanation : 1: high-skilled
2: semi-skilled and workers for special tasks
3: unskilled

Source: Statistisches Bundesamt Wiesbaden(FRG),Löhne und Gehälter Fachserie 16,Reihe 2.1-Arbeiterverdienste in der Industrie April 1987.

Table 7: Qualifications and Functions of Employees in the Textile Industries
(Case of Germany F.R. as an example for industrialized countries)
(in % of employees i.e. 25 % of employment)

Qualification / Function	I	II	III	IV	V	together
Clercs						
male	-	36%	46%	15%	3%	47%
female	-	5%	33%	43%	19%	53%
Technical employees						
male	-	22%	59%	18%	1%	85%
female	-	8%	40%	42%	10%	15%
All employees						
male	-	27%	54%	17%	2%	65%
female	-	5%	35%	43%	17%	35%

explanation: I=high qualification
V=unskilled

Source: Statistisches Bundesamt Wiesbaden(FRG), Löhne und Gehälter, Fachserie 16, Reihe 2.2 Angestelltenverdienste in der Industrie und im Handel April 1987.

Table 8: Capital Intensity of Clothing, Textiles and Total Manufacturing in the Federal Republic of Germany, 1970-84

Year	Capital stock per employee (in Deutschemarks, 1980 prices)			
	Clothing	Textiles	Non-durables	Total industry
1970	19 236	63 789	46 643	70 234
1973	22 385	78 891	56 908	83 025
1976	30 395	97 733	72 263	101 120
1978	32 792	102 941	76 010	105 819
1980	34 863	105 998	79 375	108 538
1982	40 963	118 570	90 543	118 703
1984	44 [illegible]48	125 550	98 195	126 960
1985	45 [illegible]85	124 721	99 414	126 955
	Percentage change			
1970-73	16.4	23.7	22.0	18.2
1973-78	46.5	30.5	33.6	27.5
1978-84	35.8	22.0	29.2	20.0

Source: Baumgart et. al., Produktionsvolumen und -potential, Produktionsfaktoren des Bergbaus und des verarbeitenden Gewerbes in der Bundesrepublik Deutschland, Berlin, various years.

that the textile sector is a suitable starting industry for developing countries, because its capital input requirements are low and hence employment effects would be large, is no longer generally valid. In addition, modern textile technology is not only very expensive but running it and keeping it functioning also requires skilled employees. These, however, are usually not available in developing countries. In the Federal Republic of Germany the share of skilled labour - increasingly employed for monitoring functions - in total employment of the textile industry has risen in recent years (Table 4). The German textile industry is also intensifying its efforts to further raise the training level of its employees. Proof of the increasing demand for more highly skilled labour is the rising ratio of trainees. This ratio has risen - with fluctuations - from 2.9 % in 1977 to 4.9 % in 1986 (Table 9).

Table 9: Trainees in the German Textile Industry

Year	Commercial	Industrial	Total	In % of total employment
1977	4 447	5 145	9 592	2,9
1980	4 519	6 785	11 304	3,7
1982	3 366	5 038	8 404	3,2
1984	3 227	5 760	8 987	3,8
1985	3 492	6 747	10 239	4,4
1986	3 709	7 400	11 109	4,9

Source: Bundesanstalt für Arbeit.

The fact that, despite this rise in the share of the more highly skilled workers, the average level of training of those employed in the textile industry is still below that of numerous other branches (Table 5) is primarily due to two factors: For one, some labour-intensive jobs (especially sewing) in garment production require shorter training, and secondly, the bridging of the so-called automation islands requires considerable transportation and handling, which is mostly performed by unskilled labour. Correspondingly, the share of unskilled labour in total employment has also risen (Table 4).

II. Pace and Degree of Future Application of New Technology

It was mentioned above, that the development of textile technology will proceed in coming years, but without large jumps or discontinuities. In particular, the speed of the machines and their degree of automation will continue to rise and the individual manufacturing stages will increasingly become integrated. It appears that in the year 2000 the running of machines without operators will have become reality, at least in some areas.

The question arises about the extent and the pace at which firms in the textile industry will introduce the new technologies into the production process. In principle it must be assumed that numerous barriers exist concerning the spread of new technologies, like the availability of capital and of skilled labour and management. Industrialized countries are better endowed with these resources than the developing or newly industrializing countries. Nevertheless, in the past these countries frequently modernized their stock of equipment faster than the industrialized countries. Differentiation between the spinning and weaving sectors permits a greater insight into the process of diffusion.

In the developing and newly industrializing countries, the share of machines which are less than ten years old in the total capital stock is generally higher in the area of ring spinning systems and O-E spinning compared with a world average (exceptions are Asia and Oceania in long-staple systems and O-E rotors as well as South America in O-E rotors). In other words, numerous developing and newly industrializing countries modernized their stock of spinning machines to a greater extent than the industrialized coun-

tries (Table 10). In weaving the picture looks somewhat different: Here an above-average rate of modernization was only achieved by Africa, Asia, and Oceania (Table 11).

Despite the generally remarkably high modernization investment by the developing and newly industrializing countries, they do, in part, lag far behind the industrilaizing countries concerning the technological standard of the stock of machinery. Thus in the EC countries the share of O-E spinning rotors in the total stock of spindles is two to five times higher than in the developing and newly industrializing countries (Table 10). Even more pronounced are the differences in weaving. Here the level of technology (i.e. the share of shuttleless looms in the total stock of looms) is up to eight times higher in the EC than in the developing and newly industrializing countries (Table 11).

Nevertheless, whenever these countries do buy new machines, they always take those embodying the latest technology, although in many cases a conventional machine (possibly with auxiliary equipment for automation) would suit their purposes better. It may therefore be correct to assume that these countries will continue to modernize their textile industries in coming years - despite their high indebtedness and related financing problems. Decisive for this process will be the way in which the price competitiveness of these countries will evolve in the near future. This concerns the future changes in costs, which will be discussed in the next section.

Table 10: Technology in Spinning

Region/Country	Rate of modernisation[a]			Technological level[b]
	Spindles			
	Short Staple System	Long Staple System	O-E-Rotors	
Africa	31,5	46,4	101,1	7,6
North America	7,0	25,0	110,3	10,0
South America	23,4	18,3	82,4	7,1
Asia & Oceania	17,1	16,2	83,2	4,0
EC	21,9	14,8	91,1	31,5
EFTA	39,8	19,0	112,5	10,1
Comecon-Europe	0,3	7,5	95,5	97,7
Other Europe	22,7	35,3	281,8	3,5
Total	15,1	17,0	95,4	19,8

a) Ratio of shipments of spindles or O-E rotors during 1977 -1986 to the stock at the end of 1985.- b) Ratio of the stock of O-E spinning rotors to the total stock of spindles (1 O-E spinning rotor corresponds to 4.5 spindles).

Source: International Textile Manufacturers Federation, International Textile Machinery Shipment Statistics, vol. 9 /1986.

Table 11: Technology in Weaving

Region/Country	Rate of modernisation[a]		Techno-logical level[b]
	Looms		
	Shuttle	Shuttle-less	
Africa	15,4	99,8	9,0
North America	4,2	68,3	32,3
South America	4,0	74,2	7,4
Asia & Oceania	10,8	137,9	5,4
EC	6,8	137,9	41,4
EFTA	7,8	138,7	42,0
Comecon-Europe	0,9	38,9	33,9
Other Europe	7,0	127,1	9,9
Total	8,8	87,7	14,2

a) Ratio of shipments of looms in 1977-1986 to the stock at the end of 1985.- b) Ratio of stock of shuttleless looms to the total stock of looms at the end of 1985.

Source: International Textile Manufacturing Federation, International Textile Machinery Shipment Statistics, vol. 9/1986.

III. Implications of New Technological Development for Production Costs and Effects on the Comparative Advantage of the Textile Industry in Developing Countries

In past years the textile industry has evolved into a capital-intensive industry. Consequently, capital costs have gained in significance, especially in the developing and newly industrializing countries. Cost studies by the ITMF[1] for Brazil, India, and Korea show that the weight of capital costs in spinning is three to six times that of labour costs (Table 12), whereas in Germany and in the United States these cost categories have about equal weights. Similar differences in weight between capital and labour costs exist in weaving for the three developing countries mentioned (Table 13).

The rising share of capital costs reduces the price competitiveness of the less developed countries compared to the industrialized countries. According to a comparison of total production costs for the manufacturing of yarns and fabrics with the most modern machines, the industrialized countries still have disadvantages compared to the developing and newly industrializing countries at the early stages of textile production (spinning and weaving) (Tables 14 and 15, second row). Taking account of freight and insurance costs (CIF prices) as well as tariffs, textiles produced in the Federal Republic of Germany in 1985 were definitely competitive in the German market. In yarns and fabric Brazilian products are even more expensive, Korean products only slightly cheaper. Only the supply prices of Indian yarns and fabrics and Korean

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[1] International Textile Manufacturing Federation.

Table 12: Total Yarn Cost Elements, 1983 and 1985 (percent of total yarn costs)

Cost Element	Brazil		Germany		India		Japan		Korea		U.S.A.	
	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
Raw Material	55	58	65	63	66	63	65	62	72	71	63	59
Labour	7	7	12	13	3	3	6	9	3	4	10	15
Capital	28	29	12	14	15	19	15	16	11	12	14	16
Others*	10	8	11	10	16	15	14	13	14	13	13	10
Total	100	100	100	100	100	100	100	100	100	100	100	100

* Waste, Power, Auxiliary Material

Source: International Textile Manufacturers Federation, 1985 International Production Cost Comparison, Spinning/Weaving, Zurich 1985.

Table 13: Total Fabric Cost Elements, 1983 and 1985 (percent of total fabric costs)

Cost Element	Brazil		Germany		India		Japan		Korea		U.S.A.	
	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
Raw Material	31	35	38	38	39	37	41	38	47	46	36	33
Labour	11	8	25	25	5	6	15	17	6	7	22	26
Capital	46	45	21	24	30	33	26	27	23	24	26	27
Others*	12	12	16	13	26	24	18	18	24	23	16	14
Total	100	100	100	100	100	100	100	100	100	100	100	100

* Waste, Power, Auxiliary Material

Source: Cf. Table 12.

Table 14: Yarn Costing Index, 1983 and 1985
(Federal Republic of Germany: 100)

Costs	Brazil		Germany		India		Japan		Korea		U.S.A.	
	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
Manufacturing Costs	112	104	100	100	75	71	95	96	69	66	86	93
Total Yarn Costs	88	91	100	100	78	71	95	93	86	83	82	85
CIF (Germany) Costs	103	104	100	100	93	85	117	112	101	97	94	97

Source: Cf. Table 12.

Table 15: Fabric Costing Index, 1983 and 1985
(Federal Republic of Germany: 100)

Costs	Brazil		Germany		India		Japan		Korea		U.S.A.	
	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
Manufacturing Costs	98	89	100	100	74	74	79	86	63	66	90	99
Total Fabric Costs	92	90	100	100	76	72	88	92	76	76	85	91
CIF (Germany) Costs	116	105	100	100	92	85	109	106	94	89	105	103

Source: Cf. Table 12.

fabrics were considerably lower, an advantage which German producers can usually offset by better commercial performance. The price competitiveness of the other industrialized countries analyzed in the IMFT cost studies is lower than that of the Federal Republic. The textile industry in Japan and fabric production in the United States had a relatively high level of costs in 1985. It is therefore not correct to say that textile products manufactured in the industrialized countries are generally competitive on the basis of cost with products from low-wage countries.

Assuming, however, that the developing and newly industrializing countries will continue to modernize their equipment in the future, then their cost advantage will decline further. The extent of this loss will paradoxically be the higher the more the low-cost countries use the latest machinery[1]. Put vice versa: It is not improbable that in the train of technological progress in textile production the price competitiveness of the industrialized countries will improve. One must take into account, however, that the international competitiveness of an industry does not only depend on costs but also on other, e.g. qualitative factors. And in this regard it is especially the application of modern technology which permits the low-wage countries to manufacture products of almost identical quality to those of the industrialized countries. The availability of skilled labour is a prerequisite, of course. The extent to which modern technology changes the demands on labour skills is the subject of the following chapter.

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[1]Cf. AECD, Application ..., p. 31.

IV. Impact on Labour Absorption and on Changing Skill Requirements

Future technological progress in textile manufacturing will affect labour in quantitative and qualitative terms. Concerning the number of employees, one must assume that new processes and further automation will lead to the loss of many manual jobs, i.e. to a reduction in labour input. Thus insiders are forecasting that in spinning technological change may save up to half of today's labour. This implies that labour input per unit will decline considerably in coming years. The textile industry will only be able to retain its current labour force if it succeeds in markedly raising its output. In the future the textile inudstry in developing and newly industrializing countries will also be able to contribute to rising employment only in exceptional cases. Certain is that in the years to come the share of the textile industry in total employment of the manufacturing industry will fall in the industrialized countries as well as in the less developed countries.

Regarding the qualitative impact on future technological progress, there is agreement in the industry that the demand for unskilled labour will decline and that for highly skilled labour will rise. The falling demand for unskilled labour is primarily due to the declining need for transportation (as a consequence of increasing integration of the manufacturing processes). It must nevertheless be emphasized that in the

future the demand of the textile industry for unskilled labour will still be relatively high compared to other branches of industry. This implies that the textile industry will continue to offer numerous jobs for unskilled labour - and thus primarily for women.

Opening up new markets and finding applications for new textile products, using modern production processes and finding new distribution channels require highly skilled employees, who are able to solve complex problems and possess a high degree of flexibility. It is therefore not surprising that in the past the textile industry increasingly employed engineers and technicians. Evidence of this is the ratio of engineers or technicians to total employment in the German textile industry. In 1984 there were 577 employees for each university-trained engineer, in 1969 there had still been 1665 (Table 16). A similar development took place with respect to textile

Table 16: Relative Importance of Skilled Employees in the Textile Industry, 1969-1984

Year	Number of employees per 1 ...				
	University-trained engineer/ chemical engineer	Textile engineer (technical collage)	Textile technician (male)	Textile technician (female)	Foreman in a textile plant
1969	1665	126	110	.	30
1974	1606	128	119	427	27
1979	1048	109	98	336	23,5
1984	577	100	94	283	23

Source: Technische Fach- und Führungskräfte in der Textilindustrie der Bundesrepublik Deutschland, Survey of 1 January 1984, ed. by Gesamttextil, Frankfurt/Main 1984.

technicians; this is especially true of the female textile technicians who work primarily as designers.

A survey of the German textile industry shows the reasons for the hiring of additional engineers. According to this survey, the additional demand for engineers results in more than two fifths of the firms for reasons which are closely related to the progress in textile technology (e.g. monitoring production, emergence of new technology, Table 17). In view of the technological lead of the German textile indistry these findings may serve as an indicator of future demand for engineers in developing countries. How strong this demand may become

Table 17: Reasons for the Additional Demand for Engineers in the German Textile Industry, 1986-1988 (percent of answers)

Reasons for additional demand	%
Better monitoring of production	27.7
More product development	26.6
Emergence of new technologies	15.2
Capacity expansion	13.3
Better qualification	10.1
Better customer relations	5.0
Other replies	2.6
Total	100.

Source: Ermittlung des Bedarfs an Ingenieuren/Ingenieurinnen in der Textilindustrie für die Jahre 1986-1988, Survey of 1 December 1985, ed. by Gesamttextil.

is signalled by the fact that the demand for university-trained engineers specializing in textiles, which existed at the end of 1985 in the German textile industry, could only be met by half. The excess demand for textile engineers from specialized institutes was even greater.

Regarding the skills required in the future of specialized workers (spinners, weavers, dyers, etc.), opinions diverge. The Textiles and Clothing Workers Union of the Federal Republic of Germany holds the view that e.g. as a result of the simpler operation of machines skills are being devalued. The textile producers are said to design operating procedures which presume as little special knowledge as possible of the operators, and thus also require shorter training periods. In the past, rationalization measures affected in particular workers in the core areas of the textile industry, i.e. in spinning and weaving (Table 18).

Table 18: Occupations/Jobs Which Were Especially Affected by Rationalization Measures (percentage of mentions)

Occupations/Jobs	%
Weaver, weaving help, master weaver preparation, weaving preparation, tufting work	25
Spinning, spooling, yarning, texturizing, carding	28
Knitting, sewing	16
Dyeing, finishing, dye-making, shearing, printing	12
Unskilled work, sorting, expediting	5
Merchandise control	3
Work in other production areas	8

Source: Gewerkschaft Textil-Bekleidung, Die Maschine treibt dich - Daten, Hintergründe und Folgen der Rationalisierung in der Textilindustrie. Düsseldorf, Sept. 1986, p. 35.

The way in which the qualifications of the specialized workers may change in detail will be presented below with the help of the most important characteristics. These are:

1a) Monitoring) Conventional occupational
1b) Operating) characteristics of specialized workers
2) Repairing and exchanging spare parts (partly done by the textile mechanic).

Ad 1a): Regarding the occupational characteristic "monitoring" developments in electronic control are of special significance. It may be assumed in general that even as electronics progresses further, at least part of the monitoring activities will be retained. One worker may possibly have to monitor a larger number of machines, however, which would imply greater responsibility and more mental work (and possibly also increased mental-psychological stress).

Ad 1b): Operating the machines will become less labour intensive in the future. This implies that the skill level will decline.

Ad 2): In the train of technological progress repairing and the exchange of spare parts gain in importance. Assumptions are that a specialized worker can take care of so-called mechanical repairs himself and of electrical repairs at least in part. He should at least be able to locate the electrical malfunctioning. This occupational characteristic therefore requires an additional skill of specialized workers. More difficult repairs will be performed by the textile mechanic.

If one tries to balance the individual occupational characteristics with respect to their future skill requirements, then "operating" (which is done mainly by female workers) will become simpler, "monitoring" and "repairing" will become more difficult. On balance the skill level should rise, although this may not apply to each individual worker, but rather to the total workforce (as individual occupational characteristics may be performed by different people). In particular, the different job descriptions will contain elements which have so far only been considered as marginal, e.g. planning, preparing, organizing, etc. In other words, specialized workers will be trained more broadly in the future, a fact which today is called "job-enrichment".

V. Global Locational Pattern of Production

The question arises whether the new textile technologies will influence the future pattern of textile production in the world. As mentioned, the progress in textile technologies has to some extent improved the competitiveness of the industrialized countries. This is also reflected in the fact that the share of the industrialized countries in world trade in textiles no longer declined in the recent past (Table 19). Their share in world trade in clothing also stabilized. To be sure, this development was also the result of special factors (e.g. the devaluation of the US $).

The clothing industry, as the most important customer of the textile industry, has continued on its declining trend in the industrialized countries, despite the progress in clothing technology (see Part B of this study). At present there is no presumption that the clothing industry may generally be relocated from the developing back to the industrialized countries. The textile industry may therefore increasingly lose its most important domestic customer. Given the existing stagnation of the domestic market in the industrialized countries, there will be no further growth in textile production there in coming years.

Table 19: Regional Distribution of World Trade in Textiles and Clothing (percentage shares)

Countries of origin	Textiles				Clothing			
	1973	1982	1984	1985	1973	1982	1984	1985
Industrialized c	73,3	65,6	63,7	63,8	55,0	44,9	42,2	43,3
Developing c. a)	17,3	23,1	25,6	.	30,3	40,2	44,8	.
State trading c.	7,5	10,2	10,9	.	14,1	13,8	13,1	.
World b)	100	100	100	100	100	100	100	100

a) Excl. traditional oil-exporting countries.- b) Incl. traditional oil-exporting countries, Australia, New Zealand and South Africa.

Source: GATT, International Trade, various years; Ifo calculations.

On the contrary, production capacities of the textile industry in developing countries will expand for the following reasons:

- The textile industry is often the "take-off" industry in many developing countries;

- the domestic textile market in the developing countries will expand considerably in coming years;

- fibres needed in textile production (above all natural fibres, but increasingly also man-made fibres) are very often produced in the developing countries themselves

For these reasons the past trend in the distribution of world production of textiles and clothing (Table 20) is likely to continue in coming years. This means that the developing countries will further increase their production shares.

