

EXECUTIVE SUMMARY

0.1 PRODUCT COVERAGE

0.1.1 Description

Various parts of a Picture Tube - Gun, Screen, Shadow Mask and Glass enclosure function independently and require different technologies for manufacture. Between B&W and Colour Picture Tube there is no difference in principle of operation. B&W produces one picture in various shades of grey. CPT produces 3 independent pictures in 3 different (primary) colours. Difference between CPT and BWPT is one of complexity.

0.1.2 Classification

PT may be classified in different ways TV Picture Tube and Monitors; B&W and Colour; by screen size; by deflection angle; by type of Phosphor.

0.1.3 Application

PTs only application is in converting electrical signals into visual images. Such applications include TV Receivers, Video Monitors and Computer Terminals (VDU).

0.2 MANUFACTURING PROCESS

0.2.1 Gun Manufacture

Gun is a mechanical assembly of pressed metal component parts held accurately and rigidly in position in the glass neck. The need for electrical operation and mechanical rigidity under high vacuum and thermal conditions requires use of special materials. Precision and accuracy are taken to the nth degree.

The CPT gun is three times as complex as B&W gun, emitting 3 electron beams, with complex focussing and deflection controls.

0.2.2 Glass Parts Manufacture

This uses sophisticated glass technology. The shell is made in 3 pieces-faceplate, cone or funnel and neck. The welding of the 3 parts into the final glass shell is done subsequently.

Screen coating for BWPT is done after shell formation. For CPT it is done before. Consequently, shell integration for BWPT can be done optionally by the glass manufacturer or the Picture Tube manufacturer. For CPT, it has to be invariably done by the Picture Tube manufacturer.

Polishing of the faceplate is an important operation. This ensures uniform glass thickness to obviate distortions and to eliminate scratches. Prior to integration the edges have to be ground to ensure gap free mating.

0.2.3 Shadow Mask Manufacture

Shadowmasks are used with CPT only. During manufacture, one shadowmask is identified with one Picture Tube and accompanies it during the whole process. Shadowmask is a thin metal sheet with tiny holes etched in it. The holes are made by chemical milling on automatic machines. The holes are previously masked using photolithographic techniques. Shadowmasks are shaped on hydraulic presses and blackened for absorption. Shadowmasks absorb about 80% of the electron beam energy, which is why CPT requires higher beam energies.

0.2.4 Technical Trends

There are a large number of technical developments taking place in image display technology. These affect Picture Tube technology in one of three ways:

- Improvements in PTs
- Replacements for PTs
- New TV technologies requiring changes in PTs

0.2.5 Improvements In PTs

These improvements are as given below:

Screen	- Flatter, squarer screens - Antiglare treatment
Shadow Mask	- Tilted array mask - Invar sheet instead of MS
Electron Gun	- Improved focussing - Smaller beam spots - Larger diameter guns (for higher currents) - Multistep focus - Beam index scanning, obviating shadowmasks

0.2.6 Replacements For PTs

Monochrome and colour displays have been developed using the following technologies:

- Liquid Crystal Displays
- Plasma Panel Display
- Light Emitting Diode Display
- Electroluminescent Panel Display
- Vacuum Fluorescent Display
- Electrochromic Display

They are all flat panel displays unlike PTs. Technically, the capabilities have been amply demonstrated. They have to be improved for size, brightness and economics.

For small size displays, LCD has already demonstrated its superiority. Possibility of small sized LCDs with projection techniques (for large displays) is being vigorously pursued.

These newer displays will first displace PTs in portable computer monitors before attacking TV. Flat shape and lower power consumption offer definite advantages whereas limited colour range may not be a disadvantage. For TV, PTs still offer the best techno-commercial-visual combination.

For large display boards, LEDs dominate because of brightness requirement. However, the system as a whole is very expensive. They are getting economical for smaller moving displays. PT is getting challenged on the top by LEDs and from the bottom by LCDs.

0.2.7 New TV Technologies

High Definition TV (HDTV) has been technically demonstrated and many systems planned in developing countries. Lack of international standardization holding back growth. Japan is pushing for superior satellite based HDTV system incompatible with present TV systems. Other countries want compatibility with present receivers (and transmitters) to avoid sudden obsolescence. Since present systems are themselves different (PAL, SECAM, NTSC and their different versions), international standardization may be coming.

Before final HDTV comes in, some intermediate stages may be introduced. The Improved definition TV uses digital techniques in the receiver to improve the picture from a conventional broadcast. Extended definition TV requires replacement of broadcast equipments to allow HDTV receivers to receive HD images and conventional receivers to receive conventional images.

Advanced compatible TV is a new technique suggested which broadcasts the signal over two channels simultaneously. One channel contains conventional information for a conventional image and the second contains image enhancing information for use by HDTV receivers.

