Labour Costs in Spinning & Weaving 1994

				Weekly Wage Cost in Sterling
			US$/hr	**£**
1	Japan		25.62	665.45
2	Switzerland		25.46	661.30
3	Belgium		23.15	601.30
4	Denmark		22.04	572.47
5	Netherlands		21.77	565.45
6	Germany W		20.77	539.48
7	Austria		19.47	505.71
8	Norway	*	18.46	479.48
9	Sweden		17.34	450.39
10	Germany E		16.26	422.34
11	Italy		15.65	406.49
12	France		15.35	398.70
13	Canada		13.6	353.25
14	Finland		13.07	339.48
15	Australia		12.42	322.60
16	USA		11.89	308.83
17	Ireland		11.07	287.53
18	UK		10.74	278.96
19	Spain		8.55	222.08
20	Greece		7.68	199.48
21	Israel		6.81	176.88
22	Taiwan		5.98	155.32
23	Hong Kong		4.4	114.29
24	Portugal		4.02	104.42
25	Korea S		4	103.90
26	Singapore	*	3.56	92.47
27	Uruguay		3.31	85.97
28	Mexico		3.22	83.64
29	Tunisia	*	2.97	77.14
30	Argentina		2.89	75.06
31	Turkey		2.31	60.00
32	Hungary		2.19	56.88
33	S Africa		2.19	56.88
34	Columbia		1.88	48.83
35	Venezuela		1.85	48.05
36	Brazil		1.76	45.71
37	Peru		1.7	44.16
38	Mauritius		1.55	40.26
39	Morocco		1.54	40.00
40	Slovakia		1.54	40.00
41	Czech Rep.		1.51	39.22
42	Poland		1.51	39.22
43	Thailand		1.41	36.62
44	Malaysia	*	1.18	30.65

45	Syria	*	1.12	29.09
46	Philippines		0.95	24.68
47	Egypt		0.64	16.62
48	India		0.58	15.06
49	China		0.48	12.47
50	Zimbabwe	*	0.47	12.21
51	Indonesia		0.46	11.95
52	Pakistan		0.45	11.69
53	Zambia		0.43	11.17
54	Sri Lanka		0.42	10.91
55	Kenya		0.41	10.65
56	Nigeria	*	0.41	10.65
57	Vietnam		0.39	10.13
58	Bangladesh		0.26	6.75
59	Tanzania	*	0.22	5.71

* 1993 figures

Ref. Werner International & Textile Outlook International - July 1995

You will find up-to-date figures in many of the current textile journals. Remember - the figures are not necessarily **wages** - they represent the **cost** of the labour and include items such as holiday pay, sickness benefit and national insurance payments and their equivalents where applicable.

These figures need to be reviewed together with the labour considerations as a whole.

<u>The Reasons for Multinational Company Investment Abroad</u>.

When surveys are carried out on company strategy in the UK, little information can be relied upon in. This is because company strategy is seen as sensitive information and, as such, is highly confidential.

Some information is released however, and the following is a result of one such survey.

The stated reasons for companies investing in production units abroad were as follows:

1. Due to the political situation

2. Due to economic considerations - growth of market etc.

3. Social circumstances

and also coming in low down the list

4. Wage differentials

Job Export

Any investment in production units abroad by a home country company is obviously an export of jobs.

However, the number of jobs involved may be far less than might be created in a developing country - dependent on the level of technology used.

Output as a Determinant of Technology Choice

When considering output, one of the most important areas to consider is the economies of scale. (see also Economics for Business Students - Vol.1 - Paulus for a simple approach OR use your Microeconomics notes)

Factors which Produce the Economies of Scale

1. Economies from the division of labour
As a company expands and output increases, this allows the specialisation of the workforce. Each operator will be an expert at a specific job and training will be easier and quicker.

2. Financial Economies
The larger the firm, the easier it is to raise capital. Larger firms offer greater security and hence can obtain capital at lower interest rates.
Is this reasonable?

.

3. Economies of Machinery
The larger the output the greater the number of products which carry the cost of large and expensive machinery.

4. Marketing Economies
Larger companies can achieve more cost effective advertising schemes than smaller rivals.

5. Economies of Research
Research and Development will make the company's products more competitive or more desirable. Only larger companies can afford research activities.

