What could be more important than efficiency?

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Defining efficiency

- More outputs from less/fewer inputs
- output ÷ input
- Physical processes are usually not perfect
- So output is usually less than input
- Efficiency usually less than 100%
- But the higher the efficiency, the better

Critiques of efficiency

- False efficiency due to incomplete accounting
- Social justice critique: equity is more important
- Ecological sustainability critique: an efficient linear process will exhaust the inputs more quickly and generate more wastes faster
- Reliability is as (more) important

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More components, more interactions

- Components
  - 2
  - 3
  - 4
  - 5
  - 10
  - 100
  - 1,000
  - 10,000
- Interactions
  - 1
  - 3
  - 6
  - 10
  - 45
  - 4,950
  - 499,500
  - 49,995,000

Untested interactions can be sources of failure

- Linear: simple cause-and-effect
- Circular interactions result in feedback
  - negative feedback leads to more stability
  - positive feedback leads to more instability
- Results of positive feedback
  - oscillatory behavior (greater extremes)
  - exponential responses (rapid increases, later followed by collapse)

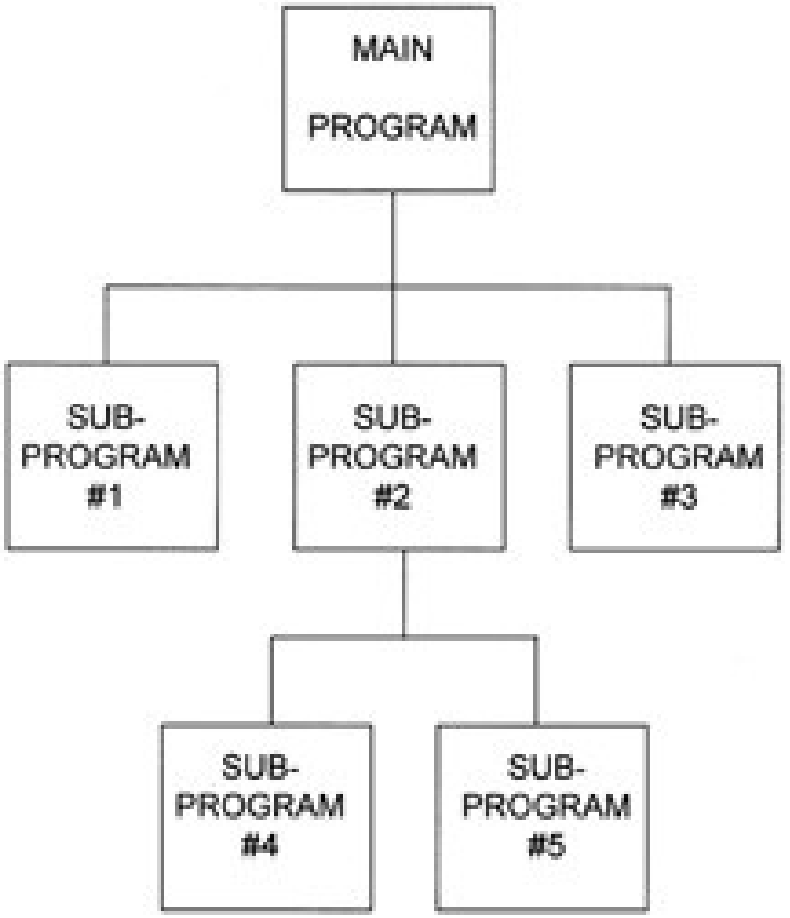
Goal of design: reduce interactions

- More components, more interactions, higher possibility of “bugs”, higher risk of failure
- Reduce interactions to manageable levels
- Test interactions thoroughly
- Every change in design creates new interactions
- With new interactions, design has to be retested thoroughly again

Modularization

- Standard way of reducing, managing interactions:
- Group components into modules
- Split up complex system into subsystems
- Increase the cohesion within modules
- Implement loose coupling among modules

Subsystems, modules



Modules improve reliability but reduce efficiency

- Fewer, more manageable interactions
- Longer paths between interacting components
- Most design will first target a level of reliability, then improve efficiency
- Reduce risk first, then maximize gain within the desired risk level

Static vs dynamic designs

- In software, hardware, etc., design makes interaction paths permanent and fixed
  - wires and pipes in a building
  - pipes, tubes, pumps in a chemical process
  - copper layouts in a printed circuit
  - statements in a program
- In economies, interactions paths arise and disappear all the time (transactions, contracts). The design is never done.