Table 20: Distribution of the Production of Textiles and Clothing Among Market Economies in the World (percentage shares)

Country/region	Textiles			Clothing		
	1970	1980	1982	1970	1980	1982
Industrial countries	70	65	63	80	75	72
North America	27	21	20	41	33	29
Japan	10	9	9	6	8	9
Western Europe	32	32	.	31	30	.
of which: EC(9)	(29)	(29)	(28)	(27)	(26)	(24)
Developing countries	30	35	37	20	25	28
Southern Europe	6	8	.	5	8	.
Asia	11	13	15	6	8	10
Latin America	10	11	11	8	7	7
Africa	3	.	.	1	.	.

Source: GATT, Textiles and Clothing in the World Economy, May 1984; Statistical office of the European Communities, Konjunkturindikatoren für die Industrie, 10/1983.

VI. Summary of Part A (Textile Industries)

1. In the textile industries most of the technological changes of the past consisted of improvements of the conventional production methods. Besides these improvements completely new technologies were developed. During coming years changes in textile technology will lead to further automation and flexibilization. It must be emphasized, however, that leaps or shifts in textile technology are not likely in coming years.

2. The employment structure in the textile industry is characterized by a relatively large share of low-skilled (specially female) workers. In recent years, however, the share of skilled labour in total employment of the textile industry has risen.

3. There exist numerous barriers concerning the spread of new technologies, like the availability of capital and of skilled labour and management. Industrialized countries are better endowed with these resources than developing countries. Nevertheless, in the past these countries frequently modernized their stock for equipment faster than the industrialized countries.

4. In past years the textile industry has evolved into a capital-intensive industry. The rising share of capital costs reduces the price competitiveness of the less developed countries compared to the industrialized countries.

5. New processes and further automation in textile manufacturing will lead to the loss of many manual jobs, i.e. to a reduction in labour input. Regarding the qualitative impact on future technological progress, there is agreement that the demand for unskilled labour, i.e. for female labour, will decline and that for highly skilled labour will rise. If one tries to balance the individual occupational characteristics with respect to their future skill requirements, then "operating" (which is done mainly by female workers), will become simpler, "monitoring" and "repairing" will become more difficult.

6. Past trends in the distribution of world production of textiles and clothing are likely to continue in coming years. This means that the developing countries will further increase their production shares.

B. Clothing Industries

I. Technological Developments and Characteristics of Employment

I.1. The State of Technology, Skills and Innovations

Clothing, like toys, electronics, electrical machinery, and precision instruments, is a typical women's industry. In these industries women are highly valued especially for assembly work. Great dexterity and the willingness to do assigned work even with a good prior education and at low wages make women desirable workers in labour-intensive production. Many industries mechanized these jobs step by step through rationalization, automation, the use of robots, CIM, etc. Thus in the automobile industry there are hardly any of the onerous women's jobs left in the manufacture of small parts. The arrival of robots in the equipping of conducting plates in the electronics industry on the one hand displaced women in these departments and on the other hand fundamentally changed the remaining jobs. Here the change in the jobs occurred through the coincidence of technological progress and automation-adjusted norms.

To be honest, regarding job quality, technological developments in many branches of the manufacturing industry ran counter to the goal of creating high-skilled women's jobs.

The fear is therefore not unfounded that women's jobs in the clothing industry could follow the general trend of technological progress and be replaced by new technical equipment and men's jobs requiring different skills. There are reasons, however, why women's work has retained its importance in the industries mentioned and in particular in the clothing industry.

The major reason is likely to be that important areas of the clothing production process do not lead themselves to thorough automation. That is why clothing production has remained labour intensive. This is a fact which equally applies to developing, newly industrializing, and industrialized countries. There are effective barriers to innovation which conserve the low capital/labour ratio:[1]

First there is the material which has resisted the many attempts of automatically putting together the individual parts of a garment or new assembly processes as a prerequisite of automation. Sewing with needle and thread at a sewing machine and guiding the cloth pieces with a skillful women's hand is today's dominant assembly technique and will remain so in the medium and long term.

The second barrier to innovation is the division of labour between the branches. In the development of the textile and clothing industry, the textile branch has always been able to achieve higher advances in automation than the clothing branch (see part A).

The third barrier to innovation consists of the characteristics and intensity of research and development. As a

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[1] See U. Adler, M. Breitenacher, Bekleidungsgewerbe, Strukturwandlungen und Entwicklungsperspektiven, in: Ifo - Struktur und Wachstum, 37, Berlin/München 1984, pp. 98 ff. The capital intensity in the clothing industry is only 1/3 of that of manufacturing industry even in industrialized countries (table 8).

rule, the clothing industry itself has only a low intensity of R&D. It concerns the adaptation of existing systems to plant requirements. Compared to the industrialized countries, newly industrializing and developing countries often contribute more to common research, because these countries consider this branch so important to the development of their manufacturing industry that research, consulting, and support are ranked much higher.

World-wide, clothing producers depend on the acquisition of innovations without being able to contribute much R&D input themselves. This is also the reason for their close co-operation with the machinery producers in solving technical problems. The producers of sewing and clothing machines have adapted to their clients accordingly. They are able to respond flexibly to individual demands for special and specialized machinery. This is relatively easy as basic machines of a certain technological standard may simply be adjusted to special requirements. Specialized machines and semi-automated equipment frequently only differ from basic machines by feeders, positioners, stackers or certain devices. This kind of innovation, aimed at reducing the cost of a single work station, usually suffices to meet the demands posed by a clothing manufacturer on the machinery producer. The innovation delivered is made to order. In principle, the machinery industry and the producers of data processing equipment as well as consultants, researchers, institutes, etc. could supply more innovation transfer to the clothing industry if it were required. That this requirement does not exist is due to a global problem.

At today's state of the art it is easier and also cheaper to relocate production to or establish new production facilities

in low-wage countries than to compensate relatively higher wages by more capital-intensive technology. It is easier to find cheaper labour markets for an existing technology than to develop a technology which suits the high wages. The fact that entry into the clothing industry is simple because of low fixed investment and low skill requirements, makes the tendency of relocating production in low-wage countries more attractive. It is, however, also responsible - from a global point of view -for the fifth barrier to innovation on this list.

The sixth barrier to innovation lies in the concept of organization. Clothing production is a prime example of Taylor's concept of organization. This concept makes labour cost the decisive variable cost element. For lack of other approaches, this industry focuses entirely on minimizing labour costs. The work process, especially that of assembly, is broken down into individual, easy steps. This organization is the prerequisite for hiring unskilled and on-the-job trained workers. The clothing industry is forced to rely on corresponding labour markets, as it can only pay low wages and must therefore do with low-skilled labour[1]. The stepwise organization has the advantage that jobs may be filled at low cost and that short training suffice when jobs are changed. The entire innovation in machinery is geared to this overall concept. The co-operation described above between the producers of clothing machinery and the users is directed at optimizing individual work processes or consecutive work steps. Furthermore, at fixed investment of about $ 5000 per job[2], it is not difficult to prove that it is cheaper to purchase an additional special machine that needs lower qualification

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[1] For human capital situation see tables 4 and 5

[2] This menas investments for one workstation. The investments per capita for a new plant of usual technolgoy is about 80.000 to 120.000 $.

than to invest in training and to cope with downtimes and set up at a universal machine. There is therefore an intrinsic (cost-based) logic, not only in terms of the cost of skills, but also in terms of the input of machinery, which conserves existing concepts of work organization at a certain level of technology and skills.
The last innovation barrier consists in the fact that low skill also means apprehension of using new technology, i.e. low acceptance of technological innovation produces an unfavourable climate for innovation. Skills and the acquisition of skills are - at least concerning production in the narrow sense - entirely directed at individual piecework with high output and at learning for oneself. Details on skill requirements and their change will be discussed below.

The barriers to innovation described above are barriers from the point of view of the industrialized countries. From their point of view clothing technology is considered a "mature" technology in the sense that its advances no longer keep up with changes in the level of wages. Since the wage level is the decisive determinant of economic efficiency, the barriers characterizing the state of innovation in clothing technology are precisely the opportunities for producers in lower-wage countries. For these producers the interrelationships described generate exactly the technology which fits their relative factor costs. This is to say that clothing technology, although supplied by the industrialized countries, best meets the requirements of the developing and newly industrializing countries. The assessment of the importance of women in the production of clothing is, however, hardly different from that in industrialized countries.

I.2 Technological Development and Markets

The major conclusion emerging from the last chapter was that effective barriers to innovation preclude capital-intensive, i.e. automated production of clothing. Although there are some areas in the production process which are more highly automated, assembly is very labour intensive and will remain so, as the barriers to innovation are very stable. In this context women's work means cheap labour at a low skill level, necessary to offset the high labour intensity in total cost. The clothing industry world-wide relies on low-wage labour markets, which are as a rule supplied by women who are supplementing their own[1] or their families'[2] incomes. In order to predict changes in this basic situation, the probability and direction of change in production must be determined. Here account must be taken of the fact that there is no uniform state of production technology, although the basic characteristics of women's work are quite similar.

Technology and its change depends on the one hand on the markets at which production is aimed and on the other on the labour markets. Existing clothing technology is optimally suited to the factor costs in newly industrializing and developing countries. They have the comparative advantage of low labour costs. The latest results of the MFA[3] demonstrate the economic performance achieved and achievable by newly industrializing and developing countries with comparatively

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[1] Cf. W. Friedrich et.al.,Technik und Frauenarbeitsplätze, Ifo Institute for Economic Research, Munich/ISG, Cologne 1983, pp. 69 ff.

[2] Cf. UNIDO,ICIS 165, Women in the Redeployment of Manufacturing Industry to Developing Countries, Vienna 1980, pp. 20 ff.

[3] K. Neuendörfer: Das Vierte Welttextilabkommen, in: Schriften zur Textilpolitik nr. 4, 1986.

simple clothing technology. It must be mentioned here that protectionistic tendencies[1] in world trade in clothing importantly affect the development of markets and thus also the level of technology.

Application of new technology is above all a question of cost. In principle low wages render the input of productive technologies redundant. There are exceptions, however. In a first approximation, one may speak of two markets segments which make different demands on the application of technology (table 21).

The first market segment is the high price-quality segment. Producers supplying this market must meet similar standards of high quality, high productivity, and client satisfaction, necessitating the application of the latest technology. In order to produce for this market, prducers in industrialized countries and those in newly industrializing and developing countries alike must have the highest possible technological standard at their disposal. It is a specialcharacteristic of the clothing technology that the ability to reproduce quality depends much more on highly refined technology than on skilled labour. The technological level of production of high price-quality garments is therefore not directly related to the level of wages. This phenomenon, first described by Samuelson, is confirmed by the clothing firms in the big four major exporting countries[2] of South East Asia, the production regions of the Third World, and the large enterprises of the Comecon. These firms have considerable comparative advantages, not only because of the qualtity aspect, based on a higher degreee of automation than required by the level of wages.

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[1] Studies have found that the world clothing market, together with steel and agriculture, belongs to those markets with the greatest reglementation of trade.

[2] Singapore, Hong Kong, Taiwan, South Korea.

Table 21:

State of the art of technology in the clothing industries in relation to different types of product marktes

Labourmarket / Productmarket	Industrialized countries	Newly-industrialized countries	Developing countries
Production for high - price quality segments	Similar, upper-level technology, that corresponds to factor-cost of countries, which are below the standard of industrialized countries. Technology depends on a world-standard of clothing products.		
Production for lower priced segments	Level of technology corresponds to the factor-cost and the relation of these.		
Strategy on the markets	Rest-market with issues of fashion, quality and just in time production.	Increasing capabiltiy for innovation both in product and production-technology.	Development of industries, subcontracting, joint ventures.
Particularities	Innovation - handicaps conserve low technique. No automation that fits to the factor cost	Low level productivity but low wages Partly own R+D and computer industry	Growing participation in the world-market of clothing.
	Chances of informations technolgy		

Source: Ifo-Institute for Economic Research,Munich,

The second market segment is that of middle and lower-priced supply with competition at a similar level of demand. Lower demands on the product permit a lower state of technology. Producers supplying this market segment adjust their production technology to their labour costs (Heckscher-Ohlings theory) with the goal of lowering their production costs by saving capital when wages are relatively low. The competitiveness of the so-called low-wage countries lies exactly in this area, based on their ability to produce the same product a bit cheaper.

For producers of middle and lower-priced products the application of new technologies does not depend on what is technologically feasible, but rather on what is "economical". For these producers the innovation problem outlined earlier does not exist. It is primarily a problem of the industrialized countries, for which there exists no degree of automation which could offset their relatively high labour costs. This means that for most suppliers from low-wage countries to the lower-priced market segment the clothing technology offered suffices to make them competitive on domestic and international markets. In addition, concerning the state of production technology, account must be taken of the fact that there are large markets which are not subject to direct international competition at all. Thus the giant markets of China and India, but also of the Soviet Union or Brazil are not import markets, but domestic markets with outstanding growth rates. These markets may be developed well, either by free-market or planning strategies, with a comparatively low level of technology and traditional forms of organization.

The problem markets and problem locations are those of the industrializied countries. They are subject to a thorough change in international competition, and nobody knows how to meet this structural change or what the final outcome may be.

On the markets of the industrialized countries those producers have an advantage who are able to supply at low prices. They include less and less the producers from the industrialized countries themselves.

The clothing producers[1] in the industrialized countries therefore try to offset their disadvantage in price competitiveness by rationalization, by redeploying production to the low-wage countries as well as by offering new lines of products. By offering fashionable trade-mark and high-quality products they try to appeal to a customer segment which is also willing to pay higher prices. For this kind of supply export opportunities are also better, as there is a small group of high-income consumers everywhere in the world. Overall, the firms carry a product mix, which aside from their own production and supplementary purchases of merchandise must also include a large proportion of imports in order to keep prices down by cost-mixing.

For domestic manufacturing in industrialized countries which also have a high import share (United States, FR Germany, France, Italy, United Kingdom) this does not only cause production problems which are also cost problems, but also repercussions on women's work and its payment.

If production is aimed at markets with a higher-income, but also very choosy clientele, then order lots decline, the multitude of fabrics and models increases, production time per product falls, the risks of a collection rise, and pro-

[1] cf e.g. Fresse, G., Der Modemacher aus Wattenscheid, in: Die Zeit Nr. 2, 1987, S. 23 and Kruse, F.H., Eine japanische Herausforderung?, in der Bekleidungstechnologie hat die Massenproduktion an Glanz verloren, in Bekleidung und Wäsche 24/1984, S. 1270 ff.

duction runs become shorter. Firms producing for this "marginal" market are subject to growing pressures and must face the problem of rising flexibility-related costs of changing products and production. In detail these are costs for:

- Order processing and filling,
- product development,
- production preparation
- management
- training/retraining, further education
- quality control
- inventory/fashion risks, etc.

Many firms find out too late that product innovations in clothing can never bring a competitive advantage which cannot be reproduced by their competitors. Fashion novelties may not be patented either. This experience applies to all producers in the high price/high quality/brand name market-segment. The demand for technology coming from these producers concerns productive and more flexible work stations and aims at lower-cost presentation of information of a flexible clothing firm (cf. chapter B.II). New impulses may be expected from here.

With respect to the characteristics of labour and skills, growing demands on the firms have also given rise to growing quantitative and qualitative demands on the performance of labour, without the chance for adequate payment (chapter B.V).

Even though the industrialized countries are considered high-wage countries, because wages are frequently twice to four times those in newly industrializing or developing countries, the wage level in the clothing industries is heavily influenced (in a downward direction) by international competition (cf. chapter B.IV). This means that the wages in the industrialized countries have been falling behind the growing demands on the capabilities of labour. This is a plausible trend. Given international competition and the international division of labour, it must be assumed that with an increasing capacity to innovate the capabilities of labour will also increase in the newly industrializing and developing countries. In the medium term the remaining gaps will close.

Regarding the importance of production[1] in the industrialized countries, export growth could be achieved in some middle to high priced segments. The share in total, world production and total world trade declines (cf tables 19/20). But the decline in employment could not be halted (Table 22). The job risks in the clothing industries of the industrialized countries remain high. Winners in the world-wide structural shifts and beneficiaries of the demand stimuli in the clothing sector are unambiguously the newly industrializing and developing countries (Table 23/24). They exprience growth. One must be aware of the fact that today's situation in world clothing production is characterized by an innovation momentum which will let the developing countries approach the performance of the industrialized countries and by growing protection of production in the industrialized countries which must not be underestimated. Compared to the goal of the developing and newly industrializing countries of

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[1] The entire complex of the international division of labour has been described by Fröbel, F, a.o. Die neue internationale Arbeitsteilung, Hamburg 1977 and Fröbel, F. a.o. Umbruch in der Weltwirtschaft, Hamburg 1986.

Table 22: The Employment of important Countries of the E E C in the Textile an Clothing Industries

(Figures in thousand of employed Persons)

Country \ Year	1979	1980	1981	1982	1983	1984	1985	annual percentage growth
Germany F.R.	749	737	687	630	581	568	560	- 5.0 %
Italy	1094	1086	1068	1060	1035	1014	1000	- 1.5 %
France	657	645	600	582	563	538	517	- 4.1 %
Netherlands	64	60	52	46	42	40	39	- 8.6 %
Belgium/Luxem.	116	111	103	98	97	98	98	- 2.9 %
Un.Kingdom	839	777	656	606	560	550	540	- 7.6 %
Denmark	40	37	36	37	37	39	41	± 0.0 %
Spain	445	426	386	372	362	349	341	- 5.6 %
Portugal	305	310	311	315	311	306	304[&)]	± 0.0 %
A l l countries	4309	4189	3869	3746	3558	3502	3440	- 3.8 %

Source : Chronos Data , OECD ,Paris .&) Employment of Portugal has been estimated according employment data for 1982-1985 from Statistisches Bundesamt Wiesbaden Statistik des Auslandes ,Länderbericht Portugal 1987,page 47.

Table 23:

Index Numbers of World Industrial Production
1980 = 100

Region/Branch \ Year	1973	1974	1975	1976	1977	1978	1979	1901	1982	1983	1984	Annual Growth rate 72-84	Percentage weight (1980)
World[a]													
Manufacturing	80	83	79	86	90	95	100	100	98	102	108	+ 3,3	78,3
thereof: light manufacturing	83	85	83	90	93	96	100	100	100	103	107	+ 2,6	28,3
thereof: Textiles	91	91	88	95	95	97	100	99	97	99	101	+ 1,4	4,4
Clothing[1]	86	87	89	94	96	98	101	100	98	99	102	+ 1,7	3,4
Developed marked economies[b]													
Manufacturing	89	90	82	90	93	97	101	100	96	98	105	+ 2,1	83,2
thereof: light manufacturing	92	91	86	93	96	98	102	99	97	100	104	+ 1,3	26,9
thereof: Textiles	104	99	92	101	99	98	102	97	93	95	96	- 0,3	3,3[e]
Clothing[1]	102	100	98	105	105	104	105	97	94	94	95	- 0,5	2,8[f]
Developing marked economies[c]													
Manufacturing	68	71	73	78	85	90	96	102	103	107	116	+ 5,7	49,6
thereof: light manufacturing	73	75	77	83	86	97	97	103	105	110	117	+ 4,6	24,5
thereof: Textiles	84	86	87	93	93	96	98	101	101	105	107	+ 2,6	5,0
Clothing[1]	75	81	83	90	89	93	96	105	104	107	115	+ 4,5	2,7
Centrally planned economies[d]													
Manufacturing	64	71	76	82	87	93	96	102	105	110	115	+ 5,7	88,2
thereof: light manufacturing	73	78	83	87	91	95	97	100	102	106	109	+ 4,0	36,8
thereof: Textiles	76	80	85	89	93	97	98	101	100	102	103	+ 3,2	7,7
Clothing[1]	70	75	80	85	88	92	95	102	103	105	108	+ 4,1	5,4

1) Clothing, Leather, Footwear

a) all countries (excluding Albania, China, Democratic People's Republic of Korea and Vietnam).
b) North America, Europe (excluding centrally planned economies and Yougoslavia), Australia, Israel, Japan, New Zealand and South Africa.
c) Carribean, Central and South America, Africa (other than South Africa, Asian Middle East and East and South-East Asia other than Israel and Japan) and Yougoslavia.
d) Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania and the USSR.
e) - 0,9/3,7.
f) - 1,5/3,7.

