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AN ASSESSMENT OF THE MARKET OPPORTUNITY

IN FRICTION SPINNING MACHINERY

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ASSESSMENT OF THE MARKET OPPORTUNITY IN FRICTION SPINNING MACHINERY

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ASSESSMENT OF THE MARKET OPPORTUNITY IN FRICTION SPINNING MACHINERY

EXECUTIVE SUMMARY AND CONCLUSIONS

- The principal addressable world market for a market entry-level SpinWell based spinning machines, (i.e. relating to the production of short staple knitting yarns), amounts to 60 million ring spindle equivalents, i.e. around 30% of total short staple spinning capacity worldwide.
- At the spin-box's preferred productivity rate of just 7.5 faster than ring spindles, this equates to a potential market of 8 million spinning positions, assuming 100% replacement of existing machines (mostly ring spinning).
- The inclusion of a number of weaving yarns (which Belroy maintain the current technology is capable of producing) would roughly double the size of the SpinWell's addressable market to an equivalent of around 15 million spinning positions.
- 50% of this market lies in low labour cost countries of the Far East and Indian sub-continent and investment in these markets, particularly in ring machines, has been falling sharply due to over-capacity and depressed world markets. In contrast, automated rotor spinning has shown some recovery in the US and to a lesser extent in Europe. World deliveries in 1993 fell to fewer than 4 million spindle equivalents.
- In the longer term, world markets for short staple knitting yarns are forecast to grow by less than 2% per annum. Most machinery growth to cope with this increased demand is predicted for China, India, Pakistan and Brazil, while the spinning of short staple yarns in developed economies and NICs is expected to continue to contract.
- Spinning machine scrappage rates also remain low, particularly for ring machines. Over 8O% of short staple spindles are more than 10 years old.
- There is no evidence of any imminent major breakthrough in spinning technology able to offer the required versatility and step change in production costs required to encourage yarn producers to change their existing system; recent developments remain restricted to niche markets.
- More detailed analysis may be necessary to establish whether, at its current level of development, the SpinWell spin-box offers significant enough cost savings in the largest and most buoyant (low labour cost) ring spinning economies, or the versatility for European spinners, to induce widespread adoption of the new technology. The US may represent one possible potential market, despite that country's commitment to rotor spinning.
- A major cost saving factor in the SpinWell's favour is that the technology enables high quality short staple yarns to be produced from the cheaper and less cleaned cottons than either ring or rotor can use.
- It is not too optimistic to assume that 1% of the 8 million addressable world market for SpinWell spinning positions (i.e. just knitting yarns) will come up for replacement annually, equating to an opportunity for the sale of 80,000 SpinWells per annum.
- At a total machine selling price of $3,000 per spinning position, a potential annual market for knit yarns of $240 million.
- Winning a 15% market share would equate to a turnover of $36 million per annum.
- If we take the total addressable market (i.e. including weaving yarns) of 15 million spin-boxes, and using the same assumptions as above, we get an opportunity for the sale of 150,000 SpinWells per annum, a potential annual market of $450 million, giving a turnover of $67.5 million per annum.

ASSESSMENT OF THE MARKET OPPORTUNITY IN FRICTION SPINNING MACHINERY

1 INTRODUCTION

1.1. Background

Over a period of years, Mr. Roy & Beryl Parker (trading as Belroy) have spent some £2.5 million on the development of a new friction spinning technology called the SpinWell. Belroy is now keen to proceed to the pre-production phase which will require external financial and manufacturing resources. Following the conclusion of lengthy, but ultimately fruitless discussions between Belroy and Schlafhorst, Mackie are now considering entering a licensing agreement for the machine's development and production.

Since Mackie are not currently directly involved in the short staple spinning sector, they have asked David Rigby Associates (DRA) to produce a short report on the market opportunity that the SpinWell represents.

1.2 Objectives and Scope

This report sets out to describe the market opportunity for the SpinWell friction spinning machine, by reference to:

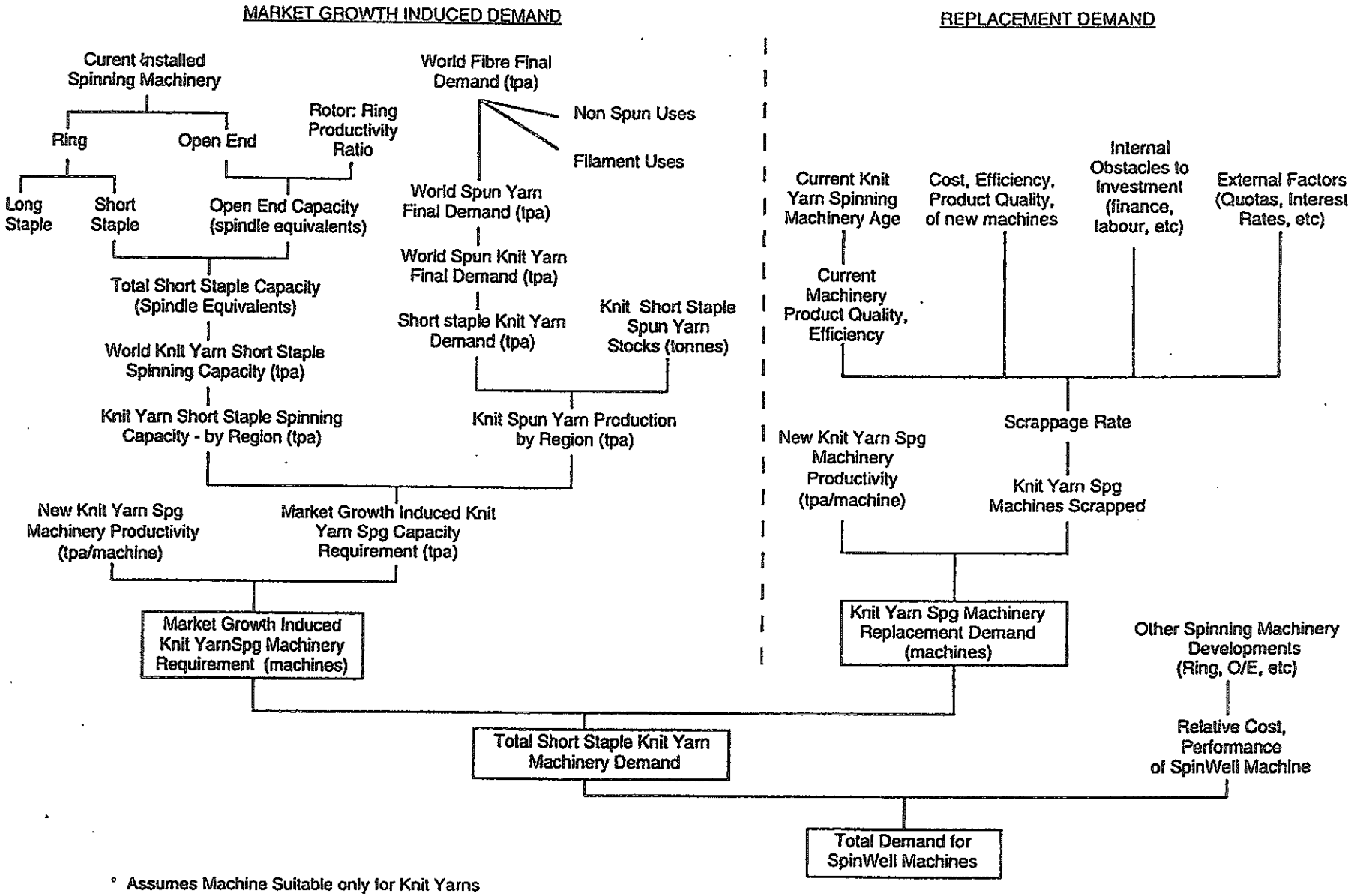
- current short staple spinning machinery installations worldwide and the level of capacity utilisation;
- projected rates of growth in demand for short staple yarns;
- an analysis of cost and other factors which impact on the rate of spinning machinery scrappage;
- an assessment of new or impending spinning machinery developments which may present a threat to the SpinWell machine.

