Layout Planning of Chemical Industrial Parks

Raghu Babu Nukala
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Layout Planning of Chemical Industrial Parks: Some Core Issues

» Improper siting of chemical industrial parks

» Unplanned development and haphazard land use changes around Industrial Parks

» Disaster management aspects not integrated into Layout/Site Master Plans of Industrial Parks

» Lack of guidelines, criteria etc. for planning of industrial parks

» Lack of capacities for proper layout/site master planning of industrial parks
Contents of the Presentation:

Layout/Site Master Planning
- Existing standards/criteria/guidelines for planning
- Case examples
- Some criteria for planning

Siting aspects
- Industrialisation trends
- Siting approaches
- Siting criteria

Recommendations

Layout/Site Master Planning of Chemical Industrial Parks
Some Reference Criteria

**Industrial Park Level:**
- Indian Green Building Council (IGBC) - Green SEZ Rating System, Green Townships (India), Green Landscape
- UN indicators for sustainable development (UNDESA 2007)
- OECD Green Economy Indicators
- Chinese Eco-Industrial Park Standard
- Chinese ISC Guide for Low Carbon Industrial Zones
- Indicators of Kaiserslautern University of Technology
- Indian Green Building Council (IGBC): Green SEZ Rating System
- DGNB (German Sustainable Building Council)

- Guidelines for Planning Mega Project, Punjab
- Guidelines for Planning Industrial Estates, 2011, Gujarat
- Industrial Policy 2007, Tamil Nadu
- Industrial Policy 2011, Haryana
- Master Plan for Delhi – 2021

**Industry/Building Level:**
- Green Star Rating (Green Building Council of Australia)
- Energy Conservation Building Code (Ministry of Power, India)
- Indian Green Building Council (IGBC): Green Homes, Green Existing Buildings, Green Factory Building, High-performance commercial buildings (India)
- LEED (Leadership in Energy and Environmental Design) Rating System, USA

Summary of Reference Criteria

- **Site selection:** site preservation & restoration
- **Site planning & design:** innovation & design, adaptability & future-proof
- **Resource efficiency** (energy, water, materials) - renewable energy; recycle/reuse of water, materials, energy etc.
- **Minimise environmental impacts:** wastes, waste water, ecosystem
- **Social infrastructure**
- **Improved business performance**, staff productivity and well-being
- **Buildings** – materials used, energy efficiency etc.
- **Quality site management and administration**

Disaster aspects are not reflected in the available Industrial Park criteria/rating systems
Green SEZ Rating System for Industrial Estates - IGBC

» Site preservation and restoration
» Reduced use of fossil fuels
» Energy efficiency
» Water efficiency
» Handling of solid waste
» Materials & Resources
» Innovation & Design Process

Green Factory Buildings (IGBC)

» Site Selection and Planning
» Water Conservation
» Energy Conservation
» Material Conservation
» Indoor Environment Quality and Occupational Health
» Innovation & Design Process
DGNB Germany Criteria for Industrial Estate Sustainability Certification

» **Environmental quality** (effects on the global and local environment; resource use; waste generation)

» **Process quality** (participatory planning, detailed and integrated planning, planning process)

» **Socio-cultural and functional quality** (social quality; health, comfort and user satisfaction; functionality; design quality)

» **Technical quality** (technical infrastructure – energy, wastes, etc.; technical quality – transportation system etc.)

» **Economic quality** (life-cycle costs of buildings, site development/plan efficiency etc.)

---

Disaster Management Provisions for Chemical Industrial Park Planning (Germany's Major Accidents Ordinance to Industrial Estates)

» “Closed” Industrial Estate: Industrial Estate with common fences, shared emergency management and shared infrastructure

» Coordinated emergency response and integrated emergency management

» Joint security service

» Joint emergency management for the whole Park

» Joint fire brigade organised by infrastructure operator

» Fence at the perimeter of the whole Park

» High risk/vulnerability areas may need additional security

Source: Guidance Application of the Major Accidents Ordinance to Industrial Estates (SFK-GS-44), German Federal Ministry for Environment, Nature Conservation and Nuclear Safety
Case Example: Hoechst Chemical/Industrial Park (Germany)

» Infrastructure company (owned by major operators) responsible for emergency management and fire brigade
» Joint Disaster Management Plan for the Park
» Joint command centre
» 24hrs/7 days service of “Emergency Managers” and medical centre
» Senior managers from Park users act as Emergency Director in case of major incidents
» Internal command with Park Fire Chief and Emergency Director. Authority may take over in case of outside impact.
» Costs are shared according to risks

---

Case Example: Bayer Chemical Park, Leverkusen (Germany)

Compact; Well laid out road network; Well defined industrial blocks/zones, Entry/exit points, Separate provisions for trucks and passenger cars
Case Example: Shanghai Chemical Industrial Park (SCIP) (China)

» Emergency Response Centre
» Fire fighting station
» Centralised Industrial Gases: CO2, H2, O2, N2, Plant air, Instrumentation air
» Centralised Co-generation Plant: Electricity- 600,000kw; Steam : 660t/h
» Centralised Incineration facility for hazardous wastes
» Jetty, Tank Form and Pipe Racks – for distribution of chemicals etc.

