Concept Paper

Electronincs Support Centres (ESCs)

to develop the

Electronics Industry of Pakistan

Technology Upgradation and Skill Development Company
Ministry of Industries & Production
State Cement Corporation Building, Township, Kot Lakhpat, Lahore
Tel: +92-42-111-000-143, 5111965 Fax: 5121658
Website: www.tusdec.org.pk Email: info@tusdec.org.pk
(A company setup under Section 42 of Companies Ordinance 1984 having capital share)

Background:

Electronics is considered one of the world's fastest growing industries with global revenue worth trillions of dollars per annum.

Unfortunately in Pakistan the electronics sector is still in infancy and never became a major revenue generating industry. The sector basically focuses on consumer electronics, with activities confined to assembly of conventional TV sets, radios, cassette recorders and other allied consumer electronic products from imported Complete Knock Down (CKD) or Semi Knocked Down (SKD) kits imported from mostly China.

A few companies are involved in somewhat higher level of production/assembly of items like pay-phones, energy meters, security systems and telecommunication equipment for defence through reverse engineering but using imported components or sub-assemblies.

Despite the huge growth potential, Pakistan has lagged behind in the development of its electronics industry. It is, thus, imperative that a coherent strategy is put in place to develop this sector with a view to increasing the country's growth potential as well as achieving self-sufficiency by reducing dependence on foreign sources of products, materials, components and equipment.

Government of Pakistan has included the electronics sector in its Medium Term Development Framework (MTDF). The government has planned to help develop an international quality indigenous supply chain and to raise the share of electronics in the output of the manufacturing sector from under 3% at present to 10% in 2010 & to 20% in 2020.

TUSDEC has focused its study on enhancing value added production through a Common Facility or 'Teaching Factory' approach to upgrade Pakistan's electronics industry to enable adoption of modern techniques and generate trained human resources.

To assess the current status of Pakistan's electronics industry, a series of visits to various companies were carried out which helped identify the problems faced by the industry. Following issues emerged from these studies:

- Lack of a technology base.
- No CFCs for promotion of modern technologies such as Surface Mount Assembly (SMT)
- Weak supply chain – sourcing systems are not established and lack specifications
- Insufficient R&D capabilities and skilled engineers although universities are producing electrical and electronic engineers
- Lack of quality standards

Vision:

TUSDEC proposes setting up a common facility centre (CFC) to immediately uplift the industry by importing contemporary technology machinery and obtaining training with skill enhancement together with practical production training.

This would be accomplished through consultants, machinery suppliers and 'know-how' agreements to keep pace with developments in processes and machinery.

The 'Electronics Support Centres' would provide the industry with complete printed circuit solutions commensurate with 'economy of scale' as well as expert services for product design and prototyping.

The centres will be equipped with modern electronics design and quality assurance laboratories for design and development. The CFCs will contain high-tech SMT machines for assembly of Printed Circuit Boards (PCBs) with both through-hole and surface mount components. They will also provide PCB design, lay-out, fabrication and electronic component procurement services.

Collaboration with international partners would prevent obsolescence of the machinery, equipment and processes.

Output:

PCB Design & SMT Assembly:
Electronic products are getting smaller, slimmer and smarter in design. Advent of smaller surface mount devices is the primary reason for such development. In Pakistan surface mount technology is almost non-existent. The main output of these centres would be to promote this technology in Pakistan by making it available as a common facility, providing contract assembly and a one-stop solution to the local and export industry.

The centre would handle all the requirements of an electronics producer's printed circuit boards. It would provide services such as PCB design, layout, fabrication and SMT assembly. The industry and exporters would place their orders and submit their design data to shorten production time.

They would have the option to either utilise the PCB Design facility only or engage in contract assembly of their PCBs for final incorporation into finished products. These common facilities will be made available to local and international markets.

Product Design and Prototyping Laboratory:
TUSDEC's industry and literature survey also pointed to the lack of R&D and product diversification in Pakistan. In order to address this problem the centres would provide local companies with product design and prototyping services in a phased manner after setting up the respective Common Facility Centre. Products would be designed according to a customer's requirements, tested and prototyped for production by the customer/client together with the supply of required tooling and documentation. The laboratory would also train students and skilled manpower for employment in industry.

Material Management Services:
The Centre would solve the component sourcing problems faced by local manufacturers through procurement consultancy and training for their PCB assembly needs.