These technologies will affect PTs in the following ways:

- Increased number of colour dots on screen
- Change in aspect ratio from 4:3 to 5.33:3
- Larger screen sizes (127 cm (50") and over)

50" represents limits of conventional PT technology.

Other technologies like satellite direct broadcast, etc., will not affect PTs.

0.2.8 Historical Developments

TV technology has developed historically from initial fumbling with mechanical scanning to B&W, to colour to satellite TV and HDTV.

Present PT technology (colour) is mature technology. CTV is over 30 years old, and when developed, used technologies of that period. Technologies have developed since then. Using latest technologies, vast improvements in TV image and sound processing are possible.

TV in India came rather late. No effort to develop the technology is yet being done. Indian industry shall be followers for some years, may be for ever, if action is not taken soon.

0.3 STRUCTURE OF INDIAN INDUSTRY

0.3.1 BWPT Industry

BWPT industry, having started earlier (than CPT) is better entrenched in India but had a 20% decline in demand.

The problem was aggravated by the increase in installed capacity, by units who felt that the boom growth of the early and mid 1980s would continue for ever. The free licensing of the 1980s show a huge licenced capacity as compared to actual production. Actual production versus licenced capacity (IL plus Registrations) reduced from 28% in 1981 to 4% in 1990. Since there was significant, even healthy, growth in production during most of this period, the increase in licenced capacity to account for this decline in percentage must have been phenomenal.

0.3.2 CPT Industry

The CPT industry fared better than BWPT on account of the following:

- The decline of CTV production was not as drastic as for BWPT.
- Substantial imports of CPTs existing at the start of the decline cushioned the Indian units.
- Over capacity was not as much.

0.3.3 Parts Manufacture

The BWPT industry is vertically integrated with all the major components-glass shell, gun and PT manufacture all being made in India. For CPT the industry is far less integrated. Shells, shadow masks and phosphors are totally imported. Manufacture of gun assembly is taking place partly, and the balance is imported. Technology for manufacture of these parts do not exist in the country.

0.3.4 Market Statistics

Past production in value terms of various elements of the Industry is as follows in million rupees :

	1986	1987	1988	1989	1990
BWTV Receivers	3968	5812	8476	8513	6700
CTV Receivers	5022	7167	8642	8388	9000
BWPT	680	1093	1815	2109	1697
CPT	0	139	739	2767	3015
BW Shells	102	198	435	556	513
BW Guns	NIL	Small	71	57	120

Projected domestic demand in numerical terms for PT are estimated as under in million numbers :

	1992	1993	1994	1995	1996
BWPT	4.1	4.2	4.4	4.6	4.8
CPT	1.3	1.4	1.5	1.5	1.6

This is based on analysis of past growth and does not include export of PTs or export of TV receivers. Export of PTs has just started but is growing in fits and starts.

0.3.5 Demand Supply Balance

In 1990, the balance was in favour of supply, and in especially case of BWPT. Figures are as follows :

(Million Nos.)

	BWPT	CPT
Licenced Capacity		
Approvals	106	39
Installed Capacity	13.7	1.9
Production	3.6	1.2

The microview is more disturbing. Certain companies like BEL & Samtel, for BWPT, achieved capacity utilizations of 80% and 73% respectively. Since industry average is only 26%, the fate of some of the others can be

imagined. Several BWPT manufacturers are close to downing shutters if not already closed down. Industrial sickness among BWPT manufacturers may be expected to increase steeply. CPT, for the moment is not in so serious a condition as only a few players could afford the huge investments. They are staying afloat in these low demand years by raising prices.

0.4 INTERNATIONAL SCENE

0.4.1 Contemporary Trends

BWPT represents obsolescent technology. Most of the growth and all developmental work is in CPT.

Though 51 cm (20") PT size is the largest installed base all over the world but, preference for large size picture tube is increasing. In developed countries, 61 cm (24") and 69 cm (27") are very common and interest in 81 cm (32") and 86 cm (34") is also increasing. This trend seems to accelerate when HDTV will be introduced and picture tube may size reach 127 cm (50").

Increase in dimension means increases of weight. Use of CAD to design PT shape to minimise glass usage (to reduce weight) has started all over the world.

The battle for computer VDU has already been lost to LCD by PT (CRT) for compact computers. CRTs are holding out in normal size computers. The competition between CRTs for monitors and TV Receivers will be resolved independently. CRTs are under greater pressure for computers than for TV.

0.4.2 Major World Players

Japan's share of PT is 45% of world demand. By the year 2000 this is expected to increase to 55%.

Today, PTs and CRTs constitute over 60% of all displays. By the year 2000, they will constitute only 35%.

Today PTs and CRTs are dominant technologies and Japan constitutes 45% of it. In 2000, LCD will be the dominant technology and Japan will constitute 78% of LCD output as they are presently well ahead of others.