Since the SpinWell machine is suitable only for short staple spinning (i.e. 100% cotton fibres and blends with man made fibres) and Belroy are promoting the machine for use, at least initially, purely for the spinning of yarns for knitting, the report concentrates on the market for short staple knitting yarns, where the SpinWell offers a bulky yarn with a soft hand at far faster speeds than the normal ring spinning production route.

A schematic representation of the principal determinants of the demand for the SpinWell machine, as seen by DRA and covered by this report, are given overleaf in Exhibit 1.

It is not the intention of this report to check the accuracy of the data relating to the SpinWell yarn's performance, production cost, etc., as provided openly by Alan and Roy Parker, nor to make a detailed technical or commercial assessment of the machine in order to produce market share forecasts.

Schematic Showing Principal Determinants of Demand for SpinWell Friction Yarn Spinning Machine*



° Assumes Machine Suitable only for Knit Yarns

2 THE WORLD SHORT STAPLE SPINNING MACHINE MARKET

2.1 Current Installed Machines and Capacities

At the end of 1993 (latest data available), a total of 163.6 million short staple ring spindles and 7.7 million open end rotors were installed worldwide. The International Textile Manufacturers Association (ITMF) calculate that on average, the productivity rate for rotors installed at the end of 1993 is 4.7 times that for ring spindles; on that basis, world short staple spinning capacity equates to some 200 million ring spindle equivalents.

Spinning machines using other technologies (such as friction, wrap and air jet) are also in place, but even their combined volumes are negligible.

Exhibit 2 shows the geographical spread of installed rings and rotors by broad region at the end of 1993. Appendix 1 gives details by individual country. Low labour cost countries of the Far East and the Indian sub-continent account for around 50% of total capacity.

Exhibit 2: Installed Short Staple Spinning Machinery End 1993 - World

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. Installed	% of Total	No. Installed	% of Total
Africa	8068	4.9	165.4	2.2
North America	12155	7.5	1067.6	13.9
South America	12040	7.5	259.4	3.4
Asia & Oceania	107205	65.5	1852.8	24.1
East Europe	12265	7.5	3581	46.7
EEC	7034	4.2	525.1	6.8
EFTA	722	0.4	29	0.4
Europe - Others	4107	2.5	195.2	2.5
Total	163596	100	7675.5	100

Source: ITMF

Principal reasons for the wide disparity in the geographical split for ring and rotor spinning capacities include:

- the widespread acceptance of ring spinning as the most versatile and lowest investment cost spinning method, most suited for countries with low labour costs and/or high costs of capital - i.e. those countries that have expanded their primary textile industry over the last 2 decades;
- the superior productivity, but higher capital cost, of O-E rotors, compounded by the frequent need to invest simultaneously in finishing equipment to remove some of the unfavourable harsh handle characteristics stemming from this yarn type;
- the greater consumer acceptability of rotor spun yarns (mostly at the coarser end) in the US (e.g. for hard-wearing denim fabrics) and in Eastern Europe.

The advantages and disadvantages of each major yarn technology are discussed in more detail in Section 4.

2.2 Knit Yarn Spinning Capacity

No data is collected on the use of spinning machines specifically for knitting yarns. However, trade discussions and published statistics on fibre usage in Europe and a small number of other markets indicate that knit yarns may represent less than the 40% of yarn production suggested by Belroy:

- An analysis recently performed jointly by ITMF and Sulzer estimated that knit yarn accounted for around 28% of all short staple spun yarn production worldwide
- Data from CIRFS (the European Man Made Fibre Association) indicated that in 1992, knit yarn accounted for 34% of all spun yarn produced in the EU (having risen from 23% in 1975) and an estimated 29% of short staple yarn
- A CIRFS estimate for China implies a 30% share of cotton yarns being produced for knitting

On the basis of taking 30% as being the world knit yarn share of world short staple yarn production, weaving accounts for around 70% and remains the dominant fabric production process in most developing countries.

The use of knitted fabrics has grown worldwide and will continue to grow mainly through the increased demand for knitted leisurewear, and in this fashion-driven knitwear marketplace DRA believes that the logo branded goods will remain pre-eminent, so it is likely that the high cost developed countries will retain a relatively strong share of world production.

Taking 30% as being the world knit yarn share of world short staple yarn production, and assuming the same output per spindle for weaving and knitting yarns on average, and using the 200 million spindle equivalents installed worldwide (which DRA estimated at 2.1 above), DRA calculations indicate that some 60 million ring spindle equivalents are currently used in the production of knitted yarns worldwide.

Assuming a productivity ratio between SpinWell and ring of 7.5 : 1 (Belroy figure), the apparent addressable market for the SpinWell friction spinning machine (for knitting yarns only) equates to 8 million spinning positions. Exhibit 3 overleaf details the geographic split of this potential market.

Belroy maintain, however, that in addition to knit yarns, the SpinWell spin-box, even at its current stage of development, is capable of producing a number of yarns strong enough for a variety of weaving end uses, particularly as face yarns in applications such as towelling and velours, and as synthetic warp yarns. Such yarns may represent a further 25% of short staple yarn production worldwide, implying a further 7 million spinning positions in the addressable market for a machine based on the SpinWell spin-box.

Thus the total addressable market for an entry-level machine could be 15 million SpinWell spin-boxes, which at say 200 SpinWell positions per machine, equates to 75,000 machines.

Exhibit 3: Estimated Knitting Yarn Production Capacity and SpinWell Potential Market for Knit Yarns only

	Estimated Knit Yarn Production Capacity (end '93) (m spindle equivalents)	Equivalent SpinWell Capacity (000 Spinning Positions)
W Europe (excl. Turkey)	3	400
EE/USSR	8	1070
Total Europe (incl Turkey)	12	1600
Africa	2	260
Americas	9	1200
Asia/Oceania	37	4940
World	60	8000
of which:		
China	17	2260
US	3	400
India	8	1170

Source: DRA

2.3 Changes in Installed Capacities

Although ring spinning accounts for 80% of short staple spinning capacity worldwide, rotor spinning, being a relatively new technology, has grown far more quickly over the last decade. Even in unadjusted terms, rotor capacity has grown by 32% compared with 13% for ring spindles. Since the rotor : ring productivity ratio has risen from 2.9 to 4.7 over the same period, the share taken by rotors worldwide in terms of spindle equivalents has risen sharply.

Exhibits 4 and 5, overleaf, confirm how this growth has been greatest in North America, where ring capacity has actually fallen. In Europe, universal pressures on the textile and clothing supply chains have seen a fall in installed capacity in both ring and rotor spinning.

2.4 Machine Deliveries

While rotor capacity has increased its share of short staple spinning capacity over a 10 year period, deliveries were on a downward trend through the 1980s in Eastern Europe (stimulated by that region's general economic decline) and peaked elsewhere in 1988. Deliveries of ring spindles into the EC and USA also fell back after 1988, but worldwide deliveries continued to grow on the back of a huge surge in investment in Asia which peaked only in 1990.

