Industrial Waste Management
Session - I

USAID Low Emissions Asian Development (LEAD) Program
Date: 28 January 2015
Session # 1

- Understanding What’s Waste
- Waste & Productivity linkages
- Reasons of Waste generation
- Classification of Wastes
- Classification of industries by polluting potential
- Why manage waste?
What’s WASTE?
“WASTE” can be regarded as a human concept as there appears to be NO such thing as waste in nature.

The waste products created by a natural process or organism quickly become the raw products used by other processes and organisms.
What’s the problem then?

Man-made systems **emphasizes** on economic value of materials and energy, and where **production and consumption** are the dominant economic activities.

The end product (**WASTE**) returned to the environment **in a form** that damages the environment and require more natural capital be consumed in order to feed the system; which is ultimately **NOT** sustainable.

The capacity of the natural environment to absorb and process these materials is also under stress.
What’s WASTE then?

The presence of waste is an indication of overconsumption and that materials are NOT being used efficiently.

“WASTE is a RESOURCE at a Wrong Place at the Wrong Time in Wrong Quantity.”
WASTE: The definition

Wastes are materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded.
What is Waste?

The legal definition of waste in the UK is derived from the EU Waste Framework Directive. In basic terms, "A waste is anything which you decide to, or are required to, throw away. Even if the substance or article is given to someone else to be reused or recycled, it is still legally considered to be waste if it is no longer required by the person who produced it."
Non-Waste

- Non-Waste is an object which has been
  ✓ assigned a **Purpose** by its (or a potential) **owner**, and
  ✓ this owner **will either use** it for that Purpose,
  ✓ or by adjustment of State or Structure, **ensure** that the object **will be able to perform** in respect to the assigned Purpose.
Waste & Causes: Productivity Perspective

Figure. Ineffective management of the conversion process often results in different types of waste. Source: Teian Consulting International, Singapore.

Lean Manufacturing: Eliminating Waste

3 Broad Types of Waste

- Muda
- Mura
- Muri

Activities that do not add any customer value (The 7 Wastes)

Unreasonableness

Inconsistency
Lean and 7 Wastes – What does it mean?

<table>
<thead>
<tr>
<th>Procedure and Guidance Notes:</th>
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<td><strong>Over production</strong></td>
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<td><strong>Inventory</strong></td>
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<td><strong>Motion</strong></td>
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<td><strong>Waiting</strong></td>
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<td><strong>Transportation</strong></td>
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<td><strong>Over processing</strong></td>
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<td><strong>Defects</strong></td>
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**OVER PRODUCTION** is considered the "Mother Of All Wastes" since it can lead to increases in all the other forms of waste.
Lean and 7 Wastes - Example

1. Clarify the problem
   What is the problem for the customer – time, cost, quality?

2. Map the Process Steps
   Study the process where the problem occurs

3. Analyse the process steps
   Decide what is value adding, value enabling and waste in the process

4. Eliminate waste
   Plan and execute actions to eliminate the waste steps

5. Reduce Value Enabling
   Once waste is eliminated, look to reduce the value enabling content where possible

5. Formalise new process
   Confirm new process, measure and monitor, and create new process map, SOP’s etc

15 July 2010, Slide 12
Measures of Prosperity

For more than 75 years, GDP (Gross Domestic Product) has been used to measure the success and prosperity of nations.

“The welfare of a nation can, therefore, scarcely be inferred from a measurement of national income.”

- Simon Kuznets
Economist who developed GDP to US Congress
Well-being and sustainability ...

“...the time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people’s well-being. And measures of well-being should be put in the context of sustainability”

- Stiglitz Commission, 2009
Prosperity Indicators & Ranking

The Prosperity Index ranks countries according to their performance across eight equally-weighted sub-indexes. The 2014 rankings reveal the most and least prosperous countries in the world.
"Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist”

(Attributed to Kenneth Boulding - economist)

“Prosperity for the few founded on ecological destruction and persistent inequality is no foundation for a civilised society … For the advanced economies of the western world, prosperity without growth is no longer a utopian dream. It is a financial and ecological necessity.”

(Tim Jackson for SDC, 2009)
Technology is part of the solution to climate change. But only part.

Radical Economic And Social Transformation required.