Source: United Nations, Industrial Statistics Yearbook 1984, pages 617 f.

Table 24:

Index Numbers of Industrial Employment
1980 = 100

Region/Branch \ Year	1973	1974	1975	1976	1977	1978	1979	1981	1982	1983	1984	Annual Growth rate 72-84	Percentage weight (1980)
World[a)]													
Manufacturing	91	92	92	95	96	98	100	99	98	98	...	1,0	92,5
thereof: light manufacturing	88	90	91	94	97	98	100	99	99	100	...	1,4	46,2
thereof: Textiles	98	101	100	100	100	102	101	96	95	95	...	0,0	9,9
Clothing[1]	82	83	87	96	98	100	102	100	100	100	...	2,2	8,9
Developed marked economies[b)]													
Manufacturing	105	104	100	100	101	101	102	97	93	92	93	- 0,8	93,2
thereof: light manufacturing	108	106	102	102	102	102	102	96	92	93	93	- 1,2	38,2
thereof: Textiles	129	122	116	114	110	107	104	92	86	88	87	- 3,2	6,4
Clothing[1]	114	110	106	107	105	104	103	96	91	90	89	- 1,8	6,4
Developing marked economies[c]													
Manufacturing	73	77	81	88	92	95	98	100	103	103	...	3,7	92,6
thereof: light manufacturing	72	76	80	88	92	95	98	100	103	104	...	3,9	64,0
thereof: Textiles	84	92	93	93	95	99	100	96	99	98	...	1,8	15,8
Clothing[1]	55	69	70	71	72	98	102	103	105	105	...	5,1	12,1
Centrally planned economies[d)]													
Manufacturing	90	92	94	95	97	98	99	101	101	100	101	1,1	91,2
thereof: light manufacturing	94	96	97	98	100	100	100	101	100	100	100	0,6	34,1
thereof: Textiles	98	99	99	100	100	100	100	100	98	97	96	- 0,1	7,4
Clothing[1]	94	95	96	97	98	99	99	101	100	100	100	0,6	8,3

1) Clothing, Leather, Footwear

a) all countries (excluding Albania, China, Democratic People's Republic of Korea and Vietnam).
b) North America, Europe (excluding centrally planned economies and Yougoslavia), Australia, Israel, Japan, New Zealand and South Africa.
c) Carribean, Central and South America, Africa (other than South Africa, Asian Middle East and East and South-East Asia other than Israel and Japan) and Yougoslavia.
d) Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania and the USSR.
e) - 0,9/3,7.
f) - 1,5/3,7.

Source: United Nations, Industrial Statistics Yearbook 1984, pages 617 f.

becoming more competitive with tried means and processes, the industrialized countries face the much more difficult task of achieving competitive advantages at the upper end of the innovation scale and with clear problems of innovation. MFA IV grants another reprieve, which may be used by the industrialized countries to adjust to a new distribution of weights in world clothing production. Everything else remaining equal, the developing and newly inustrializing countries will continue to enjoy an advantage in international competitiveness in the medium term (to 1995). In these countries the clothing industry will play an important part in the take-off into industrialization and economic development. Since the clothing industry belongs to the "pioneer" industries, the world clothing market is by no means sewn up. Whoever can offer labour at lower wages always has the chance of becoming a producer of his own line of merchandise or a subcontractor for other producers. In recent years employment in world clothing production has stagnated. The decline in employment in the industrialized countries was offset by rising employment in the non-industrialized countries. There has thus been a shift in employment in favour of the developing countries, induced by cheaper labour there.

For the time being, these countries are still occupied with the creation of industrial jobs. Seen against the background of innovative competition, a structural change in women's work is occurring at the same time, from the monotonous, underpaid, primitive work at the simplest machines without the benefits of a social net of any kind, toward the working conditions in the industrialized countries at a higher, though limited level of technology.

Women's work in world clothing production takes place between these two extremes, depending on the market and level of production costs of the individual producer. The range of technological innovation encompasses no discrete jumps, but a building kit with many single technologies which fit all

the others. This means that each producer may introduce the technological innovations step by step into the production process wherever they promise success.

In the following analysis of the state of technology account must be taken of the fact that the application of these technologies always depends on their costs. There is no particular technology for developing countries or newly industrializing countries, but only the tendencies just described.

II. Stages and Functions of Production-process affected by innovation and resistance to innovation.

A technological innovation, if realizable, will be successful for two reasons:

1) Producers need this innovation for technical reasons (e.g. quality).

2) The technological innovation pays for reasons of cost.

It is reasonable to analyze the production process with respect to its technical conditions and its technical possibilities[1], in order to derive the bases for changes in jobs and skills. The process of clothing production may be broken down into the following steps:

- Design
- pattern production
- cutting and nesting
- work preparation
- assembly (incl. preliminary assembly and final assembly)
- ironing
- stocking, transportation
- administration
- sales distribution

Design/product construction/pattern production

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[1] A good survey about this topic gives: G: Lütgering, Die Bekleidungsindustrie: Produktionsstrukturen und Fertigungstechnologien und ihre Auswirkungen auf Qalifikationsanforderung, Arbeitsbedingungen und Beschäftigung, Bielefeld, 1984.

The design forms the connection between firm and market. It is the responsibility of this department to design the clothes, to produce the clothes patterns, to construct models, i.e. prototypes, to develop lay-outs for production, and to prepare collections.
As a rule, this is high-skilled women's work. The characteristics of the jobs depend heavily on the company's functions. The tasks in this department range from copying and modifying existing designs to generating a permanent product innovation within the ongoing process of creating high-fashion collections.

Roughly speaking, the clothing manufacturers of the industrialized countries are rather sales oriented. They therefore depend on an efficient development department, which - regarding product innovation - must always be a step ahead.

The manufacturers in developing and newly industrializing countries are rather production oriented. They have (until now) not entered a new product sector or joined a new trend until it has proved profitable. In the area of standardized merchandise, forms or models can run comparatively long without requiring product development. Here design departments do not face a creative challege.

The same applies to wage processors or other sub-contractors, who must produce clothes from a set collection.

The development of clothing products is often erroneously equated to model design. Pure model design frequently involves less than 5 % of development time. The main task consists on the one hand in making a product idea presentable to the customers as fast as possible (fairs) and on the other hand in introducing customer wishes into the product idea, to produce initial series for sale, and to prepare the product

for manufacturing (patterns, stencils). In companies which design their own collections, product ideas are transformed into prototypes, from which the collection to be produced for sale is selected at trade fairs. For this collection, patterns and stencils are then produced for manufacturing. The patterns are graded and thereby varied for all standard sizes. The aim of creating lay pictures is to lay out the individual cuts of a garment in such a way as to keep fabric waste as small as possible. The major task of the design and pattern department is therefore not so much to create a product idea, but to pick out and discard unusable product ideas in order to translate the chosen product idea into technical production.

Only very large (brand-name) companies have their own stylists who cooperate with technicians in order to translate their ideas into construction. The skill required in the area model-design/pattern-creation is therefore always a compromise between the gift for design and technical manufacturing know-how, with the latter clearly dominating.

At this point a special characteristic of the manufacturing process must be pointed out. Important work in preparing and controlling production is done in functional areas of the firm which precede the assembly stage. That is why the probability of making or avoiding mistakes which then become effective in production is the highest here. The responsibility of these jobs is correspondingly high. Work in the area model-design/pattern-creation may in principle be done - after some reasonable vocational - with pencil, paper, cardboard, compasses and ruler as well as with needle, thread and scissors, given sufficient productivity. This technical level may suffice for the production of staples or standardized clothing, where little product change is required. Often the work requires only small changes in patterns, stencils and lay pictures, which sometimes may be done "free hand" even in

highly technical firms. As a rule, designing of clothing is done by hand only. There are first attempts at designing clothes at the computer screen, but they have not yet proven themselves.[1]

Computerization in the design/patterning area makes only sense if at the same time worksteps can be shortened, duplicate work avoided, learning processes introduced, preparatory work done, and manufacturing materials provided fast. At today's state of the art, it is still customary to arrive at a three-dimensional piece of clothing via a two-dimensional design. Automation begins in the digitizing of the initial steps of a model. In order to produce a model, a set of cuts of all individual parts is produced in a standard size. The pattern is stored with a digitizer. This technology has the advantage of saving time and material in the work that follows. This consists of:

- the creation of patterns,
- the duplication of patterns, or
- the construction of pattern stencils.

At present this area may be considered an isle of automation.[2] The new technique is replacing more and more old processes, which required that the grading of patterns and the creation

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[1] Some efforts in this direction did the Tattori F-ONE company, cf. G.d. Coletta, Water jet und dreidimensionale Konstruktuion, eine Tatsache bei Tattori F-ONE in: Technica della confectione e della magleria, 123/1984.

[2] For industrialized countries see: W. Baumgarten, J. Lemke, Neue Zuschneidetechnolgien in der Bekleidungsindustrie, VDI-Verlag, 1986.

of lay-outs be done by hand. In the traditional procedure the lay-outs are copied for the cutting process. Computer-assisted digitizing, grading and plotting of lay-outs are compatible with this procedure. A combination with automatic cutting and the option of connecting up with (still to be created) systems of three-dimensional construction is possible. Progress in integrating computer-aided procedures into a uniform concept of automation is technically feasible. How this development will accelerate is primarily a question of software. Increasing flexibility requirements and rising quality standards virtually demand such systems. The trend to more fashion, a greater variety of materials or quite generally to differentiation of supply places too much pressure on design and pattern departments. The ratio of prototypes produced to models sold is becoming more and more unfavourable. The possibility of doing preparatory work for a collection is limited by the multitude of products. Development efforts which go into one product cannot be transferred to another. This creates double work and stress at rising expenditures for product development.

The new technology in the creative area deals not only with designing itself, but at the same time with the following aspects:

1. the design and
2. changing the design,
3. the creation of patterns and
4. the creation of variations and changes of patterns,
5. the production of stencils and
6. changing the stencils,
7. the ability to do preparatory work, in order to facilitate later variations and changes,
8. the ability to create building blocks, a data bank of problem solutions,
9. the possibility of feedback in order to better meet the technical requirements already at the designing stage,
10. the creation of manufacturing materials like basic data, output lists, coupons, etc., and
11. the consideration of quality norms.

Barriers to the introduction of new technology are erected by the increasing variety of fabrics. Creating cut-outs for patterned quality fabrics is one example of an unsolved automation problem. Automation of cutting lay-outs presents no technical problem, however, in the case of plain fabrics or standard products. There will be considerable demand for computer-aided design, if it does not only permit drawing, but also the derivation of patterns from three-dimensional pictures, and the interfacing with production. A great advantage would be the evaluation of a collection at the screen. The area design/patterning belongs to the functional areas of the firm which are information-intensive. This makes the progressive application of electronics highly probable.

Cutting

The next step in the production process is cutting. Here fabrics are cut for assembly according to the patterns. Disregardng the fact that there is still some hand work in cutting (e.g. for single parts and models), nowadays the standard equipment of cutting comprises the following:

- Laying table and laying carriage for the laying out of the lengths oc fabric,
- Trevet for rough cutting, and
- Rotation hoop knive for fine cutting.

The patterns are either transfixed to the lengths of fabric as lay pictures or placed on the fabric as stencils in the form of single parts. Besides that, for very large volumes of output presses are used, especially for cutting out small parts and interlining. Wnen there is little automation, laying the lengths of fabric onto the cutting table is compara-

tively heavy bodily work which also includes putting on the patterns. The occupation requires knowledge of how to optimize the layers and how to place the patterns in order to minimize waste. With greater fashion orientiation the skill requirements grow, but so do the problems of automation. Thus for cutting the pattern so-called pin-tables must be used which prevent the fabric from moving during the cutting process. For this work primarily specialized male workers are required who, as a rule, are also paid at the highest wage rate. The cutting and the clearing of the lay-tables is done by women.

Automation of the cutting process concerns the technical problem of manipulating the bolts of fabric and laying the lengths of fabric on the cutting table. New laying systems already perform the automatic optimizing of lays. These technologies don't have the objective of reducing the skill requirements of cutting, but rather to adapt the capabilities. Cutting, like modelling, is that area in clothing production, which requires team work. Automation has the objective of compensating growing qualitative demands on work at increasing productivity expectations. Technological change in cutting is generally directed at increasing the capital intensity. Automatic cutting systems[1] confirm this trend. These systems replace the rough and fine cutting processes as well as the work with lay pictures and stencils. The systems are based on digitized lay pictures. They cut the stored lay pictures directly with a computer-controlled cutting head on the cutting table. There are three kinds of processes:

1. Mechanical with knives,
2. waterjet-cutter,
3. laser-cutter.

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[1] This Technology comes from the USA. Today there are developments even in newly industrilizing countries (Taiwan).

These systems thoroughly revolutionize cutting work. Their application is, however, not yet wide-spread, although these systems have existed for fifteen years. The reasons are technical, cost-related, and based on the performance of the systems, which have been restricted to cutting of unproblematic wares (great lay height, plain fabrics, firm materials, lining, interlining, small parts). With the new cutting technology the job description of the cutter would change. Today this occupation still generally requires craftsman training. The future job description will be closely geared to information technology. It remains an open question whether technological progress will turn the rather simple women's jobs into computer-related specialized jobs or whether these jobs will slowly be replaced.

Cutting is followed by nesting, where the cut parts are prepared for production, i.e.

- fitted with interlining
- sorted
- numbered, and
- arranged into manufacturing orders (serials).

This area is automated to a certain degree. Attaching the interlining to the fabric is generally done automatically. The newest processes for hot application work with micro-wave technology. Manual work is limited to placing the interlining on the fabric.

Numbering the parts has the purpose of marking all the parts belonging to one garment. This work is done semi-automatically, and this will remain so in the future. Rationalization will promote the use of bar codes or magnetic codes in the numbering process. Here the state of information technology

will be raised in such a way that information may later be processed further at various technological levels.

This completes the description of the preparatory functional areas dealing with the treatment of the fabric. Another area preceding production is work preparation.

Work preparation

The task of work preparation in a clothing firm falls into the purview of manufacturing planning. Manufacturing control is the responsibility of the lower management in the assembly. Manufacturing planning focuses on: Time studies for assembly jobs, keeping time data sheets, developing time plans and pay coupons. Skill requirements are high throughout. As a rule, these jobs are filled with technicians, who bear a high level of responsibility. They must deal with the problems of performance and renumeration, which belong to the most sensitive areas of a clothing enterprise.

There are various procedures for preparing work. Depending on the product being manufactured, and on whether or not is being produced by piece work, the whole range of manufacturing planning may be covered in simplified form in clothing manufacture. Technically this work is still done at a very low level of technology with slips of paper, tables, stop watches, lists and files. New approaches using computers do exist for the same reasons which necessitate the introduction of computers in other information-intensive departments. In industrialized countries it is the accelerating pace and the lack of time which necessitate faster production planning with reliable data. Classical systems of ananlyzing production times are frequently so cumbersome that the product is already manufactured before the data become available. In

developing countries low wages have not yet led to the use of very differentiated time-analysis systems. For these countries production-time systems are equally important in terms of being able to plan production and to fulfill cooperation agreements. Computer-aided time studies, multimoment studies, predetermined time systems, motion time measurement, time data banks, automatically produced work plans, the printing of wage coupons, automatically produced process plans, production simulation, etc. not only become possible with the help of the computer but also affordable. The chance is growing to organize the firm along scientific lines at a reasonable cost. The software packages offered today in this area run on IBM-compatible personal computers, but still have the character of special solutions for a given firm or branch of industry. Integration of the tasks and standardization of the software packages are inevitable, however. Together with decreasing costs there is a high probability that these systems will become the state of the art world-wide. Micro-electronics offers an opportunity to developing countries in particular to solve problems in a new way, as work preparation, for example, can still be very archaic. Thus it may still be limited to a top work station, which is occupied by a particularly skilled and fast seamstress. This worker has the task to "test sew" the products in order to establish planning times and standard times, against which the productivity of each individual seamstress is measured.

As will be shown below, the area of production planning and production control is most important for the computerization of manufacturing in firms in industrialized countries, which may be considered "pioneering firms" in the sense of Schumpeter. This area is decisive for the economic preparation of the production process. That is why it is the objective of new technologies in this area of women's work to foster occupational competence.

The area which follows is the most important one in clothing production: assembly. Here the cut parts are sewn together according to the guidelines established by work preparation.

Assembly

With respect to women's work, assembly is of interest in two ways. Firstly, this area comprises about 80 % of all jobs in a clothing firm. Secondly, it is exclusively a women's area. But it is also that part of production which is subject to the greatest innovation problems.

The work of assembling a garment is broken down in an almost ideally Taylorian kind of division of labour. The goal is to arrive at the fastest possible sewing activity. The division of labour is determined by the kind and number of seams to be sewn. The degree of specialization of labour depends on the product and the size of the production run. Standard products like jeans, trousers, suits, work clothes, work coats, etc. permit very specialized production (mass production). They also have very large order series. Fashion products like women's wear or casual wear require flexible equipment and variable forms of organization. For this reason there is also a higher degree of automation in mass production than in flexible production (large units with a more differentiated and specialized manufacturing organization, e.g. men's ready-to-wear clothes or jeans). A higher degree of automation does not imply a basically different sewing technology. At the core we are always dealing with sewing at a sewing machine as the only assembly technique, with the exception of some sub-areas. Automation has the task of supplementing or replacing the human hand in guiding the sewing product, a task which is, however, only feasible within limits.

As a rule, automation begins with individual work processes and tries in each case to reduce labour intensity. Due to technology this goal is only achievable by progressively simplifying the work and shortening the gripping times. The automation of work steps means specializing the sewing machines by adding guiding, holding, leading, and stacking devices. Since automation always occurs at the cost of the volume of work done at a machine, work at these machines increasingly becomes residual work limited to putting in the goods. The objective is to divide the work into (putting-in) time which is influenceable and machine time which is not. If machine time is greater than putting-in time by a factor nx, then overlapping work can be performed at n machines. This significantly raises the productivity of labour.

Work steps which are automated in this way (full cycle automation) may be combined into an automated work sequence (sequential automation). Sequential automation is used primarily for certain, frequently occurring work steps in the production process.

Fully-cycle-automation and sequential automation has its major application in typical normed work or in work which hardly changes or is very similar. Examples are collars, cuffs, pockets, belt loops, trouser seams.

With greater flexibility in production, the probability declines of economically applying this rigid form of automation. These sub-aggregates, which pay when high wages may be saved, are unprofitable at low wages.

In industrialized countries, therefore, the state of technology is stabilizing below the the threshold of automating work steps and work sequences. The situation of the industrialized countries may be exemplified later by the case of the Federal Republic of Germany (Chapter B.IV).

The latest developments in sewing technology move along three paths.[1]

1. Development of additional automated specialized equipment, e.g. also for very difficult tasks like sewing in sleeves.

2. Flexibilization of traditional rigid automation. This has been done by crank-controlled sewing machines (pockets, cuffs), which also have exchangeable sewing devices. The trend is unambiguously toward CNC- machines covering a certain manufacturing range. These systems are equipped with simply exchangeable devices and are controlled by eproms.

3. Flexibilization of sewing machines. Micro-electronics makes it possible to combine the manufacturing range of a universal machine with the productivity of a specialized machine or a semi-automated machine.

The development of sewing technology has the following objectives:

- Securing the manufacturing quality,
- improving the wokability and maintenance,
- increasing the flexibility of the machines,
- reducing the set up times,
- reducing the non productive times.

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[1] Cf. W. Herrmann, Nähsysteme, Technologie und Umwelt, in: Bekleidung und Wäsche 13/1985, pp. 25 ff.; as well as P. Moll, Show und Realität, JIAM 1987, in: Bekleidung und Wäsche 18/19/1987.