6. Purchasing Economies
The larger the firm, the larger the requirements for raw material, consumables and components. This large requirement allows bulk buying and the negotiation of generous discounts.

.

7. Management Economies
This operates in a similar manner to Labour Economies, allowing managers to specialise leading to higher work output and increased effectiveness.

.

8. Economies of Administration
As for Management. This is sometimes included in the Management Economies section.

Limits to the Economies of Scale
If we continue with the economies of scale to the logical conclusion, the result is total centralised production. According to the economies of scale, this would provide the maximum efficiency. However as an organisation grows, it finds that there is another aspect to consider where size becomes a problem rather than an advantage.

Diseconomies of Scale

Diseconomies of scale are experienced in several areas of operation.

Communications - The large size of the organisation will normally cause communication problems. Poor communication will both cause problems in maintaining efficiency and will tend to lower staff morale. It also tends to create duplication of effort.
Self Esteem - Working for a massive organisation, the worker will have little expectation of having any effect, whatever his/her efforts. This lowers staff morale and tends to lower self worth.
Increased Goods to Distribute - as the company grows, it tends to flood the market of its own area. It needs new markets, further away. This means extra transport costs, new distribution centres, more sales staff.

Marketing - In the same way, marketing costs will need to increase to cover the new areas of operations.

Also there are other possible consequences including increased supervision and management, required not for production, but to manage the complexity of the company.

External Economies of Scale

(see also - Introductory Economics - G F Stanlake)
The external economies of scale relate to the situation outside the organisation. These depend on the size and sophistication of related industry.
If an industry is heavily localised then the Economies of Concentration become relevant.

These can be seen in several areas:

Labour -

Ancillary services -

Co-operation -

What do we mean by ***heavily*** *localised industry in an area?*

Economics of Scale in the Textile Industry

All process industries have special features and factors that affect the economies of scale. The textile industry is no different.

With respect to the economies of scale of machinery, there is less relevance to textiles than some other industries. This is due to the fact that textile production, particularly areas such as yarn production, is carried out in modular units.

These units are of a relatively small size, although this depends on the level of technology in question. Production units will consist of a number of the modular units. The number of units used and the level of technology of the units will determine the output.
Therefore by planning for the required output, economies of scale can be achieved by the choice of an appropriate technology.

Production modules
In any vertical site, or one simply producing yarn, the size of the plant will be determined by the opening stage (or vice versa).
The opening stage is the single machine which anchors the module. Dependent on the actual product, the machines in the other stages may be adjusted to provide factory balance.

It can therefore be seen that the minimum size of a production unit will be that number of machines to service a single opening line. If this is not the case, the opening line will be operating at a low efficiency and incurring increased costs.

However, if a low cost, low technology opening line is used, the module size is reduced, allowing both smaller minimum sized units and smaller steps in size.

Modern high technology machinery normally has high production capability and gives a large module size - leading to larger sized production units.

At the other end of the scale, hand operated machinery has no real minimum production limits.

Although hand-operated machinery is not considered in the UK it can still be important, even protected by government, in some areas of the world.

e.g. In India -

Hand-operated machinery is the UK is relegated entirely to the Arts & Crafts area of the market, selling minimal numbers to a very specialised market.

When considering choices of technology and the economies of scale - it is important to appreciate the relative costs of machinery in a production unit. The figures show the machinery cost breakdown for a traditional style factory

Relative Costs of Machinery

Process	**% of Total**
Preparation for Spinning	17.9
Spinning	23.9
Preparation for Weaving	14.7
Weaving	43.6

The 'percentage of total' figure is the percentage of the total machinery cost of the factory

The Effect of Low Wage Labour on Factory Size

It may generally be assumed that low-wage areas will encourage the establishment of smaller labour-intensive units. However this may only be taken so far, if the production output is split into too many separate units, then costs will be greater.

In addition - other costs would also be greater, management, supervision and ancillary services.

Minimum Size of Plant
(see also Picket & Robson)
It is stated that the minimum size of plant for developing countries is 25,000 to 30,000 spindles, 70 to 90 traditional ringframes. However many plants in developing countries have only 10,000 to 15,000 spindles.