Classification of Wastes
Waste Classification: By its Physical State

Solid wastes: wastes in solid forms, domestic, commercial and industrial wastes

Examples: plastics, styrofoam containers, bottles, cans, papers, scrap iron, and other trash

Liquid Wastes: wastes in liquid form

Examples: domestic washings, chemicals, oils, waste water from ponds, manufacturing industries and other sources

Gaseous Wastes: wastes in gaseous form

Examples: emissions from domestic stoves, boilers, manufacturing industries, furnaces, crushers, automobiles, incineration, open burning and other sources
Classification of Wastes: *as per their Properties*

**Bio-degradable**

can be degraded (paper, wood, fruits and others)

**Non-biodegradable**

cannot be easily degraded (plastics, bottles, old machines, cans, styrofoam containers and others)
Classification of Wastes:
As per their Effects on Human Health and the Environment

- **Hazardous wastes**
  Substances unsafe to use commercially, industrially, agriculturally, or economically and have any of the following properties - ignitability, corrosivity, reactivity & toxicity.

- **Non-hazardous**
  Substances safe to use commercially, industrially, agriculturally, or economically and do not have any of those properties mentioned above. These substances usually create disposal problems.
Classification of wastes: as per their origin and type

- **Municipal Solid wastes:** Solid wastes that include household garbage, rubbish, construction & demolition debris, sanitation residues, packaging materials, trade refuges etc. are managed by any municipality.

- **Bio-medical wastes:** Solid or liquid wastes including containers, intermediate or end products generated during diagnosis, treatment & research activities of medical sciences.

- **Industrial wastes:** Liquid and solid wastes that are generated by manufacturing & processing units of various industries like chemical, petroleum, coal, metal gas, sanitary & paper etc.

- **E-wastes:** Electronic wastes generated from any modern establishments. They may be described as discarded electrical or electronic devices. Some electronic scrap components, such as CRTs, may contain contaminants such as Pb, Cd, Be or brominated flame retardants.

- **Agricultural wastes:** Wastes generated from farming activities. These substances are mostly biodegradable.

- **Fishery wastes:** Wastes generated due to fishery activities. These are extensively found in coastal & estuarine areas.

- **Radioactive wastes:** Waste containing radioactive materials. Usually these are byproducts of nuclear processes. Sometimes industries that are not directly involved in nuclear activities, may also produce some radioactive wastes, e.g. radio-isotopes, chemical sludge etc.
Waste Classification

- Domestic
  - Biodegradable (e.g. food waste; can be converted to biofuel)
  - Non-biodegradable (e.g. plastic bags; to be incinerated or landfilled)

- Industry
  - Hazardous (e.g. benzene; to be handed and treated by specialized waste handler before landfiling)
  - Non-hazardous (e.g. fuel oil; can be landfilled or incinerated directly)

- Medical
  - Hazardous (e.g. blood; to be handed and treated by specialized medical waste handler and incinerated)
Waste Classification: Overlapping definitions

Different approaches and overlapping definitions

Waste Classification

What activity generated it?

Waste origin approach
- municipal waste
- recycled waste
- incineration residues
- packaging waste
- e-waste

How dangerous is it for human health and the biosphere?

Waste toxicity approach
- hazardous waste
- stabilized waste
- medical waste
- asbestos
- nuclear
- lead

Nuclear waste is a typically ambiguous categorization: it tells about the origin of the waste (nuclear energy production or military activities), but what most people read is the high toxicity and the specific waste management processes it requires.

Waste composition approach
- organic waste
- plastic waste

Waste management approach

Statistical institutes of the world use various waste classifications, based on different approaches. This diversity is the major obstacle to data globalization and comparison.
## Waste Classification & Management Objectives

<table>
<thead>
<tr>
<th>Mgmt Objective</th>
<th>Classification Type</th>
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<tbody>
<tr>
<td>Treatment / disposal</td>
<td>Treatability based</td>
</tr>
<tr>
<td>Safe Transport</td>
<td>UN Hazard Classification</td>
</tr>
<tr>
<td>Waste Minimization</td>
<td>Process Origin/ Waste Stream based</td>
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<tr>
<td>Segregation of Hazardous/ Non Hazardous Waste</td>
<td>Listing</td>
</tr>
</tbody>
</table>
## Classes of waste *(Pongráz & Pohjola 1997)*