Case Example: Shanghai Chemical Industrial Park (SCIP), Shanghai, China

SCIP Emergency Response Center

» Information collection and transmission
» Local safety monitoring
» Accident prevention, command and management.
» Public safety/security
» First aid
» Fire Fighting
» etc.
Case Example: APSEZ Visakhapatnam

![Diagram showing emergency exits, green belts, and zoning for different hazard levels.]

Layout/Site Master Plans
Provisions for Disaster Risk Management

- Zoning of industries as per disaster risks
- Adequate entry/exits, emergency exits
- Proper road network (IRC standards) and circulation system, Access controls
- Separate provisions for passenger and goods traffic, hierarchy of parking – overnight stay, temporary parking, loading/unloading
- Buffer zones, green belts – industrial park level, zone level, plant level
- Fencing for the whole Park and for sub-zones (as per reqt.)
- Emergency Response Centre
- Fire station
- Common infrastructure – tank forms, pipe racks, waste incinerator, cogeneration plant etc.
Suggestions:

- Specify “disaster management” requirements for Industrial Parks
- Develop Guidelines for integration of “disaster management” aspects into Industrial Park Planning
- Develop criteria on “disaster management” for integration into Industrial Park “Rating Systems”
- Undertake capacity building (organisational and individual) on planning of industrial parks

Understanding The Industrialisation Trends
**Types of Industrial Parks**

- **Industrial Clusters** (e.g., DMIC; BMIC etc.): Textiles, electroplating, tanneries etc.
- **Specialized/Theme Based Parks**: Hardware Parks, Science & Technology Parks, Biotechnology Parks, Leather Parks, etc.
- **Industrial Estates** (Industrial Parks, Industrial Estates, Industrial Development Area, Chemical Parks, etc.): Special Investment Regions (SIRs) (> 100 sq.km)
- **Special Investment Regions (SIRs)**.
- **PCPIRs** (Petroleum, Chemicals & Petrochemical Investment Regions) (≈ 250 sq.km)
- **National Investment and Manufacturing Zones INIMZs** (≈ 5,000 Ha)
- **Industrial Corridors** (e.g., DMIC; BMIC etc.): DMIC: 1,483 km long, 300 km wide
- **Arabian Sea**
- **Delhi-Mumbai Industrial Corridor (DMIC)**
- **End Terminals**
- **J.N. Port**
- **Example: Delhi-Mumbai Industrial Corridor (DMIC)**
  - DMIC: 1,483 km long, 300 km wide
  - Area under Influence: 14% & Population: 17% of the country
  - Total Population: 173.4 Million
  - Total Workers: 68.36 Million
  - Total 82 Districts of Six States within the Influence Area (excluding MP)
  - 24 industrial nodes have been proposed along the DMIC

**Example: Delhi-Mumbai Industrial Corridor (DMIC)**
New industrial areas need land use planning (Site Master Plans, Development Plans/Regional Plans) integrating “disaster management” aspects

Existing industrial areas too need retrofitting integrating “disaster management” aspects

(over 2,000 industrial estates exist in the country)
Understanding Siting Aspects

Proper site selection is important to minimise disaster risks.
Associated Activities/Land Uses with Industrial Parks and Investment Zones

There is need for planning and regulating land uses around industrial areas for minimising disaster risks.

Land Use Planning of Industrial Areas

The state/local level authorities such as:
- industrial Development Corporations
- infrastructure Development Boards

are identifying locations for:
- industrial estates,
- investment zones/regions, and
- industrial corridors, and

preparing development/master plans. (e.g. Dholera Special Investment region of DMIC by the Gujarat Infrastructure Development Board)
Example: Dholera SIR (Gujarat)

Total Area (including 22 villages) 90,370 ha
Total Jobs 827,000
Industrial, Tourism & other Jobs 343,000
Support Jobs 484,000
Supported population 2.5 million
Population living in DSIR 2.0 million

Source: Presentation on “Industrial Park Development In the State of Gujarat”, by Gujarat Infrastructure Development Board, Oct 2013

There are **1,666 MAH units** in India.
Out** of 602 districts in India, **263 districts** have MAH units.
170 districts have clusters of more than 5 MAH units (hazardous/industrial pockets).

**Source: Dr. Anil K. Gupta, Associate Professor, Sreeja S. Nair, Assistant Professor, NIDM, New Delhi; Presentation on “Siting of Industries in a Multi-hazard Environment: Risk Mapping and Knowledge Management”.