Japan has largest number of manufacturers of flat panel displays in the world. They are very strong in CRT manufacture with many of the world's largest companies located there. These include Matsushita, Toshiba, NEC, etc.

Singapore, Taiwan, Korea and China are other Eastern countries with strong bases in PT manufacture. Most of Philips Group's PT facilities are located in Taiwan.

Korea dominates supply to Europe and North America of small size CTV and all BWTV. Local manufacturers are concentrating on large size (high value) CTV.

The TV industry is in the throes of change. Developments like HDTV, large size screens, more efficient guns, etc., are all likely to be introduced in the next decade. There will be more fundamental changes in TV technology taking place in the next 10 years than what took place in the last 30 years.

The display market itself is changing. This market, internationally, is growing @ 2%. India is not even in non CRT displays.

By the year 2000, present day CTVPT (as available in India) is expected to be as obsolete internationally, as BWPTs are today.

In view of the changes taking place internationally, an export thrust based on past scenario may not be successful for very long. Continual upgradation must be done if we wish to play in foreign markets.

In BWPT, vertical integration of the industry is almost complete. In CTV, technology for Shadow Masks, Shells and Guns will have to be acquired as quickly as possible. This is the base on which further technological developments can be built, since BWPT is virtually obsolete internationally.

The process of "catching up" starts after this base technology is absorbed. India has to "catch up" to a technological frontier which is itself moving forward.

Latest technologies will be expensive and difficult to acquire. India may have to develop most of it herself. The international trend towards protection of Intellectual Property Rights (which includes patents, technology, process knowhow, etc) will be working against India acquiring the

latest knowhow. The world is shifting from military hegemony to technological hegemony.

0.5 TECHNOLOGY ABSORPTION

All the foreign collaborations for PTs in India have been from Japan or Korea. The first one was BEL with NEC in 1970s. The three CPT manufacturers are tied up with Japanese companies as follows:

JCT	-	Hitachi
Uptron	-	Toshiba
Samtel	-	Mitsubishi

Most of the smaller BWPT, surprisingly, have started manufacture without formal collaboration. They have procured plant from Taiwan and obtained process information and training from the plant supplier itself. Everyone contacted expressed satisfaction with the knowhow.

The original capacity was for 40,000 PTs with knowhow from NEC. Subsequently, BEL has increased the capacity (in two stages) to the present 300K level without foreign assistance. BEL has developed suppliers for various items of plant. BEL has even transferred knowhow to several other units.

All units have R&D, except the really sick units. The function of the R&D has been mainly to do indigenisation and not any real developmental work. In general there is gloom in the BWPT industry and it is a matter of day-to-day survival rather than development of technology.

CPT, being a newer industry is still in the process of absorbing the technology it has acquired. It does not manufacture the FST which is expected, because this requires change not only in picture tube processing but also in glass shell production.

PT manufacture and application combines technologies of glass, materials, mechanics and electronics. To refine and develop PTs require inputs of a very high order in each of these areas. There is no single Institution which concentrates on these technologies.

The financial constraints facing PT manufacturers (including CPT) precludes much expenditure on R&D. This may improve once the status of the industry improves. As of today, the industry views itself as a sick patient and anything other than day to day operation is cut out.

Most of the companies contacted have worked on indigenization of materials with considerable success. BEL has developed gun technology on its own. BEL has installed a glass shell factory with collaboration from Corning Glass. The product is being stabilised and production increased.

There is considerable scope for capital goods manufactured in India since the bulk of the items are for material handling. Here also, BEL is the pioneer.

CPT lines have not been developed in India but there is no reason to believe that there is any difficulty by Indian manufacturers developing such lines. There is similarity between CPT & BWPT manufacturing. Test equipments and certain critical machines may be required to be imported.

The major constraint facing units in developing technology is financial. The industry is passing through a bad phase with local demand stagnating or even declining and export not yet picking up. Unless the market (export or domestic) picks up significantly, no significant R&D development is likely to take place.

0.6 CONCLUSIONS

0.6.1 Indigenization & Integration

- i) There are basically two PT technologies existing in India, namely BWPT and CPT. BWPT represents obsolescent technology but there continues to be a fairly large market internationally. In India, BWPT technology will continue for some more years. CPT technology is a mature technology internationally but it still has potential of further improvement. In fact new innovations in CPT are emerging.
- ii) Market preference in India for BWPT stems from the ability to produce a low cost TV Receiver using BWPT. The expected life of BWPT in India arises from the fact that India's large and poor population would prefer to see a B&W picture, to seeing no TV at all (since customer price of CTV is high).
- iii) BWPT technology (and thus BWTV) in India is almost fully indigenous. Glass shells, gun, chemicals and PT are all being manufactured within the country. Other components of BWTV are also made in India. Given co-operative working, this could result in a breakthrough in the still existing markets for not only BWTV but also monochrome computer monitors. At the same time it must be

clearly recognised that BWPT is obsolescent technology, and demand will be declining internationally, leaving India only a limited time window for taking advantage of the export potential.