<table>
<thead>
<tr>
<th>1. Non-wanted Objects, Created Not Intended, Or Not Avoided, With No Purpose</th>
<th>Into this group belong outputs with negative market value, <em>non-useful by-products, emissions, processing and process wastes, cleaning wastes, etc.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Objects that were given a finite purpose, thus destined to become useless after fulfilling it</td>
<td>This is the group of single-use products: <em>most packaging, single-use cameras, disposable diapers, etc.</em></td>
</tr>
<tr>
<td>3. Objects with well-defined purpose, but their performance ceased being acceptable</td>
<td><em>Obsolete products, old furniture, discarded household appliances, non-rechargeable batteries, demolition wastes, etc</em></td>
</tr>
<tr>
<td>4. Objects with well-defined purpose, and acceptable performance, but their users failed to use them for the intended purpose</td>
<td><em>Spoiled products, products used in excess, products that go beyond their target, or simply products that the owners do not wish to own anymore.</em> They could be perfectly useful, they are waste solely due to the holder’s wrongful action, and often are non-retrievable. This class embodies the essence of wastefulness.</td>
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Categorization of Industries
Categorization of Industries

Industries or Projects are categorized into three broad categories viz. Red, Orange and Green in decreasing order of severity of pollution.

HIGHLY POLLUTING  MODERATELY POLLUTING  MARGINALLY POLLUTING  NON-POLLUTING INDUSTRIAL ACTIVITIES  [Exemption from Consent]

As the ecological configuration and sensitivity together with geometeorological parameters widely from place to place there cannot be a uniform classification throughout the country.
Highly Polluting Industries: 17 Industrial Sectors

A Industries identified by Ministry of Environment & Forests, Government of India as heavily polluting and covered under Central Action Plan. Viz;

1. Aluminium smelter
2. Cement
3. Chlor alkali
4. Copper smelter.
5. Distillery including Fermentation industry
7. Fertilizer (Basic) (excluding formulation)
8. Iron and Steel (Involving processing from ore/scrap/Integrated steel plants.)
9. Oil refinery (Mineral oil or Petro refineries).
11. Petrochemicals (Manufacture of and not merely use of as raw material)
12. Pharmaceuticals (excluding formulation).
13. Pulp and Paper (Paper manufacturing with or without pulping).
14. Sugar (excluding Khandsari)
15. Tanneries.
16. Thermal power plants.
17. Zinc smelter.
Industries discharging effluent directly or indirectly into a water course (including rivers and lakes) AND

(a) Industries handling hazardous substances OR

(b) Effluent having a BOD load of 100kgs per day or more

AND

2. A Combination of both (a) and (b)
Waste Generation Trends - India

2025 Projections
Indian Waste management market: worth **US$ 13.62 billion**

Waste Management Market Growth projections: by 2025

- Municipal solid waste (MSW): **CAGR of 7.14%**
- e-waste: **CAGR of 10.03%**
- Bio medical waste: **CAGR of 8.41%**

India has planned to achieve a capacity of 2.9 million hospital beds by 2025

“THE FIRST RULE OF SUSTAINABILITY IS TO ALIGN WITH NATURAL FORCES, OR AT LEAST NOT TRY TO DEFY THEM.”

PAUL HAWKEN

© Lifehack Quotes
Why Manage Waste?
What is the cost of inaction?

"We do not face a choice between protecting our environment or protecting our economy. We face a choice between protecting our economy by protecting our environment — or allowing environmental havoc to create economic havoc."

~ Robert E. Rubin, Co-Chairman, Council on Foreign Relations and former U.S. Secretary of the Treasury
Why Manage Waste?

1. Affect human health and environment
2. Affects socio-economic conditions
3. Affects climate and the cascading impact on livelihood, survival
4. Statutory requirements & Associated Liabilities
5. Impacts Corporate Image
6. Concerns Business Sustainability/ Continuity Risks
7. Improve Productivity levels
8. Conserve Natural Resources
9. Potential product/ by-product recovery
Cost of Waste Management

- Disposal cost
- Inefficient energy use cost
- Purchase cost of wasted raw material
- Production cost for the waste material
- Management time spent on waste material
- Lost revenue for what could have been a product instead of waste
- Potential liabilities due to waste.
“By recycling almost 8 million tons of metals (which includes aluminum, steel, and mixed metals), eliminated greenhouse gas (GHG) emissions totaling > 26 million metric tons of carbon dioxide equivalent (MMTCO₂E).”
Why manage Waste?

