1. Overview of Early Stage Processing

David Cottle

Learning objectives

On completion of this topic you should be able to:

- Outline the main wool processing systems
- Understand the value adding aspects of the Australian early stage processing industry
- Describe the major players in the Australian early stage processing industry
- List factors affecting the growth of the early stage wool processing industry in Australia

Key terms and concepts

Worsted, woollen, blending, scouring, carding, combing, spinning, value adding.

Introduction to the topic

This topic provides an overview of the steps involved in Early Stage Wool Processing (ESP), the costs and value adding aspects of the industry, the major players in the Australian industry, recent changes in the industry and impediments to future growth.

Subsequent topics in this unit provide more technical details on each processing step in early stage processing. Technical information and help on processing is available via the AWI website www.woolontheweb.com.au.

The ESP industry is involved in the scouring, carbonising and manufacture of tops from Australian greasy wool. ESP products are sold to Later Stage Wool Processors (LSP) who are primarily yarn spinners. *There is also a Sheep CRC LSP unit available for study*. ESP in Australia is an export oriented industry that also services the domestic LSP market. The Australian ESP industry processed wool with a value in excess of $1 billion in 2001/02.

1.1 Overview of early stage processing

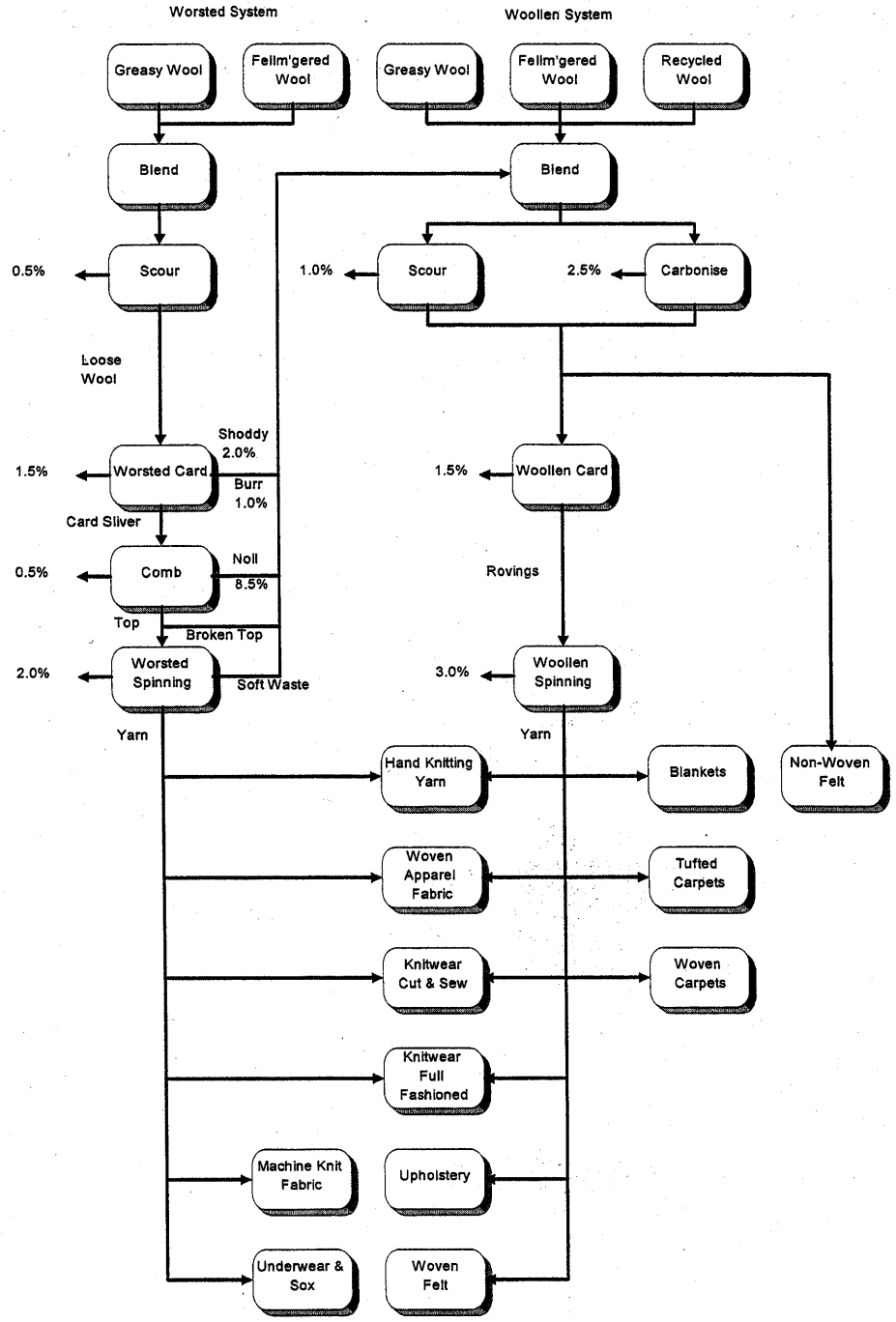
There are two main systems used for processing wool from fibre into yarn: the ***worsted*** system and the ***woollen*** system (Figure 1.1). There are a number of processes common to both systems: ***blending*** of the wool types to be used; ***scouring*** of the wool to remove a range of impurities (e.g. dirt and grease); ***carding*** to disentangle the fibres and remove impurities like vegetable matter; ***spinning*** of fibres into a yarn. However, the technical aspects of these processes do differ between the systems due to differences in the 'raw materials' used by each. Also, there are additional processes specific to each system. The result is that worsted and woollen yarns differ in their structure and properties which ultimately influence the attributes of the fabrics produced from each system.

The main steps in worsted and woollen processing are shown in Figure 1.1, together with the principal products and typical losses incurred at each stage of processing. Processes such as shrinkproofing, mothproofing, dyeing and finishing, for which there may be major differences between particular products, have not been shown for simplicity.

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Worsted system

Figure 1.1 Basic processes in the worsted and woollen systems, figures show percentage of losses or by-products at each processing stage. Source: Teasdale (1995).



Approximately 80% of the Australian wool clip enters the worsted system. It only uses virgin wools, generally being finer than 27 micron, longer than 40 mm and with low levels of vegetable matter. The worsted system utilises ***gilling*** and ***combing*** processes to give greater alignment of the fibres, resulting in a smooth and strong yarn. Both woven and knitted fabrics can be produced from these yarns, the fabrics being characterised by a smooth (or less hairy) surface. Men's suits and women's dress fabrics are examples of worsted garments.

In worsted processing there are many steps required (20 or more processes in sequence) to convert fibre to yarn, as summarised in Figure 1.1.

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There should not be any defects (such as cotts or too much vegetable matter present) which would cause excessive fibre breakage in processing. As well as greasy wool, by–products and wastes from worsted processing (such as noils and card wastes) are used as raw material for woollen processing. For every one kilogram of clean wool fibre which enters worsted processing as greasy wool, less than 850 g emerge as yarn. The rest is either non–recoverable (such as card fly - very short fibres which float away during carding or is by-product used in woollen processing (about 100 g per 1 kg of clean wool fibre processed).

Worsted yarns are fine, smooth and strong. Worsted fabrics are smooth and the fabric structure is visible (for example, men's suit material).

Woollen system

The woollen system utilises virgin wools, worsted by–products and recovered fabric waste. The virgin wools are generally shorter than 40mm and often coarser than those entering the worsted system. It can also accommodate very high levels of vegetable matter contamination by use of a chemical process called ***carbonising***. Woollen yarns are relatively hairy as less fibre alignment is achieved, resulting in more fibre ends protruding than in worsted yarns. These yarns are relatively coarse and weak. The fabrics produced are usually bulkier, thicker and have more protruding surface fibres. Blankets and bulky knitwear are examples of woollen products.

Figure 1.1 shows the major steps followed in woollen processing, although the preliminary steps will vary, depending on the source of the fibre. Woollen processing utilises many fewer steps than worsted processing.

Noils and card waste (by–products from the worsted system) will generally be carbonised. However for high quality end–uses, wool may be processed to top on the worsted system to remove vegetable matter, then processed (as broken top) on the woollen system.

Woollen yarns are relatively coarse with many fibre ends protruding and are relatively weak. Fabrics are thicker and the structure is often hidden by surface fibres (for example in woven blankets).

Scouring

There are a number of processes which are covered by the term scouring. These include preparation of wool for scouring by opening and blending, wet processing (scouring), drying and dried wool handling. An integral part of the process is liquor handling and effluent treatment (effluent is carried in the scour liquor and sludges which are removed).

Opening and blending

Wool products are almost always achieved by blending together raw materials. These may be greasy wool from different properties, countries or different histories such as reworking previously processed wools. There are reasons for doing blending such as minimising the cost and special effects.

Typical blends may contain 6 or 8 components although each component may represent a "house type" which is itself made up of numerous elements (such as sale lots).

There are a number of specialised pieces of equipment which may be used to carry out opening and blending operations in wool processing such as:

- bale heating
- balebreaker
- feed hopper
- drum opener (greasy and wool opener)
- weightbelt
- stepped opener/blender, and
- blending bins.