- iv) For CPT, local manufacture has started only recently. Production is still picking up. While gun assembly has started in a small way (mainly for captive consumption), glass shells, and shadow masks are still being imported fully.
- v) The advantages of a fully indigenous and integrated manufacturing base of BWPT and BWTV in India is not yet being realised. If all the materials are indigenous and manufacturing is done within the country, then, it should be possible to face effectively international competition. Even prices in India should be low.
- vi) This consideration can be extended to CPT also when full indigenization is achieved. However, CTV market is so much import dependent that local volumes are not rising and investors have held back.

0.6.2 Fractionisation of Capacity

- i) There are about 13 companies producing about 4M BWPT per year, and 3 companies producing about 1.2M CPT per year.
- ii) This has to be related to international production levels of typically 5-10 times these volumes. Large capacities have advantages of lower amortised overheads, lower materials cost (larger volumes of purchase), etc. All these advantages are lost to Indian companies.
- iii) Optimal capacity is a complex matter and will be determined by factors such as Project cost, Labour costs, Transportation costs (significant in this case), etc. It cannot be imposed externally. However, in general, larger capacities are preferred because of advantages of volume production, volume purchase, lower amortised overheads, lower amortised marketing and servicing costs, etc.

0.6.3 High Input Costs

- i) The demand of PT is constrained by the production of TV receivers. The cost structure of PT must be looked at the total cost of a TV.

- ii) Even if PT costs are made very low, the domestic market is unlikely to expand unless the TV receiver's cost itself is brought down. Of course PT cost is a major factor in receiver cost.
- iii) Materials cost break-up is as follows, for a PT producer who buys all the materials and manufactures the tube :

Glass Parts	45%
Chemicals	13%
Electron Gun	18%
Energy	10%
Overheads	14%
Total	100%

The above cost figures include duties, etc., applicable on imports, taxes, Excise Duty, etc., on domestic purchases.

Cost of inputs for a CPT are as follows : (The figures are approximate)

Item	FOB (\$)	Landed (Rs.)
Glass	24	1152
Mask	3	144
Gun	6	324
Phosphor	2	50
Others	5	240
Total	43	1910

- iv) The corresponding unit selling price, for different categories of PTs are as follows :

BWTVP	51 cm (20")	Rs. 165.00
	43 cm (17")	Rs. 590.00
	35.5 cm (14")	Rs. 365.00
BWTC Monitor	35.5 cm (14")	Rs. 640.00
	30.5 cm (12")	Rs. 580.00
CPT	53.4 cm (21")	Rs. 3500.00

The prices are list prices with ST extra. The CPT price is inclusive of Deflection Yoke which is integral to the picture tube. These prices were as of mid 1991.

- v) It will be seen that if chemicals, electron gun and glass parts are imported (as is the case for CPT) the import content is as high as 76%. This will reduce in future various components get indigenised. The time scale is as follows :
- Assembly of guns in-house will reduce import content by about 5-10%. This has already started.
 - Indigenization of glass shell in 1994 when Samtel's and GNFC's glass parts projects start production. This will reduce the import content by 45%.
- vi) There are no specific projects to manufacture parts for guns and phosphors. These are likely to be imported for some time. However the projects already in the pipeline will reduce the import content of CPTs from 76% to 20-25% by 1993.
- vii) Most of the manufacturers, internationally, are vertically integrated and have cost structures quite different to what exists in India. Material cost, in the case of glass parts manufacture, is only 16%. As a percentage of PT selling price, the value will still be lower (say around 8%). Since glass manufacture is a heavy consumer of energy, the share of energy in the final cost will go up steeply.
- viii) Internationally, PT manufacture is considered energy intensive and factories are located where energy is available relatively inexpensively. Sources of energy are usually electricity or gas. As per the information available, no international manufacturer has used coal as a source of energy in PT manufacture. Since coal and solar energy are plentiful in India, these could be considered as alternatives. Direct use of coal is ruled out since PT manufacture requires a clean environment and coal is notoriously the opposite. The feasibility of converting coal into gas for use in the manufacturing PT would reduce dependence on import of petroleum products and of electricity.
- ix) It has not been possible to get the share of energy in the overall cost structure of international companies. Such information is considered confidential. But it has been admitted by foreign manufacturers

that the cost of energy is a crucial factor in cost control. To reduce its impact, such effort is desirable - reducing primary cost through proper location and choice of energy source (thermal/hydel power, gas, etc.) through efficiency, periodic energy audits, etc.