Over the last 4 years, the picture appears to have changed with investment in O-E rotors recovering in the US and to some extent in Asia, while ring spinning has continued to fall to levels less than half of their 1990 peak (see Exhibits 6 and 7). In 1993, some 2.6 million ring spindles were delivered worldwide compared with 290,000 rotors.

Full details of a country by country analysis of 1993 deliveries are given in Appendix 2.

Exhibit 4: Changes in Installed Capacities 1983 to 1993 - Ring Spindles

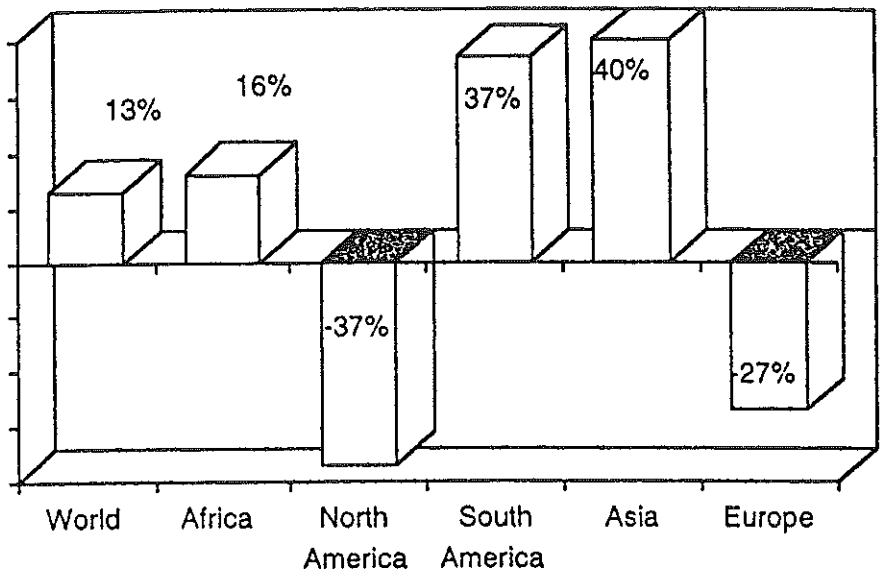
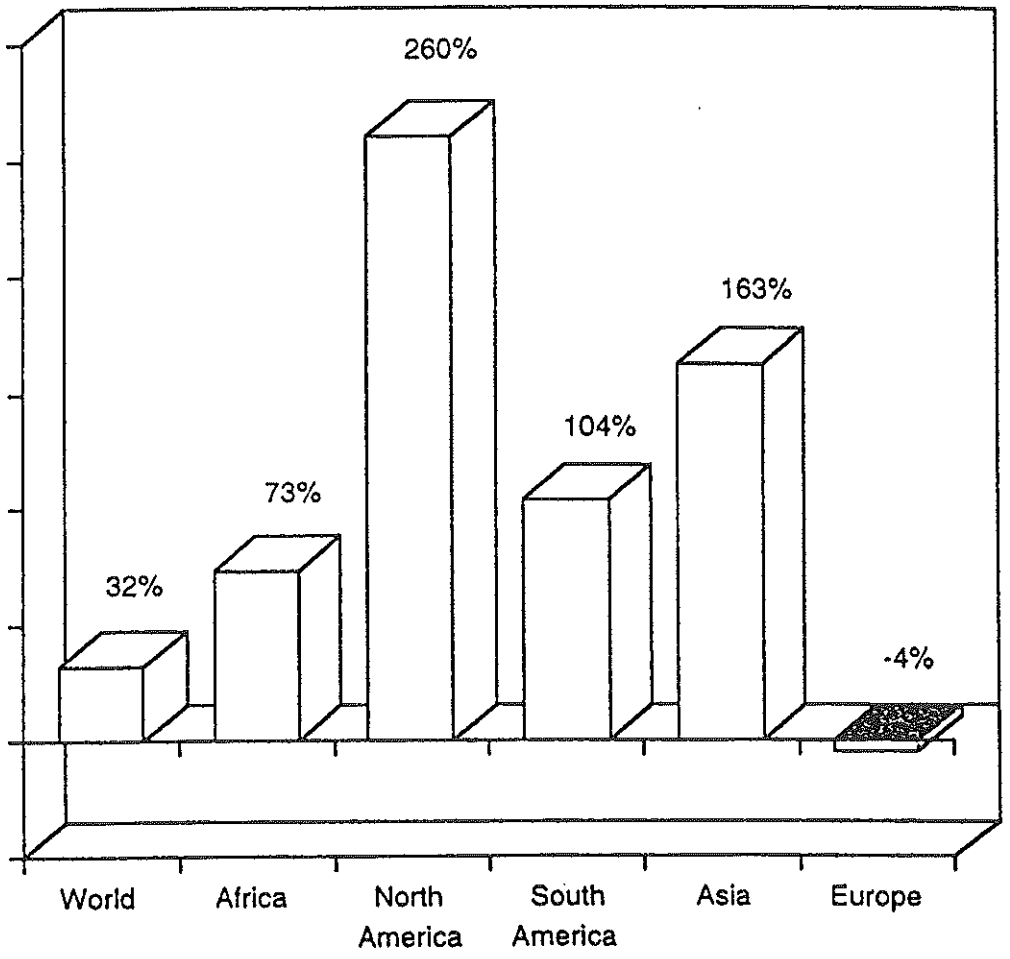
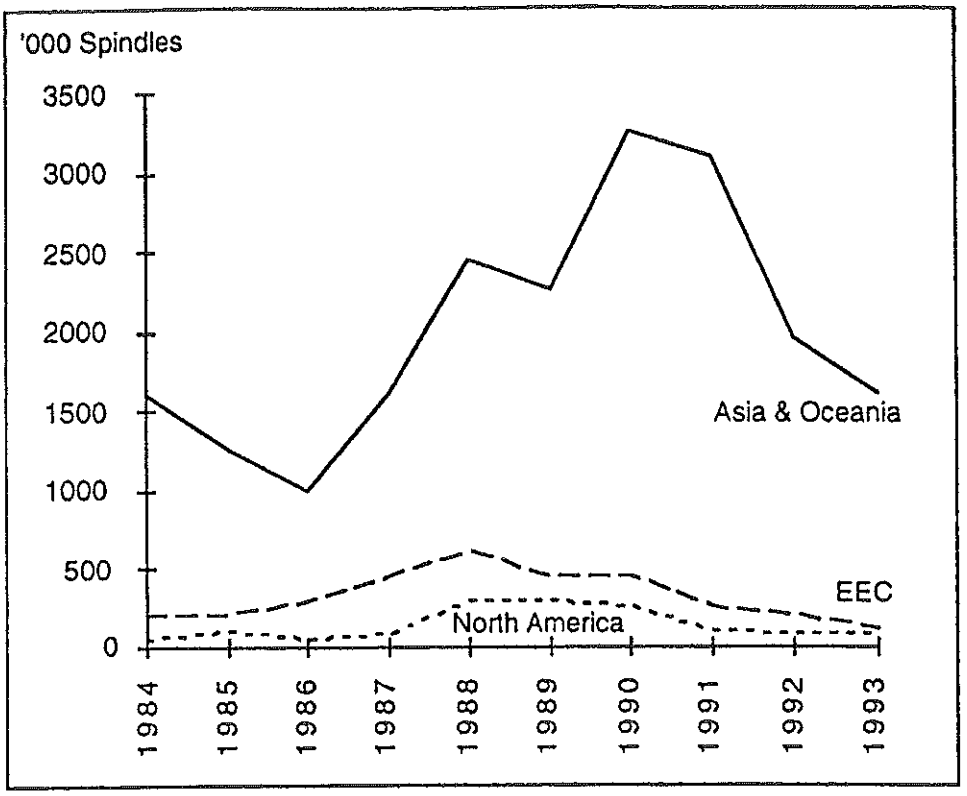


