Systems Ecology as a Design Tool for Water Resources and its Environmental Education

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Concept of ecosystem

• Natural Ecosystem

• Conceptual model of ecosystem based on food web

https://media.proprofs.com/images/QM/user_images/1452023/1430982767.jpg

http://www.stephsnature.com/images/Websitelifescience/ecology/energypyramid.png
Ecosystem model in Systems Ecology
Energese of Systems Ecology

H.T. Odum’s System of Generic Symbols (Energy Circuit/Systems Language Symbols)
Objectives

- Architects and school managers
  - difficult to integrate all aspects of sustainability
  - not able to apply sustainability on facilities in buildings and on campuses.

- Therefore,
  - illustrate a systematic method to assist designers or school managers
  - clarify all possible components of improving campus sustainability
Notations

Application on built environment

Source Element
Producer Element
Consumer Element
Storage Element
Processes
Outbound
Modules of System Models:
connecting elements with processes

**In Series**

1.  
2.  
N

**In Parallel**

1.  
2.  
N

一階模組
二階模組
N階模組

一級並聯
二級並聯
N級並聯
System of Water Resources and its Environmental Education on Sustainable Campus (SWREESC)

• Model boundary: Hardware and software sustainably related to water resources management on campus.
• Providing design whims for architecture, engineering, and teaching activities
• Monitoring, examining, and controlling pathways
• Utilizing notations from Systems Ecology to create the “System Model of SWREESC” (SMSWREESC)
Development of model application

SWREESC

Model building and its 4 states

- Literature review
  - Sustainable development,
  - green campus,
  - green building,
  - water management,
  - systems ecology

- Special team program (STP) of experts
  - Focus and divergent discussion

- SWREESC
  - Water Volume
  - Organic Matters
  - Energy
  - Knowledge of Environment Education
Hydrological Concept of Sustainable Water Management

Input
- Tap water
- Ground water
- Surface water
- Rain water

Output
- Drainage
- Infiltration
- Evaporation
- Transpiration

On Site Recycling

State: Water Volume
Ideal System of Water Volume

State: Water Volume
SWREESC connecting 4 states

Knowledge

• Sustainability
  ➢ Environmental: Organic materials, recycling
  ➢ Social: Environmental education
  ➢ Economic: Energy, water volume

Energy

Organic materials

Water volume
Case application: Mr. Y. K. Wang

- Dormitory at Chung Yuan Christian University (CYCU)
Flowchart of Current Water Usage and Drainage of CYCU Dormitory
System model of current usage and drainage of CYCU dormitory
Looking for missing elements and/or disconnections
Design Whims

All equipment would be used for environmental education with posters and banners to illustrate the relevant sustainable knowledge

1) Roof rain-light garden: developed usage of solar energy and rain water;

2) Wind-light corridor: both solar and wind energy were induced;

3) Water purified and ecological corridor: living sewage was purified with aquatic water in a stream-like channel, and flow into a pond.

4) Flywheel exercise area: Transforming manpower to generate electricity.
Roof Rain Light Garden
Wind Light Corridor
Water purification and ecological corridor
Flywheel exercise area
Expanding system boundary

1. Exchanging services: public education, farms, shops, factories, recreations.

2. Integrated infrastructure: water, materials, and energy.
Conclusion

- To create a learning space for sustainability
- To combine different states and elements of a campus in order to provide connections of all needs and disconnections.
- May apply to larger spatial areas, such as community and urban open space.
Contribution

• A design tool is necessary for architects to examine the water use and its related environmental education facilities and programs in a sustainable campus.

• Systems Ecology used the Odum’s energy language to describe natural ecosystems.

• The water use and its environmental education facilities and programs, which contain water, materials, energy, and knowledge, are compared analogical to an ecosystem, so that the energy language was transformed into a design tools to describe the campus water management and education bionically and systematically.
Thank you