As indicated before, whenever clothing supply reaches a world-wide clientele a common technological standard prevails, guaranteeing a minimum quality level. This standard is completely independent of relative factor prices. It is an obligatory prerequisite for participating in the international division of labour. The introduction of micro-electronics and sensorics can raise this standard. How does it look in detail ?:

"Conceivable are small improvements in guiding the fabric, in adapting seams to fabrics, in putting together the fabric or in forming seams. Such improvements would not only raise the manufacturing quality, but would also improve the ability to run the machines and execute the work. Today machines are being offered which are equipped with a silently working edge cutter. There are machines which automatically adjust the stroke of the sewing foot to the fabric, adjust the pressure of the sewing foot to the thickness of the fabric, or can regulate the speed of transport according to the speed of sewing. Important for the quality remains the ability to reproduce sewing patterns. This is where all producers have made the transition to programmable machines, either via bord-computers (Pfaff), exchangeable eproms (Kochs-Adler) or seam contour programmes. The objective is to combine this reproductive ability with flexibility. Programming does not only include new functions (aspects of securing quality), but also the ability to recognize mistakes. Stitch count, bar-tacks, needle position, thread cutting, and storable seam programmes have been standard. New are a presettable speed with function assignment, the entering of stitch counts in order to bridge machine signals, slow start at the beginning of a seam, entering and indicating the sewing foot pressure depending on the rpms of the machine, digital indicator of the main transport stitch length, differential transport

settings, indicators of the preset thread tension and thread irregularities, various sewing programmes as well as signal outlets assignable to the sewing programmes".[1]

The very ability to program the machines eliminates the rigidity of the classical specialized machines, the rigidity which had been the bottleneck in using the equipment in line with production requirements. By becoming programmable, a machine combines several functions of a specialized machine, to be chosen among a certain range of options and objectives. This raises flexibility and eliminates the old downtime problem[2] of the clothing industry. These approaches are still limited to the area of partial automation. The concept may, however, spread as soon as the economic advantages of reduced conversion times and downtimes are realized. Whereas this concept permits the fast choice among work processes in the area of partial automation and the fast choice among specialized tasks in the area of specialized machines, another concept goes one step further. With electronics, seam patterns may be superimposed and by integrating them in different ways an entire seam pattern package may be offered.

The development of the intelligence of the new generation of sewing machines is still in its early stages. It will continue with the improvement of a mature technology. Even today this improvement is not limited to electronic intelligence.

Especially the area of attachments, devices, pick-ups, stakkers and positioners as well as other precision peripherals becomes ever more important with the use of intelligent machines. Higher work speeds, quality requirements, frequency

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[1] W. Herrmann, op.cit, p. 25.
[2] U. Adler, Der Stand der Technik in der Bekleidungsindustrie unter dem Aspekt der Arbeitsstrukturierung, in: Ifo-Schnelldienst 29/1979.

of work change can only be handled by the seamstresses with corresponding work aids. It remains to be seen whether the changes in sewing machines introduced by micro-eletronics will simplify sewing work so much that a robot may be used to guide the sewing goods. This would also imply that the work requirements posed by the sewing process would decline sharply which, in turn, would mean that complex work could also be performed by unskilled labour. Research at the University of Siegmaringen[1] (FRG) must continue to be observed.

In addition, cost-saving production, well organized stock-keeping of spare parts, and simple maintenance require that the sewing machines producers construct consistent series, build the machines in modules i.e. in unitized construction, and thereby generally achieve standardization.

From a purely technical point of view, classic full automation of clothing production is conceivable if only one product in one size is produced. Flexibility remains the problem and leads to flexible automation.

In research on the fully automated factory[2], Japanese producers of clothing technology stand out in particular. In Japan MITI has supported these developments for almost ten years. In the clothing industry - more so than in other branches - the factory without people remains a dream of the future. Japanese efforts in this area are more likely to bear fruit in the year 2000 than in the medium term to 1995.

Ironing

The area of ironing permits only limited innovations. Inbetween ironing during assembly, in order to improve on the manufacturing quality, is still largely performed by hand. Automation prevails at those points with a high degree of

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[1] cf. D: Liekweg, Computersteuerung an Universalmaschinen, in, Bekleidungstechnik, Nähtechnik, 10/1986, Zürich.

[2] cf. C.E.T.I.H., Rapport de la Mission Scientifique et Technique Francaise du 2 au 14 Octobre 1982, Lautomatisation des Industries de L´habillement au Japon, Paris 1982.

standardization and a high frequency of repetition. Automatic ironing equipment works according to the rotation principle. With this equipment one garment is being ironed while another is being stretched onto a form. The general state of the art is semi-automatic equipment. This consists of two foldable positive-negative forms which are permeated by steam and give the fabric smoothness and shape.

Work in these departments is performed by men, as it is hard physical work. It takes place under conditions of considerable heat and noise. While new technologies can take care of these environmental conditions, they increase the pressure on piecework.

Stock-keeping/Transportation

The areas of stock-keeping and transportation[1] have increased in importance. This is true in developing countries as well as industrialized countries. International cooperation and division of labour has also made for a trend towards more sophisticated inventory systems by the cooperation partners. In the industrialized countries it is questions of qualitity and cost, but also of competition, which necessitate stock-keeping of fabrics and finished goods which is sophisticated in terms of information technology, but also new approaches to transportation technology. Although logistics are largely taken care of without technology, new solutions are being tried by producers of high-priced quality segments.

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[1] The stand of technology in industrialized countries. cf. H.J. Braczyk, Ch. Gebbert, J.H. v. Knesebeck, Neue Transporttechnologien in der Bekleidungsindustrie, VDI-Verlag 1986.

1. Product scanning, which has the objective of finding defects in expensive fabrics in order to avoid price discounts (scanner technology).
2. Stock-keeping systems. In fashionable, flexible manufacturing complete fabric batches are hardly ever processed. Precise knowledge of the stored fabrics is a must.

3. The manufacturers assume the storage of finished products as a service to their customers. Information technology permits immediate recovery.

4. The most used technology for transportation within the plant is the trolley, a small cart on which the material for an order is transported (by hand) from one station to the next. The trolley is the flexible transportation system per se; it does have the disadvantage of hardly being able to take care of large lots, while many small lots require a lot of space. For these reasons hanging conveyer systems were developed for mass production. These systems supply the work stations on a rigid production line with material step by step.

In the fashion-oriented flexible manufacturing in the industrialized countries these rigid means of organization have lost in significance. The need for flexibility of the high-price quality segments is met by new computer- controlled transport systems. They make possible the flexible response in clothing production by allowing for the free choice of material supply to the work stations. They also permit a variable work process according to the work plans of different products. The advantage of computer-controlled transport systems lies in additional rationalization functions. With the help of the computer these systems not only automate the control of production and transport, they can also do important elements of controlling (measuring the degree of performance) and the payroll. On the road to more automated production the entire area of logistics is of the greatest importance.

Information Technology in General

Logistics is increasingly becoming one of the information-intensive functional areas of the firm, which characterize the development of clothing technology. In this sector the application of modern technology is largely determined by whether or not the firm needs the scientific administration which characterizes the software of these systems. There is a general trend towards more information technology in the clothing industry. The producers in the high-price quality segments depend very much on help in "scientific administration" for reasons of cost. They therefore may be considered "pioneering firms" which step by step feel their way towards solutions which lateron become the industrial world standard. Technological progress in computers and the high rate of innovation in the development of software make reasonable and cost-saving application of information technology even in the low-price segments feasible in the medium term. The effect on skill requirements depends strongly on the software, i.e. on whether it replaces skills or supports capabilities (cf. chapter B.V).

Administration/Sales

The areas of administration and sales are normally very similar in their technological characteristics to those of the manufacturing industry in general. The jobs are commercial (men's and women's) jobs which require good education and training. Besides the well known office automation microelectronics get applied even in marketing. The best example is the italian company Benetton.

III. Pace and Degree of Future Application of New Technologies, Both in Developed and Developing Countries

The quintessence of the discussion of the individual stages and functions of the industry's production process and the technology used therein may be put as follows:

1. Technical innovation in the area of new technologies is primarily geared to the needs of the industrialized countries. The "new needs" run unambiguously in the direction of flexible machines and the safeguarding of quality. In this context microelectronics opens up new potential. This applies to sewing technology as well as to other production technologies and their integration, and also to the software for planning, steering, and administering the production.

2. Innovation barriers have seen to it that technological progress in the clothing industry did not permit the intensive automation needed by the industrialized countries.

3. The state of technology therefore remained at a "sub-industrial" level. This means that clothing technology is adjusted to the newly industrializing and developing countries in such a way that these countries cannot only produce economically, but may also develop a high degree of international competitiveness.

4. That is why for these countries clothing production is a factor in the development of industries and exports. For these countries the existing innovation practice is also totally sufficient.

5. Women's work has held the largest share in employment. Even in the industrialized countries more than 80 % of these industries' labour force is accounted by women.

6. For the future it must be assumed that the clothing producers in newly industrializing and developing countries will become more innovative themselves. This implies a general trend from subcontracting to the full range of business with products of their own. For these countries the traditional clothing technolgy represents a set of sufficiently economical production alternatives, with which they may move into a new range of products at less effort than it takes the industrialized countries to move forward. In the medium term, too, the industrilaized countries' competitiveness will lie in the high-price quality segments as far as domestic production. In the medium term, too, the industrialized countries will take advantage of the cost advantages of the newly industrializing, developing, and other low-wage countries in order to augment their product range by imports of their own foreign-produced textile goods.

What are the implications of this for the development and application of new technologies in developed and developing countries? The answer to this question has three levels:

1. The development and production of clothing technology.

2. The recent technological development.

3. The markets at which production is aimed.

Ad 1:

Without doubt, there is a sewing machine industry in almost all countries, whose production is strongly geared to the population size, since it focusses on simple home sewing

machines (cf. Table 25). According to the number of units produced, the sewing machine market is a growth market (+5.3 % since 1980), in which the People's Republic of China represents a major share.

Regarding specific production technologies at least at the level of the universal speed sewing machines, the world market is cornered by Japan, the FR Germany, the United States, the Asian newly industrializing countries, and Italy (to a certain extent also by Sweden and Switzerland) (cf. Table 26). Japan and the FR Germany together account for around 60 % of world trade in sewing machines or the corresponding production technology. This high-tech market has grown less in value terms than the entire sewing machine market (in units). At a share of 70 %, the industrialized countries are the major customers. Developing and newly industrializing countries share 30 % of the world market.

Japan, as a traditional supplier of simple technology, but at the same time a supplier of sophisticated automated equipment, exports in roughly equal parts to developing and developed countries. The FR Germany is a supplier of mature specialized technology. Three quarters of its exports go to the industrialized countries. Its one-quarter share of exports to the developing countries is thus below the world average of one third[1]. These figures are some proof of the notion that the industrialized countries demand high tech with an increasing tendency, while the developing and newly industrializing countries need standard technology with a slightly declining tendency. An excellent growth market, served primarily by Japan, is the People's Republic of China.

The big loser in world trade in clothing technology is the United States. It lost its position in exports of sewing machines and accessories to the Southeast Asian NIC's. These countries are primarily expanding their exports to the indus-

[1] The same is true of the other European world supplier, Italy.

Table 25: Sewing machines – Machines à coudre

Unit : Thousand units — Unité : En milliers

Country or area	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Pays ou zone
Africa	56	66	45	61	64	60	61	57	59	56	Afrique
Nigeria	—	62	40	54	57	—	—	—	—	—	Nigéria
Tunisia	3	4	5	7	7	7	8	4	6	3	Tunisie
America, South	961	994	1 043	1 017	1 101	1 241	1 379	1 145	1 387	1 383	Amérique du Sud
Argentina	82	85	75	80	63	74	45	27	23	37	Argentine
Brazil	760	797	855	854	971	[1] 1 092	1 222	1 074	—	—	Brésil
Chile	10	17	15	9	5	5	7	0	—	—	Chili
Colombia	72	—	—	49	41	50	71	21	—	—	Colombie
Peru	37	31	38	25	21	20	34	—	—	—	Pérou
Asia	8 462	8 244	8 905	9 522	9 584	10 468	12 297	14 573	16 732	15 821	Asie
China	3 189	3 567	3 638	4 242	4 865	5 868	7 678	10 391	12 860	—	Chine
India[2]	343	264	361	382	245	336	345	332	319	342	Inde[2]
Indonesia	65	[3] 520	164	197	159	353	342	377	496	—	Indonésie
Israel[2]	4	3	—	—	—	—	—	—	—	—	Israël[2]
Japan	4 266	3 362	3 947	3 834	3 431	3 155	3 247	2 873	2 593	2 558	Japon
Korea, Republic of	250	287	568	552	496	444	350	312	165	127	Corée, République de
Pakistan[4]	76	55	64	58	62	62	67	65	67	—	Pakistan[4]
Philippines	48	—	[3] 14	[3] 89	—	—	—	—	—	—	Philippines
Sri Lanka	27	15	13	14	32	33	44	—	—	—	Sri Lanka
Turkey[5]	194	121	132	150	160	163	150	129	134	181	Turquie[5]
Europe	3 015	2 902	2 891	2 908	2 643	2 723	2 677	2 322	2 166	2 061	Europe
EEC	*1 753*	*1 654*	*1 700*	*1 626*	*1 425*	*1 443*	*1 409*	*1 092*	*1 022*	*921*	*CEE*
Denmark	5	11	13	12	10	0	0	—	—	—	Danemark
France	200	206	212	179	152	—	—	—	—	—	France
Germany, Fed. Rep.	621	582	620	643	527	541	507	404	390	355	Allemagne, Rép. fed.
Italy	884	832	826	760	709	731	754	553	513	438	Italie
United Kingdom[7]	43	23	29	32	27	[8]	7	5	—	—	Royaume-Uni[7]
EFTA	*187*	*218*	*222*	*206*	*184*	*184*	*174*	*167*	*131*	*145*	*AELE*
Sweden[6]	187	218	222	206	184	184	174	167	131	—	Suède[6]
East Europe	*575*	*668*	*612*	*663*	*652*	*698*	*759*	*741*	*705*	*705*	*Europe de l'est*
German Dem. Rep.	193	195	206	216	233	239	242	255	272	282	Rép. dém. allemande
Hungary	2	3	2	3	3	4	4	4	5	2	Hongrie
Poland[9]	302	331	334	339	322	364	409	383	350	372	Pologne[9]
Romania	78	74	70	95	94	86	95	99	78	49	Roumanie
Other Europe	*509*	*427*	*357*	*415*	*382*	*483*	*344*	*322*	*308*	*291*	*Autre Europe*
Spain	389	315	244	299	—	264	217	195	—	—	Espagne
Yugoslavia	111	112	113	116	120	139	127	127	133	—	Yougoslavie
USSR	1 536	1 508	1 512	1 516	1 514	1 474	1 477	1 518	1 528	1 547	URSS
Byelorus. SSR	*91*	*72*	*78*	*79*	*80*	*81*	*80*	*82*	*80*	*80*	*RSS de Biélorussie*
Ukrainian SSR[9]	*7*	*6*	*7*	*8*	*8*	*8*	*8*	*9*	*9*	—	*RSS d'Ukraine*[9]
Total	14 030	13 715	14 395	15 016	14 826	15 966	17 891	19 687	21 785	20 869	Total

General note.
All types of sewing machines, whether operated by hand or fitted with a built-in electric motor, for household use or for industrial use (tailors, dressmakers, shoe industry etc.). (SITC 71730–0).

[1] Production by establishments employing 5 or more persons.
[2] Production by large and medium scale establishments only.
[3] Marketed local production.
[4] Twelve months ending 30 June of year stated.
[5] Shipments.
[6] Excluding industrial sewing machines.
[7] Industrial machines only.
[8] For household use only
[9] For industrial use only.

Remarque générale.
Machines à coudre de tous types, mues à la main ou par un moteur électrique incorporé, utilisées pour les travaux domestiques ou dans l'industrie (tailleurs, couturières, industrie de la chaussure etc.). (CTCI 71730–0).

[1] Production des établissements occupant 5 personnes ou plus.
[2] Production des grandes et moyennes entreprises seulement.
[3] Production locale commercialisée.
[4] Période de douze mois finissant le 30 juin de l'année indiquée.
[5] Expéditions.
[6] Non compris les machines à coudre industrielles.
[7] Machines industrielles seulement.
[8] Pour usages domestiques seulement.
[9] Pour usages industriels seulement.

Source: OECD-Industrial Statistics Yearbook 1983,Volume II,Commodity Production Statistics ,New York 1985.

Table 26: The World Market of Sewing-Machines – 1981 and 1985
in Mill. of U.S. Dollar

Importing Countries \ Exporting countries		USA		EEC(9)	(A)	thereof: Germany Fed.Rep.		France		Italy		United Kingdom		Japan		Asian NICs	(E)	World	(I)	Annual Growth Rate		Shares of the markets in %
		1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1981	1985	1985
USA		0	0	54	67	39	47	1	1	11	12	17	4	66	110	72	84	259	316	+ 5,1 %		20,8 %
EEC (12)	(A*)	52	37	225	235	129	131	7	7	42	37	14	10	73	109	42	49	455	487	+ 1,7 %		32,1 %
EEC (9)	(A)	49	36	193	175	110	115	6	7	33	29	12	10	66	94	40	48	405	445	+ 2,2 %		29,1 %
thereof: Germany F.R.		19	10	24	24	.	.	2	2	10	8	4	2	34	54	9	19	97	122	+ 5,9 %		8,0 %
EFTA(6)	(B)	3	2	41	35	30	25	1	1	7	7	1	1	5	7	3	5	69	66	- 1,1 %		4,4 %
Japan		6	6	9	10	7	8	0	0	2	1	0	0	0	0	8	16	24	34	+ 9,1 %		2,2 %
other.ind.countries	(C)	29	12	29	15	19	15	0	1	7	7	1	2	44	39	11	19	140	112	- 5,7 %		7,4 %
Comecon		0	0	16	43	19	39	0	1	2	7	0	1	3	6	0	0	20	56	+ 7,3 %		3,7 %
Industrialised countries	(D)	90	57	374	410	243	265	9	11	71	71	33	18	211	271	136	173	967	1.071	+ 2,6 %		70,6 %
OPEC		8	6	25	16	14	9	2	2	7	4	2	1	62	29	0	0	98	53	- 16,6 %		3,5 %
Asian NICs	(E)	10	10	14	20	9	15	0	0	3	3	2	1	130	112	0	0	154	144	- 1,7 %		9,5 %
Latin America	(F)	45	34	30	22	20	14	1	1	9	6	0	0	45	22	0	0	123	79	- 11,7 %		5,2 %
Africa	(G)	0	0	6	9	2	3	1	1	2	1	0	0	3	3	0	0	10	10	± 0,0 %		0,7 %
China		1	1	3	6	2	3	0	0	0	1	0	1	20	39	0	0	24	46	+ 17,7 %		3,0 %
Developing countrie and LDCs	(H)	73	52	132	142	77	88	7	6	30	25	8	6	291	252	0	0	509	446	- 3,4 %		29,4 %
World	(I)	163	109	506	542	320	353	16	17	101	97	25	24	502	524	136	173	.476	1.517	+ 0,7 %		100,0 %
Annual Growth Rate		- 10,5 %		+ 1,7 %		+ 2,5 %		+ 1,5 %		- 1,0 %		- 1,0 %		+ 1,0 %		+ 6,2 %		+ 0,7 %				
Shares of the market in 1985		7,2 %		35,7 %		23,3 %		1,1 %		6,4 %		1,5 %		34,5 %		11,4 %		100,0 %				

(A*) F, I, UK, NL, B, L, DK, IRL, GR, Sp, P , FRG
(A) A* without Greece, Spain, Portugal
(B) A, CH, SF, N, S, IS
(C) Canada, South-Africa, Australia, New-Zealand
(D) All industrialised countries with Greece, Spain, Portugal
(E) South-Korea, Singapur, Taiwan, Hong-Kong, Malaysia, Philippines
(F) Without Equador and Venezuela
(G) Without Egypt, Marocco, OPEC, Sout-Africa, Tunesia
(H) Without Egypt, Gibraltar, Israel, Jougoslavia, Turkey, Marocco, Tunesia, Syria, Libanon, Jordan, asian developing countries
(I) Without trade between not OECD-countries

Source: OECD Statistics, Paris; Ifo-Institute for Economic Research.

machines (cf. Table 25). According to the number of units produced, the sewing machine market is a growth market (+5.3 % since 1980), in which the People's Republic of China represents a major share.