The optimum size will depend on a variety of factors, one of the major ones being the type of operation. If the plant is vertical and finishing is included, then the minimum size will be much greater, due of course to the high production capacity of a finishing plant.

An alternative system is for multiple yarn and fabric production units to be associated with a single finishing plant, i.e. distributed production.
In general however, the modern trend is for larger units.

How to Obtain the Economies of Scale in Textile Production.

Machinery economies - to obtain the economies of scale for machinery there is a need to:

Some of these may be available in particular situations, where a new factory is being equipped, of is being re-equipped. Otherwise it is likely that the settings are made for optimum production.
e.g. ---.
Management economies - obtaining the economies of scale for management is relatively simple. Supervision and management should increase at a slower rate than labour, in an expanding operation.
Note -
.

Labour economies - obtaining the economies of scale for labour is generally more difficult. For a given technology, the man-machine ratio is relatively fixed. It is unlikely that workers can run more machines without a consequent fall in machine efficiency levels.

One method of achieving an decreasing the man-machine ratio is to improve the quality of the processing material. High fibre quality will mean :

better efficiency
less faults
more output
better product
easier sales, even possibly higher sales prices.

However - there are also certain costs which would be incurred:

either - better (more expensive) raw material
or - improved cleaning process - i.e. more waste

plus improved quality control
improved inspection
better maintenance of machines.

The major problem is that the improvement of raw material is generally by far the greater cost. Improved cleaning by removing more waste is also an expensive option.

However if quality can be improved without major changes to these two cost areas then there can be major advantages in this route.

Quality

Quality is a major factor in the choice of technology and in the planning of production. It is therefore important to appreciate what we mean by quality, good quality, quality control etc.

Quality itself is a measure of successful operation, and there are THREE factors which determine quality

1. Design of Product - the design of a product is a measure of its usefulness in a specific job, together with the aesthetic pleasure it gives. In some products it is totally the use while in others it is a mixture of the two.
Can you give some examples?

2. **Workmanship -** workmanship depends on the care and attention paid to the product at EACH stage of its production. This is the area, together with design above, which determines the useful life of a product.

3. **Uniformity -** True uniformity is normally not available in textile products. Hence in textiles and clothing standards or limits may be agreed to ensure an acceptable level. *Uniformity is important -- why?*

Good Quality - is the quality JUST sufficient for the customer's requirement.

Quality Control within a Factory.

Quality Control is the department of section within the organisation that ensures a certain level of quality by means of regular testing of materials, and machines. Inspection of finished products may also be part of the QC department.
In any production unit there must be some form of quality control.

Results of Effective Quality Control.

1. Minimisation of process waste

2. Minimisation of rejects

3. Increased operator efficiency

4. Standard product quality

5. Consistent standard of the raw material
   (This is actually impossible in some areas)

6. Fairness of pay rates

7. Minimisation of complaints

8. Better management information

9. Rapid rectification of error

10. Increased machine efficiency

11. correct and consistent temperature & humidity.

Quality Control Activities
Quality control activities normally take the form of sampling and observation. Sampling may be random, as in regain testing, or it may be regular samples taken as when checking sliver weights from drawframes.

Obviously, sampling is simply examination of a very small percentage of the output. It must be remembered that the majority of testing is destructive testing and hence causes waste of materials and of capacity.

The amount of sampling is crucial - too much testing increases costs, too little may allow errors to pass and create even greater costs later.

Although most testing is destructive, up to the point of spinning waste may be re-worked. Sliver waste may be fed with raw material, whilst roving waste must be opened in a separate process.

Even with re-workable waste, the losses are significant. Only a set percentage of waste may be fed, this is determined by the product quality required.

What types of loss?

Following spinning - waste must be sold off for waste spinning systems, this gives a loss of possibly 90% on raw material cost.

Points to Remember about Quality

Quality is important at *all stages*

Quality cannot be mended into a product, it must be spun into the yarn and woven into the cloth.

Even with a good and enthusiastic quality control, quality cannot be guaranteed, is can only be "statistically positive"

Activities of a Quality Control Department.

The types of tests carried out by quality control staff vary dependent on the processes, the machinery, and the material. The list below shows the type of tests that would be expected to be carried out in a yarn production plant. It covers machines up to and including cone winding.