0.6.4 Competition with Imports

- (i) In India CTV receiver technology has been obtained from different countries. Initially, the kits were coming from different collaborators. CTV receiver manufacturers preferred to import kits and supply receivers to the Indian market.
- (ii) The effect of this on the Indian market (for PT) were several :
 - Different models became standardised causing fractionalisation by specifications.
 - Imports were by kits and kit prices did not reduce significantly when one item in the kit was deleted.
 - Screwdriver technology flourished and receiver manufacturers were unwilling (or unable) to modify designs to incorporate Indian PTs.
- (iii) This situation is now changing. At the same time, availability from domestic sources is improving. Under these two forces the share of imports is steadily coming down. Indian suppliers of PTs have two advantages over imports. The exchange rate of Rupee has made imports more expensive vis-a-vis domestic supply. The second advantage is that transportation cost in this case is quite high. Since the product is fragile, and since the shape is odd, transportation costs are based on volume (by container), especially since supply is from as far away as Korea, Japan and even Brazil. The cost of transportation is lower for CPT since the face plate, cone and neck come separately.
- (iv) In general, competition from imports arose on account of the desire of TV receiver manufacturers to continue kit imports, and unwillingness to change to suit Indian PT, rather than on technical and commercial grounds. The FST continues to be imported since the product is not being made in India presently.

0.6.5 Gaps with International Technology

- (i) While Indian industry is yet to fully indigenise CPT guns and shells, new gaps with international technology are appearing. As examples larger screen sizes 53.4 cm (21" is maximum for Indian CPT market); flat square tube (FST); high definition TV (HDTV) tubes; and so on. These gaps will call for changes not only in PT processing but also in glass shell production.
- (ii) Better performance of LCD flat panels abroad is already challenging the BW monitor tube, when it comes to simple displays of text, graphs and small pictures. "Personal" and "pocketable" BWTVs using LCD are already available at reasonable prices as also word processors, lap-top and notebook PCs. This gap needs to be filled before BWPT itself becomes redundant in India.
- (iii) As regards CTV, increasing number of receiver dishes and onset of Cable TV are seen. In this upper end of the market, including Laser Discs and advanced format VCR, a trend towards High Definition Picture Tubes is visible.

0.6.6 Items with Potential for Development

- (i) The areas in which some sort of developmental activity is presently taking place in India are as follows :

Technology	Organization
Glass (B&W)	CGCRI & BEL
Phosphors (B&W)	NPL
Gun Parts (Colour)	Samtel & Philips
Gun Parts (B&W)	BEL

Since a start has already been made in these areas, it would be fair to assume that more progress would be possible in a limited period of time in these areas than in entirely new areas. It should also be noted that the above programs were started to solve specific problems faced by manufacturers. The phosphors program at NPL was started as part of a general R&D program about 20 years ago, although work has not been going on in this area all the time.

- (ii) Most of the aspects of B&W PT are covered in the above activities. CPT, being a newer technology in India has, less developmental

activity. Samtel in association with Philips, is trying to indigenise CPT Gun parts in an effort to reduce costs. Other than this, there is little apparent developmental activity in CPT.

- (iii) There are three major component parts to a BWPT. They are Glass envelope, Gun and Phosphor. Development work in India presently covers all these areas. The only problem is that the direction of this effort is towards import substitution. A program to upgrade these efforts to develop new products and to improve (specs and reduce costs) performance should be undertaken. The program can be widened to include components for CPT also. The technologies are fundamentally similar except that products are an order of magnitude more complex. Initiation of such programs will ensure that India, in course of time, comes closer to the leading edge of technology.
- (iv) The SSPL (Solid State Physics Lab.) is doing some research in chemical etching which is the technology used in Shadow Mask manufacture. While SSPL has other priorities in research, perhaps a program could be drawn up not only to use the expertise with them, but their facilities also.

0.6.7 Prospects for Exports

- (i) It should be recognised that India has already started exports in a small way in both BWPT & CPT. Statistics are given in Chapter 2. It should also be recognised that most of this export has been to countries or to regions where India has special trade relations, such as the erstwhile USSR, China, Bangladesh, GCC, and others.
- (ii) Since PTs can only be exported to countries who manufacture TV receivers, the prospect of export of BWPTs to hard currency areas is dim. It has been explained in Chapter 3 that manufacture of BWTV receivers has been phased out in almost all developed countries. Their requirement of BWTVs are being met by importing the complete receiver. Presently, the major source of supply is Korea. Therefore prospects of export of BWPT itself is rather dim since the number of countries wanting this product are few. Prospects of export of CPTs is much better - at least in principle.
- (iii) BWTV represents an obsolete technology. It is at the end of the product cycle. Its main advantage over other forms of audio visual entertainment is the low cost of the hardware. In the export of BWTV

picture tube, therefore, its Unique Selling Point (USP) is its low price. The low price is to be looked at from the TV Receivers point of view and not that of the BWPT only. The possibilities of export of BWPT is to countries manufacturing BWTV in large quantities (China, Korea) but they already have their own PT factories. But it would be difficult to be competitive in export of BWPTs to these countries on account of freight and transportation costs as compared to their own production. Consequently, export will be only to the extent that these countries have a shortfall.