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Japan, as a traditional supplier of simple technology, but at the same time a supplier of sophisticated automated equipment, exports in roughly equal parts to developing and developed countries. The FR Germany is a supplier of mature specialized technology. Three quarters of its exports go to the industrialized countries. Its one-quarter share of exports to the developing countries is thus below the world average of one third[1]. These figures are some proof of the notion that the industrialized countries demand high tech with an increasing tendency, while the developing and newly industrializing countries need standard technology with a slightly declining tendency. An excellent growth market, served primarily by Japan, is the People's Republic of China.

The big loser in world trade in clothing technology is the United States. It lost its position in exports of sewing machines and accessories to the Southeast Asian NIC's. These countries are primarily expanding their exports to the indus-

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[1] The same is true of the other European world supplier, Italy.

trialized countries. Taiwan, Hong Kong, Singapore, and South Korea are serious competitors as producers of sewing technology. They closely imitate[1] the Japanese model. At this point the argument may already be introduced, that the future development of production technology may also be determined by newcomers, which, like the big four Southeast Asian Nic's, have their own R&D potential, as well as their own computer and precision-instrument industries.

The demand for industrial clothing technology is thus largely determined by the requirements of the industrialized countries. Special markets like the Comecon countries or the PR China have pent-up needs. There is a tendency to buy entire factories of a given technological standard. As will be shown in chapter B. VI, the demand of the PR China is simultaneously a reflection of big successes in clothing exports.[2]

Ad 2:

Regarding the problems of intensive automation, ten years ago a study by the KSA consultants already pointed to the potential and limits of technological change[3]. In this study the following technological developments until the end of the 1980s was considered conceivable:

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[1] With capital from the industrialized countries, of course.
[2] Cf. A. Gälli, Von der Seidenstraße zum Textilstrom?, Probleme und Chancen der chinesischen Textil- und Bekleidungsindustrie, Köln/München, 1983.
[3] KSA Report for the Commission of the European Economic Community, The Decade for Technlogy - A Study of the State of the Art of Assembly of Apparel Products, Geneva 1979.

- Fully cycle automation,
- sequential automation,
- introduction of computer technology for improved administration,
- automated transport systems.

In this the following building blocks were to be prerequisites for dramatic technological change:
- Development of easily exchangeable devices,
- development of devices for the positioning of parts,
- processes for temporarily stiffening the cloth,
- multiple-purpose sewing machine heads.

The study concluded that while there are many solutions, concepts are lacking for the economical integration of these processes. The study's conclusion that the 1980s could become "a decade of technology" warranted an examination of the development of the application of new technologies in industrialized countries exemplified by the case of the FR Germany. The Ifo Institute conducted two surveys (1983/1987) in order to ascertain this development.[1]

The results of the 1983 survey were unambiguous. They were characterized by the necessity to overcome the increasing costs of diversifying the product range and of making production flexible; a trend which is still continuing. The state of technology could be ascertained first. In 1983 technology was concentrated in the area of universal and specialized machines. For the medium term (to 1986) an increasing trend toward the use of specialized and semi-automated equipment

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[1] Cf. U. Adler, M. Breitenacher, Strukturwandlungen, op. cit., and U. Adler, Wettbewerb, Technik und Arbeitsgestaltung - neue Tendenzen im Bekleidungsgewerbe, to be published shortly.

could be discerned (Table 27). New technological approaches, aside from those which could make the machines and the work stations more flexible, were hardly accepted. The true finding of the survey was its confirmation of the KSA forecast of an increasing use of microelectronics. That is, the first half of the decade was characterized by a gradual computerization of the firms which had and still have to control the cost problems of an increasing information content of production (Table 28).

The 1987 survey, whose objective was to describe technological change with a view toward the year 1990, confirmed the 1983 results, although a slight change in attitude is discernible. This may be due to the fact that there is more information on new technologies. It quite certainly is due to the positive experiences gained from data processing. What is the present state of new-technology use in the industrialized countries with a view toward 1990? This will again be exemplified with the case of the FR Germany.

At the forefront of the application of new technologies are manufacturing planning and steering, followed by sewing, cutting, design, and the production of patterns. These are the sensitive areas of a clothing firm, in which "unproductive times", double work, mistakes and thus labour intensity increase dramatically with flexible production and traditional organization, management, and information.

At the level of individual technologies, these core activities are very different, confirming that clothing production can only be modernized step by step with a mixture of technological innovation.

The company survey regarding the application of new technologies yielded a marked change in innovational attitudes (cf. Table 28). In comparison with the 1983 survey the answers reflect two major trends:

Table 27: The State of Technology and Tendencies in the Clothing-Industries of the F R G.

(Figures in % of answers -equiry 1983)

Time / Part of manufacturing process	1 9 8 3					1 9 8 6 (forecast)				
	Hand-work	Universal machines	Single-purpose-machines	Semiauto-mation	Auto-mation	Hand-work	Universal-machines	Single-purpose-machines	Semiauto-mation	Auto-mation
Design	71%	27%	21%	5%	3%	61%	25%	21%	7%	13%
Cutpatterns	61%	11%	22%	8%	13%	33%	9%	27%	13%	34%
Planning of work	65%	18%	14%	7%	10%	45%	14%	20%	13%	20%
Cutting	26%	25%	58%	22%	6%	21%	21%	45%	32%	19%
Assembly	13%	39%	67%	28%	7%	10%	32%	61%	39%	16%
Pressing	17%	33%	51%	31%	7%	13%	29%	45%	41%	14%
Storing/Transport	63%	22%	21%	14%	4%	47%	18%	22%	23%	14%
Management/Administr.	39%	25%	27%	29%	25%	29%	22%	26%	25%	39%
Selling	59%	22%	16%	12%	14%	51%	21%	15%	14%	18%
Together	24%	35%	59%	28%	10%	19%	28%	52%	34%	17%

Source: Ifo-Institute for Economic Research 1984

Table 28: The Implementation of New Technologies in the Clothing Industry of the Federal Republic of Germany (Figures in % of answering firms)

ENQUIRY / TIME-PERSPECTIVE / TECHNOLOGY	Enquiry 1983			Enquiry 1987		
	already implemented	will be implemented until 1986	no chance	already implemented	will be implemented until 1990	no need
A) Automation of Production						
-Full cycle automation	10	21	69	16	46	38
-Sequential automation	8	26	66	12	30	58
-Flexible sewingmachines	20	37	43	9	55	36
-Automatic cutting	6	21	73	14	55	30
-Automatic transport	11	20	69	4	40	56
B) Computerization of the Production						
- C A D	18	35	47	16	42	42
-Cutpattern-making/nesting	-	-	-	28	40	32
-Automatic storing	-	-	-	31	34	35
-Managing of orders	44	30	26	60	28	12
-Production-planning	38	38	24	41	45	15
-Production-steering				30	50	20
-Payroll-work	62	25	13	48	37	15
-Managementinformation and information on production-process	33	36	31	29	46	25
	(only information on production)					
C) Other necessary technical innovations						
-Ergonomic design of the workplaces	45	28	27	33	42	25
-Pic-ups,staplers,roboters, automatic handling	5	8	87	28	26	46
		(only roboters)				
-New technologies like: glewing,welding,molding, 3-dim-sewing	9	9	82	5	40	55

Source: Enquiry of the Ifo-Institute for Economic Research Munich

- Rising intentions to introduce new technologies in the medium term,

- expcetations of better chances and greater demand for the introduction of new technologies in the long run.

At the top of the medium-term acquisition plans are systems for production planning and steering, new cutting technologies, more flexible machines due to sensors and microelectronics, and fully cycle automation. An additional area of great impotance is management and product information. More than 55 % of the surveyed firms intend to introduce corresponding technologies until 1990.

Considering the generally different response behaviour in the second survey, a large majority still sees no need to introduce technologies for glueing, bonding, three-dimensional sewing, and molding, or for robots, automatic handling systems, CAD systems, automatic transport systems, and sequentiall automation. These are the areas for which in 1983, too, the response was "no chance of being introduced". The number of such responses declined noticeably, however. This change confirms the thesis of a changing awareness of problems.

The introduction of a new level of technology makes already solved problems appear in a new light. Ten years ago, it was already helpful to be able to duplicate pattern sheets in a way which was production oriented. At today's state of technology, CAD designing simultaneously includes producing the pattern parts, optimizing the positioning of the pattern, and grading. Thus over time the function of technological progress changes, as does its perception. It is therefore only honest if, in view of especially pronounced progress, only

that level of technology is considered possible which has just been achieved. Without trying to over-interpret the data, this effect may be observed in the area of introduced technologies. The frequency of technologies mentioned as "introduced" is much lower than that contained in the 1983 plans with respect to automation of work sequences, flexibilization of equipment, automated transportation systems, CAD, PPS systems, systems of performance and wage determination as well as management information systems and new assembly technologies.

On the other hand, the firms' plans regarding the automation of work processes, cutting technologies, order management and processing, as well as handling equipment and stackers were fulfilled. In these areas processes are common today, whose applicability was still unkown five years ago. Looking at technological progress we always see step-by-step developments reflecting learning processes.

Different phases may be distinguished along this innovation path. The first phase is that of the so-called island solutions. This phase was covered by the 1983 survey. The objective of this innovation step was to improve production with individual solutions based on information technology. The idea was to move up rationalization thresholds, to lower the threshold of order sizes, to make the capital stock more flexible and more productive, to order the flow of material, and to raise the state of technology of information flows. The 1983 survey signalled a clear impulse on the level of this island-solution strategy.

In the meantime new technologies have been created which allow the integration of island solutions. New transportation systems, for example, contain functions of work preparation in the area of production planning and steering as well as

functions of controlling and wage billing. New time-control systems contain programs for multi-moment studies, time files, plan-time systems, etc. Integrating various functions of information technology is also useful for systems of product development (CAD) and work preparation (PPS). Increasingly the objective is to have fast access to production-related information, which up to now has necessitated the elimination of labour-intensive media discontinuities.

It would be an exaggeration to claim that the market necessitates this innovation behaviour. While the market creates a production situation which may suggest such solutions, it is primarily due to the drastic decline of computer prices that microelectronics now fits into the investment budgets of the firms. For years businessmen have been complaining about the low rate of return on investment and the long pay-off periods. The simple reason is that automation technologies are too expensive. Sensorics and microelectronics may be built into the machines at prices which will more than offset the increase in the cost of the equipment by raising productivity, eliminating down-time, and safeguarding the quality of work. Programmable stitches and seams simplify work so much, that there is not only greater flexibility, but in the long run there will also be greater scope for automation. What is true of production technology is also true of information technology. Just six years ago, a well-known system for computing predetermined time costed almost DM 50,000, including installation. The hardware alone accounted for about half of the price. Today a similar, if not quite as comfortable a system may be run on a programmable handheld calculator which is equipped with an extended memory and may be connected to a printer and PC. This machine is being offered for DM 5,000.

The costs of raising the productivity and efficiency of experts within the firm in finding solutions to particular problems have declined considerably. This means that now a range of products is emerging which must be taken seriously and also promises effective help.

This is also perceived by those firms which view the early forms of information technology existing five years ago from quite a different level of problem awareness and problem solution and thus respond to the survey in a much more differentiated way. The change in perception is simultaneously a sign of the described transition to a new phase of utilizing information technology in which the application potential is seen and at the same time core areas of application are formed.

It will be up to a third phase to integrate man and his abilities into these lines of innovation as an option on the solution of production problems. Because of its very labour intensity, the clothing industry might become the bellwether in this area.

In production, information technology may have various functions. Their effect on work depends on the particular function. Today information technology is the reaction to the growing diversification of clothing supply by the industrialized countries, resulting in increasing costs of specialists in production preparation, execution, and control. Studies of firms in industrialized countries, producing for the high-price quality segment, found that only 45 % of the work is pure executing work. These firms are dependent on a reduction of their oganizing costs.

Today's information technology follows the old philosophy which separates executing unskilled work and organizing high-skilled work. Chapter B. V will show that the distinction becomes blurred as the product becomes more sophisticated. At present information technology as technology for experts seems to go in the direction of reconstructing the originally organisational separation of unskilled executing (women's) work and high-skilled planning work. The concepts try to raise the productivity of the experts in planning, administering, and controlling the production process and to save costs. This may be economical as long as the information system remains an effective link between unskilled work and the growth dynamics of the market.

The philosophy of innovation must change, however, if skilled labour is to be used in production. The information system as an expert system must then democratize the knowledge of the experts and must support general occupational competence.

It is quite evident that technological development is unambiguously moving in the direction of systems for experts. Most clothing producers are able to handle that. Introducing these systems is relatively easy, as they are based on traditional, clearly delineated organizational patterns and divisions of responsibility.

Ad 3:

These are issues of technological progress which primarily concern the industrialized countries and their range of production. Regarding the application of new technologies, there are differenent requirements depending on labour costs and markets. In general, automation technologies are no longer justified when low labour costs eliminate the labour-saving

argument. An automated pocket-attachment machine, e.g. costs around US $ 50,000. The rationalization advantage over a specialized machine just suffices to offset rising labour costs in the medium term and to earn the higher rate of return on investment. Considering that labour-cost ratios range from 4:1 to 12:1 in the international division of labour for comparable assembly work, then the economic limits of this type of equipment are evident. Even if several machines are operated at the same time, productivity increases of 400 % to 1000 % are inconceivable.

Low labour costs tend to make automation uneconomical. This is also the reason for relocating production. A large part of world clothing production is based on the concept that "labour-intensive production makes capital-intensive manufacturing superfluous". In developing and newly industrializing countries this applies to all home markets which are untouched by high-level international competition. This category comrises large markets like that of India, the PR China, parts of Latin America, Africa, and the Communist block. Here the wage level and capital intensity correspond. Domestic manufacturing technology suffices entirely for production for these markets. Producers there find sufficient rationalization potential in medium-level technology like that used in Europe in the early 1970s. At that time, sharply increasing labour productivity was still possible with relatively simple technolgy even in Europe.[1] This approach to technology, which saves capital at low wages, provides for international price competitiveness. Quite generally, developing countries or non-industrialized countries, respectively, must generate industrial jobs for the development of their economies. Their

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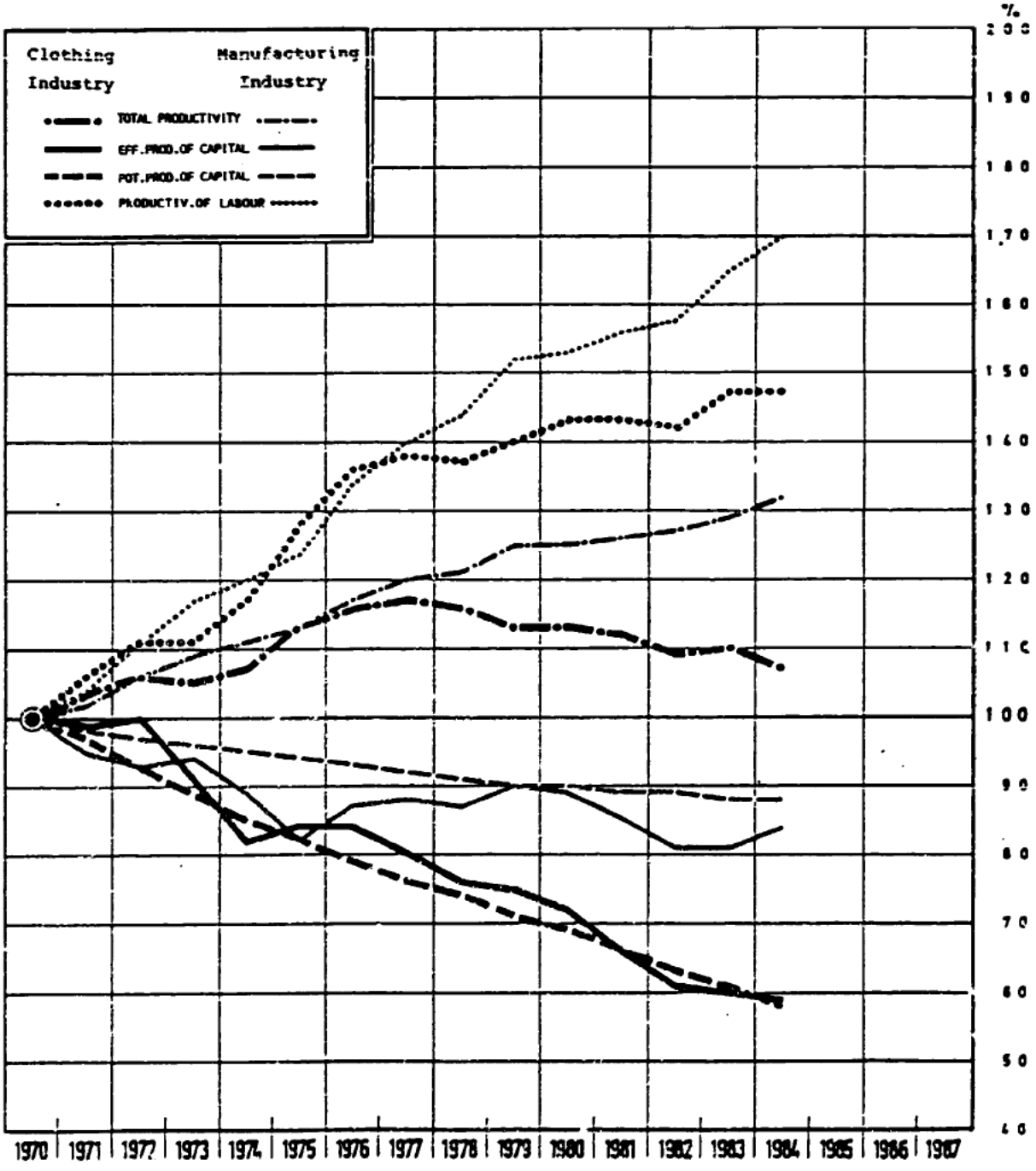
[1] Diagram 1 shows productivity growth in the case of the FR Germany. From 1970 to 1976 Labour poductivity rose by approximately 7 % p.a.

DIAGRAM 1 :

PRODUCTIVITY IN THE CLOTHING INDUSTRY
The case of the Fed.Rep.of Germany in comparison to the manufacturing industry



Source:Baumgart u.a. Produktionsvolumen und - potential, Produktionsfaktoren des Bergbaus und des verarbeitenden gewerbes in der B R Deutschland ,Berlin 1985.Ifo-Institute.