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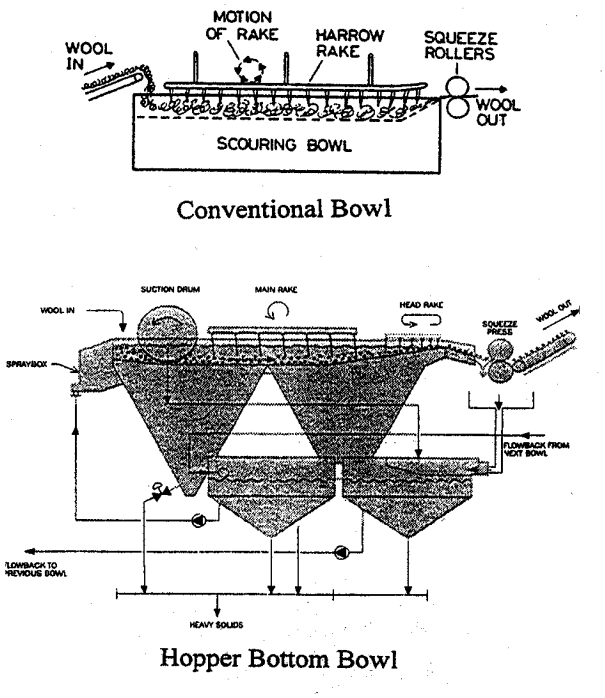
Bowls and liquor handling

There are many factors to consider when specifying wool scouring bowls and related equipment for scouring different types of wool.

Bowls

Two main types of bowls are in use (see Figure 1.2). Conventional bowls sit flat on the ground and Hopper Bottom Bowls which allow solids to settle where they are removed through a timer operated valve at the bottom of the hopper.

Figure 1.2 Scour bowl types. Source: Teasdale (1995).



Typical widths of bowls are 1.2, 1.5, 2.0 and 2.4 metres. Wool is moved through bowls by a variety of means. The most common method is using rakes or harrows/harrow forks which are rows of tines on .a frame. These move through the water pushing the wool, then lift up and back to re–enter the water and engage more wool. The movement may follow a square or circular motion when viewed from the side.

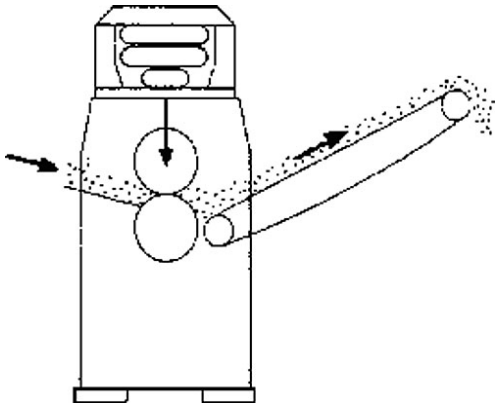
The most efficient form of energy available for heating water in bowls is gas although steam may also be used. In this case there may be large energy losses at the boiler as well as significant team transport losses.

Squeeze press

A Squeeze Press (Figure 1.3) comprises a pair of rollers through which wool passes as it leaves each bowl. For most bowls the pressure applied is up to 10 tonnes but for the last rinse bowl pressures of up to 20 tonnes may be used in conjunction with higher water temperatures to reduce drying energy requirements.

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Figure 1.3 Squeeze press. Source: Teasdale (1995).



Effluent treatment

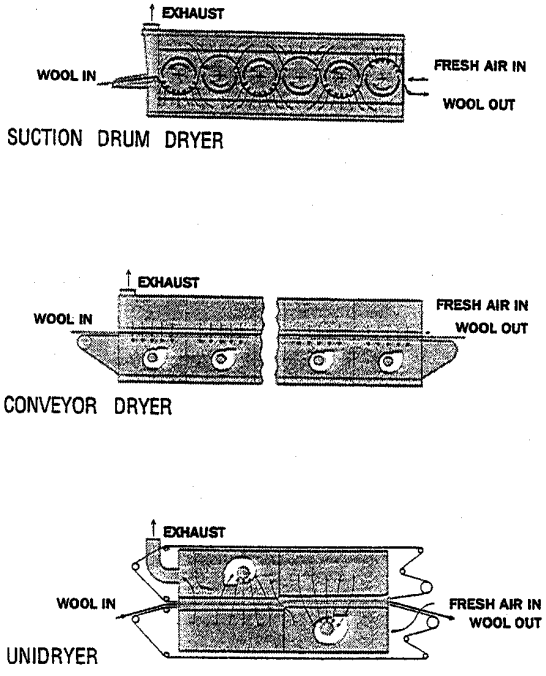
Primary effluent treatment is intended to remove as much wool grease and suspended solids as possible. Typically up to 50% of suspended solids and 50% of wool grease are removed from the liquor flows.

Drying

Wool is typically dried to around 8 to 12% regain. There are three main types of dryers available for wool:

- suction drum dryer - these generally use either gas or steam for heating
- conveyor dryer (Figure 1.4), and
- unidryer.

Figure 1.4 Wool dryers. Source: Teasdale (1995).



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Loose wool transport and pressing

In vertical mills, scoured wool is usually moved to bins using conveyors or pneumatic ducting. If pneumatics are used the wool must be removed from the airstream. One method is a condenser where a rotating perforated wheel traps wool and drops it out of the airstream.

A scouring mill

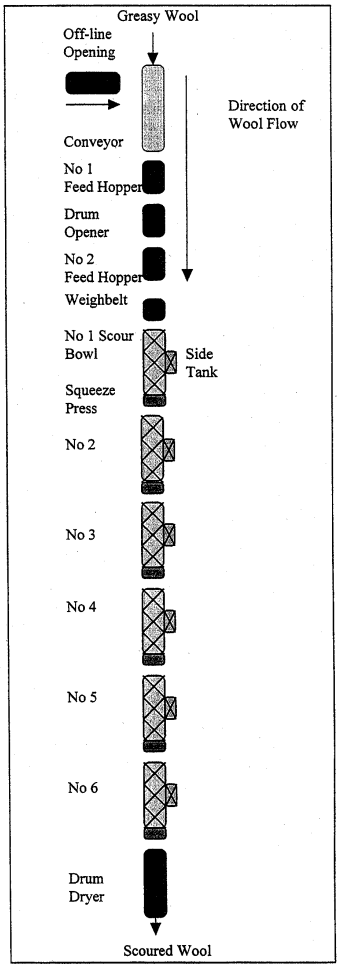
The main objectives of scouring are to remove contamination and to minimise fibre damage in the process. Success in scouring is usually measured by looking for:

- low residual grease
- low residual dirt
- low residual suint
- low residual protein residue
- low fibre breakage
- low fibre entanglement, and
- good colour

Traditionally this has been accomplished in water and today most wool is aqueous, rather than solvent, scoured.

Figure 1.5 shows schematically the main components of a modern wool scouring mill designed for apparel wools. The number of bowls and the number of hoppers in each bowl is influenced by the types of wool to be scoured. Care must also be taken not to over–scour very fine wools with scours that are too long.

Figure 1.5 Typical worsted scour configuration. Source: Teasdale (1995).



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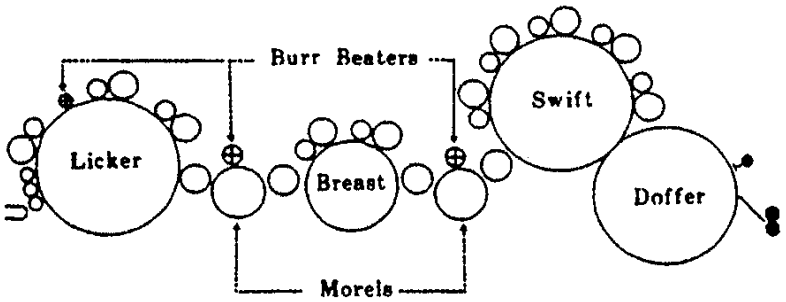
Modern scours designed for the middle range of merino wools are typically 6 bowls long with 12 to 14 hoppers in total. Coarse carpet wools are generally processed on scours with mainly single hopper “minibowls”. As few as 7 or 8 hoppers may be used.

Bowl temperatures tend to decrease as the wool moves through the scour. If non–ionic detergents are used, the first scour bowl is usually in the range 60°C to 70°C, dropping a couple of degrees per bowl. This is well above the 40°C needed to soften and melt wool grease on fibres. If soap and alkali are used instead of detergent, the bowl temperatures must not exceed 55°C because wool is damaged in alkali at high temperatures. Rinse temperatures are generally lower than for scouring, usually in the range of 40°C to 50°C. The exception to this is the tendency of some scourers to finish with a rinse bowl temperature of 65°C or higher as this is believed to give savings in drying energy.

Carding

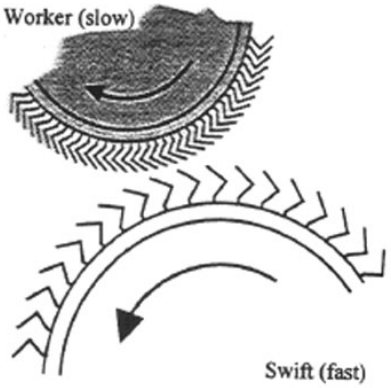
Carding is the process where metal teeth or pins (on rollers) tease fibres apart and lay the fibres roughly parallel into a card sliver. Carding also removes some of the vegetable matter present in the wool. These objectives are achieved by a number of different mechanisms. Figure 1.6 shows a typical arrangement of rollers in a worsted card.