The list should demonstrate that the job of the quality controller is an important one.

Tests Performed by Quality Control Department (up to Cone Winding)

Moisture content of raw material
Temperature and humidity control throughout factory
Staple length
Trash content
Lap weights
Nep counts
Sliver weights at card & drawframe
Machine and roller speeds on cards, opening, drawframes, speedframes, spinning and winding.

Sliver regularity
Roving weight
Roving regularity
Flyer speeds
End-break checks on speedframe

Yarn twist tests
Spindle speeds
Yarn strength
Yarn weight
Yarn regularity
End-break checks on ringframe
End-break checks on winding
Blackboard tests
Moisture regain tests following conditioning

Quality Considerations as a Determinant of Technology Choice

With older levels of technology, machines may have only stop-motions and nothing in the automatic monitoring area. This means that the quality controller is the only barrier to faults and errors, and must locate all problems by means of the sampling system.

Whilst production levels of this type of machine are generally low, hence regular sampling will avoid large amounts of faulty material entering the system.

With modern machinery, more machines have automatic monitoring and remedial actions.
What are some examples?

.

Some types of machine only have automatic stop motions -.

Machines with automatic monitoring and remedial actions still require attention from the quality controller, as settings may change due to vibration, wear, error etc.
Also this type of machine also has a large production capability, hence any variation from the standards for any time will mean a massive amount of reject material.

A few points to note -

- because of the automatic control higher quality levels can be achieved
- high speeds will increase production, m/c stress and wear, causing faults
- automation is not a total replacement for human monitoring.

In a well-run production unit high quality can be achieved. The same level of quality may not be achievable with low technology options.
This high quality may be what is required - if so then the level of technology may be determined by this single fact.

Labour is also important - if QC staff are not available they must be trained, obtained imported, stolen etc. Lack of staff of sufficient quality might also determine the choice of the level of technology - albeit at a much lower level.

Output as a Determinant of Technology

When choosing the technology level, it is important to consider the output required. Modern production machinery, in balanced modules, may provide a greater capacity than is required. The limits may be placed on the company by agreements, licences, contracts or the size of the market.

If the size of the market is limited, then it will be necessary to limit production OR to increase the size of the total market, by opening new markets.
This latter option may increase costs due to extra staff required for:

marketing
sales
exports
legislation aspects.

In addition, new markets may also mean other changes - *such as?*

In textiles other changes may be required, new blends, different counts, different colours for ranges of clothes etc.

Technology as the Determinant of Output !!!

In certain circumstances, where a large multinational wishes to set up a production unit abroad, it may wish to use similar levels of technology to that used in home country production sites. They then need either to operate high production machines at less than optimum speeds and capacity; (This tends to be very expensive, but it may be an acceptable option in certain cases.) or to use a variety of advertising and promotional techniques to change the market. The company uses its expertise to reshape consumer tastes.

(see the article "Darkest Before the Dawn" by McMeekin in 'Textiles in the 1980s' Pub. British Textile Federation)

Investment in Foreign Countries

Any company which considers investing in production units abroad must analyse the situation carefully. The risk factor on the investment is increased if the investment is in a foreign country, but the risk factor is drastically increased in the country being considered is a less-developed or developing one.

Large multinational companies however have the power to demand guarantees from many smaller or weaker developing countries, to protect their investment.

These guarantees might include:

- no nationalisation of foreign assets;
- specially low tax rates;
- special foreign exchange arrangements, allowing easy transfer of assets;

The company may also be big and powerful enough to flout local laws –
see Vietnam-Nike Fact Sheet in web notes.

Efficiency of Production

Static Efficiency
When considering industrial efficiency, it is relatively simple to establish optimum conditions for maximum efficiency, providing that the parameters do not vary. Even when a few parameters are allowed to vary, for example - target output levels, efficiencies may still be maintained at high levels.
The concept of calculating efficiencies on relatively static parameters is known as Static Efficiency

Dynamic Efficiency
The concept of dynamic efficiency refers to the firm's ability to deal with economic uncertainty and with new developments. These new developments may be technological or they may simply be changes in the market, or changes in the product in response to outside pressures.

Dynamic efficiency is a measure of the flexibility of the company, of its ability to adapt.