Exhibit 5: Changes in Installed Capacities 1983 to 1993 - O-E Rotors



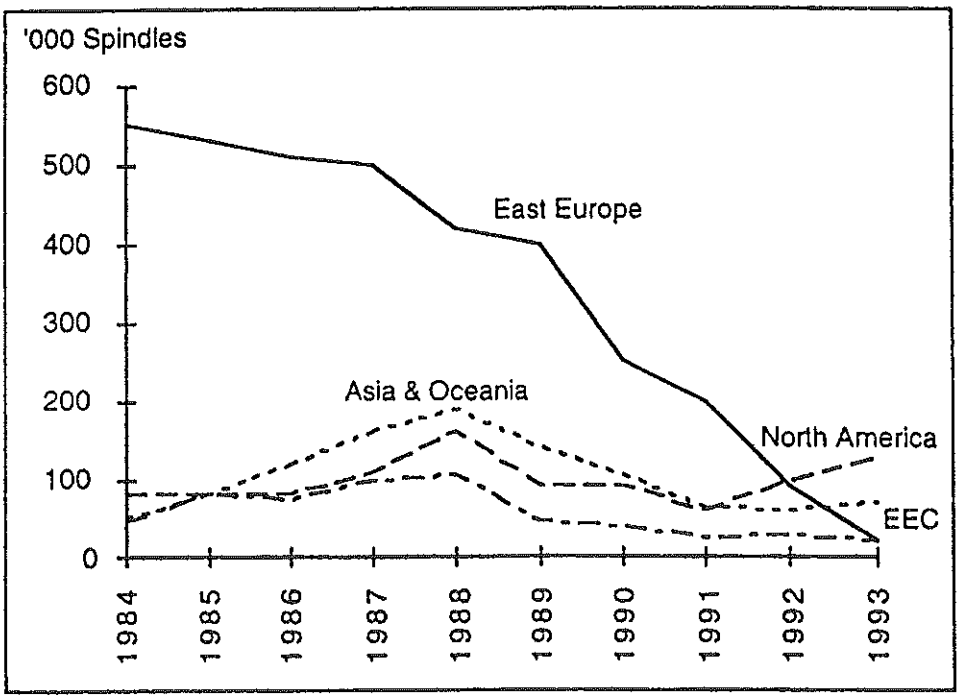
Source: ITMF

Exhibit 6: Recorded Shipments 1984 to 1993 - Short Staple Spindles



Source: ITMF

Exhibit 7: Recorded Shipments 1984 to 1993 - O-E Rotors



Source: ITMF

2.5 Capacity Surpluses

The improvement in the share of rotor spinning over recent years will undoubtedly have been promoted by the rapid increase in machinery productivity (see Section 4.3), but is principally due to external factors affecting the overall attractiveness of investment in the ring using countries of Asia relative to the main rotor buying areas of the US and to a lesser extent.

Europe:

i) The ITMF estimated that, by comparing growth in fibre consumption with the increase in installations of short staple spinning machinery, excess capacity of 12 million spindle equivalents had been created in market economies by 1991, equivalent to around 13% of capacity.

ii) Exhibit 8 shows DRA's more detailed analysis of this excess capacity, comparing fibre consumption growth (defined as short staple yarn production) and spinning capacity changes between 1980 and 1993, by region. This reveals that the principal area of excess spinning capacity build up has occurred in Asia - which will have contributed towards the large contraction in ring machinery deliveries in that region in recent years.

Exhibit S: Short Staple Spinning Capacity vs Fibre Consumption, by Region, 1980-1993

	Capacity (m spindle equivalents)			Fibre Consumption (m tonnes)		
	end 1979	end 1993	% change	1980	1993	% change
W Europe (excl. Turkey)	18.7	10.4	(44.4)	1.66	1.21	(27.1)
EE/USSR	29.3	29.1	(0.7)	4.02	1.42	(64.7)
Total Europe	51.1	44.5	(12.9)	6.10	3.24	(46.9)
Africa	6.2	8.8	41.9	0.74	0.94	27.0
Americas	32.0	30.4	(5.0)	4.00	5.01	25.3
Asia/Oceania	67.8	115.9	70.9	9.13	14.09	54.3
World	157.2	199.7	27.0	19.97	23.28	16.6
of which:						
China	17.4	41.4	138.0	3.49	5.48	57.0
US	17.9	11.6	(35.2)	2.26	2.95	30.5
India	20.7	28.9	39.6	1.46	2.33	59.6

Source: ITMF

iii) In contrast, Europe's capacity has fallen even more rapidly than its production, thereby explaining some recent recovery in rotor demand in that region, while the growth in US rotor deliveries since 1991 can be rationalised by a sharp growth in yarn production since 1980 despite a substantial reduction in spinning capacity through the decade.

iv) In 1993, world yarn stocks were double their 1987 level, relative to production. Stocks were particularly high in Asia, again promoting a reappraisal of new spinning investment in that region.

v) Investment in the developing countries of Asia is closely correlated with the economic well being of its major developed European and US markets. These were experiencing general recession during the early 1990s.

3 PROJECTED KN'ITTING YARN DEMAND AND THE RESULTANT IMPACT ON THE SPINNING MACHINERY MARKET

3.1 World Fibre Demand

Based on forecast growth rates of incomes and the correlation between incomes and fibre consumption, it was estimated by the FAO in the early 1990s that overall fibre consumption could rise by over 30% between 1992 and 2002, with Eastern Europe and developing countries accounting for most of the required increase in textile production.

This optimistic outlook was based on:

- the rapid growth of China as both producer and consumer
- the emergence of Eastern Europe as market economies
- the gradual removal of trade barriers.

In the light of sluggish growth in world economies over the last 2-3 years, however, the FAO have revised downward their forecasts for fibre demand, reducing the annual growth rate from 2.3% to 2% for the period 1989-2000.

3.2 Short Staple Knitting Yarn Demand

The relationship between total fibre consumption and short staple knit yarn consumption is affected by the following factors:

Factor	Impact on Short Staple Knit Yarn Demand
Yarn vs Non Spun Uses (eg nonwovens)	Nonwovens generally increasing their share of fibre consumption, especially in developed economies
Knit Fabrics vs Woven Fabrics	Knitting end uses have increased over recent years, but trend returning to woven fabrics, especially those including elastomeric yarns
Short staple vs Long staple	Marginal decline in long staple share as a result of shift away from wool type fabrics in some end uses
Spun yarn vs Filament	Filament yarns likely to continue to expand their share slowly *via* new products such as air textured yarns for furnishings and sportswear.

In overall terms it is probable that the demand for short staple knit yarns will grow rather less quickly than total fibre consumption (ie 1.8-2.0% pa).

3.3 The Prospects for Short Staple Yarn Production and Spinning Capacity by Region

3.3.1 Western Europe

In Western Europe, total spun yarn production in total reached a peak in 1987 at 3.3 million tonnes. Production then fell steadily to 1991 (2.9 million tonnes), before stabilising in 1992 (latest year data). Spinning of cotton fibre has shown the greatest decline.