Figure 1.6 Worsted card. Source: Teasdale (1995).



Wool is opened by teeth working point–to–point as shown in Figure 1.7. This action takes place between the main rollers (called a swift or breast: and the worker rollers. The workers take wool from the swift and at this point the fibres are opened and straightened. Most fibre breakage in carding is likely to occur at this point (about 40% of fibres are broken in carding, greatly reducing average fibre length and increasing fibre length variability). The fibres are carried around on the worker rollers to stripper rollers.

Figure 1.7 Point-to-point carding action. Source: Teasdale (1995).



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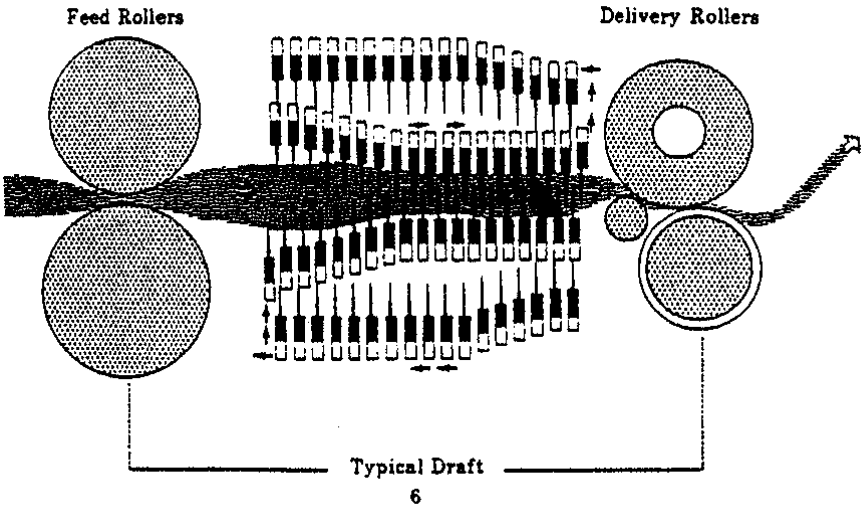
Burr beaters are rollers with blades attached which knock lumps of vegetable matter out of the mass of wool. Burr beaters are very effective on large pieces of vegetable matter such as Bathurst and Noogoora burrs. Some vegetable matter also falls out of the fibres at transfer points in the card.

Preparer gilling

This process is used to prepare wool for combing. Card slivers are laid parallel and passed through the gill. This machine has rows of pins which intersect the slivers (see Figure 1.8). The new sliver formed is pulled through the pins by faster moving front rollers, so that some straightening of fibres occurs. On modern gills the rows of pins are carried around at high speed on chains.

The gilled sliver is then combined with other slivers and regilled giving considerable mixing of fibres. Two or three preparer gillings are commonly used. The large number of sliver which are combined to produce a single sliver in gilling and combing provides a high degree of blending at each stage.

Figure 1.8 Gilling pin action. Source: Teasdale (1995).



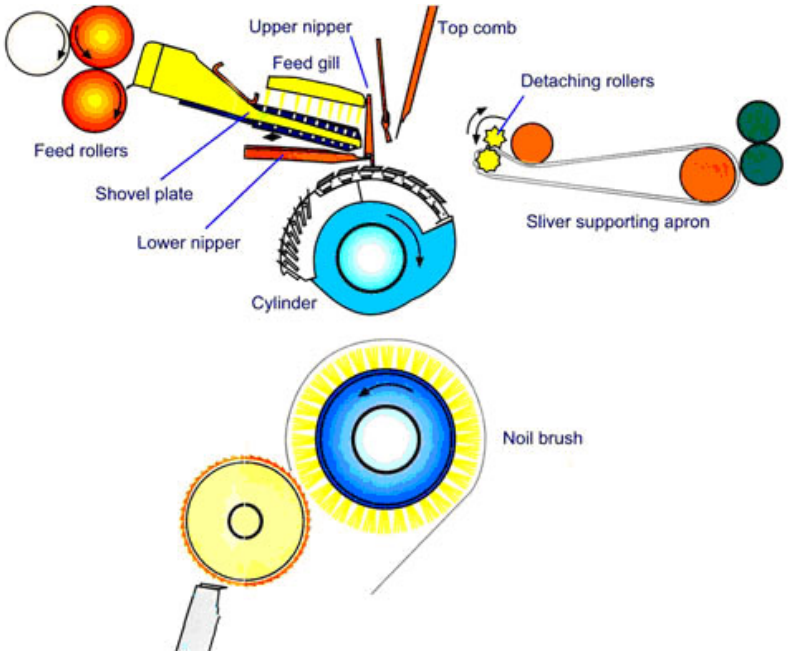
Combing

Combing straightens the fibres in the sliver and gives them a high degree of alignment, producing combed sliver or top. Combing also removes most of the remaining vegetable matter and fibre neps (tight fibre entanglements) and fibres shorter than about 20 to 30 mm. The short fibres removed are called noils.

The rectilinear comb (also known as the French or Schlumberger Comb, see Figure 1.9) is described here as it is almost universally used for worsted combing.

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Figure 1.9 Rectilinear comb – side elevation. Adapted from: NCS Schlumberger.



24 or 32 slivers are laid parallel and fed into the comb which operates on a cycle. The slivers are held by the feed gill (several rows of pins). The upper nipper jaws then grip the slivers. The feed gill pins withdraw and the slivers pull back leaving a fringe held by the nipper jaws. The fringe held in the nip is then combed by pins on the comb cylinder, straightening the long fibres and removing short fibres and vegetable matter.

After combing, the drawing–off rollers move forward and grip the fringe of fibres and lay it over preceding fringes to form combed sliver. The feed gill then operates to present more sliver for combing. The intermittent nature of combing leads to some irregularity in the positions of fibres in the combed sliver.

Finisher gilling

Combed sliver must be finished by re–gilling to give a satisfactorily uniform sliver called top. A finisher gill operates on a similar principle to a preparer gill and two finisher gillings are commonly used. Further blending is also achieved.

A combing mill

A Combing mill must provide a balance between the various processes to maximise productivity.

A 2.0m scour line typically produces around 1000 kg per hour of 21 to 23 µm scoured wool. An example of a Combing mill to handle this production is given in Table 1.1.

Table 1.1 Combing mill throughput. Source: Teasdale (1995).

Equipment	Throughout per machine	Number of machines required
Card (3.0 m)	120 kg/hr	8
1st Preparer Gill	400 kg/hr	3
2nd Preparer Gill	400 kg/hr	3
3rd Preparer Gill	400 kg/hr	3
Comb	30 kg/hr	30 to 40
1st Finisher Gill	400 kg/hr	3
2nd Finisher Gill	400 kg/hr	3

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Carbonising
Some wools contain high levels of vegetable matter of types which cannot be removed mechanically. The only viable way of processing these wools is to carbonise them.

Acidising
The wool passes from the scour directly into one or more acid bowls where it is immersed in about 7% sulphuric acid.

Drying and baking
The wool is rapidly dried in a drum or conveyor dryer at temperatures below 70°C to prevent fibre damage. It then passes into the baking oven to dry and bake at around 120°C to l30°C. Here the vegetable matter becomes charred and brittle. A conveyor dryer is usually used for baking. Intermediate crushing and dedusting may occur between the dryer and baking oven.

Crushing and dedusting
The wool then passes through a number of sets of crusher rollers to break up the carbonised vegetable matter which should be brittle. These rollers operate under high force and care must be taken to limit fibre damage.

Neutralising
The dust–free wool then passes into the neutralising line which usually comprises about 4 or 5 scour bowls. Remaining sulphuric acid is neutralised with alkali such as soda ash and the wool is given a final wash and rinse before being dried as for normal scoured wool.

A carbonising mill
A carbonising mill comprises a number of operations which must be matched to each other to provide a commercially acceptable product. Because of the chemical and physical processes involved (sulphuric acid, high temperatures and physical crushing), there must be a balance between:

- maximum removal of vegetable matter
- minimal damage to the wool fibres (colour, strength and entanglement), and
- minimum fibre losses.