The adaptability required may be in policies and procedures, in the product range and the individual products, or even in the structure of the company due to a changing economic environment.

.

Efficiency in Textile Plants

To have a high efficiency, any production plant must be in, or close to, an ideal balance.
When any changes take place in the production plant, the balance will be affected and efficiency is likely to fall.

One major factor in the efficiency of a plant is the length of production runs. Short runs will drastically decrease the efficiency and increase the operating costs. Short runs are the result of

The actual loss of efficiency is dependent on the type of process. Changes in yarn count will affect only the spinning, winding and beaming, causing minimal loss of efficiency.
Blend or fibre changes however, cause massive upheaval, affect almost all machines, requiring changed settings and total cleaning and scouring of machines. This will have a very significant effect on the efficiencies.

If production can be planned over a longer time scale then longer runs may be possible, and costs may be reduced.

Alternative Technologies available in Textiles

Is there such a thing as an alternative technology?

Certain economic theories state that only ONE choice of technology is feasible, this being the latest technology. However these theories do not take into account all the factors which should be considered.

It is generally agreed that there are a small variety of technology levels available to industry, i.e. alternative technologies, any of which may be suited to a certain situation and series of conditions.

For example, a highly labour intensive, low capital technology may be useless for a capital-intensive society with high labour charges. However, in a society with little capital, little foreign exchange, a large population with high unemployment and low wages, the technology would be almost ideal.

These wide variations in ideal levels of technology between developed and developing countries are mirrored in a lesser way, within developing countries. Differences in area, population and geographical situation within a country may require different solutions in the choice of an ideal level of technology.

Defining an Alternative Technology

What do we mean by an alternative technology? How can possible alternatives be assessed?

The only real assessment is by means of the result, the product.

For a piece of cloth, it may be specified by many variables -
These range from the fibre and yarn,

through the fabric aspects,

through the finishing processes.

No two processes will produce precisely the same cloth. Hence an alternative technology is one which produces an equivalent product, suitable for the same end-use.

From an economics point of view, if the market considers two products as equal alternatives for an end-use, then the products are 'perfect substitutes' and the technologies used to produce them are alternatives.

Limits on Alternative Technologies

To make a decision on alternative technologies, the first step is to draw up a short list. This short list will show the **available** alternative technologies. Although a wide range of possible technologies might exist, it is likely that only a certain number of the levels exist or are available. Some technologies may be available to some, but not to others.

In other areas of processing, it may be that there are few levels of technology.
e.g. warping & sizing (see 'Technology Choice in Developing Countries' - M Amsalem)

NOTE - ‘Currently available’ as used above, means either of the following:
- available new from manufacturers
- available in used condition from machinery brokers and dealers.

To understand fully the concept of alternative technologies, it is advisable to examine individual processes, to list the levels and to examine the features which differentiate them.

Alternative Levels of Technology

Winding

The level of technology in winding is based on the degree of automation in three particular areas:

a) knotting & restarting the package after an end-break;
b) knotting & restarting the package after replacement of a supply package (can include replacement of ring tube);
c) stopping at full output package (cone), doffing, inserting new core and restarting winding.

The different levels of technology that are currently available are shown below.

1. Manual - e.g. Leesona Rotoconer
   All operations are manual.

2. Single knotter - e.g. Uniconer

- Knotting is done automatically by one knotter per winding frame.
- Empty supply packages are removed and replaced by the knotter from the winding unit’s own single reserve package automatically.
- Doffing of cone is done manually.

3. Multiple knotter - e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads
- Empty supply packages are automatically replaced from a multiple reserve
- Manual doffing of cones
- Because of the lower number of heads and the multiple reserve there is higher efficiency and the machine is less operator dependent.

4. Multiple knotter (as 3.) with Automatic Doffing - e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads
- Empty supply packages are automatically replaced from a multiple reserve
- Because of the lower number of heads and the multiple reserve there is higher efficiency and the machine is less operator dependent.
- Automatic doffing of cones and automatic core replacement - leaving operator free to service magazines

5. Multiple knotter (as 3.) plus remote preparation- e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads
- Empty supply packages are automatically replaced from a multiple reserve
- Manual doffing of cones
- Because of the lower number of heads and the multiple reserve there is higher efficiency and the machine is less operator dependent.