In a recent study performed by CIRFS, it was projected that short staple spinning in Western Europe (all fibres and end uses) will decline by between 11 and 24% by the year 2000. On past trends, the brunt of this decline in production will be borne by the ring spinning sector, whose capacity could fall by a further 15% by the end of the century. Rotors should decline only marginally.

Only broad estimates are made for knitting yarns specifically; it is projected that knit yarn production in Western Europe will be adversely affected by increased imports of knitted underwear and a further increase in the 50% penetration rate in knitted cotton outerwear.

3.3.2 China

Short staple spun yarn production in China grew by oyer 55% between 1980. and 1990, and is forecast to expand by a further 31 % between 1991 and 2000, with most growth occurring in synthetics. This is translated into a forecast increase in spinning capacity from 39 to 42 million short staple spindles and 550,000 to 600,000 rotors.

Knitwear is a target growth area for the Chinese and the production of knit yarn is likely to outstrip the overall growth projections for short staple yarn production and spinning capacity.

3.3.3 India

The rate of expansion of short staple spun yarn production in India is forecast to slacken from the 44% achieved between 1980 and 1990, to 21% between 1991 and 2000. Yarn production is expected to remain heavily biased towards weavmg yarns.

Short staple spindle capacity is forecast to grow 10% during the 1990s to reach 29.3 million by 2000, with rotors more than doubling from 67,000 in 1991 to 150,000.

3.3.4 Pakistan

Short staple spinning in Pakistan doubled between 1980 and 1990 and is forecast to increase by 21% between 1991 and 2000, mostly for weaving yarns. Spinning capacity has grown substantially over the last 3 years.

It is forecast that short staple spindles will further expand from 6.9 to 7.4 million and rotors from 97,000 to 100,000.

3.3.5 Japan

As in Western Europe, yarn production in Japan has been declining steadily, and is expected to fall a further 10% during the 1990s (short staple). Installed ring spindles and rotors have fallen sharply over recent years and are expected to decline further from 6.0 to 5.5 million, and from 123,000 to 110,000 by 2000, respectively.

3.3.6 South Korea

Production of short staple yarns in S Korea seems to have peaked and is forecast to fall by over 10% during the 1990s. Spindles will fall from 3.7 to 3.5 million and rotors halve from 40,000 in 1990 to 20,000 by the end of the decade.

3.3.7 Taiwan

Yarn production in Taiwan is believed to be peaking currently; a modest decline in short staple spinning of 6% is projected for the 1990s. Spindles will fall from 4 million to 3.5 million over the same period, but rotors are expected to expand from 122,000 to 180,000, an increase virtually achieved by 1993.

3.3.8 USA

The US spinning industry continued to grow through the 1980s and short staple spinning is expected to remain broadly unchanged in size through this decade. Installed spindles are expected to continue to decline, by 10% from 1991, with rotors falling from a recent peak of 960,000 to 900,000.

3.3.9 Brazil

Spun yarn production in Brazil is expected to continue to grow modestly (by 5-10%) during the 1990s. A significant increase in installed spinning equipment is anticipated by CIRFS, however, from 8 to 10 million spindles and from 150,000 to 250,000 rotors, over the same period.

3.3.10 Eastern Europe

Between 1990 and 1991, short staple yarn production fell by almost 40%. On the basis of some economic stabilisation in the region during the 1990s, output is expected to recover by around 10% during the 1990s. Spinning capacity is expected to continue to contract, however, from a 1993 level of 6.5 to 6.0 million spindles and from 612,000 to 500,000 rotors, as productivity improves.

3.3.11 Former USSR

Data on the former USSR is sketchy, but it is forecast that short staple spun yarn production will remain relatively static during the 1990s with little change in the number of installed spinning machines.

3.3.12 Turkey

Yarn production in Turkey grew strongly in the 1980s, but is expected to remain broadly flat to the end of the century. A marginal increase in short staple spindles from 4.1 to 4.3 million is forecast, together with a more significant increase in rotors from 195,000 to 220,000.

3.3.13 Summary

Exhibit 9 summarises the forecasts for installed spinning machinery by major region to the end of the century based on CIRFS forecasts for total short staple yarn production and any existing spinning capacity surplus or shortfall, as discussed in 2.5 above.

Exhibit 9: Forecast Short staple Yarn Production and Installed Ring and Rotor Spinning Capacities, 2000

Country	Short Staple Yarn Production (m tonnes)			Installed Short Staple Spindles (m)			Installed O-E Rotors (000)		
	1991	2000 (F'cast)	% Change	1993	2000 (F'cast)	% Change	1993	2000 (F'cast)	% Change
W Europe	1.22	0.93-1.08	(23.6)-(11.4)	7.75	6.6	(14.8)	554	530	(4.3)
China	5.53	7.23	30.7	38.8	42.0	12.1	550	600	9.1
India	2.06	2.5	21.4	28.3	29.3	3.5	130	150	15.4
Pakistan	1.24	1.5	21.0	6.9	7.4	7.2	97	100	3.1
Japan	0.86	0.8	(7.0)	6.0	5.5	(8.3)	123	110	(10.6)
S Korea	0.55	0.53	(3.6)	3.22	3.0	(6.8)	23	20	(13.0)
Taiwan	1.0	0.98	(2.0)	3.73	3.5	(6.2)	178	180	1.1
USA	2.65	2.7	1.9	7.09	6.5	8.3	960	900	(6.3)
Brazil	0.86	0.93	8.1	8.2	10.0	22.0	165	250	51.5
E Europe	0.5	0.59	18.0	6.5	6.0	(7.7)	612	500	(24.6)
USSR	2.34	2.52	7.7	7.7	7.7	--	3344	3300	(1.3)
Turkey	0.56	0.6	7.1	4.1	4.3	4.9	195	220	12.8

Source: DRA from CIRFS, ITMF

It is clear from this table that the largest growth markets for spinning machinery to the end of the decade continue to be centred mainly in the Far East and Sub-continent, with Brazil also featuring. The outlook for open-end rotors is marginally better than for ring spindles.

4 MACHINERY REPLACEMENT DEMAND

4.1 Scrappage Rates

The market for spinning machinery is heavily dependent upon the rate of machine scrappage and replacement, in addition to changes in yarn demand. The ITMF assume that spinning machine scrappage levels will remain at around 2.8 million spindle equivalents per annum (market economies only), the rate achieved during the 1980s, although this represented a period of extensive modernisation.

This scrappage rate implies replacement demand of around 2.3 million spindle equivalents after adjusting for improved machinery productivity.

Factors which affect this rate of scrappage (which may vary between region and machine type) are discussed below.

4.2 Age of Installed Machinery

Across the world, on average, just under 20% of ring spindles are under 10 years old, while 85% of O-E rotors have been installed over the last 10 years (see Exhibit 10).

Exhibit 10: Age Structure of Spinning Equipment 1984-1993

	Short Staple Spindles		O-E Rotors	
	Capacity 1993 ('000)	Shipments 1984-1993 (%)	Capacity 1993 ('000)	Shipments 1984-1993 (%)
AFRICA	8068	19.7	165.4	61.7
USA	7086	10.8	960	91.1
NORTH AMERICA	12155	9.8	1067.6	34.2
Brazil	8200	18.3	165	40.1
SOUTH AMERICA	12040	16.6	259.4	63.8
China	38820	1.8*	550	45.4
India	28320	29.4	129.9	98.9
Japan	6024	24.4	123	31.1
South Korea	3224	35.3	22.9	169.9
Taiwan	3727	48.3	178.7	56.2
ASIA & OCEANIA	107205	18.7	1852.8	54.8
EAST EUROPE	12265	21.8	3581	96.8
Germany	782	69.2	74.9	152.7
Italy	1809	71.0	93.5	169.9
EEC	7034	43.8	525.1	109
EFTA	722	58.7	29	126.2
Switzerland	447	44.2	6.5	215.4
EUROPE - OTHERS	4107	38.8	195.2	113.5
WORLD	163596	19.9	7675.5	84.6

Excludes domestically produced spindles. Source: ITMF

Significant variations in machine age exist between countries. In Western Europe, around 50% of ring spindles have been replaced over the last decade, while the rate of investment in the US has been very low for a developed economy, at around 10%.