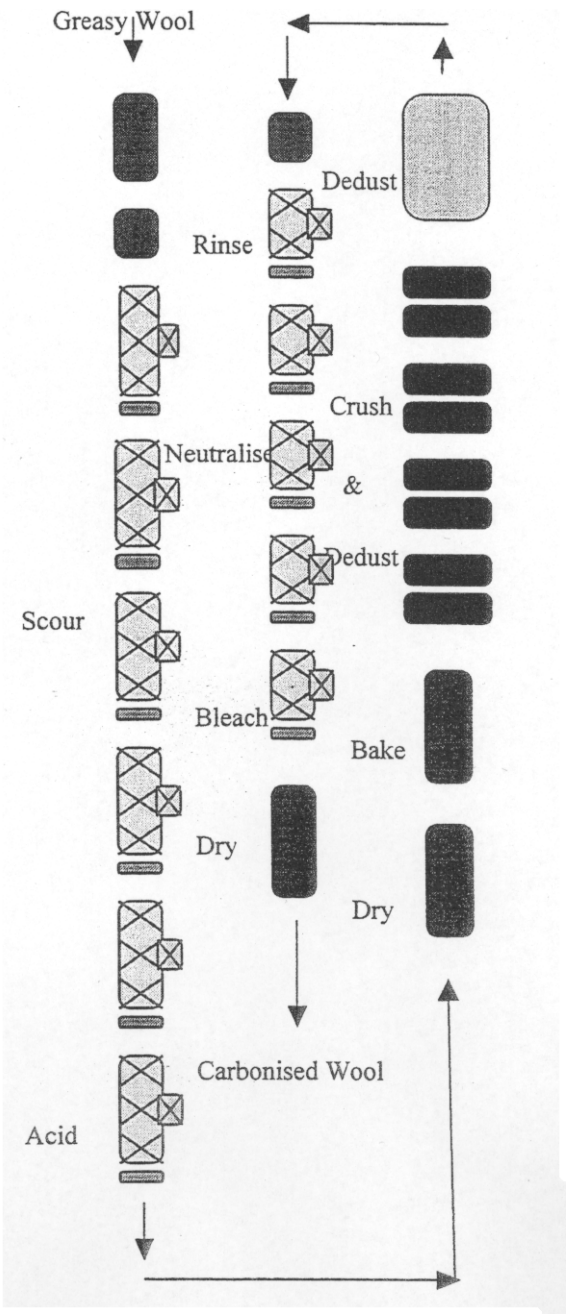
Some important measures of acceptability of carbonised wool include:

- the count of vegetable matter specks remaining in the wool
- the acid content remaining (measured as pH of aqueous extract or acid content %)
- fibre length, and
- fibre damage (measured as alkali solubility %).

There are many variations of a carbonising mill layout possible. One example is shown in Figure 1.10.

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Figure 1.10 Example of a carbonising mill layout. Source: Teasdale (1995).



1.2 Costs and value adding

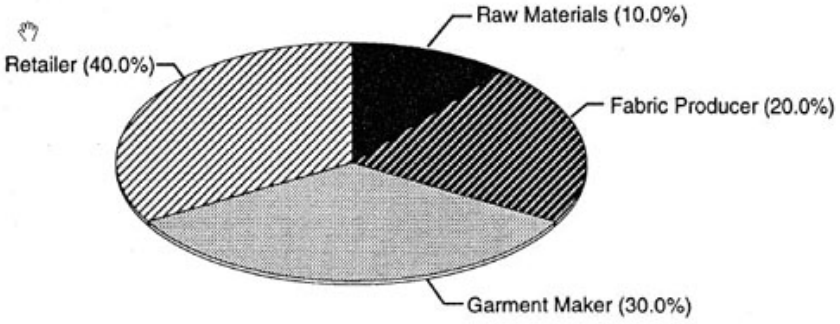
The typical costs of a scour plant are calculated on a spreadsheet produced by Andar (see Readings, Andar Spreadsheet.xls). It is interesting to relate these costs to typical commission scouring charges of about 15-30 cents/kg.

In 1993 Prof. Ross Griffith argued that Australia was losing too much value by having most of its wool processed off-shore. However his paper did not address many of the issues raised in section 1.3 of this topic.

Griffith (1993) stated that it is generally accepted in the textile and clothing industry that the division of the consumer clothing dollar yields only a 10% return to the raw material producer, including fibre, zippers, buttons, etc.. The break up of the consumer dollar is shown in Figure 1.11.

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Figure 1.11 Clothing Consumer - Dollar Division. Source: Griffith (1993).



A specific example of the value adding chain can be seen in the production of cotton jeans, a relatively simple, low cost product. Expressed as value per kilogram, the fibre is worth $2.00; the yarn $4.50; the fabric $10.00; the garment $30.00 wholesale to yield a retail price of $60.00. The value adding multiplier in manufacturing processes is therefore, 30 ÷ 2 = 15.

For a typical product made from Australian wools, namely men's suits, the overall value adding multiplier is approximately 40 as indicated in Figure 1.12. It is very clear from this figure that the big dollars in value adding occur later in the manufacturing sequences rather than earlier.

Figure 1.12 Value Added In Processing Men's Suits. Note: Overall V.A. Multiplier approximately 40. Source: Griffith (1993).

	AVERAGE SUIT		QUALITY SUIT	
FIBRE	$6.50		$12.00	
V.A.		5.00		7.00
TOP	$11.50		$19.00	
V.A.		13.50		27.00
YARN	$25.00		$45.00	
V.A.		40.00		135.00
FABRIC	$65.00		$180.00	
V.A.		185.00		320.00
SUIT	$250.00	WHOLESALE	$500.00	WHOLESALE
	$500.00	RETAIL	$1000.00	RETAIL

Griffith (1993) noted the major thrust for value adding in Australia has been directed towards ESP. From 1980-1993 these activities increased from 20% of greasy clip being semi-processed to levels of about 30% in some years (Figure 1.13).

Figure 1.13 Australian ESP capacity in 1993. Source: Griffith (1993).

		(m kg)
Scouring	(25 Facilities)	180
Carbonising	(10 Facilities)	30
Topmaking	(6 Facilities)	40

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The total scouring capacity of 180,000,000 kg represented a capacity to process approximately 30% of the Australian clip at 1993 production levels. The utilisation of this capacity for the year 1991-1992 is shown in Figure 1.7. Whilst Australia was running at near capacity levels, particularly in scouring and carbonizing, Figure 1.13 clearly indicates that most of this early stage material was exported without further processing, leaving only a very small quantity of wool for conversion in Australia to yarn and fabric. The CIE (2002) report provides reasons for this. Figure 1.13 also indicates that exports of these elaborately transformed manufactures was negligible.

Figure 1.14 Use of capacity 1991-1992. Source: Griffith (1993).

-|-	PROD	EXPORT	% EXPORT
Scouring	160(130)	106	80
Carbonising	30	26	85
Topmaking	30	24	80
Yarn & Fabric	5	Neg.	Neg.

Clearly, whilst Australia was increasing its participation in ESP, it was not and is not transforming this into anything like the potential that is actually available for value adding, if Australia were to go forward into elaborately transformed manufactures such as fabric or clothing.

Griffith (1993) also studied the ownership of ESP manufacturing capacity in Australia in 1993 and identified in percentage terms the major overseas participants by country (Figures 1.15 and 1.16 respectively).

Figure 1.15 Ownership of capacity – million kg. Source: Griffith (1993).

	TOTAL	O'SEAS	AUSTRALIA
Scouring	180	120	60 (33%)
Carbonising	30	14	16 (53%)
Topmaking	40	23	17 (42%)

Figure 1.16 indicates that Australia was a minor partner in ESP with the majority of the industry being overseas owned. Table 1.2 shows this remains the case in 2005. Interestingly, countries of ownership of our ESP capacity (Figure 1.17), did not reflect final usage patterns of raw materials.

Figure 1.16 Major overseas ESP participants. Source: Griffith (1993).

	Scouring	Carbonising	Topmaking
U.S.A.	17%	23%	0%
FRANCE	16%	0%	32%
JAPAN	9%	0%	18%
U.K.	6%	0%	8%

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Griffith (1993) also raised the controversial topic of 'transfer pricing' between subsidiaries of companies to reduce their taxation. By comparing the dollar per kilogram figures for scoured and carbonised wools, he found that for most years the value per unit mass was less than the equivalent clean value in the greasy form (Figure 1.16). Generally the wools processed in Australia are at the lower value end of the Australian clip, however Griffith (1993) thought it doubtful that this phenomenon could account for the relatively low export income achieved for scoured and carbonised wools.

Griffith (1993) also thought it doubtful that the processes would have been carried out at a financial loss. He suggested that, recognising the predominant overseas ownership in these activities, it is perhaps not unreasonable to anticipate that some favourable pricing arrangements have been negotiated.

Figure 1.17 Export income form Australian wool 1973-1992. Source: Griffith (1993).