(iv) Rather than export BWPT, India would be much better placed to export BWTV receivers and thereby export BWPT indirectly. India is well placed to do this. There is a large excess capacity to manufacture BWPTs. India also has a large production base in BWTV manufacture. Most of the other components are also being manufactured in India (although some may have import content). The value of FE earned for BWTV will at least be two times of what could be earned for BWPTs.

(v) The difficulty in exporting BWTV is in the area of marketing. BWTV has to sold to the final customer (individuals and families) and will require the following :

- Countrywise promotion campaign
- Media advertising
- Distribution and servicing networks
- Creation of brand images, etc.

These activities are expensive to set up and require expenditure of FE, to start of with.

(vi) An interesting development is the tie up of the RP Goenka Group with the Goldstar (Korea) group to manufacture BWTV for 100% export. Goldstar will have 51% equity. Obviously, Goldstar is trying to keep their costs down by sourcing from India since costs in Korea are increasing. Such tie ups are good for the BWPT Industry.

0.7 RECOMMENDATIONS

0.7.1 Strategic Approach

(i) The basic objective behind policy decisions are be to make the industry in India integrated, and to aim for the export market. The

basic raw materials for PT are available in India and, in principle, there should be no impediment to a fully integrated industry. There may be need to acquire technology at some levels.

- (ii) It should be clearly recognised, that the display industry is on the threshold of major changes. Market requirements are changing and the PT must respond suitably to be able to retain its market share. It must be recognised that Indian PT manufacturers will be pitched against international giants who will be equally keen on retaining their market shares. Consequently, as India becomes a world player, it will become increasingly more difficult and expensive to acquire new technologies from other manufacturers, who will be competitors. The technology must be developed in India itself. This clearly indicates that India must not only gain control over its raw materials and manufacturing processes, it must also gainfull master over the technology.
- (iii) To achieve this last point, the industry must have a sufficiently large turnover and sufficient funds to be ploughed back for R&D. Consequently, policies must be directed at concentrating resources-money, technology, people - in organisations which will achieve the desired results.
- (iv) In summary, the strategic approach towards development of the industry, should be threefold :
 - Develop a vertically integrated industry within India.
 - Acquire total mastery over the full range of technology.
 - Concentrate resources in suitable organisations to keep technology up-to-date.

0.7.2 Restructuring of Scale

- (i) There is no scope for any more capacities to be set up to manufacture BWPT. In CPT, for the moment, there is no scope for new capacities on account of the difficulties the domestic receiver industry is facing. Additional capacities should be considered only after domestic demand increases to match present installed capacities and/or domestic exports match present installed capacities.

- (ii) In considering new capacities, as and when the need arises, the preference must be for existing companies to increase their capacities. It is estimated that expansion of an existing capacity to double its present level will require incremental investment of only about 50-60% of the investment for an equivalent additional capacity in a new unit.
- (iii) It is recommended that capacities for both BWPT and CPT should be targeted above 1 million per annum to approach international scales of production. To this end companies should be encouraged to expand their capacities (when needed) by :
 - Takeover of sick units or closed down units.
 - Additional balancing investments in their own plants.

0.7.3 Restructuring for Integration

- (i) The whole range of manufacture of Picture Tubes should be divided into 3 or 4 stages as given below, based on technologies:

BWPT	CPT
Shell Manufacture	Shell Manufacture
Gun Manufacture	Gun Manufacture
PT Manufacture	Shadowmask Manufacture
	PT Manufacture

Policywise, each of the above stages should be treated independently. Independent and common source manufacturers should be encouraged for each stage who will imbibe the technology and expertise in a concentrated fashion. Manufacturers in each stage will set up capacities of international scales, and address not only the domestic market but also the world market. Manufacture of products with similar technologies for BW and Colour (e.g. shell and guns) could be combined for improving the scale and viability. Each stage should be encouraged to set up R&D facilities to develop the technologies further. In all cases the recommended capacities are 1 M or above.

- (ii) It is further recommended that development of technology should be considered at 2 levels - short term and long term. Short term development of technology should be left to individual companies.

These companies are in the market place and will be aware of the needs of the customers. They will be in the best position to modify current technology for meeting the immediate demands of the market.