The rate of renewal for open end rotors has been higher across the world, albeit from a lower base, largely because of a far faster rate of technological obsolescence. The renewal rate varies from 30% in Japan to over 200% in Switzerland.

The generally higher age of ring machines, compared to rotors, is a positive indication of the sales potential for the SpinWell machine in its principal addressable market (ie ring machines used for spinning knit yarns).

4.3 Relative Machinery Cost and Efficiency

The speed at which machines are replaced depends partly on the relative efficiencies in terms of cost per unit of output of existing and new machines.

Exhibit 11 shows that while significant improvements have been made in the productivity of ring spinning over the last 25 years, (with output/ spindle/ hour doubling), these have been outstripped by a quadrupling in the equivalent measure for rotor spinning. No other technology has been developed to threaten either of these technologies for the mass market (see Section 4.6).

Exhibit 11: Developments in Productivity in Ring and Open-End Rotor Spinning, 1970, 1980, 1985 and 1992

	1970	1980	1985	1992
Ring Spinning				
No. of spindles/machine	450	550	1000	1000
Production/spindle (gm/spindle/hour)	19.6	21.3	24.9	39.0
Winding speed (metres/minute)	800	1000	1200	1500
Rotor Spinning				
Rotors/machine	144	168	216	288
Rotor speed (rpm)	30000	60000	90000	120000
Production/spindle (gm/spindle/hour)	53.5	106.5	160.2	213.9

Source: Lenzing Fibres

Despite this apparent differential in terms of productivity improvement between ring and rotor spinning over the last 25 years, the actual cost advantage to rotor spinning (per kilo of yarn produced) - and hence the incentive to switch from ring to rotor - remains generally small (for medium count cotton yarns).

Moreover, because rotor spinning is relatively expensive in terms of energy and capital cost, the cost advantage of rotor spun yarns is even smaller in those countries where these factors are relatively expensive, and where labour, on which rotor spinning saves, is relatively cheap (see Exhibit 12).

Exhibit 12: Comparison of Spinning Costs (Combed 100% Cotton Yarn, Ne30), Ring vs Rotor, 1992, (Units of national currency per kg of yarn)

a) Ring

	Brazil	India	Italy	Japan	Korea	Thailand	USA
Waste	9943	5.27	479	36	277	8.53	0.29
	23%	*9%*	*11%*	*12%*	*20%*	*18%*	*13%*
Labour	2152	1.65	1620	87	92	2.31	0.56
	5%	*3%*	*38%*	*29%*	*7%*	*5%*	*24%*
Power	3215	7.04	377	49	146	5.61	0.16
	7%	*12%*	*9%*	*16%*	*10%*	*12%*	*7%*
Auxiliary material	2581	2.90	160	14	90	3.20	0.10
	6%	*5%*	*4%*	*5%*	*6%*	*7%*	*4%*
Depreciation	15339	20.03	817	80	502	13.34	0.91
	35%	*34%*	*19%*	*27%*	*36%*	*29%*	*39%*
Interest	10193	21.78	818	34	286	13.29	0.33
	24%	*37%*	*19%*	*11%*	*21%*	*29%*	*14%*
Total Manufacturing Costs	43423	58.67	4271	300	1393	46.28	2.35
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

b) O-E Rotor*

	Brazil	India	Italy	Japan	Korea	Thailand	USA
Waste	6856	3.70	332	25	191	5.89	0.20
	18%	*7%*	*11%*	*10%*	*15%*	*14%*	*11%*
Labour	1015	0.71	683	40	43	1.00	0.24
	3%	*1%*	*22%*	*16%*	*3%*	*2%*	*12%*
Power	3354	7.34	393	51	152	5.85	0.16
	9%	*13%*	*13%*	*21%*	*12%*	*13%*	*9%*
Auxiliary material	3155	3.66	195	16	112	4.02	0.13
	8%	*7%*	*6%*	*6%*	*9%*	*9%*	*7%*
Depreciation	13790	18.96	728	79	507	13.23	0.84
	37%	*34%*	*24%*	*33%*	*39%*	*31%*	*45%*
Interest	3148	20.69	728	33	285	13.22	0.31
	25%	*38%*	*24%*	*14%*	*22%*	*31%*	*16%*
Total Manufacturing Costs	37318	55.06	3059	244	1290	43.21	1.88
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

c) Comparison of Total Manufacturing Costs, Rotor vs Ring (US$)

	Brazil	India	Italy	Japan	Korea	Thailand	USA
Ring	1.74	1.87	2.80	2.80	1.71	1.83	2.35
Rotor	1.49	1.75	2.01	2.27	1.58	1.71	1.88
Rotor as a % of Ring	86%	94%	72%	81%	92%	93%	80%

* Source: ITMF

4.4 SpinWell Costs

Using the same cost breakdown as in Exhibit 12, it is possible to compare the relative cost of yarn production on rotor, ring and Spin Well machines.

Exhibit 13: Yarn Production Cost Comparison, SpinWell Friction Machine vs Ring, Rotor

Cost Factor	SpinWell compared with Rotor	SpinWell compared with Non-automated Ring
Waste	Marginally Better	Better?
Labour	Marginally Better	Much better
Power	Better	Marginally worse
Auxiliary material	Marginally Worse	Worse?
Depreciation	Better	Much worse
Interest	Better	Much worse
Total Manufacturing Costs	Better	Probably better, but dependent on location/factor costs

Source: DRA estimates from Belroy information, ITMF

Experts agree that for a new spinning technology to be introduced successfully, it must combine a step change improvement in machinery cost efficiency with a high level of versatility. While Belroy's figures on production costs are impressive, they emphasise the technology's advantage in labour costs (7 operative hours per tonne compared to 64 hours for unautomated ring spinning) at developed country wage rates (£5/hour). At developing country labour rates (typically 40p/hour), the advantage is significantly lower.

Moreover, the full impact of the higher capital cost of the SpinWell machine on both depreciation and interest charges, as well as maintenance cost, has not been calculated for different markets.

Overall, it is probable that, at current performance levels, the Spin Well's competitive edge on cost grounds will be limited to high labour cost countries.

A major cost saving factor in the SpinWell's favour is that the technology enables high quality short staple yarns to be produced from the cheaper and less cleaned cottons than either ring or rotor can use.

4.5 Automatability

In addition to yarn production speeds and direct spinning costs, the attractiveness of a new technology is dependent upon the cost of fibre preparation, final winding etc, and, in particular, the extent to which the process is automatable. It is in this area that rotor spinning has made great strides, eliminating the roving stage and using fully automated piecing, winding etc. In contrast, ring spinning still generally involves far more stages and yarn handling.

The SpinWell scores well in this area, offering automation levels at least on a par with O-E rotor spinning (unlike its MasterSpinner predecessor) and a minimum of processing steps.