	GREASY				SCOURED			CARBONISED			TOPS		
	($Am)	(mkg)	($/kg) greasy	($/kg) clean	($Am)	(mkg)	($/kg)	($Am)	(mkg)	($/kg)	($Am)	(mkg)	($/kg)
73/74	1062	488	2.18	3.45	51.2	19.8	2.58	16.6	6.8	2.44	22.3	5.8	3.84
74/75	664	457	1.45	2.30	59.4	31.6	1.88	12.2	6.9	1.77	16.3	5.0	3.26
75/76	842	583	1.44	2.29	73.0	35.9	2.03	18.9	9.1	2.08	25.3	8.5	2.98
76/77	1276	675	1.89	3.00	118.0	41.1	2.87	35.9	12.1	2.97	43.6	11.7	3.73
77/78	993	494	2.01	3.19	112.6	35.4	3.18	34.0	l0.5	3.24	39.6	9.6	4.13
78/79	1227	566	2.17	3.44	153.2	46.3	3.31	43.1	12.0	3.59	49.5	11.1	4.46
79/80	1282	504	2.54	4.04	188.7	49.4	3.82	48.0	12.0	4.00	63.9	12.5	5.11
80/81	1454	529	2.75	4.37	240.7	55.6	4.33	64.6	13.7	4.72	72.2	13.1	5.51
81/82	1470	497	2.96	4.69	236.9	52.3	4.53	50.3	11.3	4.45	78.4	13.5	5.81
82/83	1469	489	3.00	4.77	205.4	46.0	4.47	37.3	9.5	3.93	98.0	16.2	6.05
83/84	1573	497	3.16	5.02	252.5	53.1	4.76	61.3	13.1	4.68	77.5	13.8	5.62
84/85	1956	554	3.53	5.60	289.6	56.8	5.10	88.8	18.4	4.83	91.8	15.1	6.08
85/86	2285	608	3.38	5.36	395.3	70.6	5.60	118.2	20.2	5.85	124.2	16.9	7.35
86/87	2837	677	4.14	6.65	527.0	84.2	6.25	132.5	20.8	6.37	127.5	16.2	7.87
87/88	4270	663	6.44	10.22	749.2	84.2	8.90	195.1	21.2	9.20	175.0	17.5	10.00
88/89	4581	628	7.29	11.58	753.9	72.1	10.46	169.3	19.4	8.73	232.3	19.0	12.22
89/90	3275	540	6.06	9.63	527.7	60.5	8.72	143.8	19.0	7.57	146.2	15.0	9.75
90/91	2140	461	4.64	7.37	524.3	76.7	6.84	109.3	19.9	5.49	170.6	20.0	8.53
9l/92	2558	622	4.10	6.50	712.0	106.0	6.70	171.0	26.0	6.58	165.0	24.0	6.87

Comparing the final column in the tops category again indicates a relatively modest increase in value compared to the clean equivalent value in the greasy form. At 1993 prices topmaking would cost approximately $2.00 per kilogram and it is clear that these levels of additional value are not shown in the comparison. Griffith (1993) thought it could hardly be said that Australia had derived appropriate value adding by undertaking the processes of scouring, carbonising and topmaking in Australia.

Needless to say, Griffith's observations caused outrage at the time amongst the processers attending the UNSW Wool School where his paper was delivered.

1.3 Early stage processing in Australia

Figure 1.17 can be used to calculate the percentage of greasy wool scoured in Australia each year before export. Savage (1988) reported that in 1986-1987, greasy wool production was 813.7 million kg, giving a clean wool equivalent of 523.8 million kg. Of this amount 112.4 million kg (or 21.5%) was scoured in Australia, 19.8 million kg (or 3.8%) was carbonised and 24.5 million kg (or 4.7%) of top was produced. Exports for 1986-87 were: Scoured 84.2 million kg, Carbonised 20.6 million kg., Tops 16.2 million kg. The total value of these exports was in excess of $1,000 million.

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The approximate flows of wool through the whole wool processing pipeline in Australia are shown in Figure 1.18 The list of Australian Wool Processors in 2003 is given in Table 1.2.

Figure 1.18 Volumes of wool processed in Australia.
Source: Maddever, D. (pers. comm.).

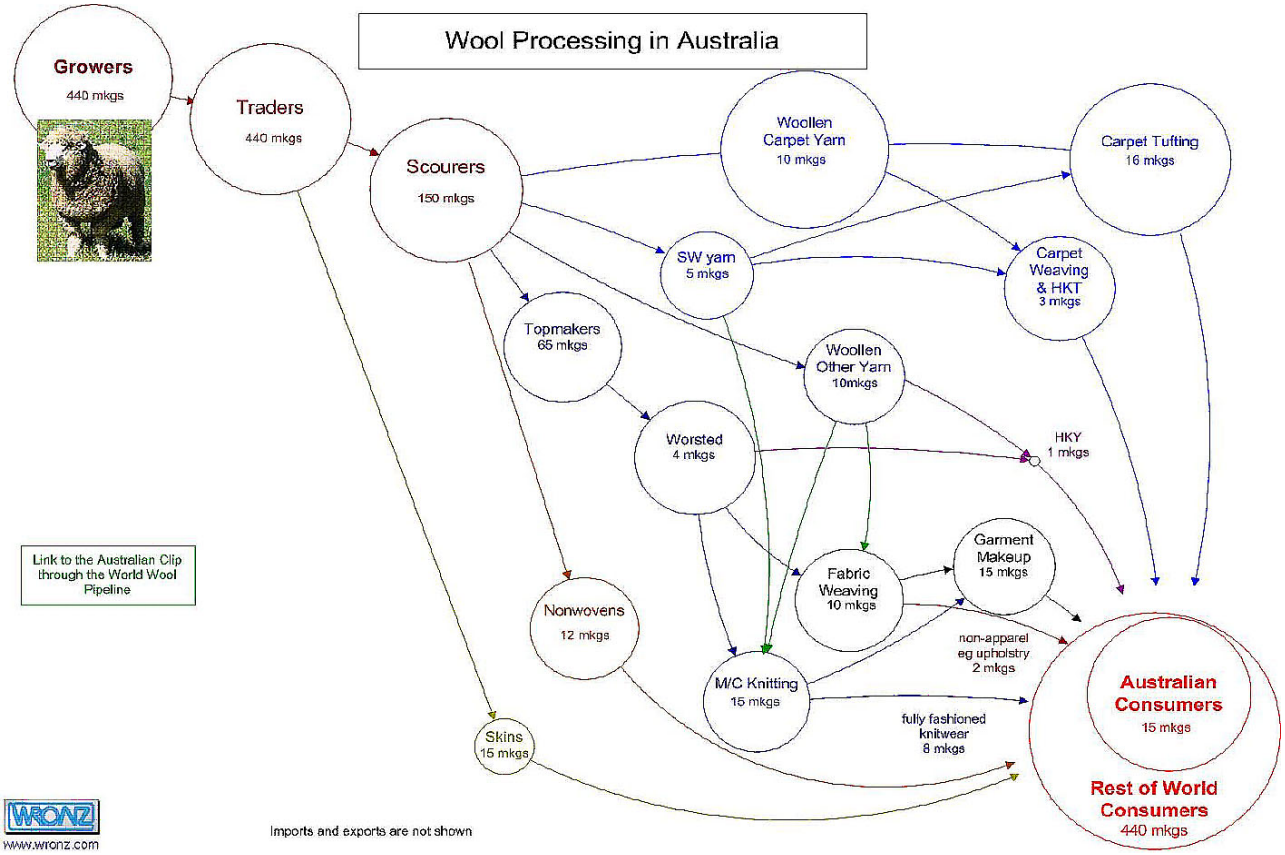


Table 1.2 Australian based early stage processing plants.
Source: Australian Wool Processors Council (2003).

COMPANY	LOCATION	OWNERSHIP	
Australian Topmaking Services	Parkes, NSW	BWK/Elders group	Australia/Germany
Clyde Wool Scouring	Geelong, Vic	Fox & Lillie and Jackson group	Australia
EP Robinson	Geelong, Vic	Robinson/Laycock families	Australia
Fletcher International Exports	Dubbo, NSW	Fletcher family	Australia
Geelong Wool Combing	Geelong, Vic	BWK/Elders group	Australia/Germany
Fox & Lillie Woolcombing	Melton, Vic	Fox & Lillie and Lempriere groups	Australia
Michell Australia	Salisbury, SA	Michell family	Australia
Goulburn Wool Scour	Goulburn, NSW	CIL	France
Jandakot Wool Washing	Rockingham, WA	CIL & Standard Wool	France/UK
Grampians Wool	Hamilton, Vic	Fox & Lillie group and Graham Smith	Australia
Lachlan Industries	Cowra, NSW	Kanebo	Japan
Melbourne Scouring Company	Laverton, Vic	McKendrick family	Australia
Port Phillip Wool Processing	Williamstown, Vic	Itochu/Nippon Keori	Japan
Riverina Wool Combing	Wagga Wagga, NSW	Chargeurs group	France
Victoria Wool Processors	Laverton, Vic	Kim family	Australia and Korea

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Since 2003, the industry has experienced significant problems (see Section 1.4) with Clyde no longer having Jackson group involvement, Geelong Wool Combing closed, Fox and Lillie closed, Lachlan Industries closed, Melbourne Scouring Company closed, Port Phillip Wool Processing closed and some of the plant moved to VWP at Laverton in a joint venture between Itohchu/Nippon Keori and Kim, opened in April and Michells are only carbonizing now (Avery, M. pers. comm.).

Before this Canobolas Topmaking (Orange), Warwick Wool Processors and Conagra Scouring in Melbourne closed and Fox and Lillie at Melton closed their topmaking activities to only scour (Douglas, S. pers. comm.).

In New Zealand, the scouring capacity in 2005 (Coleman, A. pers. comm.) consisted of Godfrey Hirst (Clifton two 2.4m wide scours, Clive 2.4m and 2m scours), Wool Services International (Kaputone 3m scour, Cockatoo 3m scour), Cavalier (Canterbury Wool Scour 3m scour, Timaru 2.4m scour) Feltex (Kakariki 2.4m, Hawkes Bay 2.4m) and Ashburton (old 4 foot scour). The 3m-wide scours process twice as much wool per hour (6 tonnes) as the 2.4m scours (see spreadsheet) and have more powerful squeeze rollers so the scoured wool quality is improved (Dwyer, M. pers. comm.).
The principal international ESP plants include:

- Chargeurs (Europe, China and elsewhere)
- BWK (Europe)
- Standard Wool (Europe)
- Dewavrin (Europe)
- Modiano (Europe)
- Itochu (Japan and Australia)
- Cheil (Korea)
- Jaya Shree (India)
- Indorama (Thailand)

Chargeurs and BWK are the big two and are also represented in Australia.