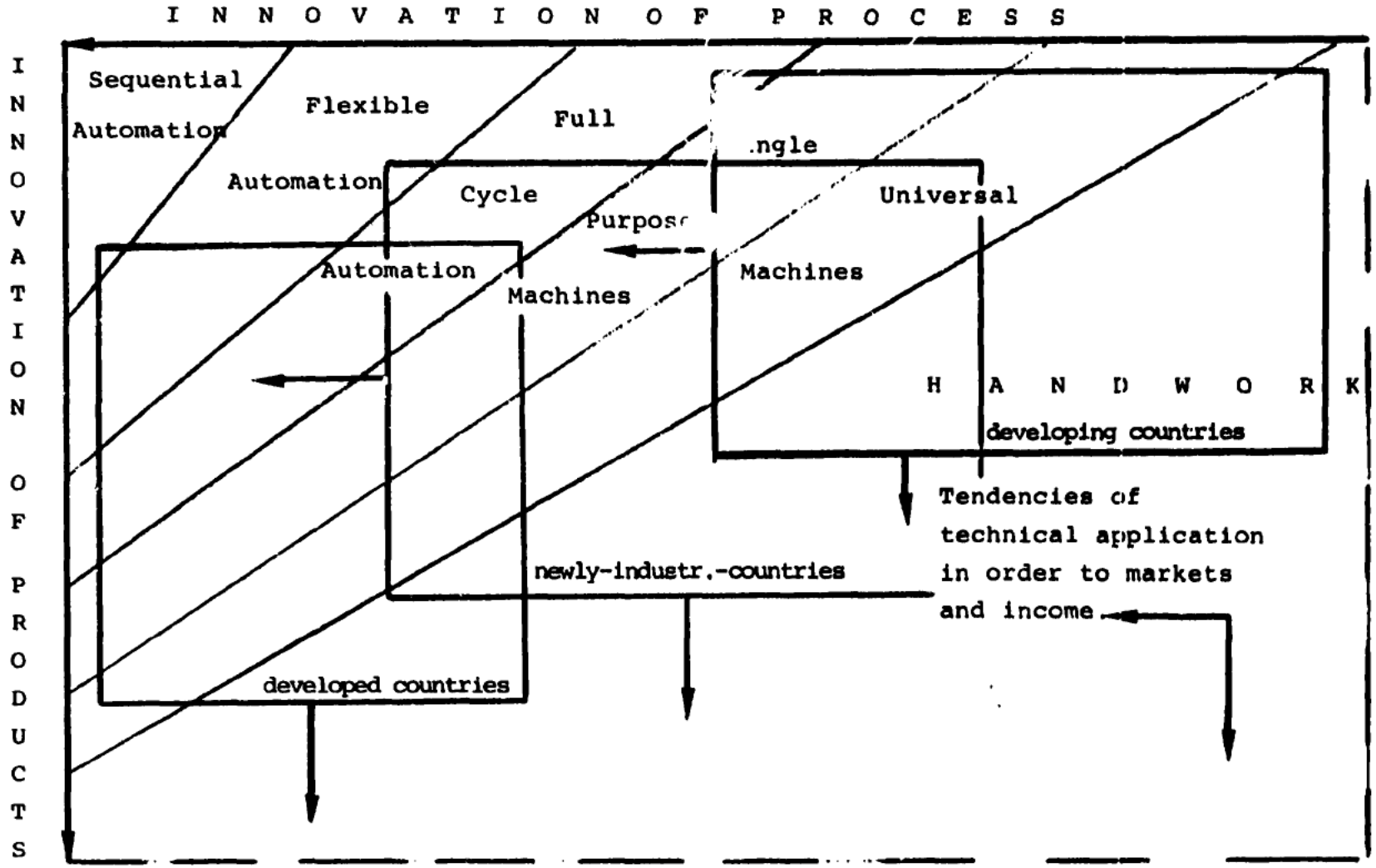
task is above all to produce goods which may also be purchased with the income earned in producing them. Technological progress must be labour-using, and may only be achieved within limits with capital-intensive technolgy.

Technology from fifteen years ago is still useful for developing countries to achieve pure price competitiveness. As the product range evolves from the lower priced segments towards the higher-quality segments, the available technology becomes ever more important. The classical wage-contracting countries, i.e. the developing and newly industrializing countries, occupying a firm position in world trade in clothing, also have a comparable reasonable standard of technology. These are in part the large companies of the Communist block (GDR, Hungary, Czechoslovakia, Yugoslavia), the large four East-Asian countries (Hong Kong, Taiwan, South Korea, Singapore), also the Mexican (maquiladora) enterprises, which produce primarily for the United States, and generally the production zones of the Third World.

New technology must fit the markets (product and labour markets) and must be profitable. As mentioned before, there may be exceptions. A higher technological standard may, e.g. be necessary for reasons of quality. This, too, is basically a cost argument, however. Technology for the safeguarding of quality pays only if skilled labour for the safeguarding of quality is expensive. The approximate state of technology and its direction is shown in Diagram 2.

In addition, there is the problem of financing the new technology. For many developing countries purchasing automated systems is a problem of foreign exchange, which is usually solved by attracting foreign capital into tax-free production zones. Foreign-exchange problems also stand in the way of

Diagram 2 : Innovation and Different Use of Technology as a Function of Different Markets



Source: Ifo-Institute for Economic Research, Munich.

thorough modernization of the clothing industries in the Communist-block countries. There central planning determines the acquisition strategy which is to a large part aimed at buying entire factories with new technology. The ability of industries like those of the GDR, Hungary or Yugoslavia to become wage contractors in the upper quality segment with only average technology is due to the relatively high level of training of the labour force.

Regarding the opportunities and risks of new technologies for developing countries, there are two principal positions. The first one focuses more on the risks and holds that increased automation in the industrialized countries will lead to a relocation of the simple assembly work.[1]

The second position holds that new technologies open up new sources of welfare for developing countries as well. The idea is that the developing countries may circumvent classical ways of industrialization on their route to an information society.[2] Without trying to retrace this dispute in detail, the use of new technologies in developing countries may be justified under the following conditions:

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[1] The relocation thesis is held e.g. by J. Krugmann-Randolf, Überrollt der technische Fortschritt die dritte Welt? in: Das Parlament, 2 March 1985; also by Schütte, "Exportfreihandelszonen - schwindende Attraktivität durch neue Produktionstechnologien?", paper presented at the GTZ meeting on "Forderungen betrieblicher Kooperation", March 1984.

[2] Cf. Centre for Applied Studies in International Negotiations, Development and Interdependence in an Automating World, Geneva 1986.

- If production must conform to a world standard, i.e. if a very important benefit requires these systems and makes them profitable;

- if, as part of technological progress, new systems become the general standard, e.g.
  -- microelectronics in equipment,
  -- software for planning, executing, and controlling production;

- if, as is the case in a number of developing and newly industrializing countries, the country has a good R&D base or its own precision instruments industry (India, Brazil, Mexico, Pakistan, VR China, Taiwan, South Korea, Hong Kong, Singapore). These countries have very active innovators, backed by a disciplined labour force, who are able not only to develop their own adapted technologies, but quite generally to grow into the market of industrial technology and industrial software.

At present the price advantage of low labour costs and low capital costs is still the dominating factor for the developing and newly industrializing countries. Exceptions are special export markets. Their technological standard will gradually move towards that of the industrialized countries, at the pace at which product and labour markets (labour costs) require different technologies. A dampening element in this are new clothing manufacturers, able to produce at low wages or in closer proximity to the final customer. As long as there are such newcomers, automation will hardly be necessary.

IV. Implcation of New Technological Developments for the Level and Structure of Production Costs

For the determination of the effects of new technologies on the level and composition of production costs, two aspects are important:

- the high labour-intensity of the industry;
- the fact that the clothing market is a buyers' market in which prices may not be changed at will in order to cover costs.

The most important cost element is the wage bill, which in the FR Germany, exemplifying the industrialized countries, amounts to about 22 % of sales or more than 80 % of the effective value-added (Table 29). At 1.2 - 1.5 % of sales and 5.6 % of the effective value added, capital costs, in contrast, are very low (Table 30). Correspondingly, wage changes explain prices in industrialzed countries better than changes in fixed assets (the stock of machinery and equipment). Experiences with the economic situation of the clothing industry in industrialized countries show that capital productivity is continuously declining (cf. diagram 1). It is therefore likely that capital is encountering diminishing returns. This finding also agrees quite well with the result that the elastizity between wages and production prices lies with 1,3 far above the elecastizity between fixed assets and production prices (0,28). At the same time the probability between wages and production prices is better (r^2=98 %) than the probability between fixed assets and production prices (r^2= 87 %). Since not any price may be charged in the clothing market, technological innovation in industrialized countries must pay for itself by saving labour costs and by productivity gains. That is why the real volume of fixed assets is stagnating at the branch level. New technology is applied wherever it is profitable according to the criteria

Table 29: Labour costs in the Clothing Indutries

(Germany Fed.Rep. several years)

Year	Gross wages per workhour in DM		Total earnings in% of turnover		Labour costs per piece[a)]	
	Clothing Industry	Manufacturing Industries	Clothing Industry	Manufacturing Indusrties	Clothing Industry	Manufacturing Industries
1970	4,95	6,85	23,0	21,3	0,44	0,38
1971	5,51	7,70	23,0	22,0	0,47	0,41
1972	6,11	8,46	22,8	22,2	0,49	0,42
1973	6,93	9,56	24,5	22,4	0,56	0,45
1974	7,64	10,96	23,5	21,9	0,59	0,50
1975	8,42	11,97	23,9	22,5	0,60	0,54
1976	8,91	12,66	23,9	21,2	0,60	0,53
1977	9,52	13,79	23,7	21,8	0,64	0,56
1978	10,15	14,73	24,4	22,1	0,69	0,58
1979	10,85	15,74	24,7	21,4	0,72	0,59
1980	11,55	17,04	24,3	21,3	0,77	0,63
1981	12,25	18,12	24,0	20,9	0,81	0,66
1982	12,69	18,89	23,5	20,6	0,84	0,68
1983	13,00	19,41	22,5	20,1	0,82	0,69
1984	13,42	20,03	21,6	19,4	0,82	0,70

a)Gross-earnings to effective gross value added in prices of 1976 (gva 1976 = 1) .

Source: Statistisches Bundesamt Wiesbaden(FRG) ,Fachserie 4,Reihe 2.1 und 4.1.1;
R.Krengel u.a. Produktionsvolumen und -potential ,Produktionsfaktoren des Bergbaus und des verarbeitenden Gewerbes in der Bundesrepublik Deutschland.

Table 30: Selected Costs of the Production in the Clothing Indutries

(Case of Germany F.R. for industrialized countries)

(shares of the gross net value of production in%)

Consumption of material, trade-goods, and sub-contracting				Labour costs				Services	Taxes	Retals	Depre-ciations	other costs
to-ge-ther	material	trade goods	sub-con-trac-ting	together	gross-wages (with-out wages for home-workers)	gross-salaries	social-costs					
57,6%	40,4%	5,9%	11,4%	26,3%	14,7%	7,2%	4,3%	o,6%	o,8%	1,3%	1,2%	9,1%

Source: Statistisches Bundesamt Wiesbaden (FRG), Fachserie 4 Produzierendes Gewerbe, Reihe 4.3.2 Kostenstruktur der Unternehmen im Investitionsgüter produzierenden Gwerbe 1985.

mentioned above. It represents a qualitative improvement of fixed assets, which must be figured against low rates of increase in sales and prices. The prime rule, that the ability to innovate is determined by prices, applies equally to industrialized and developing countries. The developing countries, in particular, are bound to low product prices by the fact that they must compete in the lower-priced segments, that they are facing a low purchasing power in their home market, and that they are positioned at the lower end of production costs in the international division of labour.

In detail, the capital needed for an investment is determined by the following equation:

$$A = (I + II) \times (III)$$

$$A = (\Delta K + p\% \times \frac{U}{5}) \times (\frac{2+n}{2+n} \times z); \text{ where}$$

A = necessary capital,
K = labour costs saved,
p % = productivity gain,
U/5 = share in (marginal) sales revenue which may be used for financing,
n = years of depreciation,
z = interest rate.

Depending on whether the investment is directed at growth, term II of the equation will become more or less important.

For the case p % = 0, the determination of the necessary capital reduces to the saving of labour costs. This is the result for a closed economy. The clothing industry, however, is characterized by the fact that it can draw internationally on cheap labour markets with similar technology.

Table 30:

THE EFFECTS OF SOCIAL- AND FIX-COSTS ON THE PRODUCTION-COSTS OF SELECTED COUNTRIES

ASA Table 31

RANK	COUNTRY	AVERAGE LABOUR-COSTS AND SOCIAL-COSTS PER HOUR DM/h	COUNTRY	AVERAGE LABOUR-COSTS PER HOUR DM/h	COUNTRY	PRODUCTION-COSTS PER MINUTE DM/minute
1	Denmark	15.79	Norway	22,56	Norway	0.741
2	Norway	15,56	F.R.G	21,18	Denmark	0.591
3	Swizerland	14,55	Italy	21,00	Italy	0.553
4	F.R.G	11.90	Denmark	20,61	Finnland	0.524
5	Finnland	11,12	Swizerland	19,79	F.R.G	0.512
6	Italy	10 50	Finnland	17,24	Swizerland	0.499
7	U S A	9,86	Austria	14,92	Austria	0,422
8	France	8,50	France	13,18	France	0,410
9	Austria	7,85	U S A	12,82	U S A	0,381
10	Ireland	6,68	Ireland	8,35	Ireland	0,325
11	Un.Kingd.	6,40	Un.Kingd.	7,81	Un.Kingd.	0,285
12	Spain	5,58	Spain	7,54	Spain	0,278
13	Malta	4,61	Malta	5,77	Greece	0,269
14	Greece	3,95	Greece	5,73	Malta	0,258
15	Hong Kong	2,98	Hong Kong	3,73	Haiti	0,246
16	Turkey	1,95	Turkey	2,73	Egypt	0,229
17	Portugal	1,91	Portugal	2,42	Hong Kong	0,227
18	Haiti	1,49	Haiti	1,85	Sri Lanka	0,217
19	Tunesia	1,32	Egypt	1,60	Marokko	0,212
20	Egypt	1,10	Tunesia	1,58	Tunesia	0,206
21	Marokko	1 05	Marokko	1,21	Turkey	0,206
22	Sri Lanka	0,37	Sri Lanka	0,52	Portugal	0,171

Given alternative locations with respect to production costs and benefits (equal benefits at lower costs and higher benefits - quality, readiness to supply, flexibility, up-to-dateness, proximity to the customers - at equal costs), the determination of production costs requires consideration of the following factors:

- Wage costs,
- social security costs,
- productivity,
- absentism,
- vacations and holidays,
- normal workweek,
- shift work,
- material fixed costs,
- transportation costs.

A comparison of operating costs[1] in this sense yielded surprising results, reflecting the high differences in labour productivity, weekly worktime, and social security costs.

Assuming an identical level of technology, countries like Morocco, Egypt, and Sri Lanka, all typical low-wage countries, rank at the same level of finished costs as e.g. Spain and Greece, due to their lower total productivity (cf. Table 31). In contrast, Turkey and Portugal, far ahead of the typical low-wage countries, have about one third the cost level of middle Europe, because of favourable productivity and benefit effects. The table 31 points out, that on a certain extent of technological input, there are no further benefits of lower labour cost. The model account of KSA shows a barrier at about 0,2 DM per minute. At this level change in fixed assets causes more change in production costs.

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[1]KSA Betriebskostenvergleich für 22 Länder, Darmstadt 1987.

Production costs in the clothing industry thus depend strongly on non-technical costs of the human factor of production. And those costs a higher in developing countries. This, however, also makes the handling of technology an important prerequisite of labour productivity. This is the reason for the question concerning the skill requirements arising from new technologies. Before this very issue is considered in the next chapter, a brief comment is in order on the production environment.

This environment consists on the one hand of the costs of production, and on the other hand of the socio-political environment. Looking at the entire costs of production, from the fabric to the manufacture of clothing and finally to the marketing, we find a relationship which is pictured in diagram 3. In the industrialized countries, high costs of the fabric and the manufacture of clothing contrast with low marketing costs, as far as the high-price quality segment is concerned. In this segment high marketing and selling costs offset the cost advantage of the developing and newly industrializing countries. Only in product segments in which marketing is possible at almost zero cost, does the cost advantage of the low-wage countries become effective.

Low-cost production is, however, only conceivable in a stable social and political environment. The closing of e.g. the Southeast Asian production belt is as probable as the spread of stability there. Thailand[1] is one example of this process. Whether Bangladesh and Indonesia will follow, remains to be seen.

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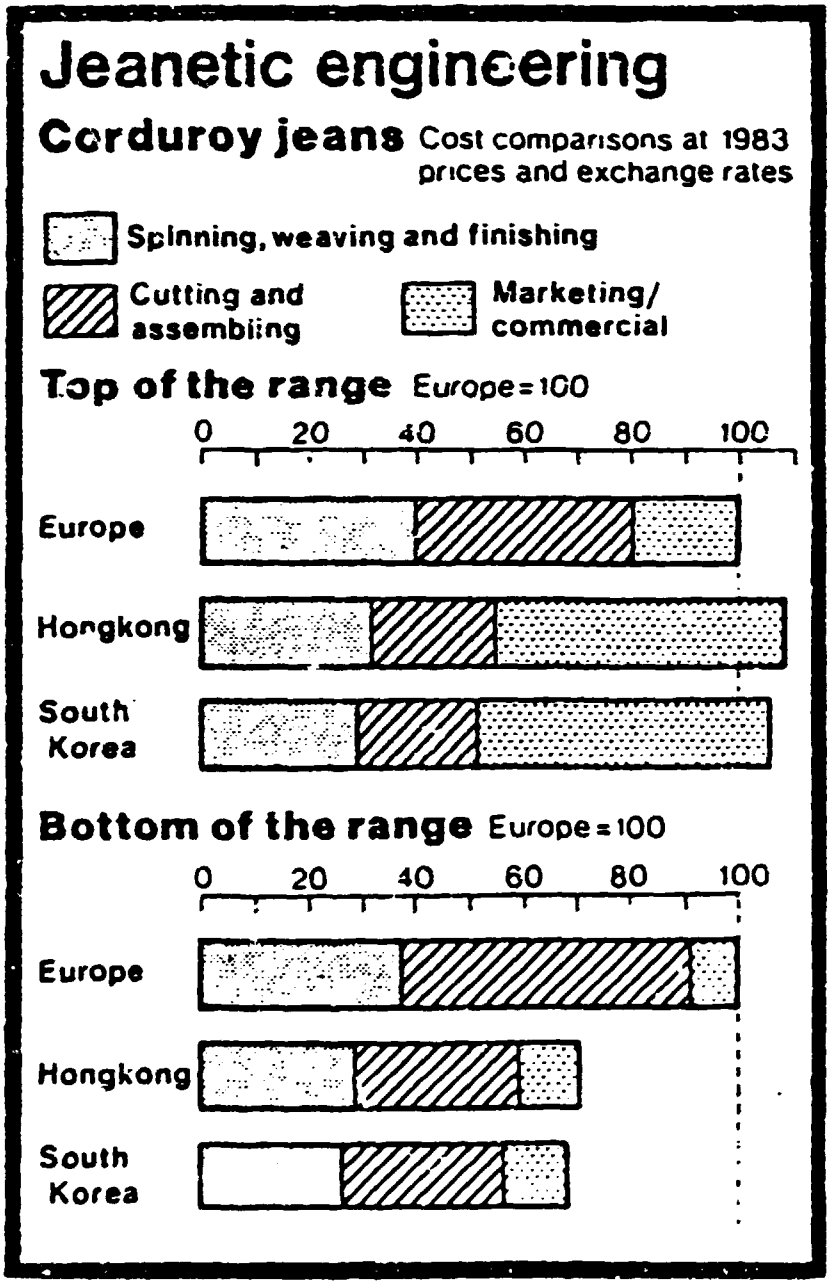
[1] Thailand, tropical balance. A recipe that still tastes good, in: The Economist, October 13, 1987.

Diagram 3: Cost-Comparison,Jeans-Market 1983



Source: The Economist after Boston Consulting Group,July 1983 .

V. Impact on Labour Absorption and on Changing Skill Requirements

In summary, regarding the effects of technological change in clothing production on skill requirements, one can say, therefore, that in the medium term (to 1995) no fundamental changes are to be expected in the production structure. In the long run, too (beyond the year 1995), women's work will remain very important in this industry. It may be asumed that in the medium term the industrialized countries will remain in top position regarding the use of new technologies. The newly industrializing countries will work their way up to this level. The developing countries will step-by-step assume the function of the newly industrializing countries. New entrants will replace some of the developing countries as low-wage countries in the international division of labour and world trade.

A discussion of the skill situation in the industrialized countries thus captures the possible development in the newly industrializing countries in the next 3-7 years and that in the developing countries in the next 5-12 years. Such a rather conservative assumption about changing skill requirements avoids an incorrect planning of labour skill development. We want to provide against the fear that technological progress might turn the clothing industry into a "men's industry".