4.6 Machinery Performance and Versatility

Apart from cost factors, the choice of spinning machine reflects other characteristics of the technology and the yarn produced:

- versatility of the technology - ability to spin, efficiently different fibre types and staple lengths into yarns for a variety of end uses; this is becoming increasingly important in Europe where a low labour content must be complemented with the ability to produce relatively short runs of different yarns from the same machine in response to changing fashions
- yarn quality - market demand for particular yarn characteristics such as strength, regularity and handle, and consequent realisable price premium.
- consistency of yarn - over time and from different spinning positions on the same frame.

While some new spinning technologies have been successfully introduced over recent years on the basis of meeting a particular yarn requirement, none has been able to offer the versatility of the ring system. As a result, with the exception of O-E spinning, the new technologies have been limited to niche markets.

Exhibit 14 overleaf compares the versatility of the most important yarn spinning technologies.

Exhibit 14: Versatility of Alternative Spinning Technologies

	Repco	OE Rotor	OE Dref II	OE Dref III	Air Jet	Wrap Spg	Ring Spg	Spin-well
Shirting					✓		✓	
Bedding					✓		✓	
Outerwear	✓				✓	✓	✓	
Sportswear	✓			✓			✓	?
Towelling						✓	✓	(✓)
Home Textiles	✓	✓	✓	✓		✓	✓	(✓)
Blankets	✓	✓	✓				✓	?
Knitgoods	✓			✓			✓	✓
Carpeting			✓				✓	?
Woollen			✓			✓	✓	
Worsted							✓	
Technical	✓	✓	✓				✓	
Staple Length	Long	Short	All	All	Short	Long	All	Short
Fibre Type	Acrylic	All	All	All	Synth	All	All	All
Yarn Count Produced (Ne)	Coarse	6-35 (-60?)	0.5-10	3-18	20-75	6-25	6-120	10-50
Prod Rate (m/min)	150	85-160	150-230	150-230	130-190	150	18-40	120-240?

Source: ETH Zurich, DRA

At its current yarn strength rating the SpinWell machine performs better than rotor spinning in terms of its versatility, but relatively badly compared with ring. The resulting restriction in the size of the addressable market is one reason quoted for Schlafhorst's ultimate lack of interest in the SpinWell machine.

In addition, while the SpinWell machine appears to offer a high quality yarn for knitting (better bulk than ring yarn, better handle than rotor yarn), its ability to produce consistent yarn from position to position has not been tested under commercial conditions.

4.7 Internal Constraints to Investment

Even if a new, cost efficient and versatile technology becomes available, demand may not be forthcoming, particularly for existing operations looking to upgrade an existing facility, as a result of a variety of other internal/ operational constraints. These include:

- the cost of eliminating surplus labour
- the cost, or difficulty, of training labour to required higher skill levels
- the need to modify other aspects of the existing production process - eg drafting, twisting, etc
- fear of the impact of breaks in power supplies on new, higher speed, capital intensive processes
- fear of rapid technological obsolescence.

Many of these obstacle will apply, particularly, to existing ring spinners considering investing in SpinWell technology.

4.8 External Factors

In addition to the direct and indirect impact of the economic environment in both the producing and consuming markets (e.g. through interest rates, quotas, etc.), modernisation programmes and the related availability of funds can represent a major external influence on machinery scrappage rates.

Currently, increasing amounts of money are being made available, mainly by World Bank bodies, for the modernisation of textile sectors in developing countries. In addition, there are signs of other regions of vast productive potential such as China and Eastern Europe accessing hard currency to buy new equipment or devising other schemes (e.g. foreign credit lines or even bartering) to enable modernisation programmes to take place.

As a result, more confidence can be attached to the ITMF forecast that past scrappage rates will be maintained during the 1990s, at least outside Europe.

5 YARN SPINNING DEVELOPMENTS

5.1 Industry Research

A wide search of relevant publications and discussions with a number of industry experts reveals no evidence of any major impending technological breakthrough by spinning machinery producers based on either existing or new spinning technologies.

Apart from Belroy, no company is known to be researching friction spinning technology (other than possible further refinement of DREF systems by Ernst Fehrer). Schlafhorst have apparently abandoned research in this area in collaboration with Belroy, partly because of SpinWell's limited range of applications, possibly combined with the threat to their existing business that a successful friction spinning technology could ultimately represent.

It is of course possible that research is proceeding secretly by any textile machinery company, whether or not currently involved in spinning machines.

In addition, progress continues to be made in a number of areas which have lead to steady improvements in yarn quality and performance in the main ring and rotor spinning technologies:

- faster rotor speeds (offset by harsher yam and higher energy costs)
- spinning of finer yarns on rotors, mainly through improved fibre quality, but also by improvements in rotor size/performance
- increased ring spindle speed (offset by higher energy costs and increased breakages)
- improved automation/process elimination in ring spinning.

5.2 Academic Research

In addition to the manufacturing sector, research is being undertaken at Leeds University (originally planned to be in co-operation with Schlafhorst) and at UMIST (Manchester) to develop a new spinning technology.

Little is known of the types of technology being researched, but it is unlikely to be based on friction spinning. In the case of Leeds, a prime requirement is likely to be production flexibility - the ability to produce all types and counts of yarns in one integrated process. At UMIST, the target is believed to be faster production speeds - to the order of 1,000 metres/minute (compared with current maxima of 40 m/min for ring spinning and 160 m/min for rotor).

It is unlikely that this University based research presents any major threat to the SpinWell machine, not least due to the lack of any manufacturing involvement and engineering development.

5.3 Summary

Exhibit 15 summarises the main areas of research in different spinning technologies and their likely competitive threat in the short to medium term to the introduction of SpinWell technology.

Exhibit 15: Areas of Research into New Spinning Technologies and their potential threat to SpinWell

Spinning Technology	Development	Researcher	Potential Threat to SpinWell
Rotor Spinning	Faster rpm; yarn handling; better piecing, low energy machines	Schlafhorst, Rieter and others	Negligible
Ring Spinning	Elimination of roving and other processes	Suessen ("RingCan"), Fehrer ("RingDref"), Rieter, etc	)))
	Improved rings, travellers, and guide arms	Rieter ("HiPerSpin")	)Marginal)
	Improved evenness	Rieter, etc	)
	Increased spindle speed	Rieter, etc	)
DREF Spinning	Broadening of product range	Fehrer	Negligible
Air Jet Spinning	Suitability for cotton fibres	Murata	Potential threat in finer counts, not knits
Wrap Spinning	None Known	n/a	Negligible

Source: DRA

Installed Short Stapled Spinning Machinery, end 1993

c) The Americas

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. installed	Average no. active during the year	No. installed	Average no. active during the year
NORTH AMERICA				
Canada	400		26	
Costa Rica	14		0.6	
Cuba	600			
Dominican Rep.	35	20		
El Salvador	235		5	
Guatemala	145		16	
Mexico	3600		60	
Nicaragua	40			
USA	7086	6601	960	912
Total	12155		1067.6	
SOUTH AMERICA				
Argentina	935	760	14	10
Bolivia	50		2.4	
Brazil	8200	8200	165	165
Chile	400		2.5	
Coloumbia	940	940	23	23
Ecuador	200		8.5	
Paraguay	40	40	1	1
Peru	700	350	15	10
Urguay	25	10	3	3
Venezuela	550		25	
Total	12040		259.4	

Source: ITMF

Appendix 1

Installed, Short Staple Spinning Machinery, end 1993

a) World

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. Installed	% of Total	No. Installed	% of Total
Africa	8068	4.9	165.4	2.2
North America	12155	7.5	1067.6	13.9
South America	12040	7.5	259.4	3.4
Asia & Oceania	107205	65.5	1852.8	24.1
East Europe	12265	7.5	3581	46.7
EEC	7034	4.2	525.1	6.8
EFTA	722	0.4	29	0.4
Europe - Others	4107	2.5	195.2	2.5
Total	163596	100	7675.5	100