**Declare Major Hazard Vulnerable Areas and set timeframe for preparation of Land Use Plans by state agencies**

- Areas with “Major Accident Hazard” industries
- Areas with major accident hazard activities, other than industries: include areas with gas/chemical pipelines, ports/harbours, storages of chemicals etc.
- Areas prone to natural disasters
Site Selection Approach:
Example of Zoning Atlas of CPCB

- All forests
- National parks, Sanctuaries and other critically ecologically sensitive areas
- Monuments
- Tourist sites
- High land capability areas
- High physiography areas
- Organised bathing places
- Flood prone areas etc.

**Step 1: Elimination approach - Mapping of areas to be avoided**

**Legend**
- Low
- High
- Medium

**Land Use Sensitivity**

**Dispersion Sensitivity**

**Air Pollution Sensitivity**

**Overlay Matrix**

<table>
<thead>
<tr>
<th>Disp. Land Use</th>
<th>High</th>
<th>Med</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Med</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Step 2: Risk assessment**

Risks due siting of air polluting industries
Step 3: Site suitability assessment for industries

Site Selection Approach:
Example of Renewable Power Generation and Resources
Recovery Facility, Puerto Rico

Step 1: Exclusion Analysis: Conservation areas; Historical and
archaeological sites; Wetlands; Landslide prone areas; Federal lands; Natural
reserves; Soils of agricultural significance; Coastal barriers; Schools etc.

Step 2: Inclusion Analysis: Flat land (<21% slope), Process water supply -
less than 3 miles; Proximity to major Highway Network – less than 3 miles;
Accessibility to a 115KV or 230kv sub-station for power production — less than 2 km;
Proximity to sanitary sewer line – less than 3 miles; Wastewater treatment plant –
less than 3 miles etc.

Step 3: Suitability Analysis (weightage)

Step 4: Comparative Assessment of Sites

Step 5: Site selection
Site Selection Approach: Methodology from NIDM, New Delhi

Source: Presentation on “SITING OF INDUSTRIES IN A MULTI-HAZARD ENVIRONMENT: Risk Mapping and Knowledge Management”, Dr. Anil K. Gupta, Associate Professor, Sreeja S. Nair, Assistant Professor, NIDM, New Delhi

Hazard Identification

All hazards have to be identified comprehensively and systematically ...

- **Operation hazards**
  - eg. „classical“ EHS-hazards, loss of production, ...

- **Network hazards**
  - eg. failure of utilities, supplies, transportation ...

- **Environmental hazards**
  - eg. natural hazards, adjacent plants and traffic ways, ...

- **Environmental vulnerability**
  - eg. densely populated areas/buildings, natural reserves, ...

- **Terrorist threats**
  - eg. plant vulnerability, neighbourhood/environment sensitivity, company image, ...

Source: Presentation on “European Best Practice for industrial Disaster Risk Management (iDRM)”, Dr. Christian Jochum, InWEnt Senior Advisor (www.inwent.org), Director of Centre, European Process Safety Centre, Chairman, German Commission on Process Safety
DGfB Germany Criteria for Industrial Locations

» Life Cycle Assessment (resource consumption and emissions)
» Water and Soil Protection
» Changing Urban Microclimate
» Biodiversity
» Environmental Risks [Indicators: earthquake; avalanches; storm; flood; landslide, soil subsidence]
» Land Use [Indicators: proportion of fallow land; area integration; area pollution]
» Total Primary Energy Demand
» Resource-efficient infrastructure
» Drinking Water Demand and Waste Water Volume

Safety Distances
Commission on Process Safety (German Federal Ministry for Environment - BMU)

Safety distances – mandated in line with Germany’s major accidents law under Federal Pollution Control Acts
(based on long term operating experience and analysis of major accidents)

www.kas-bmu.de
Recommendations:

1. Undertake district-wise risk assessments and identify areas to be avoided for MAH Units.

2. Develop siting criteria for MAH Industries and other installations.


4. Identify “Major Hazard Vulnerable Areas” and direct state agencies to prepare Land Use Plans (development plans/regional plans/master plans).

5. Specify “disaster management” requirements for integration into Industrial Parks.

Recommendations:

5. Develop Guidelines for integration of “disaster management” aspects into Industrial Park Layout/Site Master Planning.

6. Develop Criteria on “disaster management” for integrating into Industrial Park rating systems.

7. Apply for all new industrial areas and investment regions,

8. Retrofit existing/old industrial areas.

9. Undertake capacity building (organisational and individual) on planning of industrial parks.
Raghu Babu Nukala  
Indo German Environment Partnership (IGEP) Programme  
Senior Technical Advisor & Programme Coordinator  
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH  
3rd Floor, B5/2 Salarjung Enclave  
New Delhi 110 029  
T +91 11 49495353, Ext: 2358  
F +91 11 49495391  
E: nukala.raghu@giz.de  
I: www.giz.de; www.ecoindustrialparks.net

Ongoing Site Master Planning Activities with GIZ Support

Green Industrial park AP)  
APSEZ (AP)  
Multi-product SEZ (AP)  
Women entrepreneurs industrial park (AP)