

EE 4016 - Introduction to Design for Sustainability – Part 2

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Role of Engineers in Sustainability!

□ Grand Challenges for Engineers:

<http://www.nae.edu/Activities/Projects/grand-challenges-project/57302/57305.aspx>

Sustainability Design Principles

Designers

All those who change the
environment with the inspiration of
human creativity

Design

The conception and realization of
human needs and desires

Sustainable Design

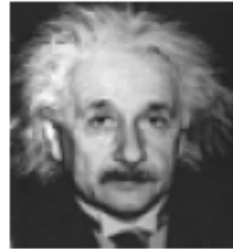
the conception and realization of
environmentally sensitive and
socially responsible expression as a
part of the evolving matrix of
nature

The Hannover Principles

Different Way of Thinking

“We cannot solve our problems with the same thinking we used when we created them.”

Albert Einstein



“If you cannot measure it, you can't improve it.”

Lord Kelvin



High-level Design Principles

- ❑ **Recognize interdependence:** Expand design considerations to recognizing even distant effects
- ❑ **Create safe objects with long-term value:** Don't burden future generations with unnecessary maintenance and potential dangers
- ❑ **Seek to use renewable energy sources:** efficiently and safely
- ❑ **Understand the limitations of design:** Use nature as a model and mentor

The Hannover Principles

Design Principles

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The Hannover Principles

Nature as Model: Biomimicry Principle

- ❑ Nature runs on sunlight
- ❑ Fits form to function
- ❑ Recycles everything
- ❑ Banks on diversity
- ❑ Curbs excesses within

Source: Janine Benyus, “Biomimicry”, 1996

Biomimicry Examples



CAMP Woodpecker Ax
for Ice Climbing



Biomimicry Examples



Biomimicry Examples



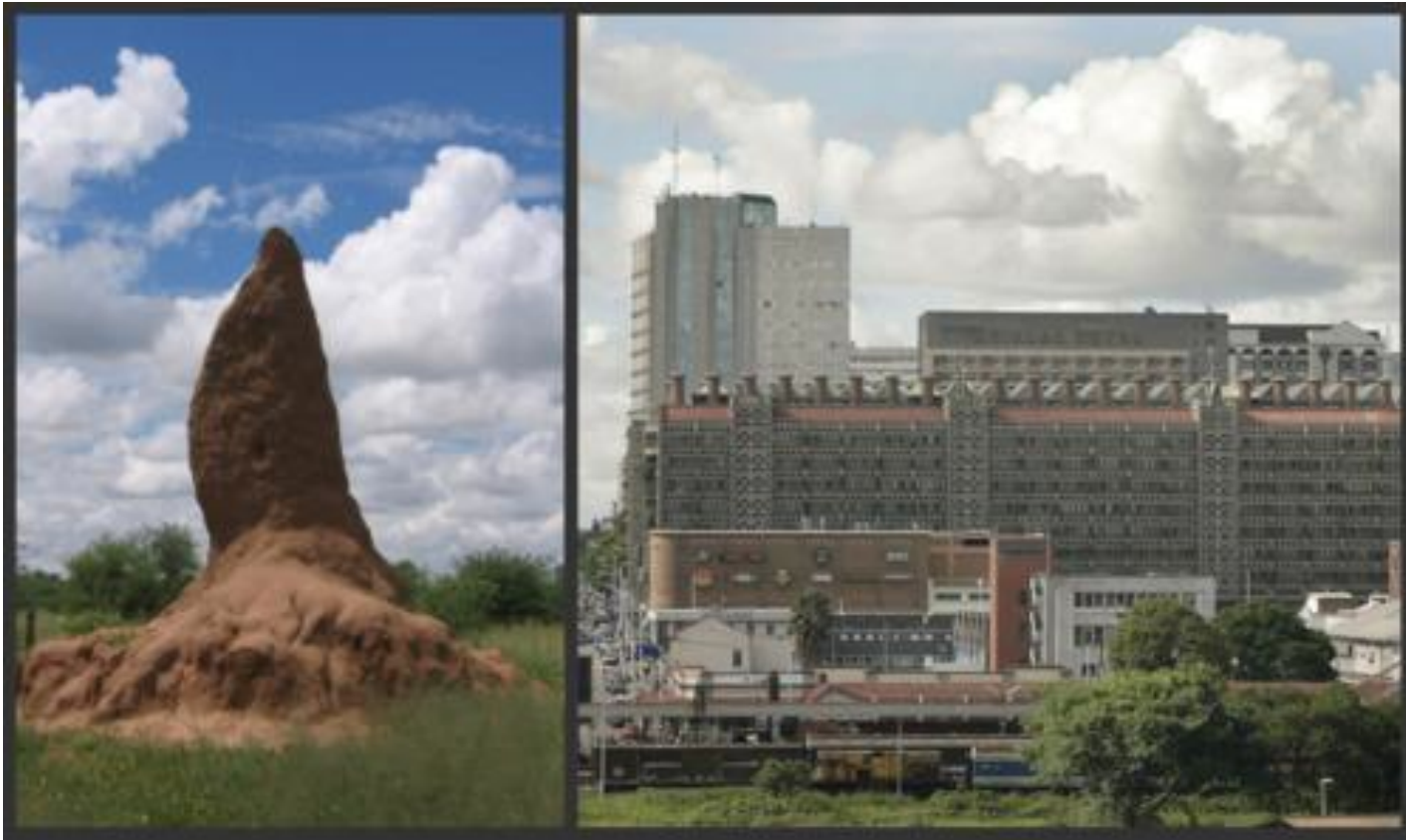
Nose of the Concorde was designed to be lowered on approach after the head of a swan

Biomimicry Examples



Velcro imitates the stickiness of burdock seeds (idea came to Swiss engineer, George de Mestral after a hunting trip – 1941))