  Remote machine prepares tubes -

6. Multiple knotter (as 5.) plus remote preparation & Automatic Doffing
   - e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads
- Empty supply packages are automatically replaced from a multiple reserve
- Because of the lower number of heads and the multiple reserve there is higher efficiency and the machine is less operator dependent.
- Remote machine prepares tubes - removing bunches and overwinds to increase the efficiency of the winder.
- Automatic doffing of cones and automatic core replacement - leaving operator free to service magazines.

7. Multiple knotter (as 3.) but Supply from bulk bin - e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads

  Empty supply packages are automatically replaced from a bulk bin -

- Manual doffing of cones

8. Multiple knotter (as 7.) but with Auto. Doffing - e.g. Schlafhorst Autoconer

- An automatic knotter services a small number of winding heads
- Empty supply packages are automatically replaced from a bulk bin - a reserve that readies the tubes and supplies all winding positions.
- Automatic doffing of cones and automatic core replacement - leaving operator free to service magazines.

9. Multiple knotter (as 8.) but with Direct Supply - e.g. Schlafhorst Autoconer

   Supply tubes are automatically transferred from spinning frame to winding frame

- Empty tubes are returned automatically to spinning frame.
- Automatic doffing of cones and automatic core replacement - leaving operator free to monitor knotters.

(This assumes automatic doffing on the ring frame.)

Other levels could be considered.

The levels shown only consider knotters, the autoconer particularly also has a splicer option to improve yarn quality and reduce end-breaks at subsequent processes.

Weaving

The levels of technology in weaving are considered in terms of :
- method of weft insertion;
- method of weft supply.

These greatly affect the sped of operation of the machines.

1. **Hand Loom - Typical speed 60 weft insertions per minute (60 ipm)**
- Full manual operation
- Hand and foot operation

2. **Power Loom - (120 ipm) - e.g. Lancashire loom**
- Automatic shuttle insertion
- Shuttle changes by hand for new weft supply

3. **Automatic Shuttle Change - (150 ipm)**
- Automatic shuttle insertion
- Automatic shuttle changes
- Manual loading of pirn into shuttle

4. **Automatic Cop Change - Side picking (175 ipm)**
- Automatic cop change
- Shuttle does not change
- Magazine of readied pirns
- Mechanical sensing of weft
- Simple pivot of picking stick
- Loose connection with shuttle

5. **Automatic Cop Change - Parallel picking (200 ipm)**
- Similar to 4.
- Compound Pivot on picking stick
- Constant shuttle drive point on picking stick

6. **Electronic Control Automatic Cop Change - (240 ipm)**
- Similar to 5.
- Electronic sensing of weft
- Pirns required metal collars

7. **Rigid Rapier - (260 ipm)**
- Shuttleless loom
- Telescopic arm(s) carry weft
- Large supply package

8. **Flexible Rapier - (270 ipm)**
- Similar to 7.
- Flexible arms
- Less space required
- Large supply package

9. **Projectile - e.g. Sulzer (300 x 2 ipm)**
- Shuttleless loom
- uses small gripper shuttle (or bullet) which pulls weft across loom.
- Can weave double or triple cloths
- Large supply package

10. **Air Jet - (450 ipm)**
- Shuttleless loom
- Large supply package
- Uses jet of air to carry weft

11. **Water Jet**
- Shuttleless loom
- Limited use
- Uses jet of water to carry weft
- High water consumption

12. **Multiphase (original types 600-700 ipm)**
(New types 2400 ipm and above)

- Normally multiple projectile loom
- Positive projectile drive
- Several weft insertions occurring simultaneously
- Waveform shaped shed

13. **Triaxial Weaving**

- Uses two sets of warp yarns
- Interlacings at 60 degrees

14. **Circular Weaving**

- Similar to multiphase

Identifying Available Technologies

The identifying of available technologies begins with the shortlist. From there any limits to the use of individual technologies must be identified. These limits may be political** (as noted earlier) or they may be economic. Some alternatives may simply be too expensive, either as a whole or in certain features, e.g. must be purchased with hard currency.

**Political limitations may be in the supply of a high level of technology, in the supply from a certain country, due to popular enmities, religious differences, ideological differences or simply economic feuding.