Gain maximization, risk minimization

- Communities: risk minimizers
- Corporations: gain maximizers
- Optimum: maximum gain or minimum risk?
- Adam Smith says: gain maximizers also maximize total welfare of society
- Economic systems select for gain maximizers, leading to globalization

System theory for economics

- Global variables
- Local variables
- Internal cohesion
- Well-defined interfaces
- Spaghetti code
- System crash

- IMF, WB, Microsoft
- Domestic business
- Nationalism
- Tariffs, controls, regulatory systems
- Liberalization
- Global financial crisis

Even biological systems have firewalls

- Ecology is all about “interdependence”?
- Wrong! Ecology also builds firewalls, to minimize risk of genetic interactions
- Little or no genetic interaction or exchange: sperms in water know which egg to fertilize
- GMOs are creating new genetic interactions, increasing the risk of genetic bugs and system crashes

Abundance needs reliability

- Abundance
  - information, living organisms, water, air, minerals, solar energy
- Needs protection, management
- Reliability (protection from risks of failure) of sources of abundance more important than efficiency
- Abundance leads to commons
- Risk reduction = precautionary principle

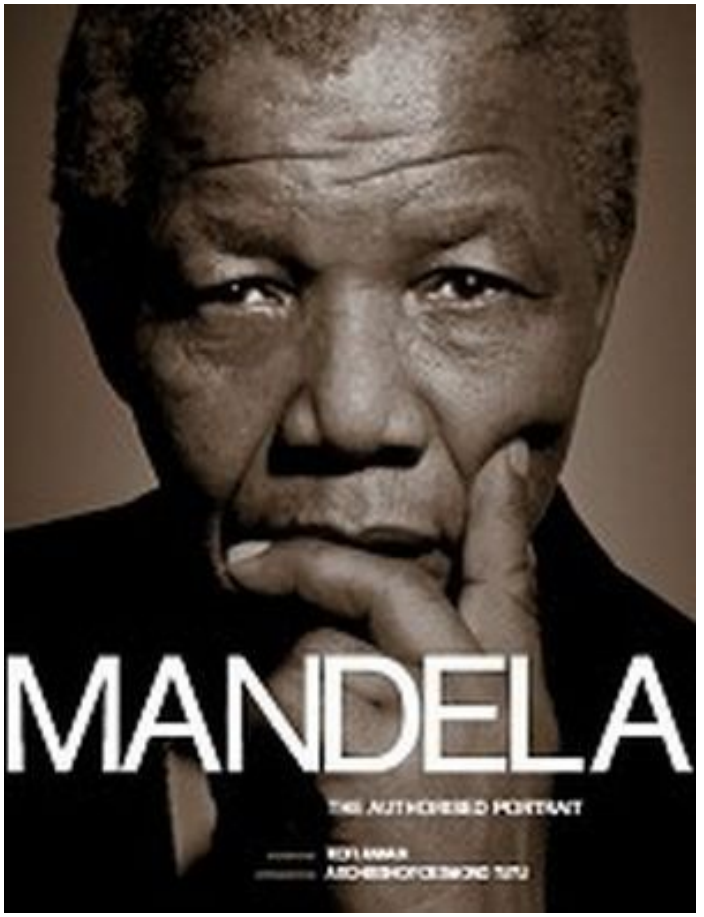
For free software advocates:

Three meanings of “free”

1

2

3



Thank you

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