Presently Pakistan's industry has to arrange component supplies from multiple sources while suffering cost problems due to economy of scale. Local as well as international suppliers are so scattered that it takes industrialists considerable time to source a part and get it delivered. On top is the extra cost borne due to low quantities. The planned CFC will offer advisory services where the industry is suffering economy of scale problems.

Benefits:

Electronics sector in Pakistan has been neglected. Successful economic growth of a country is dependent on its high-tech industry. The centres would be the first step towards development of an electronics industry in Pakistan.

The CFC's processing of stakeholder requirements and material management would be driven by continuous market pressure to shorten time-to-market, enhance asset utilisation, keep abreast with up-and-coming technologies, and master complex processes.

The proposed CFCs would provide immediate access to local manufactures and entrepreneurs to have their products readied using modern design techniques and test equipment by utilising the services of expert engineers and consultants.

The CFCs would acquire and master surface mount technology by installing modern and state of the art SMT assembly and test machinery. This would improve the industry's technical capabilities and help solve multiple problems faced while buying or having their PCBs assembled abroad. It

would also encourage those manufacturers who have not ventured into modern assembly techniques such as surface mount technology due to unavailability of such facility in the country or being beyond their economic reach.

The Centres' capabilities and services would allow the local electronics companies to focus on their main competencies like research & development and sales & marketing.

The fully operational SMT assembly units would have high production volumes and sharing of components, thus reducing costs for local companies while allowing for leading edge manufacturing where it is most cost effective. Emphasis would be placed on encouraging local industry to use the centres to enter export markets - obtaining export orders and utilising the services of these common facility centres.

High production volumes would create the need for an in-country raw material and components industry. This would encourage local manufacture of electronic components like electrolytic capacitors, resistors, laminates and other items where economy of scale justifies. A local vendor industry will develop and electronic product producers will in turn be encouraged to invest in modern assembly facilities and replicate the CFC facilities into their own factories.

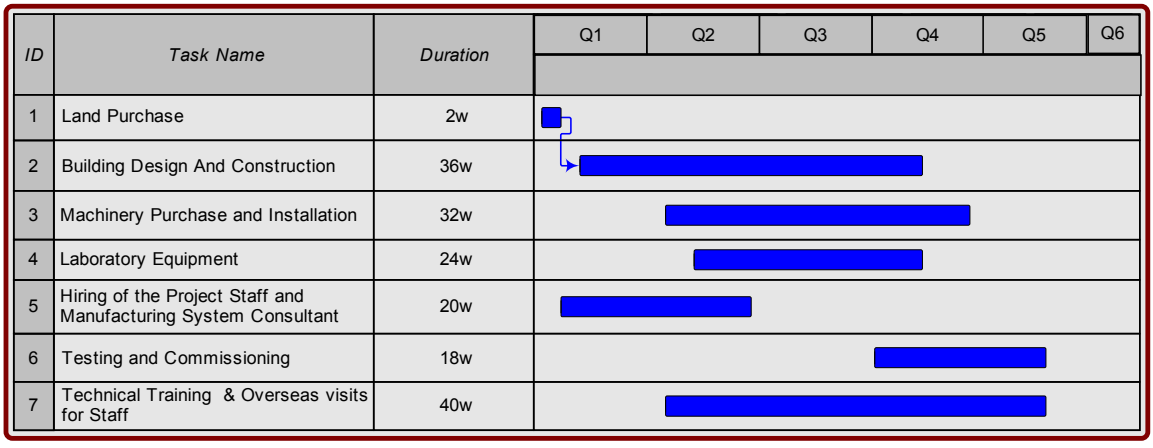
Collaboration and sub-contracting to international brands would not only help introduce new technologies in the country but also generate foreign exchange by capturing some part of lucrative PCB assembly market. It would help bring further foreign investment by developing a good image for the country and ensure the technology is keeping abreast with the developed world.

The centre would also act as a teaching factory where students from universities would be allowed to work on modern machinery, use the design lab and familiarise themselves with various aspects of electronic product design and assembly. This would strengthen their technical and management skills and overcome the deficiency in skilled man-power.

Anyone who wants to benefit from this Centre and new technologies would be welcomed. The Centre will create employment opportunities for engineers, technicians as well as management and marketing personnel.