Tables 32/33 and 34 show that the proportion of women is high, at 84 %, even in the comparatively well technologically equipped clothing industry of the Federal Republic of Germany. With 88 % for blue-collar workers, it far exceeds the industrial average of 22 %. Even for white-collar workers the proportion is markedly higher, at 55 %, than the average

Table 32: Qualifications and Functions of Employees in the Clothing Industries
(Case of Germany-F.R. as an example for industrialized countries)
(in % of employees i.e. 20% of employment)

Qualification / Function	I	II	III	IV	V	together
Ciercs						
male	-	36%	43%	17%	4%	39%
female	-	7%	33%	46%	14%	61%
Technical employees						
male	-	40%	47%	12%	1%	54%
female	-	15%	50%	32%	3%	46%
All employees						
male	-	38%	46%	14%	3%	45%
female	-	10%	39%	41%	10%	55%

explanation: I=high qualification
V=unskilled work

Source: Statistisches Bundesamt Wiesbaden(FRG) Löhne und Gehälter,Fachserie 16, Reihe 2.2 Angestelltenverdienste in der Industrie und im Handel April 1987.

Table 33: Qualification of Workers in the Clothing Industries
(Case of Germany F.R.as an example for indust.countries)
(figures in% of workers i.e.80% of employment)

Qualification / Sex	1	2	3	together
male	51%	37%	12%	12%
female	17%	68%	15%	88%
all workers	21%	64%	15%	100%

explanation : 1: high-skilled
2: semi-skilled and workers for special tasks
3: unskilled workers

Source: Statistisches Bundesamt Wiesbaden(FRG),Löhne und Gehälter
Fachserie 16,Reihe 2.1-Arbeiterverdienste in der Industrie
April 1987.

Table 34: Qualification of Workers and Employees in the Manufacturing Industries
(Case of Germany F.R. as an example for industrialized countries)
(figures in % of employment)

Function \ Qualification	1	2	3	4	5	together
Employees						
male	-	32%	53%	13%	2%	65%
female	-	7%	40%	43%	10%	35%
Workers						
male	56	35%	9%			78%
female	7%	44%	9%			22%
		qualification degrees see table 32 and table 33.				

Source : Statistisches Bundesamt Wiesbaden (FRG) ,Löhne und Gehälter Fachserie 16,Reihen 2.1 und 2.2 Arbeiterverdienste und Angestelltenverdienste in der Industrie,April 1987

of 35 % of the manufacturing industry. This implies that white-collar jobs for women are relatively plentiful in the clothing industry. The tables also reveal a general problem of women's work, which is quite independent of the economic system, the culture, the wage level, or the level of technology.[1] Women in blue-collar or white-collar jobs can always be found in the lower echelons. Almost 83 % of women belong to the group of unskilled, semi-skilled, and special workers and craftsman. For men this proportion is not even 50 %. The relationship is even more unfavourable in the white-collar segment. Here women have a share of over 50 % in the lower skill areas, whereas men represent almost 85 % of the middle or higher functions. The percentage of women holding the highest positions (skill group II) is hardly any higher in the clothing industry than in the entire manufacturing industry.

The skill level always interacts with technology and the market. In the lower-priced segments with simple organisation and production technologies, the production systems have a tendency to place all women into unskilled and semi-skilled jobs.

A global characteristic of the clothing industry is that it offers below-average career chances for women. Professional development, transgressing areas of responsibility, is, as a rule, reserved for men. It may be observed, moreover, that even women with better entry qualifications progress more slowly than men. It is thus comparatively easy for men to

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[1] An excellent description of the problem of women's skills is contained in: UNIDO, Women in the Redeployment of Manufacturing Industry to Developing Countries, Vienna 1980. The situation of developed countries describes: Gebbert, Ch., Leistungsentlohnung contra Verberuflichung, in; Sektion Frauenforschung in den Sozialwissenschaften, (Hrsg.) Frauenforschung - Beiträge zum 22. Deutschen Soziologentag, Dortmund 1984, Frankfurt/Main, Campus Verlag 1985.

achieve a middle-management position with only a middle-school diploma, followed by an apprenticeship, i.e. the career of a skilled worker. Women, in contrast, may have a middle-school or high-school diploma or that of a skilled worker and may still rarely get above the low-management level (group leader, foreman). There is a surprising identity of women's jobs spanning quite different cultures. It is, without doubt, the generative and marriage behaviour of women which affects their work careers. In developing and newly industrializing countries this has the result that it is primarily young women who work in the clothing industry. In industrialized countries it results in the so-called phased work pattern. In the case of patriarchal-family societies women work in order to contribute to the income of the (extended) family. In the other case they work in order to supplement their husband's income and to assure a certain standard of living. Both positions benefit considerably from women's rising entry qualifications. Even in developing countries the number of new female market entrants with middle-school or industrial-school diplomas is rising. Here additional performances are made possible which simplify the task of opening new markets, introducing new technologies, creating flexibility, performances which - to be sure - remain underpaid, because women, also with good education and training, tend to be willing to work at low pay. Important steps in the professional development of women will become possible, if women prepare for a management position by completing fashion schools of specialized colleges. There are better opportunities for women to get into management positions in the clothing industry than in other branches, even considering the plant of the future.

At present there are two major topics:

- In industrialized countries an increasing importance of work in the area of production preparation, production steering, and production control with a simultaneous qualitative enhancement of industrial jobs. This is leading to new, more flexible concepts of organization.

- A renaissance of piecework and traditional ways of organizing production as the low-wage countries gain importance in the clothing sector.

In the second case the skill question reduces to that of the special characteristics of simple piecework. The organization of the plant is geared to workers who, without special prior knowledge, may easily be introduced to the jobs, who may be retrained at low cost, and who produce good work with skilled fingers and great diligence.

With rising flexibility the organizational effort increases, but so does the organizational momentum. Growing attention to fashion and quality demands flexible forms of organization. Unplannable situations become more frequent, requiring the staff to assume greater responsibility. At the level of skills[1] this does not only mean knowing more work processes, but also part taking in the decisionmaking and in the responsibiltiy. Table 35 shows the work range of a skilled seamstress in a fashionable clothing firm. Diagram 4 presents the distribution of this worker's time between working and planning.

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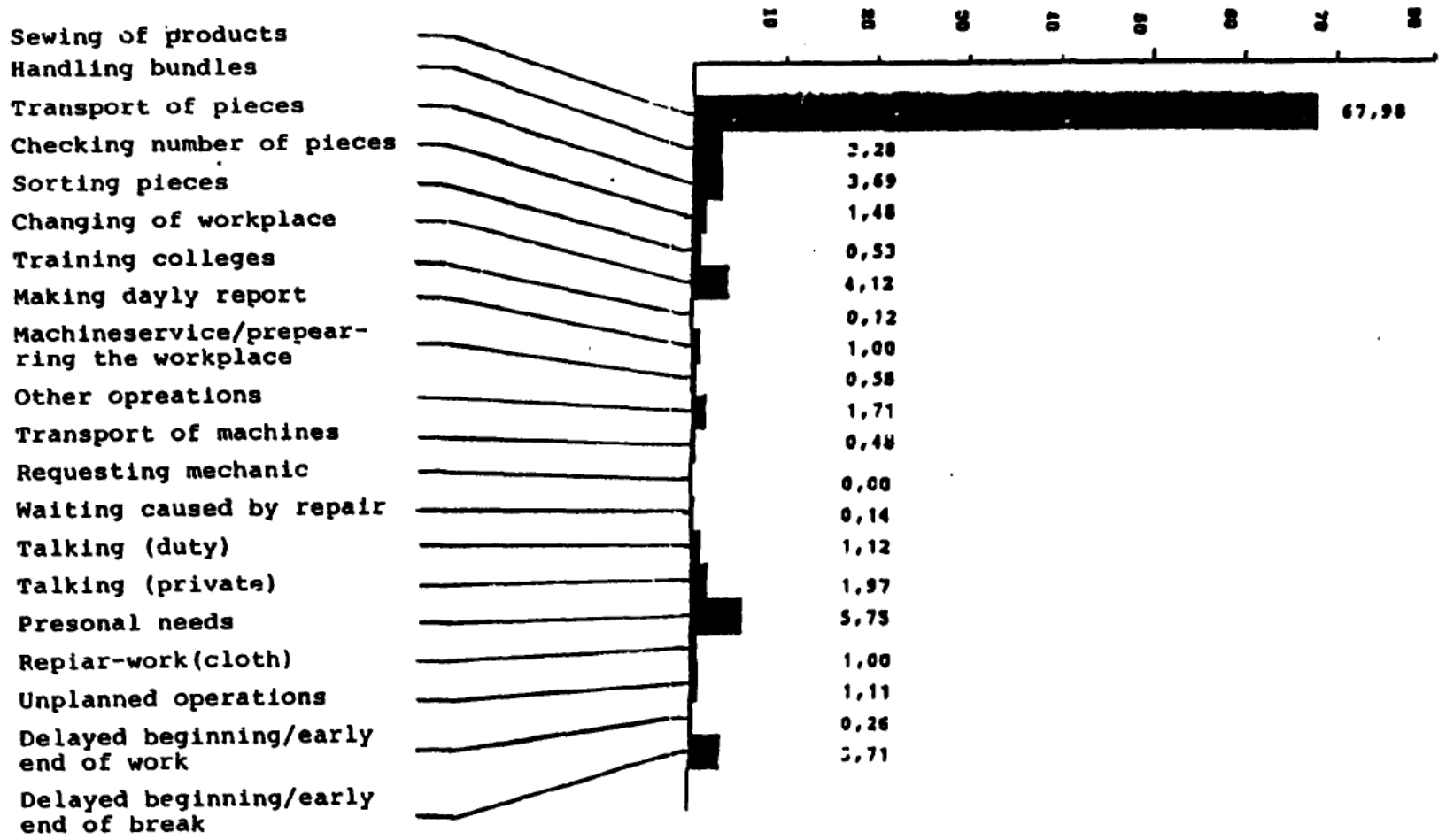
[1] Cf. U. Adler, Arbeitsstrukturierung in der Bekleidungsindustrie. Neue Arbeitsstrukturen als soziale Innovation, Munich 1986, pp. 117 ff.

Table 35: Analysis of Operations carried cut by a well-trained worker in an assembly of a clothing production(top-level garment)

	Primary-operations	Secundary-operations	other operations	together/ average
Planned time per opreation	0.87 minutes	0.87 minutes	0.66 minutes	0.78 minutes
Number of operations, carried out	4	3	4	11
Number of :				
•commissions	35	11	1	50
•bundels	202	51	20	273
Productivity in relation to the normal efficiency of all workers	129%	119%	98%	121%
Share of total output	77%	15%	8%	100%

Source: Ifo-Institute for Economic Research,Munich

Diagram 4 : Functional Distribution of Operations
in the Assembley of a Clothing Production.
(developed country,middle - segment)
figures in % of total opreation time



Source: A W F i Institute ,Berlin.

With new skill demands on labour it becomes evident that the entire learning situation must change. In industry learning is still tied to piecework and changes therein, in the sense of individual work. With the change to more flexible markets, learning can only be done in a cooperative way. Concerning technology, piecework always means such a one-sided orientation, that the low skill becomes a barrier to innovation. That is why handling the technology, just like e.g. safeguarding the quality, must be subject of the training. This also applies to information technology. The point of view that low qualification brings some problems with the absorption of new technology veryfies for developing countries. Great problems exist with the services of machines and the delivery of spare parts.

If the development of a clothing plant is conceived as structural change between the positions sketched here, then the function of the floor managers also changes.[1] They advance from being a first foreman to gradually becoming a supervisor, who makes sure that production is meeting market requirements.

If this general statement is broken down, in light of the basic skill position and the changing situation, into training contents and lines of training, the past argumentation is confirmed (cf. Tables 36/37). These tables present the current situation for work in clothing firms in the FR Germany, exemplifying an industrialized country. They are results of a survey. White-collar workers are expected to have more technical, informational, and communicative skills. It is assumed that the basic training must be augmented.

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[1] Cf. Neue Arbeitsstrukturen in der Bekleidungsindustrie, Frankfurt/M. 1984 and Fischer, J., Führungskräfte im Organisationswandel. Bekleidung und Wäsche, H. 17 (1986).

Table 36: Future issues in qualification of workers and employees in the clothing industries of industrialized countries (results of an enquiry in Germany F.R.) figures in % of answering firms

Qualification issues	Empoyees	Workers
A) A S P E C T S		
- more basic knowledge	41 %	39%
- more productivity	-	41%
- more flexibility	-	74%
- more knowledge for enriched jobs		
+ responsibility for equipment	39%	40%
+ transport	14%	9%
+ planning,steering and controll of productionprocess	39%	8%
+ computer-qualif.	68%	11%
+ information,communication	43%	4%
+ quality	32%	53%
B) AIMS		
- responsibiliy for the own labour	38%	30%
- safety of planning	32%	14%
- precondition of new technologies	32%	45%

Source: Enquiry of the Ifo-Institute for Economic Research Munich

Table 37: Future Issues in Qualification of Managers in the Clothing Industries of Industrialized Countries

(results of an enquiry in Germany F.G)
figures in % of answering firms

Function / Qualification needs for:	Upper-management	Middle-management	Lower-management
- Computer - application	60 %	57%	29%
thereof: Production-planning-, -steering-and -controlsystems	13%	17%	9%
- Cooperative staff-management	40%	52%	33%
- Production-technology	29%	46%	33%
- Quality-control	18%	40%	43%
- Development of staff vocational performance			
+qualifying staff	25%	31%	31%
+training of "methods"	6%	28%	40%
+teamwork	25%	30%	25%
+work-structuring	19%	40%	30%
- Marketing/selling	43%	26%	3%
- Businessaccounting	34%	27%	7%
- Job-evatuation	10%	30%	26%
- Development of organisation	27%	31%	8%
- Product-design	15%	36%	9%
- Transport/logistics	14%	22%	10%

Source: Enquiry of the Ifo-Institute for Economic Reasearch, Munich

For workers, the training must be expanded in the direction of flexibility, safeguarding the quality, and more understanding of the technology or its handling. The question of computer training is not yet so important here, but for employees.

In the area of management, high skill requirements are expected, however. The expected skill trends follow, only with different intensity, the traditional distribution of tasks. Personnel development as a responsibility of group leaders or department heads will place higher demands on them and will thus require higher skills. Leading own's co-workers is more the responsibility of the upper and middle management and less that of the group leaders, who are to be regarded as first foremen. That is why in this area skill requirements will rather concern the plant management, the business management, and the department heads.

Of prime importance is the safeguarding of quality. Here more than 40 % of the companies foresee a need to increase management skills. Besides, in an industry which relies on selling it is plausible for the executives to presume the need of additional skills in their own area of marketing and sales.

With economic development, industrial work in a clothing firm moves from pure piecework toward more universal, more highly skilled work. The job work characteristics are obviously concentrated somewhere between these extremes. It goes without saying that the use of technology does not necessarily create skilled jobs. It does decisively depend on the organization.

Even if lately there is much talk about new technologies, the technologies in assembly are still labour-intensive and demand extremely repetitive, one-sided work. The work places great demands on haptics and sensomotorics.

In the past, new technical developments were not at all certain to initiate an increase in job qualification. Whereas in mechanical engineering flexible automation changed vocations, e.g. turning a lathe operator into a programmer of automated equipment, the solutions in the clothing industry rather turn employees into residual members of production. While e.g. a CNC automatic lathe can de-couple the operator completely from the pressure of phase-time, the pressure on a phase-tied operator of a NC-controlled automatic pocket-sewing machine is likely to increase. This differing effect of technological innovation on job quality may be explained by the completely different relationship of automation. In mechanical engineering the CNC automat serves the flexible automation in an organizational concept directed at innovative dynamics. In the clothing industry the classic automatic pocket-sewing machine assumes a work position in a thoroughly organized process and partially automates it. What remains is residual work, because the concept of automation uni-dimensionally aims at replacing labour. Technological change in the clothing industry is based on a concept of automation and rationalization which has the objective of minimizing labour costs as the "only" variable element. This explains the particular quality of the job. Through its multi-functional organizational concept, the NC automat has the task of realizing the functions of this concept. Through its ability to allow for

flexible automation, the CNC automat is not tied to the linear replacement of labour, but makes new levels of efficiency possible. The machine does not replace, but rather boosts human labour. To these levels of performance necessarily corresponds a higher skill level, because the operator is no longer just responsible for the execution of the work, but also for the innovation dynamics. Diagram 5 is to show the interaction between innovation and skill.

Diagram 5 : The Relation of Automation on Different Levels of Evaluation

Concept \ Dimension	Qualification	Responsibility	Time
Full cycle automation	un-skilled , semi-skilled,	Responsibility for carrying out pre-organized options for own dezisions and own dispositive labour	great lots, short operation-times,
Sequencial automation	un-skilled, semi-skilled,	Responsibility for carrying out highly organized work. "Rest- labour"of automation	great lots, very short operation-times, production"on stock",
Flexible automation	skilled,with a high degree of own responsibility.	Making dispositions and and dezisions for the own labour. Responsibility for flexibility and the dynamic of innovation.	smaller lots, different products, neutralizing cycles of work and machines, production for orders.

Source: Ifo-Institute for Economic Research,Munich

VI. Global Location Pattern of Production

With few exceptions, production[1] has primarily risen in non-industrialized countries during the past 5 to 8 years. Tables 19/20/23/24 have already shown this basic trend in world clothing production. As mentioned before, the relatively simple production technology helps the non-industrialized countries to build up, with little investment, reasonable manufacturing for the homemarket and, with a somewhat higher skill level, to achieve international competitiveness. Clothing technology meets Henry Ford's old dictum[2] for job creation, that workers must earn an income with which they can buy the goods they produce. In this sense clothing production in developing countries will grow in line with the rising domestic demand deriving from income growth. That this represents a potential corresponding to the classical concepts of economic growth, is exemplified by the People's Republic of China, which has started to become "newly clothed" about three years ago.

In the industrialized countries demand has been stagnating for years. Production is declining in the same measure as it is rising in low-wage countries (cf. Table 24). For developing countries, a solid foundation, built on domestic demand and low labour costs, is still a good starting point for becoming internationally competitive, even though trade regulations have sharply restricted the world market for clothing. Despite the serious constraints of the international

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[1] A good survey of the situation in the international division of Labour give: - Fröbel, F. a.o., die neue internationale Arbeitsteilung op.cit and Fröbel, F.a.o., Umbruch der Weltwirtschaft op.cit.

[2] H. Ford, Mein Leben und Werk, Leipzig 1924.

trade agreements (MFA I - IV) on the developing and newly industrializing countries, these countries have been able to increase their share of world trade (cf. Tables 22/23/38/ 39/40/41). This share has grown until 1985 to more than 50 %! In 1985 developing countries' exports to the industrialized countries accounted for almost 12 % of their total exports. Today the MFA must be considered merely an agreement of transition, which makes the structural change occurring in the international division of labour tolerable for the industrialized countries. Of course, the MFA strongly influences the global patterns of the location of production.[1] Ten years ago nobody would have expected that e.g. Bangladesh could build up a clothing industry worth mentioning. Today, at more than 150,000 workers, that country's clothing industry employs almost as many people as Germany's. The importance of the Caribbean region as a supplier of and wage contractor for the US market has also increased considerably. Both regions have special quotas under the MFA and are therefore also very interesting for foreign capital.

The importance of such newcomers will not have diminished by 1995. Peace in the Near East (Iran, Iraq), Central America, but also in Sri Lanka will create a new potential of low-wage producers which may become wage contractors or full exporters. With rising wages in developing countries and especially in the newly industrializing countries (cf. part 4), there is not only the described trend toward more innovation, but also toward the complete business. This means that efforts are being made to start processing one's own fabrics. The present situation of the world exports in the clothing market is described by the ILO-Report III op.cit as follows (cf. Table 39).

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[1] The entire complex of world production of clothing is analyzed in: ILO, The Impact on Employment, op. cit., ch. B.I.