Shortening the Shortlist

The available levels of technology must now be assessed individually before finally choosing the ideal one.

The most important feature of this assessment is probably the capital/labour ratio.
Each level of technology has its own costs and its own requirement for labour. The labour obviously has to be split into its major groups based on ability, skills and expertise.
One way of assessing each section may be to examine the process under the following points:

- degree of mechanisation of processing task
- degree of mechanisation of associated handling task
- level of automatic control (manual/computer control)
- unit productivity level (actual production available per machine)

These are not in any order of importance, this will vary with the process and the situation.

Variation of Capital/Labour Ratio.

The ratio has an interesting feature in that the variation of its constituent parts varies by very different amounts. While the difference in capital requirements between hi-tech and low-tech options may be 4:1 the difference between labour requirements for the same options may easily be 1:15 or more.

This requirement for labour needs to be assessed together with labour costs to achieve a useful figure.

One of the features of a labour intensive alternative is that most of the extra labour required is at the semi-skilled or operator level, very little extra supervisory or skilled labour is needed.

Capital intensive alternatives generally require a much higher level of staffing in the skilled labour area particularly in machine maintenance. Also a capital-intensive alternative will often need a much higher level of skill in its skilled labour than the labour intensive alternative. This is because the more complex machines perform more and specialised tasks. This requires more complex components, more specialised components, and hence a higher level of knowledge and understanding.

When considering siting a plant in a developing country, this latter point becomes a major consideration.

Whilst training of operator/semi-skilled labour is an in-house operation, skilled training is a longer term operation and will need either:
+ off-site training -
+ Guided training -

There is an added problem with capital-intensive systems, where the low number of workers can provide problems both in allowing time for training and in finding suitable instructors.

An added problem for capital intensive options is that the more complex components are expensive, can be quite numerous and, either
need to be stored on-site in good condition,
.

or have to be air-freighted at when required

Hi-tech complex components are unlikely to be available in the country - whereas with low-tech solutions there may be options to use local suppliers and craftsmen to produce less complex items.

A factor that is normally in favour of the capital-intensive solution is the accessories required. The accessories might include,

- sliver cans
- roving bobbins
- ring tubes
- tubs for transport
- pirns/shuttles etc.

Normally, hi-tech capital intensive solutions will use fewer accessories if the factory balance is correct.

Consideration of the Buildings Required for the Machinery Choice

The choice of technology will of course, affect the building requirement. This in turn will affect the amount of capital required.

In the majority of cases, capital intensive options will require less space than labour intensive ones. Hence there may be savings expected with hi-tech solutions.

This factor is important in a developed country where land and buildings are expensive. In a less-developed country, the land costs are low, building costs are much lower and the costs of a larger building are less. This possible saving for a hi-tech solution therefore becomes a minimal issue.

However, hi-tech options may have special building requirements which can increase building costs beyond those for the labour intensive option.

Before moving on to the actual choice of technology we need to consider some features of costs and studies that have been carried out previously.

Study on the Economics of Spinning

A study on the Economics of Spinning, in different sites around the world, was undertaken in 1982

For full details of the study see -

"Textile Machinery: Investing for the future" - Textile Institute 677.0285.TEX

The study is by A Thompson and is titled

" The Techno-Economic Aspects of Textile Machinery Investment"

The object was to compare the TOTAL spinning costs in THREE areas, Far East - (Korea), North America - (USA) & Western Europe - (UK) One material was chosen, produced in a small range of products - polyester/cotton in a range of counts.

Any new investment scheme must be judged by its costs and its projected returns
(i.e. the payback period)

In the study the return on investment was assumed to be dependent on :

- capital cost
- energy consumption & costs
- labour costs
- building & site maintenance costs

The figures were calculated for a ring spinning plant of 30,000 spindles, the technology was assumed to be modern - with minimal automation.

Costs

Machinery costs were taken as list price plus an allowance for spares. The machinery was depreciated over 5 years

Energy Prices per kW.H in US$

Korea	0.063
USA	0.050
UK	0.072

Labour costs were calculated as the costs to the employer - not wages.
Costs are US$ per hour

Korea	0.91
USA	6.20
UK	5.75

Building costs were calculated to cover total costs including upkeep & maintenance. Costs are US$ per sq. ft. per year.