Implementation:

The following figure shows a tentative schedule of major activities during implementation in the form of a Gantt chart. Activities start after project approval and funding.



Schedule of major activities

Activities:

The CFC would provide Electronic Manufacturing Services (EMS) and would be equipped with modern design & test laboratories and PCB assembly equipment. It would be aimed to help local as well as international manufacturers, offering design and assembly solutions.

PCB Design:

Design of a PCB is a major step in developing overall product design capability. The CFCs would have expertise in board design and layout of multi-layer (any layer count) boards. Work would be carried out using standard industry tools to provide customers an efficient design according to their requirements.

Below is a list of desired capabilities:

- Multilayer (Any Layer Count) Designs
- Analog & Digital Designs
- Micro-BGA and BGA
- Ultra High Speed Designs
- Flex Circuits
- Netlist Translation
- Design For Manufacturability
- Design For Test

Deliverables include:

- Fabrication drawings
- Assembly drawings
- Gerber data
- Drill files

PCB Assembly:

Latest SMT machinery would be acquired for supporting industry. Partnerships with SMT machine manufacturers, consultants and technology licensor (if any) and industry would be made to keep the units up to date. This would help prevent the machines and equipment suffer obsolescence as the product life cycle in the electronics industry is very short.

The CFCs would be available for any local or international company for complete assembly of their PCBs in the centres or sub-contract out a portion of the facilities where they may produce their own products.

Desired PCB Assembly Capabilities:

- SMT & Through-hole
- High Speed Placement
- BGA and Micro-BGA Capabilities
    - CSP (Chip Scale Packaging)
    - Flip Chip
    - X-Ray Verification
    - Reballing
    - Rework (De-population and Re-population)
- Fine Pitch
- 0201 Placement
- Optimized Reflow Profiling
- Double-Sided SMT
- De-ionized Wash
- Rework and Touch up Capabilities
- Minor PCB Repair
- Strict ESD Control
- Functional Testing
- Turnkey or Consigned Kits
- High Volume Production

The PCB Assembly areas would consist of the following:

Prototyping, Training and Entry Level Production:
All new electronic products require prototyping. In SMT, prototyping tends to be much more difficult then in the previous through-hole technology. It requires specialised knowledge and equipment and tends to be costly. However, there is no way to bypass it.

A prototyping and entry level set-up, which could also be used for training would consist of the following:

- Manual Solder Paste Printer
- Semi-Automatic Pick and Place Machine with CAD Conversion Software
- Entry Level (4000CPH) Automatic Pick and Place Machine
- Three Zone (300mm width) Reflow Oven
- Rework Station with BGA Microplacer

Mid Level, High Mix Production:
For lower technology, lower volume products, a high mix, high flexibility middle capacity (22,000Components per Hour CPH) lines are planned.

A Line would consist of the following:

- Automatic PCB Magazine Loader
- In-line Printer
- Automatic mid level (22,000 CPH) Pick and Place Machine
- Inspection Conveyor
- 7 Zone Reflow Oven
- Automatic PCB Magazine Unloader
- Desktop Automated Optical Inspection
- Flying Probe Tester
- SMD Tower Storage Magazine
- Component Baking Oven
- Solder Paste Storage
- Rework Station and BGA Microplacer
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High Volume Production:
The high volume production will be separated into two lines:

- High Technology Line (capable of 3D assembly of 3G cell-phones and similar products)
- High Speed Line (capable of high speed assembly of consumer electronics)

The exact specification of these lines depends on the type and quantity of product to be manufactured. To achieve a specified output, it may be necessary to have multiple chip and IC placement machines in the same line.

High Technology Lines:
Capable of double-sided assembly of high technology products like 3G cell phones
Capabilities Required: Double-Sided High Speed Precision Mounting of 01005 size chip components, 0.3mm pitch QFPs, BGAs, micro BGAs, CSPs and flip chips. True three dimensional assembly using Package on Package (POP) techniques, conformal coating and under-fill.
Line 1 for first side of double sided PCB (with flip chip capabilities on this side)

- Loader
- In-line Printer
- In-line Automated Solder Paste Inspection
- High Speed Chip Mounter
- Multifunction IC Placer with paste/flux transfer and 3-D POP capability
- Flip-Chip Bonder
- Automated Pre-Reflow Inspection
- 14 Zone Reflow Ovens
- Automated Post-Reflow Inspection
- Un-loader
- Line 2 for second side of double sided PCB (without flip chip capabilities)
- Loader