- (iii) The long term strategy should be setting up R&D facilities for each stage listed in para 0.7.3(i). The existing cess could be used for this purpose. The policies and priorities of the above set up should be laid down, from time to time by a group which would comprise of representatives from the concerned departments/organisations of the government, industry and R&D laboratories with interest in the area. The results of research conducted would be available on a wide basis.
- (iv) The above facility would have a small production shop associated with it. This pilot facility would undertake to convert essentially laboratory technology into one suitable for a commercial unit. The productionization of the technology would be done only at the request of a particular unit, who would have to bear part or whole of the cost. The R&D set up would provide some sort of guarantee of the process and provide support to the manufacturing units when taking over the technology. Documentation, training of staff, etc., would form part of the technology package.
- (v) The R&D set ups would be run on a no-profit-no-loss basis. The idea would be for it to become financially self sufficient in course of time. They could also take up specific sponsored studies.
- (vi) The integration of technology thus achieved will bring a focus to the industry. Glass shell manufacture essentially uses glass technology. The various manufacturers and the R&D set ups would concentrate on developing this technology alone. Even development of glass for other applications (lenses, etc.) would fall outside the purview of these organizations. With such a concentration of efforts and resources, it is hoped technology will be mastered, developed, and taken upto international levels.
- (vii) Similarly, manufacture of guns uses materials and mechanical processing technology. the concentration of this set up would be on this technology, again to the exclusion of other technologies. Similarly, for picture tube manufacture, separate set up should be there for B&W and Colour Tubes.

(viii) The suggested set ups could be established in association with the following organizations for the indicated technologies.

CEERI (Pilani)	-	Picture Tube Design and Technology
CGCRI (Calcutta)	-	Glass Technology & Shell design
BEL (Bangalore)	-	Gun & Gun parts technology
NPL (New Delhi)	-	Phosphor Technology
NCL (Pune)	-	Special Chemicals Technology

0.7.4 Ancillarization

(i) The technology of PT manufacture is such that scope for development of ancillaries is limited. The following areas have been identified as possible areas which can be developed by ancillary units :

- Commercial chemicals
- Pure chemicals
- Rim band
- Rim band brackets
- Packing materials

In value terms, all of the above together comes to less than 5% of the value of the PT.

(ii) Most of the 5 items listed in para 0.7.4 (i) has already been indigenised by existing manufacturers. Quality and delivery are said to be satisfactory. Variation in specification from batch to batch is stated to be a problem. This, in turn, stems from variation in materials specifications, which SSU are not in a position to test. The problem, according to units surveyed, is not intolerable.

0.7.5 Injection of Technology

(i) B & W picture tube manufacture is vertically integrated and well established in India. Since the technology is basically an obsolescent one, additional injection of technology by way of foreign collaboration is not recommended. If any improvements in product specifications, processes (to reduce cost), etc., are developed indigenously, it will be very good, especially since some residual international markets can be claimed. Essentially B&W picture tube should be treated as a technology which should be continued only as long as it is needed, with concentration on maximising usage of local

materials and reducing cost. The emphasis should be on producing a low cost product.

- (ii) Concentration on development of technology should be on CPT. This represents mature technology and is likely to be in use for another decade before new technologies will supercede this. CPT therefore represents a technology with growth potential, not only in India but internationally. In fact, the growth in India may be constrained by the lower purchasing power of the population and there are indications that a plateau in demand has been reached at the present prices. This plateau is actually reached by the receiver industry where, considering product cost, taxes, marketing and distribution costs, etc., CTV receivers are affordable by only a segment of the population. This population segment is showing signs of saturation. Internationally, CPT represents a growth area. High exports in value terms, will lie with CPT rather than with BW picture tube.
- (iii) Since CPT technology has not been fully absorbed in India, injection of additional technology will be required in the following areas:
- Glass shell manufacture
 - Gun manufacture from raw materials
 - Phosphors manufacture
 - Shadow mask manufacture

Import of technologies/collaboration in the above areas should be freely permitted, especially if some of export is involved, to offset the outflow of FE for plant and machinery. It will be appreciated that acquisition of technologies in the above areas is likely to save the country valuable foreign exchange, since all of the above items are presently being imported totally or substantially.

0.7.6 Export Possibilities

- (i) The Government of India has given a thrust to exports through its various policy announcements. The demand for BW picture tube is declining internationally. The possibility for export comes through export of BWTV receivers. This can be done in several ways :

Export of BW picture tube to BWTV manufacturers in Korea and Taiwan either directly or through tie ups.