There are a large number of processing plants in China and in other parts of the world, particularly India. Russia has a significant, but antiquated, processing industry. World textile company numbers given in the Woolmark 2004b.pdf reading.

It is very difficult to get information on the processing capacity of different plants, their in-house costs and buying and selling patterns. This information is regarded as confidential and commercially sensitive. Some information on the CIL's Goulburn scour is public because of its Environment Australia award (see Goulburn Wool Scour.pdf reading).

1.4 The future of early stage processing in Australia

Savage (1988) stated that theoretically there was a vast potential to increase the production of both scoured combing wools and wool tops in Australia and to a lesser extent carbonised production. In 1987 about 70% of Australia's wool was exported in the greasy state.

Savage listed the following **advantages of processing in Australia:**

- **Reduction in the cost of freight,** due to the fact that only clean wool is shipped. Two factors offset this advantage to some extent:
    - Different freight rates for greasy and processed wool, which in some cases are unfavourable to processed wool
    - Because scoured wool is more resilient than greasy wool, it cannot be pressed to such high densities as greasy wool. This means that on average only 13 tonnes of scoured wool can be fitted into a container, compared to up to 18 tonnes of greasy wool. Nevertheless, in 1987 there were still freight advantages ranging between 10 and 30 cents/kg clean for scoured or carbonised product

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- **Added value of exports**

    - Obviously, processing wool in Australia adds value to the product which would normally be added overseas. This added value is in the range of 5 to 15%. depending on the end product, and thus could have a significant effect on increasing export earnings, if more of the clip is processed locally.

- **Processing costs**

    - Recent studies had shown that Australia compares very favourably with other major overseas processing countries (particularly Europe and Japan) with respect to costs such as those of labour, energy and effluent disposal. Possible exceptions are with countries such as China, Korea, Taiwan and Malaysia

- **Economic benefits for local communities**

    - In local communities such as Wagga, where Riverina Wool Combing is located, there were large benefits to be seen. In 1987, Riverina Wool Combing and Wool Processing employed in excess of 200 people in their combing and carbonising o**p**erations, which meant a payroll of over $4 million annually, that went into the local economy. In addition, many other local services benefit, both during the construction phase and in the maintenance of the plant.

Some disadvantages could include:

- For scoured combing wool, in particular, there is a problem of **a slight reduction in the mean fibre length of the top** made from wool which has been pressed and shipped, particularly in a high density form. This may mean that the spinner's specification for length is not achieved, resulting in claims on the top maker. Of course, the problem does not occur if the wool is converted directly to top in Australia

- **Restricted opportunities for blending**

In Europe, in particular, Australian wool is invariably blended with cheaper South American or domestic wools to achieve least cost blends, which still meet the spinner's specification. Obviously, converting wool to scoured form in Australia restricts the ability of the overseas topmaker to make blending decisions.

In Japan, this appears to be less of a consideration as most greasy wool stocks come from Australia in any case. China and U.S.A also have some limited opportunities for blending local wools, although there is also high demand for 100% Australian scoured wool in both countries.

Savage's summary was that in 1987 Australia had a very healthy, if relatively small, early stage processing industry which was earning Australia in excess of $1,000 million in export earnings per annum. *The 1987 Werner report on ESP stated there was the potential to double Australia's ESP export earnings by the year 2000. This did not happen – why?*
By 2001 Australian ESP processors employed in the vicinity of 1,400 people (Australian Wool Processors Council 2003). According to the Australian Wool Processors Council (2003), the industry has undertaken substantial investment in recent times ensuring its operations are world class with high product quality, world class environmental practices, and an ongoing continuous improvement culture geared towards productivity gains.

However, despite its modernity and export orientation, the ESP industry in Australia is in an extremely difficult competitive position due to:

a) The failure of key markets to reduce their protective barriers to the same levels that prevail in Australia. These barriers take the form of direct tariffs and certain discriminatory tariffs and in the case of Europe specific subsidies to allow ESP capacity to be set up in the lower labour cost countries such as Eastern Europe
b) The emergence of a significant Chinese ESP capacity. The Chinese purchase the majority of their wool in greasy form and currently purchase 42% of the Australian wool clip

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c) A global overcapacity of ESP that has in turn created an overcapacity in Australia
d) A decline in the production of Australian wool. Australian ESP can only process Australian wool (due to quarantine restrictions on imported fibre) and the decline in greasy wool production coupled with the increased Chinese propensity to purchase Australian wool in the greasy form, has exacerbated the excess capacity for ESP in the Australian industry.

The Australian Wool Processors Council has put in place strategies to meet the competitive challenges faced including:

a) facilitating restructuring
b) developing a specialist niche industry
c) supply chain partnering
d) seeking liberalisation of trade barriers in overseas markets
e) capitalising on the inter relationships within the industry
f) increasing the production of wool in Australia.

The LSP industry in Australia is an integral part of the total wool supply chain in Australia. There is an interdependence between ESP and LSP apart from the supplier/customer relationship. LSP allows the ESP manufacturers an ongoing assessment of product quality/performance and allows for the introduction (and trialling) of innovative product developments (Australian Wool Processors Council 2003).

Centre for international economics (2002) - ESP review report

A report on "Prospects for further wool processing in Australia" by the Centre for International Economics (2002) listed the limits to the further development of a larger ESP industry in Australia and was written from a wool producers' perspective. The report noted that global wool consumption is falling steadily, and competition from substitute fibres is squeezing wool out of its traditional apparel markets, which themselves are in decline. The key to a strong future was seen as the ability to actively increase the demand for wool-based apparel products outside traditional markets. There is evidence that this has been achieved, on a modest scale, with the success of Sportswool™. The continual development of new processing technologies will also create new products that have specific properties that are demanded by consumers, i.e. creating wool-based products that consumers want to buy (CIE 2002).

The summary of findings in this report, commissioned by AWI, was as follows:

Adding value to wool through further processing

'Traditional wool processing activities are under intense pressure and there is little opportunity for profit in this industry in the short term.'

- Australia exports the majority of its wool in greasy, scoured or carbonised form, and is a small world player in terms of wool processing beyond early stage processing
- The further wool processing that does occur locally is sold in the small domestic market — a market that has become very cost-focused rather than performance oriented. It is also a market that is less likely to actively select wool products — in line with world trends away from fibre choice. Factors such as performance, style, fashion and brand are the new drivers of purchasing decisions
- Competition in wool processing continues to intensify from developing countries as global processing capacity continues to shift from traditional countries in Western Europe, to Asia (principally China and India) and Eastern Europe
- Italy maintains its position at the top of the wool processing value chain, supporting very high processing costs by producing high quality, high value products that command a significant price premium
- There is currently an oversupply of wool processing capacity around the world. With world wool production at its current level, anecdotal evidence from study respondents indicates that processors are operating at approximately half of their available capacity.

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Drivers of location decisions for wool processing capacity

'Cost and quality drives the location of wool processing, there is no room for players in the middle ground.'

- Within countries that undertake wool processing, the internal location of that processing depends on a range of factors that tend to be unique to each country
- The key driver of location for current wool processing capacity in Australia is history. The majority of processors are operating where they are for reasons that drove location in the early part of the last century, these being primarily *access to wool supplies and transport links*
- The incentives offered by governments have been important considerations in the decisions of a number of processors to establish their operations in specific locations in Australia in the last 10 years
- Wool processing undertaken in Italy is supported by the price premium that a "Made in Italy" label conveys to Italian made textile products. Within Italy, processing is undertaken in the region around Biella. This is supported by:
    - the cluster of associated businesses which can handle every aspect of the wool processing chain, and
    - proximity to the fashion and design centres of Europe.
- Wool processing is undertaken in China in areas where low cost labour with a heritage of textile production is available; primarily these areas are in close proximity to the clothing manufacturers. In addition, China has a large and growing domestic market for wool-based apparel.
- With overcapacity in the wool processing industry if there were to be an increase in wool processing in Australia, it would only occur at the expense of processing in an alternative location. **There is no business case to add capacity in a dramatically oversupplied market**. For Australia to be considered as a country for potential relocation, it would need to be capable of either processing at a lower cost than existing locations or at higher quality. There is no evidence to suggest that Australia is able to achieve either of these outcomes.
- Neither the Italians nor the Chinese seriously considered Australia as a possible location for further processing of wool. The Italians believed that costs in Australia are similar to Italy, and that Australia does not have the necessary heritage and skilled labour for textile production. The Chinese dismissed Australia on the grounds that labour costs are significantly higher than in China.