- In-line Printer
- In-line Automated Solder Paste Inspection
- High Speed Chip Mounter
- Multifunction IC Placer with paste/flux transfer and 3-D POP capability
- Automated Pre-Reflow Inspection
- 14 Zone Reflow Oven
- Automated Post-Reflow Inspection
- Un-loader

Conformal Coating and Under-fill Line

- Loader
- In-Line Conformal Coating / Under-fill dispenser
- UV Curing
- Thermal Curing Oven
- Un-loader

High Speed Line:

For consumer electronic products like DVD players, LCD TVs, Computer Monitirs, and Automotive Audio products. This line also includes an Auto-Insertion conventional setup for axial and radial through-hole components.

Capabilities Required: Double Sided High Speed Precision Mounting of 0201 chip components, 0.3mm pitch QFPs, BGAs, micro BGAs, and CSPs, Auto-insertion.

Line 1 for first side of double sided PCB

- Loader
- In-line Printer
- In-line Automated Solder Paste Inspection
- High Speed Turret Type Chip Shooter
- High Speed Turret Type Chip Shooter
- Multifunction IC Placer
- Automated Pre-Reflow Inspection
- 14 Zone Reflow Oven
- Automated Post-Reflow Inspection
- Unloader
- Line 2 for second side of double sided PCB
- Loader
- In-line Printer
- In-line Automated Solder Paste Inspection
- High Speed Turret Type Chip Shooter
- High Speed Turret Type Chip Shooter
- Multifunction IC Placer with paste/flux transfer and 3-D POP capability
- Automated Pre-Reflow Inspection
- 14 Zone Reflow Oven
- Automated Post-Reflow Inspection
- Unloader

Axial Auto-Insertion Line

- Loader
- Axial Auto-Inserter
- Un-Loader

Radial Auto-Insertion Line

- Loader
- Radial Auto-Inserter
- Un-Loader

T*esting Facilities:*

All PCBs assembled would have to pass through at least two levels of testing – In-circuit and Functional Testing.

In-Circuit Testing:

For the low and medium level volumes, in-circuit testing will be carried out on fixture-less flying probe testers. For the higher level volumes, in-circuit testing will be carried out by first making test fixtures using 'bed of nails' probes and mounting them on the In-Circuit Testers (ICTs). In both cases test programmes will be written to specify the tests. Thus the following will be required:

- Flying Probe In-Circuit Testers

- Fixture In-Circuit Testers

Functional Testing:
This is carried out as the final test and the fixtures are usually computerised and provided by the customer/client whose PCBs are being assembled.

Auxiliary Services Required:
- Finished PCB washing line (if required)
- Stencil and Misprint Cleaning Machine
- Solder Paste Storage Refrigerator
- Oven for Component and PCB Baking
- PCB de-tabing machine
- 2 micron dry and filtered air supply
- De-ionized water supply
- 3-phase on-line UPS system capable of supporting all sensitive equipment
- Air-conditioning / heating and humidity control

Stencil Making:
- Laser Cut Stencil Making Machine
- Electro-polishing Machine
- De-burring Machine
- Stencil Stretcher for stencil to frame attachment

Material Management:

Apart from bulk sourcing of the raw materials and components needed by the CFCs, it may assist industry to solve procurement problems by helping sourcing of essential components or kits at international market rates. Material Management Unit would have following capabilities:

- Buying power by establishing strong alliances with key component distributors
- Quick-turnaround procurement.
- Components available at international market rates
- Global network with access to global stocks
- In-house Stock of common components
- Electronic links to key suppliers and their inventories
- Component Reels to be stored in Automated “SMT Tower Magazines with Temperature and Humidity Controlled Internal Environment”. Tower Magazines to be linked up to the on-site ERP system.