Biomimicry Examples



90% energy reduction in energy consumption in the 333,000 square feet East Gate Center, Harare, Zimbabwe

Biomimicry Examples

Whale = Turbine



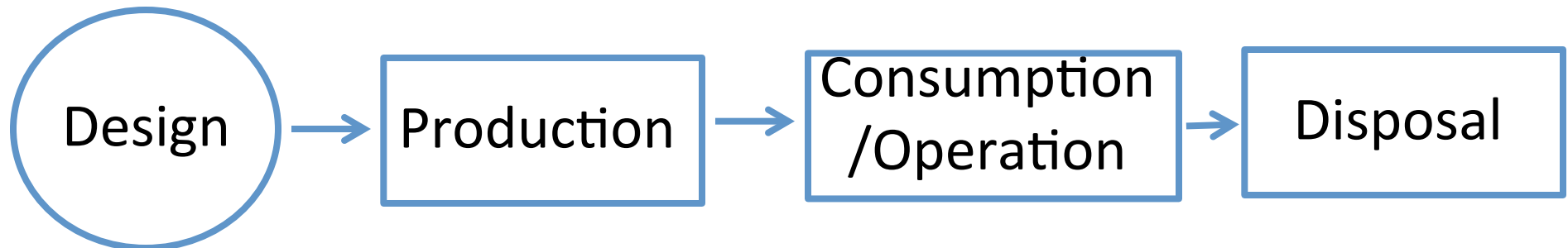
The rough bumps on the whale's fins reduce drag by 32% and increase lift by 8% - Whale Power company used that to make wind turbine blades that greatly boosts the energy produced by blade

At a Minimum - Design & Build for:

- ❑ Re-use: Full-Value recycling – not “down-cycling”
- ❑ Longevity
- ❑ Maximum energy efficiency
- ❑ Minimum carbon footprint
- ❑ Minimum use of non-renewable resources, e.g. materials

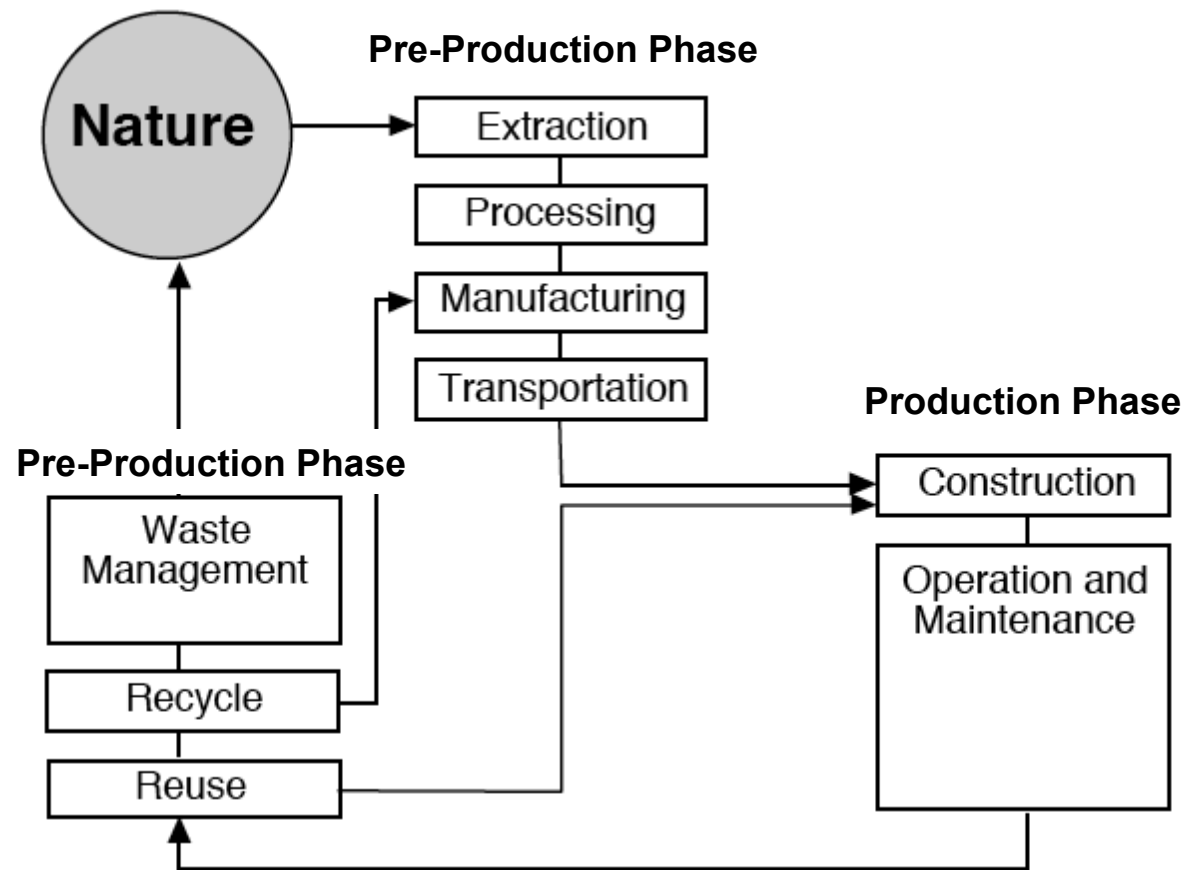
Life Cycle Design

Conventional Model of
the production life cycle



Life Cycle Design

Sustainable Design / Production life cycle



Seek a Win-Win-Win solution

- ❑ Do not degrade performance or other benefits
- ❑ Seek synergies (not compromises) between the environmental, social and economic impacts
- ❑ Think holistically – System thinking
- ❑ Don't under-estimate resistance to change