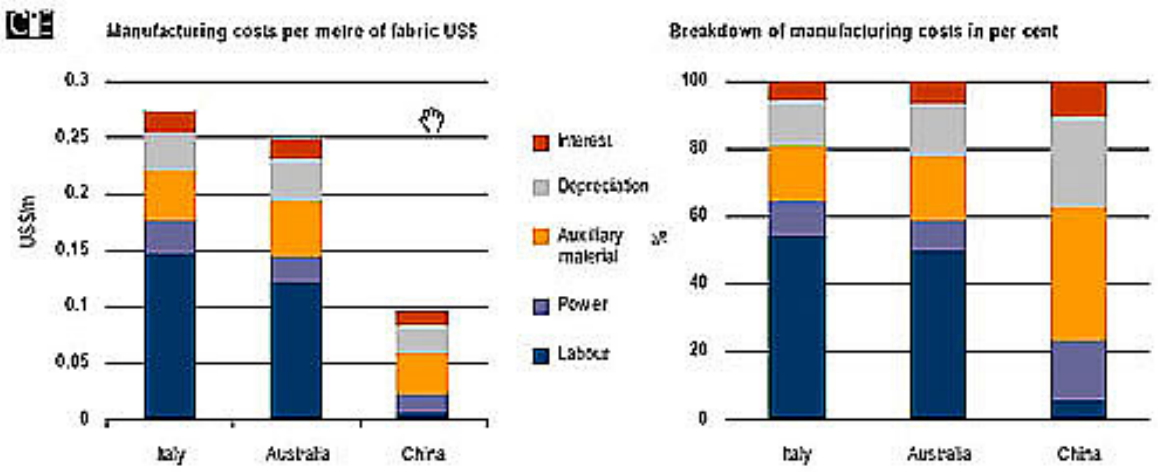
How does Australia compare as a wool processing location

'Unlike Italy, Australia does not have a marketing position that allows a price premium over Chinese wool products. New (non-traditional) products are the key to Australian industry growth.'

- Australia is very uncompetitive in terms of labour costs in comparison to developing countries. For example, labour costs are around five times higher in Australia than in China (excluding labour on-costs).
- The location of the greasy wool supplies in Australia does not have a significant impact on final fabric prices in overseas processing countries.
- Starting with Australian greasy wool and ending with woven fabric, on a 'like for like' basis, average fabric production costs are higher in Italy at US$19.00 per metre of fabric, than Australia at US$10.20 per metre, with the lowest cost location to the fabric stage being China at US$5.00 per metre (Figure 1.19). Hence, China can make fabric from (largely) Australian greasy wool for about half the cost of Australian processing, and about one quarter the cost of Italian processing. Total costs to wholesale in the full China production chain are less than one third of that in Italy and 35% below that in Australia.
- Italy is able to support its high cost structure by focusing on premium quality design and output, which, together with the 'Made in Italy' label, achieves a significant price premium in consumer markets. Based on current market perceptions and marketing practices, Australian output is not able to support a sufficient price premium in the consumer market over Chinese output to compensate for its higher production costs.

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Figure 1.19 Comparative manufacturing costs in Italy, China and Australia. Source: Centre for International Economics (2002).



Prospects for further wool processing in Australia

'To be a viable wool processing country Australia needs to change the rules, new technologies and new products can make Australia a competitive location.'

- Unless there is a sustained increase in worldwide demand for wool and worldwide rationalisation of processing capacity occurs, the opportunities for a profitable increase in the processing of wool in Australia are severely limited
- Australia does not have a competitive advantage in later stage processing and garment manufacture. Our strengths are in the design and branding stages of the process, and any benefits that will accrue to wool producers are likely to be through the increase in demand for wool products that Australian brands create
- Australia is a leader in wool science. The continued research and development (R&D) and commercialization of products are likely to create benefits for wool producers, largely through an increase in demand for fine wool
- The introduction of new technology in wool processing capability (for example, non wovens), where Australian R&D can be implemented, appears to be a good opportunity, particularly where the products being developed are closely related to the requirements of the final consumer
- The introduction of new products needs to be controlled to ensure expectations are managed and the products are correctly positioned in their markets
- There are niche opportunities for the profitable expansion of wool processing in Australia, indeed there may be a number of areas where Australian processors could operate successful businesses. However, the benefits will be confined to the individual business and not flow back to wool producers. Note that Griffith (1993) had a contrary view to this.

What matters to the profits of Australia's wool producers?

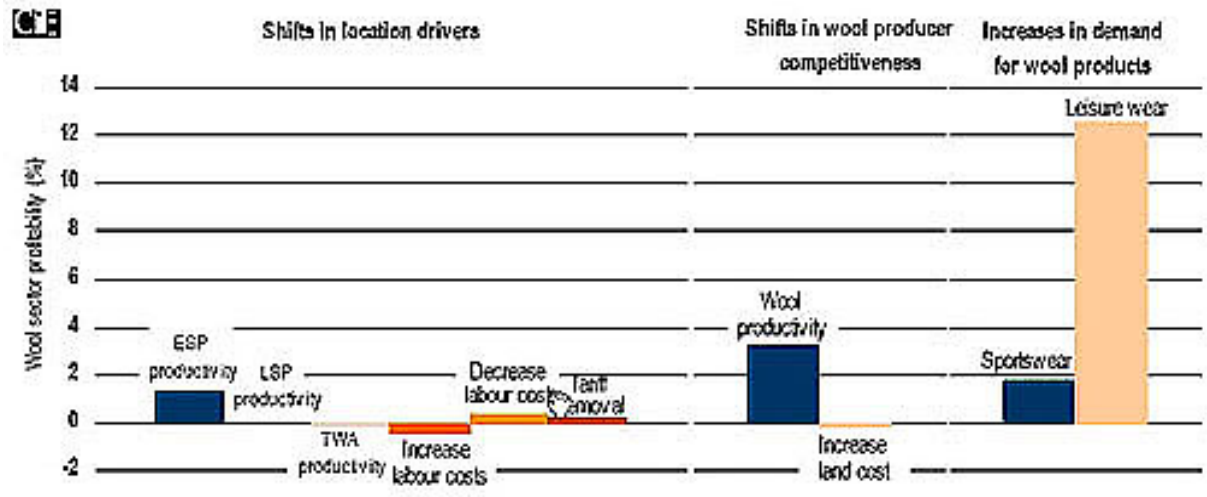
'If Australian wool processing is to have a beneficial effect on wool producers it needs to create a significant additional demand for wool-based products. Without an increase in worldwide demand, increasing the amount of wool processing in Australia does not have a positive impact on wool producers.'

- A global wool model, developed for this review, quantified the impact on wool producer profitability and output of a change in the location of global wool processing capacity, and other factors that affect wool producer returns. Modelling results show that Australian wool producers have little to gain from an expansion in domestic wool processing. Any increase that does occur will not have much effect on Australian wool producers, because it does little for the overall demand for wool (Figure 1.20)
- Changes that reduce the Australian cost of producing greasy wool (and to a lesser extent ESP) will clearly promote the growth of Australian wool production, and see relocation of international wool production to Australia

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- Increasing the competitiveness of Australian later stage processing and textile and garment manufacturing, if this could be achieved, brings little benefit to wool producers
- By contrast, increasing demand for *wool-based* apparel can generate major gains in worldwide demand for greasy wool, and the model shows the Australian wool sector capturing a larger share of any growth compared with other wool producing countries
- The magnitude of the benefit to wool producers associated with an increase in market share is very significant. The size of the overall apparel market (at roughly US$1 trillion per annum) is such that even a tiny increase in share in one of the market segments where wool is currently not well represented has a huge effect on the profitability of Australian wool producers.

Figure 1.20 Effect on wool sector profitability. Source: Centre for International Economics (2002).



A demand creation strategy to re-establish wool in world markets

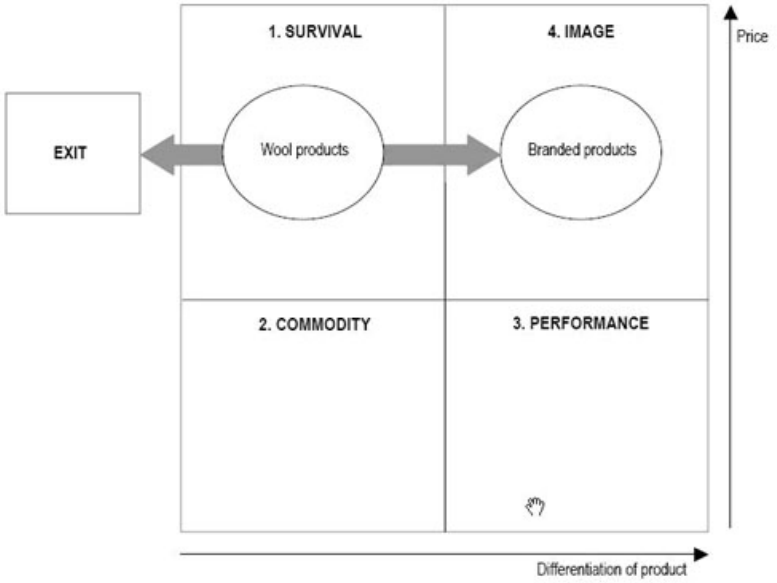
'Wool is a high price fibre; this constrains wool products to a market segment dominated by the major consumer brands. Generic wool products cannot compete against the massive marketing budgets and sophisticated branding strategies of these companies, yet wool has attributes that are highly desirable to clothing consumers. We need to harness the marketing prowess of the consumer brands to sell these attributes for us. The fibre need not be called wool but it has to come off the back of an Australian sheep.'