Table 38: The Share of Textile- and Clothing-Exports of the Whole Exports
(percentage structure of exports)

Year / Branch	1965	1973	1978	1983	1985	average annual growth	
						1978-1983	1983-1985
	industrialized to industrialized countries						
textiles	5,1	4,4	3,9	3,1	3,1	1,9	5,0
clothing	1,8	2,1	2,2	2,0	2,2	4,1	9,1
	industrialized to developing countries						
textiles	5,8	4,4	3,1	2,9	3,0	3,5	- 1,6
clothing	1,2	0,7	0,7	o,7	0,8	5,2	- 3,7
	developing to industrialized countries						
textiles	3,7	5,1	4,8	3,9	3,8	4,0	6,8
clothing	1,9	7,3	10,7	10,5	11,8	9,5	13,4
	developing to developing countries						
textiles	9,1	10,6	10,4	9,0	-	6,0	- 3,7
clothing	1,7	2,8	3,9	3,5	-	6,4	- 0,3

Source : ILO - Report III to the third tripartite technical meeting for the clothing industry, UNCTAD,GATT-Statistics.Geneva 1987
The Impact on Employment and Income of Structural and Technological Change in the Clothing Industry ,Geneva 1987.

Table 39: TRADE IN CLOTHING IN SELECTED COUNTRIES, 1979, 1982-85

(in Billions of U.S.Dollars)

	Exports (f.o.b.)					Imports (c.i.f.)				
	1979	1982	1983	1984	1985	1979	1982	1983	1984	1985
Canada[a]	0.17	0.21	0.19	0.24	0.25	0.73	0.84	1.03	1.30	1.29
United States	0.96	0.99	0.88	0.85	0.72	6.14	8.79	10.32	14.60	16.21
Argentina	0.03	0.04	0.03	0.02	...	0.04	0.03	0.01	0.01	...
Brazil	0.12	0.10	0.11	...	...	0.01	0.01	0.01	0.01	...
Colombia	0.11	0.13	0.06	0.04	...	0.01	0.01	0.02	0.02	...
Austria	0.51	0.55	0.54	0.52	0.58	0.80	0.78	0.83	0.87	0.89
Belgium-Luxembourg	0.90	0.75	0.75	0.73	0.74	1.60	1.44	1.37	1.29	1.34
Denmark	0.32	0.38	0.38	0.42	0.47	0.48	0.41	0.39	0.42	0.50
Finland	0.56	0.65	0.50	0.50	0.52	0.16	0.21	0.20	0.21	0.26
France	2.02	1.82	1.76	1.76	1.97	2.19	2.60	2.45	2.46	2.74
Germany, Fed. Rep.	2.61	2.52	2.56	2.62	2.88	7.34	6.71	6.73	7.01	7.05
Greece	0.31	0.47	0.54	0.62	0.65	0.04	0.06	0.06	0.07	0.07
Ireland	0.20	0.17	0.18	0.18	0.20	0.33	0.38	0.36	0.35	0.37
Italy	4.39	4.41	4.53	4.83	5.36	0.53	0.68	0.63	0.66	0.79
Netherlands	0.78	0.69	0.67	0.67	0.75	2.71	2.13	1.97	1.92	2.05
Norway	0.06	0.06	0.05	0.04	...	0.59	0.66	0.60	0.64	...
Portugal	0.48	0.65	0.70	0.83	...	0.01	0.03	0.02	0.02	...
Spain	0.29	0.30	0.30	0.35	0.35	0.10	0.14	0.12	0.10	0.12
Sweden	0.26	0.21	0.21	0.22	0.24	1.14	1.08	0.94	0.98	1.13
Switzerland	0.32	0.30	0.29	0.29	0.30	1.25	1.39	1.39	1.46	1.49
Turkey	0.10	0.40	0.65	1.27	...	0.00	0.00	0.00	0.00	...
United Kingdom	1.59	1.47	1.31	1.34	1.52	2.53	2.52	2.42	2.69	2.69
Yugoslavia	0.27	0.61	0.51	0.59	0.56	0.04	0.02	0.02	0.02	0.01
Czechoslovakia[a]	0.36	0.44	0.43	0.46	...	0.16	0.13	0.15	0.15	...
Hungary	0.34	0.31	0.27	0.28	0.21	0.08	0.13	0.11	0.11	0.12
Poland[a]	0.69	0.36	0.27	0.27	...	0.11	0.08	0.18	0.12	...
Romania	(0.50)	(0.60)	(0.60)	...	...	...	...	...	...	...
USSR[a]	0.03	0.02	0.03	0.02	...	1.92	2.68	2.57	2.64	...
Egypt	0.02	0.02	0.01	...	...	0.01	0.01	0.00	...	...
Morocco	0.10	0.14	...	...	...	0.00	0.00	...	...	...
Tunisia	0.28	0.33	0.33	0.29	...	0.07	0.06	0.05	0.04	...
Israel	0.09	0.23	0.21	0.22	...	0.02	0.04	0.04	0.02	...
Saudi Arabia	0.01	0.02	...	...	...	0.51	0.85	...	...	...
Australia[a]	0.02	0.01	0.01	0.01	0.01	0.32	0.42	0.34	0.42	0.40
Bangladesh	0.00	0.01	0.02	0.08	...	0.00	0.00	0.00	0.00	...
China[b]	1.43	2.03	2.14	2.93	3.15	0.03	0.08	0.09	0.12	0.13
Hong Kong[c]	4.18	5.22	5.29	6.75	6.72	0.39	1.06	1.17	1.48	1.70
India	0.54	...	...	...	...	0.00	...	...	...	...
Indonesia	0.07	0.12	0.16	...	...	0.00	0.00	0.01	0.01	
Japan	0.35	0.55	0.66	0.78	0.73	1.80	1.83	1.50	1.95	2.00
Korea, Rep. of	2.85	3.70	3.70	4.50	4.50	0.02	0.01	0.01	0.02	0.02
Malaysia	0.12	0.17	...	...	...	0.03	0.04	...	...	...
New Zealand	0.03	0.04	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.03
Pakistan	0.08	0.14	0.23	0.25	...	0.00	0.00	0.00	0.00	...
Philippines	0.22	0.31	0.32	...	...	0.00	0.01	0.01	...	...
Singapore	0.37	0.46	0.48	0.55	0.54	0.11	0.27	0.30	0.32	0.30
Sri Lanka	0.07	0.17	0.20	0.29	...	0.00	0.00	0.01	0.00	...
Taiwan	1.75	2.90	2.99	3.76	3.51	0.01	0.01	0.01	0.01	0.01
Thailand	0.21	0.37	0.41	0.55	...	0.00	0.01	0.01	0.01	...

[a] Imports f.o.b. [b] Adjusted by the Secretariat to fully reflect trade with Hong Kong.

[c] Includes significant transhipments. Domestic exports were as follows: 1979-3.99; 1982-4.68; 1984-5.96; 1985-5.73.

Sources: GATT, International Trade 85-86 Geneva 1986, Table A25;
U N S O Comtrade data base; national trade statistics.

TABLE 40 A —GROWTH IN CLOTHING TRADE OF SELECTED COUNTRIES, 1984 AND 1985

(Percentage change over preceding year)

	US Dollars		National currencies	
	1984	1985	1984	1985
Exports				
United States	-4	-15	-4	-15
France	...	12	16	15
Germany, Fed. Rep.	3	10	15	14
Italy	7	11	23	21
United Kingdom	2	13	16	17
China	36	8	60	37
Hong Kong	28	-1	37	-1
Korea, Rep. of	22	...	26	8
Taiwan	26	-7	25	-6
Imports				
United States	40	11	40	11
Belgium-Luxembourg	-6	4	6	7
France	...	12	15	15
Germany, Fed. Rep.	4	1	16	4
Netherlands	-2	7	10	11
Switzerland	5	2	17	7
United Kingdom	11	...	26	3
Hong Kong	27	14	37	14
Japan	30	3	30	3

Sources: GATT, International Trade 85-86 Geneva 1986, Table II 20 /21

TABLE 40 B —THE TEN LEADING EXPORTERS AND IMPORTERS OF CLOTHING, 1979 AND 1985

(Billion dollars)

	1979	1985
World trade in clothing	**34.3**	**49.2**
Exporters		
Hong Kong	4.2	6.7
Italy	4.4	5.4
Korea, Rep. of	2.9	4.5
Taiwan	1.8	3.5
China	1.4	3.2
Germany, Fed. Rep.	2.6	2.9
France	2.0	2.0
United Kingdom	1.6	1.5
Turkey	0.1	1.3[a]
United States	1.0	0.7
Percentage share of the ten in world exports	64	64
Importers		
United States	6.1	16.2
Germany, Fed. Rep.	7.3	7.1
France	2.2	2.7
United Kingdom	2.5	2.7
USSR	1.9	2.6[a]
Netherlands	2.7	2.1
Japan	1.8	2.0
Hong Kong	0.4	1.7
Switzerland	1.3	1.5
Belgium-Luxembourg	1.6	1.3
Percentage share of the ten in world imports	81	81

[a] 1984.

Table 41: AREA DISTRIBUTION OF TRADE IN CLOTHING - SELECTED REGIONS 1979,1982-85

	EXPORTS (f.o.b.)				IMPORTS (c.i.f.)			
	1979	1983	1984	1985	1979	1983	1984	1985
NORTH AMERICA								
Total (billion dollars)	1.1	1.1	1.1	1.0	6.9	11.5	15.9	17.5
	(Percentage shares)							
Intra-trade	12	19	23	26	2	2	2	2
Latin America	37	40	44	49	9	6	6	7
Western Europe	34	19	14	12	10	7	9	11
East. Europe & USSR	-	1	1	-	2	1	1	1
Africa	1	1	1	1	-	-	-	-
Middle East	2	6	5	4	-	-	-	-
Asia	11	8	8	8	77	84	81	78
WESTERN EUROPE								
Total (billion dollars)	16.0	16.4	17.8	19.3	21.9	20.6	21.2	22.6
	(Percentage shares)							
Intra-trade	85	82	79	80	67	65	65	68
North America	4	5	8	10	2	1	1	1
Latin America	1	-	-	-	1	1	1	-
East. Europe & USSR	2	4	4	2	5	4	4	4
Africa	3	2	2	2	2	3	3	3
Middle East	2	4	4	3	1	1	1	1
Asia	3	3	3	3	22	24	25	23
MAIN EAST ASIAN CLOTHING SUPPLIERS[a]								
Total (billion dollars)	10.2	14.1	17.9	17.9	0.4	1.3	1.6	1.9
	(Percentage shares)							
Intra-trade	3	6	7	8	55	77	81	82
North America	38	49	53	53	4	1	1	1
Latin America	2	1	2	2	-	-	-	-
Western Europe	31	22	20	18	22	9	7	7
East. Europe & USSR	4	2	1	2	5	2	1	1
Africa	3	2	2	1	-	-	-	-
Middle East	4	7	4	4	-	-	-	-
Other Asia	14	10	11	11	14	11	9	9

[a] China, Hong Kong, Japan, Republic of Korea and Taiwan.

Sources: GATT, International Trade 85-86 Geneva 1986, Table A27; UNSO Comtrade data base ; national trade statistics.

The situation of 49 countries in the international trade of clothing shows the table 39.

..."The top exporters of the past 15 years have generally remained the same. Major exceptions, or rather, major changes in ranking were as follows:

(a) China has continually improved its position since 1973 (rank 12) and now has rank 4.

(b) Portugal has steadily improved its position since 1978. It is now a member of the EC. It should be able to do even better within the Community, although EC transitional restrictions may prevent it from reaching its full potential.

(c) Turkey, whose clothing exports have climbed steeply since 1980, shot up 22 positions to rank 13, despite encountering considerable resistance in the EC and the US markets. In 1985 it was the third largest outside supplier of clothing to the 12 countries of the EC, after Hong Kong and the Republic of Korea. Whereas these latter suppliers saw their exports to the EC decline by 25 % and 20 % respectively in the period 1980-85, Turkey's exports to the EC increased by 525 %.

(d) The United States gave a particularly weak performance in export markets, falling six positions to rank 15 within a two-year period (1983-85). The appreciation of the US dollar during that period undoubtedly accelerated the structural shifts already under way in the US clothing industry. With a 30 % increase in the effective exchange rate of dollar during the period 1980-85, the position of domestic clothing manufacturers obviously worsened considerably.

(e) India has moved up five positions since 1980 and 14 positions since 1973. India's clothing industry, in contrast to its largely domestically oriented textile industry, has been successful despite domestic policy constraints and MFA barriers. Accounting for approximately 15 % of manufactured exports (in 1985), clothing is now one of India's main exports. Textiles, on the other hand, which were once a mainstay (in 1965 over two thirds of manufactured exports were textiles), have fallen far below the level of clothing exports.

(f) Thailand has moved up eight positions since 1980 and now occupies rank 22. Had it not been for the severe constraints placed on Thailand's exports by the United States since 1985, Thailand's position would now be noticeably higher. Since it enjoys relatively unencumbered access to the world's textile markets, Thailand has been able to establsih a rapidly expanding industry in and around the densely populated area of Bangkok.

(g) The Philippines succeeded in climbing to rank 16 in 1985, from rank 26 in 1980 and rank 40 in 1973. Although a sizeable amount of Philippine exports come from the Export Processing Zone in Bataan, a significant proportion is also produced by operations based on bonded warehouses or duty-drawback systems. In both systems, textiles imported from Asian sources are used to manufacture clothing which is then exported.

(h) Bangladesh, which exported virtually no clothing at all in 1980, had raised its ranking to 39 by 1985, exporting more clothing than Colombia or Brazil.

The poor performance of countries in Africa and Latin America is also evident.... There is little reason to believe that any major omissions were made; trade trends can therefore be assumed to have been relatively correctly portrayed.

Lastly, one crucial aspect that has so far received little attention is that the developing world has assumed the lead in clothing exports. With about 55 % of world trade in clothing, it has reached the position held by the industrialized world ten years ago, which is 200 % greater than its own share 20 years ago.

The data presented on the performance of clothing exporters on the world market, together with information from other sources, highlight the speed with which production has shifted from high to lower labour-cost locations. On the international scale, this shift is expressed by the increase in the developing countries' share of total world trade in clothing, which continued to rise at roughly the same rate in the five years through 1985 as it did in the five years through 1978....

> ...The volume of exports from the developing to the industrialized world relative to the volume of trade among industrialized countries is in fact much greater than it appears from the tables because of the much lower unit values of clothing from the developing world. ...This means, for example, that although US clothing imports from Italy were 400 % higher than those from Bangladesh in value terms, in volume terms imports from Bangladesh exceeded those form Italy by about 20 %. Again, it can be determined that US $ 10 of imports from Bangladesh represent approximately three shirts, whereas in terms of US production US $ 10 represents only one shirt. Assuming that shirts from Bangladesh are good substitutes for US shirts, which may not be the case, then US production and employment will decrease accordingly. In response to such pressure from abroad, production has tended to shift to other locations within the country where domestic labour costs are lower, in order to compensate for some of the price differences. However, exporting firms in developing countries often enjoy the further advantage of access to textiles from low cost sources, whereas in industrialized countries textiles often come from protected industries producing at higher cost. Access to efficient textile producers can thus be of crucial importance for the competitive position of the clothing industry."

From this overall situation we may draw the conclusion that the importance of the developing countries as exporters as well as producers within joint ventures will remain high for the industrialized countries (and increasingly also for the newly industrializing countries, which also have higher labour costs) and will also remain high as wage contractors. This is confirmed by most recent information from firms in the industrialized countries (cf. Table 42). Expiration of the MFA will not change this either, because in that case

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[1] Cited from ILO Report III to the Third Tripartite Technical Meeting for the Clothing Industry, Geneva 1987.

Table 42: Turnover of Clothing Firms in the F.R.of Germany
(Production in% of turnover of producers for middle to high-price segments ,data of enquiry)

Production :	Own Production		Sub-Contracted		Trade- Goods	
	Home	Abroad	Home	Abroad	Home	Abroad
Enquiry 1983	63%	3%	14%	10%	3%	8%
Enquiry 1987	45%	8%	14%	17%	6%	10%

Source: Ifo-Institute for Economic Research,Munich.

free trade in high quality merchandise on the one hand and in standard merchandise on the other would find additional demand. At the same time this would provide access to the cheapest labour markets, which may be of great advantage to the industrialized countries. In the medium term the low-wage countries will remain the net beneficiaries in terms of employment.

Relocation of production to the industrialized countries on a large scale up to 1995 is also improbable. Relocation could only occur on the basis of extensive automation in the industrialized countries (the Japanese suggestion). This would imply, however, that the clothing industries (even if there were such a technology) would have to be totally modernized with an entirely different investment volume. This modernization could only be realized at such a time when today's newly industrializing countries will have attained a rather high wage level. Japanese-style superautomation may - whenever it becomes available - benefit those which today have low-wage advantages more than the industrialized countries.

That is why it is more likely that automation technologies, which today are considered revolutionary, may rather induce a relocation of production to the newly industrializing countries. This will then also apply to the European low-wage countries like Spain, Portugal, Greece, the GDR, USSR, Yugoslavia, Turkey, etc. This means that adaptedness of technology will most likely persist for sub-industrialized countries. At the other hand we must see, that more automation in industrialized countries will firstly relocate only more production but not more employment to the industrialized countries. That is a point of view even the trade unions see.

As in the past, global locational patterns will be determined by market-economy and planned-economy tendencies together with regulations from trade restrictions, which as a rule are exploited to the greatest possible extent.

VII. Summary of Part B

Women's work in the clothing industry is very simple work and will remain so in the future. The developing countries represent that part of world clothing production which still has the potential to grow. In international competition they also have the advantage of low wage costs and therefore low prices. At present they account for approximately 50 % of world trade. The industrialized countries may only meet this challenge by concentrating on high quality merchandise.

From the point of view of the industrialized countries that kind of technolgical progress is lacking which could compensate for the comparative wage advantage of the developing countries. Effective innovation barriers are preventing such fundamental approaches to automation. All decisive technological developments are related to the introduction of microelectronics. In the industrialized countries the focus is primarily on containing the increasing costs of information and flexibility, which go hand in hand with production for sophisticated markets. The existing clothing technolgy allows the developing countries to create jobs with comparatively low investment, jobs whose level of production costs matches the level of income. In this respect the clothing industry is also of importance as a pioneering export industry.

In the clothing industries the work of women is not only demanded because women are more skillful and more conscientious, but because they are always willing to work for lower wages. Although the clothing industry is a women's industry, men get the higher-skill and better-paid jobs. As a rule, women with better entry qualifications even have worse careers. Unless they have an academic education, women's careers end at best at the lower management level.

In developing countries, women's work, especially in assembly, corresponds best to the general perception that the clothing industry provides work for unskilled and semi-skilled labour.

Regarding the impact of new technologies on labour, this must simultaneously be viewed as a function of the particular market segment. We support the thesis that the general relationship between low labour costs and low capital costs (simple technology) is broken whenever the product standard determines the technology. In that production segment, identified as the high-priced quality segment, the identical, latest technology is used. In developing countries, too, women's work is affected by the latest state of technological progress. The intensity and direction of this effect depends on competing lines of technological development. If technological change follows the traditional path, i.e. using machines like computers in order to separate planning tasks from processing tasks and to automate the processing tasks as much as possible, women's work will most likely remain nothing but the simplest residual work at automated equipment. This could become the problem of processing zones. If, however, machines and computers are used to develop occupational capabilities, then high-skilled work is created, which also is the prerequisite for maintaining competitiveness even in high-wage regions. It is the second line of development which offers employment opportunities in industrialized countries.

In both cases women's work will retain its importance in the clothing industries. There is no danger that by 1995 women will have been replaced by men and machinery. Quite to the contrary: Women's work is the mainstay of the clothing industry world-wide. With great likelihood today's developing countries will grow into a position corresponding to that of today's newly industrializing countries. The newly industrializing countries, in turn, will increasingly face problems similar to those now existing in the industrialized countries, with similar consequences for labour or the labour-intensity of production, respectively. The necessary innovativeness can hardly be envisioned to lead to a plant without people.

C Selected Literature

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