Ecologies of Construction: Urban Metabolism 01

©john e. fernandez sa+i.p.mit - building technology program
Urban metabolism

Figure: The material cycle

TMR (Total Material Requirement) = DMI + Domestic Hidden Flows + Foreign Hidden Flows
DMI (Direct Material Input) = Domestic Extraction + Imports
NAS (Net Additions to Stock) = DMI - DPO - Exports
TDO (Total Domestic Output) = DPO + Domestic Hidden Flows
DPO (Domestic Processed Output) = DMI - Net Additions to Stock - Exports

Image by MIT OCW.

Adapted from: Mathews et al. (2000) The Weight of Nations: material outflows from industrial economies. World Resources Institute, Washington DC, pg. 14
Urban metabolism


Figure by MIT OCW.
Facts regarding contemporary urban centers

- By 2003: urban population = 3 billion people = world population in 1960
- Today almost ½ world’s total population lives in cities (only 15% in 1900) (Davis reading 01)

Image removed due to copyright restrictions

(Rio de Janeiro, Brazil, 2004)
Facts regarding contemporary urban centers

- During the 20th century the world’s urban population increased by a **factor of 10**
- Most of the **largest cities** are now in Asia, not Europe or North America
- Asia alone contains almost **half of the world’s urban population** (even though 3/5ths of its population still live in rural areas).
- Urban population of Africa, Asia, Latin America and Caribbean is now **nearly three times** the size of the urban population of the remainder of the world.
- United Nations estimates that between 2000 and 2010, **85% of world population growth** will be in urban areas (virtually all of this growth will be in Africa, Asia and Latin America).
- That is, a large number of urban centers are **not growing rapidly** (developed western countries).
- **Megacities** are a concern but have not grown nearly as large or rapidly as predicted; by 2000, 16 cities with 10 million inhabitants or more.
  - Though today world is less dominated by megacities than once anticipated.
  - For example, in 2000 Mexico City had 18 million, not the 31 million predicted 25 years ago.
  - Kolkata (formerly Calcutta) 13 million, not 40-50 million predicted.
  - Sao Paulo, Rio de Janeiro, Seoul, Cairo – all several million less than expected.
  - Overall the world’s population 270 million less than predicted 20 years previously (Satterthwaite, D. 2002. Coping with rapid urban growth. London: R. Inst. Chart. Surv. 35 pp.)
Urban metabolism

Drivers of urban growth

1. The globalization of the economy and the birth of global cities.
   • National economies under globalization: 2000, five of the world’s largest economies (US, China, Japan, India, Germany) contained 9 of the world’s 16 megacities and 46% of cities of a million inhabitants or more.
   • 2000, all but two of the world’s 16 megacities and more than 2/3rds of its million inhabitants cities were in the 20 largest economies.

2. Global finance concentrates in very large “global” (often coastal) cities.
   • Only a handful of cities, New York, London, Shanghai, Tokyo... qualify as international centers of finance, but the growth of these cities (and their inevitably rising levels of income and wealth) spur the growth of a vast array of secondary cities of trade and production.

3. Migrants seek higher incomes.
   • Cities as centers of production and offering diverse employment opportunities attract migrants from the countryside.
Urban metabolism

Three reasons for considering cities as pivotal to sustainable development

1. The world is increasingly urban
   - Half the world lives in cities – this is likely to grow.
   - 2000, all but two of the world’s 16 megacities and more than 2/3rds of its million inhabitants cities were in the 20 largest economies.
   - Even though cities concentrate wealth, a significant proportion of the world’s population living with unmet needs lives in cities.
   - Much of the new population density has (and will continue) to occur on the coasts – areas particularly susceptible to massive loss of life from disaster.

2. Cities concentrate world’s wealth
   - Structural change in production, regulation and finance originates from cities. Location of paradigm shifts in culture.

3. Much of the world’s middle- and upper-income groups live and work in cities (highly concentrated consumption)
   - Primary draw on rural resource demands.
   - Primary producer of greenhouse gas emissions (either locally or remotely).
   - Primary source of waste, waterborne and solid.

SOURCES:
Urban metabolism

London's Ecological Footprint
1:125
(Year 2000)

Image by MIT OCW.

Image by MIT OCW.
Urban metabolism

**Facts regarding massive Chinese urbanization**

- China’s economy has recently surpassed France, Britain and Italy to become the **fourth largest** in the world behind the United States, Japan and Germany.
- And, the country’s leaders are intent on **quadrupling the economy** by 2020.
- Between 1953 and 2003 the population of China doubled, while the **urban population tripled**.
- **Six hundred and sixty cities** are now home to more than half a billion Chinese out of a total of 1.3 billion.
- The intensive urbanization of China has produced **170 cities of one million** or more residents each.
- For example, in 2005 Shanghai alone added more space in the form of residential and commercial towers than exists in all of New York City (Barboza 2005).
- China now accounts for **½ of all new construction** in the world.
- On average, China has been adding **2 billion** square meters of space annually. In 2005, China added **4.8 billion square meters**.
- It is estimated by 2020, **20 to 30 billion** square meters will have been added to Chinese cities, according to Qiu Baoging the vice-minister of Construction (Xinhua(a) 2006).
- Currently China’s per capita energy usage is well below most developed nations at **50 percent** of the global average. Along with economic development, improvements in the standard of living and consumption and the steady movement of large portions of the population to urban areas virtually assures a dramatic increase of per capita energy use approaching that of developed nations within 10 to 15 years.
- China is heading toward a great transformation **from rural to urban**.
Image by MIT OCW.
Urban metabolism

Image by MIT OCW.
Obstacles to reaching sustainable urban development

1. A persistent interest in producing sustainable cities as opposed to an urban world that reduces its environmental burden.
   • A tendency not to focus on real consumption of local, regional, national and global resources.

2. Cities easily export their environmental problems.
   • Environmental, economic and equity (social).

3. Income disparities ensure unjust environmental equity
   • Much growth has come about not through formal growth in infrastructure, housing and transportation, but in the enormous "informal" squatter settlements. (Davis reading 02)