- The consumer market trends pertinent to wool are currently unfavourable. *(See: Wool Marketing and Clip Preparation unit lecture notes)*
- The apparel market segments where wool currently has a presence are declining
- The existing consumers who prefer wool-based fabrics are aging and declining in number
- The overall expenditure on clothing in the developed world is declining as a proportion of income
- The wool industry must continue to develop and protect its existing markets; these markets will continue to provide the revenues that will support growth into new market segments
- Continual improvements in wool production capability and processing efficiency are necessary requirements to stay in business. They are essential if the wool industry is to limit the speed of its slow decline, but they are not sufficient to reverse the trend
- Australian wool producers will benefit most from a global increase in the demand for wool-based clothing (manufactured using Australian wools). There are opportunities that become apparent when the properties of wool-based products are related to the requirements of consumer clothing. A good example is Sportswool™ and its use in ultra-high-performance soccer jerseys such as those worn by Manchester United
- Wool's relatively high cost (compared to other fibres) constrains it to the market segments that are dominated by branded products, where a consumer price premium for the brand can be achieved. To increase the demand for wool, the industry needs to leverage the strengths of these brands. This can be achieved by partnering with key brands to create wool products whose inherent (wool-based) attributes convey advantage to the brand. This 'Brand Leader' strategy is the key to the penetration of wool into new market segments (Figure 1.21) and has been used successfully by Merino New Zealand

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- Through partnerships with key textile and clothing brands the potential market for wool fabric could increase significantly
- The development of non-woven technology by companies such as Macquarie Textiles, will also allow Australia to lead the world in the development of new wool products with potential savings of about 40% over traditional wool processing systems. Australia's development of these products should emulate the Italian (price premium) model rather than the Chinese model
- The expansion of wool production in Australia depends on processing it in a manner which makes it attractive to global consumers and finding the right people to sell it.

Figure 1.21 Clothing segments. Source: Centre for International Economics (2002).



Woolmark (2004) reports the intense pressure on Australian ESP companies has been brought about by the large drop in available wool supplies over the past decade, due to a combination of the fall in Australian and global wool production and the sell-off of the wool stockpile in 2001. As a result, there is excess capacity in ESP, particularly in combing, which mostly uses 24.5 micron and finer wool. It is estimated that just 58% of the total global capacity of combing machinery was used in 2003, in spite of recent closures in some of the major wool top producing countries, including Australia, Italy and Taiwan.

It is suggested that you refer to the Woolmark 2004b.pdf publication in your readings "A Global Strategic Market Analysis and Outlook for Australian Wool", in particular Chapter 2, which covers the Australian ESP industry.

In summary, the report notes that ESP capacity utilisation remains very low in many countries, in particular in China where capacity actually increased in 2003 with the relocation of machinery from Australia and Taiwan. This excess capacity at combing, and in other sectors of early stage processing has put considerable pressure on profit margins in the ESP industry. While the modest increase in Australian and global wool production expected over the next 2-3 years will help relieve this pressure, further rationalization of the ESP industry seems inevitable.

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Readings

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Summary

Summary Slides are available on CD

This topic provides an overview of the steps involved in Early Stage Wool Processing (ESP), the costs and value adding aspects of the industry, the major players in the Australian industry, recent changes in the industry and impediments to future growth.

The ESP industry is involved in the scouring, carbonising and manufacture of tops from Australian greasy wool. ESP products are sold to Later Stage Wool Processors (LSP) who are primarily yarn spinners. *There is also a LSP unit available for study*. ESP in Australia is an export oriented industry that also services the domestic LSP market.

Technical information and help on processing is available via the AWI website www.woolontheweb.com.au.

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Glossary of terms

Source: Cottle (1991).

Apparel Wool	All wool except carpet and pulled wools
Aquajet loom	A loom using a jet of water instead of a shuttle
Bradford	Main wool-manufacturing centre in Yorkshire, England
Carbo types	Very burry wools, usually short, from which the vegetable fault cannot economically be removed by mechanical methods
Carbonising	The chemical process that removes burr and other vegetable fault from wool
Carding	After wool is scoured and dried it is fed into a carding machine containing rollers covered with closely set fine pins or points, which opens up the wool into an even layer, removing as much burr and seed as possible, and draws the fibres parallel to each other to form a single continuous strand of fibres called a 'sliver'

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Carding wool	Wool suitable for use as raw material for the woollen system of yarn production in which wools are carded and not combed. Carding types are usually wools of less than 38mm in staple length
Carpet wools	Very strong or coarse wools, generally hairy or medullated, quality numbers usually from 36s to 50s, used mainly in the manufacture of carpets (30-40 um diameter)
Clothing wool	Superior Merino wools under 38mm (1.5 inches). Clothing only applies to sound fine, dense, elastic, soft types with good felting properties
Combing	A process performed (usually by rectilinear comb) after carding and gilling to remove most of the short fibres (noil), neps and foreign matter, leaving the longer fibres lying parallel to the direction of the sliver. This product after two more gillings is called top
Combing wool	Wool having a staple not less than 38mm (1.5 in.) from Merinos, and 74mm (2.5 in.) from crossbreds. Merino combing wools are classified in the following groups: 1. Full warp – a well-grown, sound, bulky, dense wool showing good character and regular length of 90mm (3.5 in.) for 64s, 60s and 58s. 2. Half warp – all the characteristics of a full warp, without its length 3.Weft – thinly grown of medium to short combing length but suitable for combing on all machines 4. French combing – irregular to short length (not exceeding 64mm) which is suitable for combing on Continental combs 5. Shafty top-makers – good length but carrying some fault 6. Inferior top-makers – short, shabby, earthy unsound wools without style 7. Preparing wools – sound 180-190mm (7-8in.) and greater. British longwools and British longwool x Merino crossbreds. They are prepared for combing on the preparer
Fellmongered wool	Wool removed from sheep skins by sweating or chemical processes
Flannel	Wool fabric of plain or twill weave made from worsted or woollen yarn and milled during manufacture
French combing	A term applied to wool suitable for combing on continental-type machinery. Describes wool 38-50mm in staple length
Gilling	In the worsted system, three gilling operations are normally carried out prior to combing and two gilling operations after combing. Carded slivers are blended together and the direction of feed alternated to make the final sliver suitably uniform for worsted spinning
Lanolin	An extract from the yolk, used in ointments, etc.
Mule spinning	Spinning process combining intermittently the three actions of drafting, twisting and winding
Neps/slubs	Small 'balls' (or aggregations) of entangled fibres, which are created during processing. These are mostly removed from the top during combing. Slubs refer to neps over 2mm in size
Noble comb	A circular comb used in the Bradford system of making worsted yarn. Limited to longer wools than the Schlumberger is capable of handling. The wool is combed with oil
Noil	The short fibre removed in the combing operation. It is a mixture of short and broken fibres, neps, and small particles of vegetable fault

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Non-woven	Fabric made directly from fibre by construction methods other than knitting or weaving
Pelt	Sheepskin with little or no wool on it
Preparing	A preliminary process of combing, which replaces the worsted card with crossbred wools exceeding about 180 mm (7 in.) in length
Regain	The amount of moisture in the fibres, expressed as a percentage of the clean oven-dry weight. Standard regain occurs at 20degreesC and 67% relative humidity. Processed wool is adjusted to a particular regain according to IWTO regulations
Roller lapping	Top manufactured from long-stapled wools, usually a lustre type, for use in covering the squeeze rollers in wool-scouring machinery. Raw material suitable for the manufacture of roller lapping
Romaine	The amount of noil produced during processing, expressed as a percentage of the top and noil produced
Roving	Final product of the drawing process, resulting in a strand of wool of the desired thickness for spinning into yarn
Schlumberger comb	A rectilinear comb designed originally for cotton and later adapted to dry combing of short wool (1.5-2in. in length). Made by a French company
Scoured wool	Wool that has been washed, usually in a series of bowls and by the use of potash, detergent and water
Sliver	A continuous band of carded or carded and combed wool in an untwisted condition
Sorting	The preparation of fleeces prior to manufacture. Fleeces are divided into matchings according to quality number, length and colour
Top	A continuous untwisted strand of combed wool in which the fibres lie parallel, with short fibres having been combed out as noil. Top is raw material for worsted wool processing and is specified in terms of fibre diameter, fibre length distribution and mean, regain etc.
Transfer pricing	The practice of setting input/output prices to minimize tax paid between export/import countries
Woollen	Description of yarn, fabrics or garments made from wools that have been produced on the condenser or yarn system and that contain wool fibres. A woollen spun yarn is descriptive of any yarn carded, condensed and spun on woollen machinery. The wool used generally has a shorter mean fibre length (40mm and less) than that used in the worsted system. The cloth produced is comparatively bulky, with many fibres extending from the surface. Woollen fabrics include tweeds, felts, flannels, blankets and knitwear
Worsted	Descriptive of yarn, fabrics or garments in which the fibres are reasonably parallel. The yarn is made from top, and undergoes more stages of processing (i.e. gilling, combing and drawing) than the woollen system. In worsted yarn the fibres are more tightly spun, resulting in smoother, stronger yarn than the woollen system. The fabric produced is smooth and dense and retains its shape well. Products from the worsted system include suitings and knitwear

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