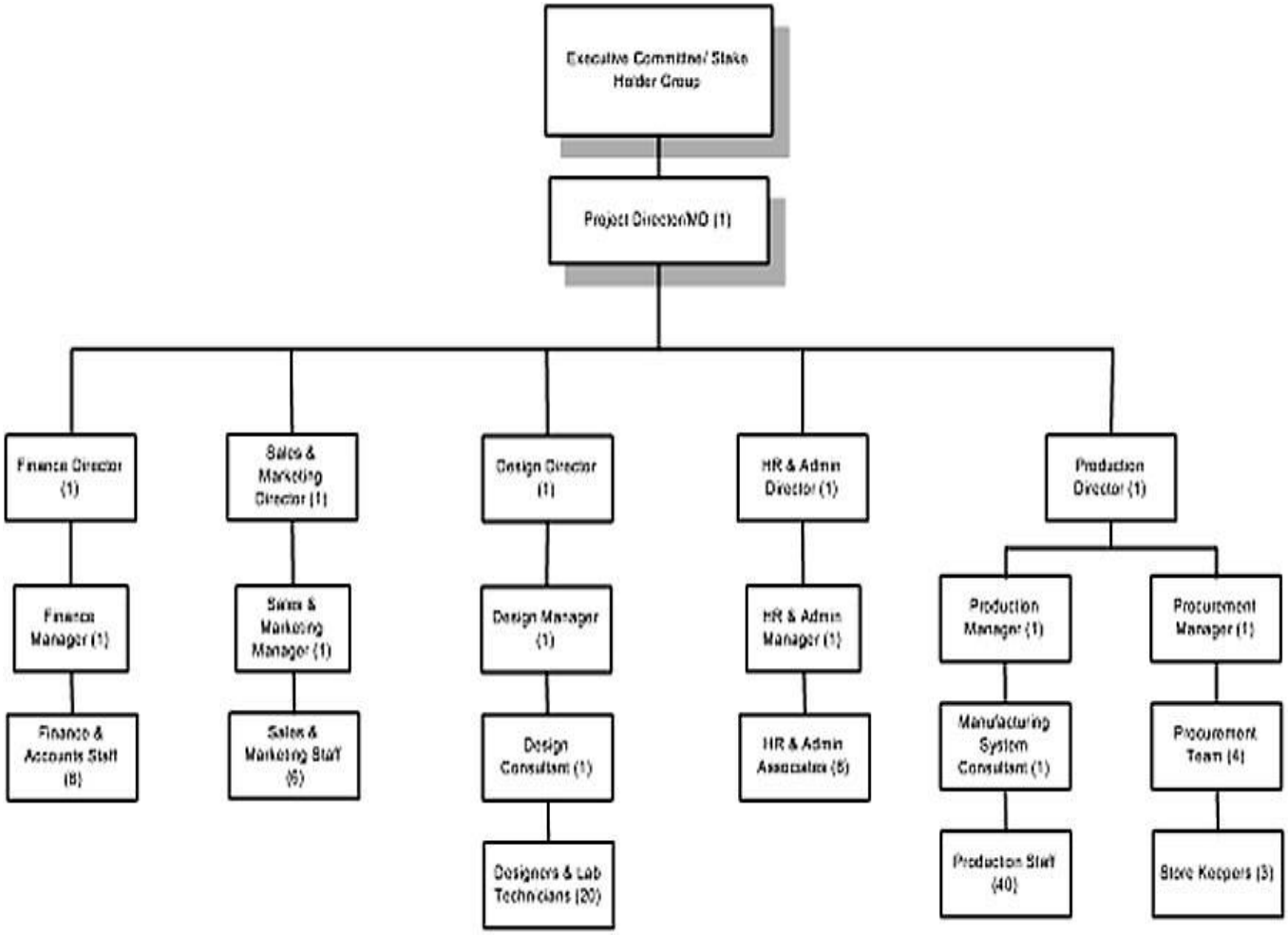
Management Structure:

The initial planned headcount is approximately 100 personnel, headed by a CEO/Project Director. The structure is divided into five major departments:

- Design Department
- Production Department
- Sales & Marketing Department.
- Administration and HR Department
- Finance and Accounts Department

Each department would be led by a departmental director, reporting directly to the CEO/project director. Additionally, a team of managers would be provided to each department head.

The CEO/Project Director would initially be managed by an executive committee which would consist of a group of stakeholders from industry and government. After operations start this Executive Committee may be replaced with a Board of Directors when the CFC is incorporated as a Company with one-third members from the Public Sector and two-thirds from the Private Sector.



Location:

Electronics Support Centres will be built in Lahore and Karachi for which the land will be provided by the respective provincial governments or relevant authority.