**High Resource Recovery Potential – makes economic sense**

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Recycled products</th>
<th>Recycling potential</th>
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<tbody>
<tr>
<td>Biomass</td>
<td>Composts</td>
<td>Future of compost depends on its environmental and agronomic quality and the dynamism of its market.</td>
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<tr>
<td>Paper and cardboard</td>
<td>Recovered paper (recycled paper)</td>
<td>Increasing demand in Asia, particularly in PRC.</td>
</tr>
<tr>
<td>Plastics</td>
<td>Recovered plastics</td>
<td>Increasingly stringent regulations and growing demand for recovered plastics in Asia, favoring development and internationalization of this market. Cost of collection system and volatile prices are limiting factors.</td>
</tr>
<tr>
<td>Ferrous Metals</td>
<td>Steel</td>
<td>In 2004, world production of scrap metal rose to 450Mt and consumption reached 405.5Mt. Can be recovered from MSW, construction waste, etc.</td>
</tr>
<tr>
<td>E-wastes</td>
<td>Recoverable materials</td>
<td>Estimated that 10 million computers contain 135,000 metric tons of recoverable materials, such as base metals, silicon, glass, plastic, and precious metals.</td>
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Why manage Waste?

eWaste:

Valuable Metals That Could be Recovered from a Mobile Phone

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<th>Quantity of Non-ferrous Metals Included in One Mobile Phone</th>
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<tbody>
<tr>
<td><strong>Gold</strong></td>
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<td><strong>Silver</strong></td>
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<tr>
<td><strong>Copper</strong></td>
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<tr>
<td><strong>Palladium</strong></td>
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Source: [http://www.rieti.go.jp/jp/events/bbl/05060701.html](http://www.rieti.go.jp/jp/events/bbl/05060701.html)

Way Ahead & Evolving Concepts
“Our central message is that... managers must start to recognise environmental improvement as an economic and competitive opportunity.. it is time to build on the underlying economic logic that links the environment, resource productivity, innovation, and competitiveness”.

Professor Michael Porter
Harvard Business School
Author of Competitive Advantage of Nations
A sustainable company:

- Is restorative of all forms of capital: human and natural as well as financial and manufactured
- Enhances shareholder value by using resources efficiently, striving for zero waste
- Conducts business in accordance with natural principles - biomimicry
- Operates in partnership with the stakeholders impacted by its activities
Need for fundamental change in our mindset and attitudes

Resource efficiency and circular economy

The Closed Loop Economy

By reducing production of wastes, and by maximising the use of reusable and recyclable materials, a city can achieve greater resource efficiency.

- Closed-Loop Economy
- Recycle Based Society
- Sound Material-Cycle Society
- Green Growth and Circular Economy

## Path to Sustainability: Frameworks vs. Tools

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<th>Frameworks</th>
<th>Tools</th>
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<td>Natural Capitalism</td>
<td>Dream team</td>
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<td>Natural Step</td>
<td>EMS/ ISO/ clean production</td>
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<td>Ecological Economics</td>
<td>DFE/ green design</td>
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<td>Cradle to Cradle</td>
<td>Life cycle accounting</td>
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<td>Holistic Management</td>
<td>Lean manufacturing</td>
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<td>Ecological Footprinting</td>
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<td>Factor 4, Factor 10</td>
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<td>Incentives/ regulations</td>
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<td>Industrial ecology</td>
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<td>Climate neutral - CCX</td>
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The creation and use of services and related products, which respond to **basic needs** and bring a better **quality of life** while **minimizing** the use of **natural resources** and **toxic materials** as well as the **emissions of waste and pollutants** over the **life cycle** of the service or product so as not to jeopardize the needs of future generation.
Product stewardship means looking at the impact of a product:

from the time it is raw materials until it is discarded

Raw Materials Manufacturing Transportation Retail Use Disposal/Recycling
everyone has a role to play

from those who make it

Producers

Responsibility: To produce goods that are safe for their customers & the environment

Distributers

to those who sell it

Retailers

to those who buy it

Consumers

Waste Management
Thank you!
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