Korea	4.4
USA	10.6
UK	9.4

The calculations of the resulting processing costs may be seen in graphical form.

The study was carried out for Ring yarn and for open-end/rotor spun yarns.

Figure 2
PROCESSING COSTS - in 3 different world economic areas

PRODUCING: 20Tex (30NeC) Polyester/Cotton Weaving Yarns

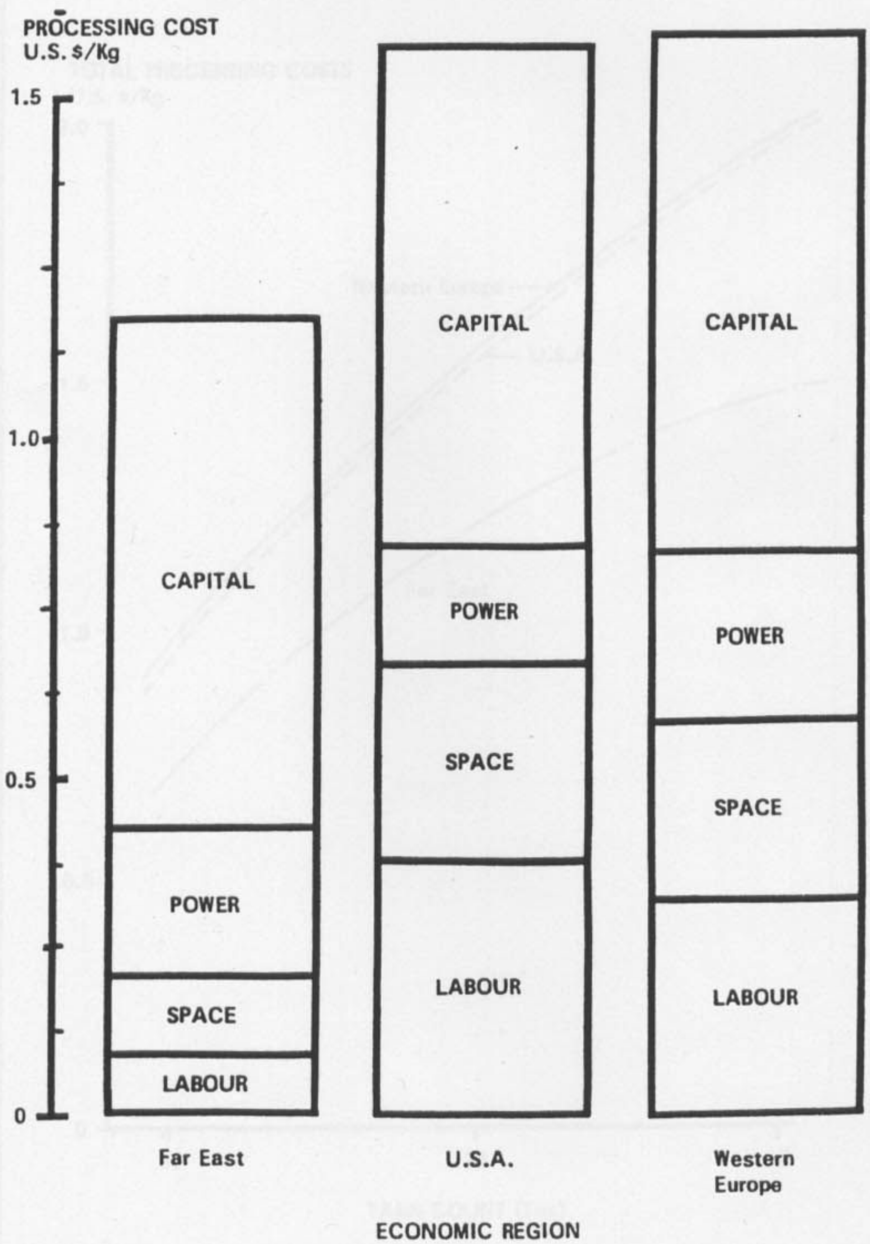

Figure 4
TOTAL PROCESSING COSTS - in 3 different world economic areas

Based on 30,240 spindle installation
Polyester/Cotton Weaving Yarns