- Indirect export of BW picture tubes to Indian manufacturers exporting BWTV receivers through Korean & Taiwan tie ups.
 - Export of BW picture tubes through export of BW picture tubes directly by Indian manufacturers.
- (ii) While there is nothing in the policy acting as an impediment to any of the above, exporting is difficult and will require incentives to take the risks. Export benefits offer advantages to exporters who are successful. But a unit with depleted cash reserves facing a stagnant market at home may not have the resources to take up an export drive on its own. This may have to be done by an export house in India or abroad. Such tie ups should be encouraged.
- (iii) The CPT industry is facing a different situation and different problems. The products suitable for export are not the ones being manufactured. The FST 2R is exportable, but is not made in India. Technology upgradation to make exportable products should be immediately done. It is encouraging that Samtel and JCT have both plans to introduce this PT in 1992-93. Samtel has started an aggressive export thrust and it is likely that a breakthrough will come about. Since Samtel is also setting up a CPT glass shell unit, they will soon be a vertically integrated plant, which will give them considerable advantages in the international market.
- (iv) With the number of BWTV manufacturers shrinking internationally (but with a residual demand remaining in developed and developing countries), India could become a base for supply. A vigorous thrust is required with co-ordinated action from Government, manufacturers, export agencies, industry associations, etc. The following advantages exist for making this thrust, a success :
- BWTV manufacture is vertically integrated with PTs, components, mechanicals with all being made in the country. Some imports for components continue but costs are largely under control of the manufacturing units.
 - BW picture tube is a major cost item and substantial capacity already exists. BWTV manufacture capacity also exists in the country and, being assembly oriented, is relatively easy to enhance.

- (v) It must be recognised that many of the BW picture tube units are financially weak to undertake an export drive on their own. Policies must be formulated which will encourage the following:
- Make exports of BWTV worthwhile and profitable.
 - Give benefits to export houses exporting BWTV even when components (including PTs are indigenously procured).
 - Make takeover and consolidation of capacities easier, in cases where it makes economic sense.
- (vi) Several BW picture tube manufacturers, facing stagnant domestic markets, are trying to manufacture monochrome monitor tubes for export. This is a good step. Internationally computer monitors are increasingly turning to colour and colour monitor tubes are enjoying a boom. There is possibility to expect that India can export colour monitor tubes also, if atleast part of the capacity is modified.

0.7.7 Policy Recommendations

- (i) It is recommended that the picture tube industry be looked upon as a number of independent industries and not merely as adjuncts to the TV receiver industry. The picture tube industry must, so to speak, stand on its own, its future delinked from the fortunes of the TV receiver industry in India.
- (ii) It is further recommended that the various segments of the picture tube industry i.e. Shell, Gun, Shadowmask manufacture and picture tube assembly - be in turn, looked upon as independent industries. The almost total dependence today of all these industries on TV industry ensures that in the event of any decline in TV receiver demand, a large number of industries become sick. This overdependence on the TV receiver industry must be avoided and each industry segment must stand on its own, looking to the international market for its survival.
- (iii) No upper limit on capacities should be placed on units, provided the concern has done its homework and has tied up its marketing, especially the international side. In view of rising costs in the countries particularly Korea, Taiwan, Hong Kong and Singapore and the liberalised policies now being formulated by the government, world markets could look to India to source their picture tube

requirements or to locate their offshore facilities. Such attitudes must find a ready soil in India. The whole picture tube industry can be looked at from its export potential.

(iv) At each stage, the industry should be delinked (as far as possible) from later stages. Each stage should be considered as an industry in its own right. Encouragement should be given, keeping the 'stages' requirements in mind, without reference to other stages. Such "encouragement" would be manifested specifically as:

- Policy pertaining to Collaboration
- Policy pertaining to Plant & Machinery Imports
- Policy pertaining to RM imports
- Policy pertaining to Exports

Each "stage" should be encouraged to become net export earners. The specific policies would be within the country's overall trade and industrial policies. In this way the industry of TV picture tube manufacture would be able to thrive, based not on the limited Indian market, but on the international market, each industry finding its own level of activity, and generating a net surplus of FE at each stage of the industry.

0.7.8 Summary

- (i) In summary, the following specific suggestions are made:
- a) Develop BW picture tube gun manufacture as an export oriented industry.
 - b) Develop BW picture tube gun manufacture starting from raw materials.
 - c) Encourage captive CPT gun manufacturers to indigenise their sources of parts.
 - d) Develop BWTV as an export industry.
 - e) Develop BWTV picture tube as a separate export industry.
 - f) Establish R&D set ups to develop future technologies in:

- Mechanical Engineering for Guns and Shadow-masks
 - Glass Technology for Shells
 - Electronic Engg. for PTs, monitor tubes, CRTs
 - Chemicals Tech. for Phosphors & Chemicals
- g) Encourage setting up of a unit to manufacture shadowmasks with imported technology.
- h) Some specific tasks of R&D set ups would be the following:
- Develop larger size CPT.
 - Develop lower cost BW picture tubes & CPTs
 - Develop guns with higher anode currents and less spread
 - Develop CPTs for HDTV.