Source: ITMF

Appendix 1

Installed Short Staple Spinning Machinery, end 1993

b) Africa

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. installed	Average no. active during the year	No. installed	Average no. active during the year
Algeria	300		4	
Angola	50			
Benin	60			
Botswana	15		1.3	
Burkina Faso	7			
C A Republic	23			
Cameroon	55			
Chad	8			
Egypt	3372	3372	31	31
Ethiopia	285			
Ghana	120		0.4	
Guinea	8			
Ivory Coast	120	120	3	
Kenya	120	70	1.2	1.2
Madagascar	70		3	3
Malawi	50			
Mali	40			
Morocco	450		40	
Mozambique	50			
Niger	14			
Nigeria	700	500	20	
Senegal	40	40	0.4	0.4
Somalia	20			
South Africa	650	540	17	14.6
Sudan	500		20	
Swaziland	50		0.2	
Tanzania	400			
Togo	26			
Tunisia	80		7	
Uganda	60		0.4	
Zaire	125		3	
Zambia	70		2.5	
Zimbabwe	130	130	11	9
Total	**8068**		**165.4**	

Source: ITMF

d) Europe

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. installed	No. active	No. installed	No. Active
EAST EUROPE				
Albania	180			
Armenia	45		15	
Azerbaijan	140		45	
Bulgaria	640	520	68	62
Byelaruss	185		60	
Czech Republic	645		170	
Estonia	150		65	
Georgia	50		15	
Hungary	500		40	
Latvia	40		20	
Lithuania	90		30	
Moldova	150		65	
Poland	900	675	175	130
Romania	2000		65	
Russia	4016[a]	2515	2379	1498
Slovakia	134	74	44	32
Ukraine	900		275	
Yugoslavia (Ex-)	1500		50	
Sub Total	12265		3581	
EEC				
Belgium	101	80	34	28.4
Denmark	20		1.2	
Eire	60		8.5	
France	438	353	92	87.7
Germany[d]	782	782	74.9	74.9
Greece	1000	850	27	25
Italy	1809	1605	93.5	79.6
Netherlands	9	9	6.7	6.7
Portugal	1321	1159	38.4	380.4
Spain	1168	1050	78.9	78.9
UK	326	296	70	50
Sub Total	7034		525.1	
EFTA				
Austria	258	258	14.7	14.7
Finland	5	5	2.2	2.2
Norway			0.6	0.6
Sweden	12		5	
Switzerland[b]	447	447	6.5	6.5
Sub Total[b]	722		29	
EUROPE - OTHERS				
Turkey	4107	3600	195.2	190.3
Sub Total	4107		195.2	
Total	**24128**		**4330.3**	

Installed Short Staple Spinning Machinery, end 1993

e) Asia & Oceania

	Ring Spindles ('000)		O-E Rotors ('000)	
	No. installed	Average no. active during the year	No. installed	Average no. active during the year
Australia	22	22	18.1	18.1
Bangladesh	1950	1350	21.5	17
Burma	260			
China	38820		550	
Hong Kong	100		50.2	
India	28320	21223[c]	129.9	128[c]
Indonesia	6300	6092	65	65
Iran	1550	1100	41.5	33
Iraq	200		15	
Israel	50		12	
Japan[b]	6024	4933	123	100.7
Kazakhstan	185		60	
Kirghizstan	100		30	
Rep of Korea	3224	2833	22.9	19.6
Malaysia	600	500	7.4	7
Pakistan	6944	5573	97.4	72.9
Philipines	1520	1217	47.9	45.9
Singapore	80		16.5	
Sri Lanka	290	290		
Syria	519	500	24.2	23.2
Tadzhikistan	150		45	
Taiwan, ROC	3727		178.7	
Thaliand	3800		55	
Turkmenistan	45		20	
Uzbekistan	1425	1425	220	220
Vietnam	1000		1.6	
Total	107205		1852.8	

a Substantially revised.

b Based on the assumption that the ratio between installed and active machinery has been the same for ring spindles and rotors.

c The figure for active machinery represents the maximum average number worked in a shift in any month.

d Spinning machines installed in member mills of 'Industrievereinigung Garne + Gewebe' only, representing approx. 90% of total in Germany.

Source: ITMF

Appendix 2

Spinning Machinery Shipments 1993 ('000)

a) World

	Short Staple Spindles	O-E Rotors
Africa	46.3	5.7
North America	89.8	125.4
South America	150.6	10.9
Asia & Oceania	1615.4	70.3
East Europe	282	23.6
EEC	117.5	23.3
EFTA	6.7	1.5
Europe - Others	267.8	29.8
Total	2576.1	290.4

Source: ITMF

b) Africa

	Short Staple Spindles	O-E Rotors
Egypt	11.5	
Morocco	1.0	0.2
Nigeria	5.0	0.4
South Africa	7.6	0.2
Sudan		3.4
Tunisia		0.9
Zambia	21.2	0.4
Zimbabwe		0.2
Total	46.3	5.7

Source: ITMF

Spinning Machinery Shipments 1993 ('000)

c) The Americas

	Short Staple Spindles	O-E Rotors
NORTH AMERICA		
Canada		1.3
El Salvador	5.5	0.4
Guatemala		1.0
Mexico	44.7	8.9
USA	39.6	113.8
Total	89.8	125.4
SOUTH AMERICA		
Argentina	25.4	2.3
Brazil	102.1	3.5
Colombia	21.1	1.3
Ecuador	1.8	0.6
Paraguay	0.2	
Peru		1.6
Venezuela		1.6
Total	150.6	10.9

Source: ITMF

d) Asia & Oceania

	Short Staple Spindles	O-E Rotors
Australia		2.0
Bangladesh	29.2	
China	10.6	0.8
Hong Kong		4.5
India	1026.9	14.1
Indonesia	113.8	2.0
Iran		18.3
Japan	20.0	0.2
Kazakhstan		2.4
Rep. of Korea	71.0	2.5
Malaysia	100.7	
Pakistan	52.4	1.2
Philippines	10.8	1.4
Syria		1.4
Tadzhikistan	11.7	
Taiwan ROC	112.6	1.7
Thailand	5.2	4.1
Turkmenistan		6.4
Uzbekistan	50.4	7.2
Total	1615.3	70.2

Source: ITMF

Spinning Machinery Shipments 1993 ('000)

e) Europe

	Short Staple Spindles	O-E Rotors
EAST EUROPE		
Azerbaijan	0.9	0.6
Bulgaria		0.3
Byelaruss		1.2
Czech Republic		0.2
Lithuania		0.1
Poland	1.3	0.1
Russia	261.3	20.2
Ukraine	18.5	0.5
Yugoslavia(Ex-)		0.4
Subtotal	282.0	23.6
EEC		
Belgium		0.2
Eire	1.6	0.7
France	6.9	6.1
Germany	20.1	4.7
Greece	24.2	0.2
Italy	32.0	7.5
Portugal	21.7	1.2
Spain	10.8	2.5
UK	0.2	0.2
Subtotal	117.5	23.3
EFTA		
Austria	6.7	1.1
Finland		0.1
Switzerland		0.3
Subtotal	6.7	1.5
EUROPE - OTHERS		
Turkey	267.8	29.8
Various		
Subtotal	267.8	29.8
Total	674.0	78.2

Source: ITMF