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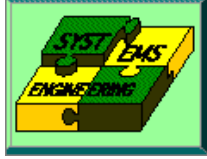

SYST 101: Intro to Systems

Week 1, Lecture 2: Design Processes

Jan. 23, 2003

C. Wells, SEOR Dept.

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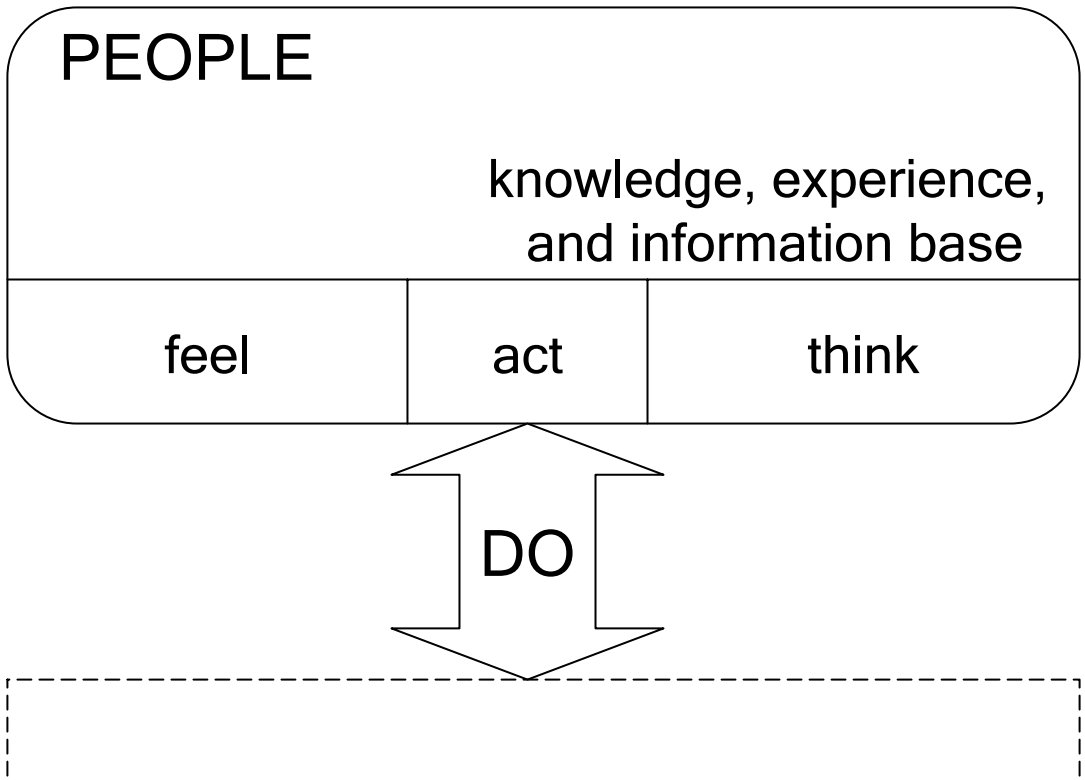
Wells' "People Do Things" Paradigm



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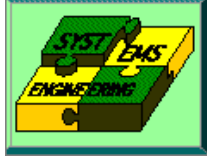
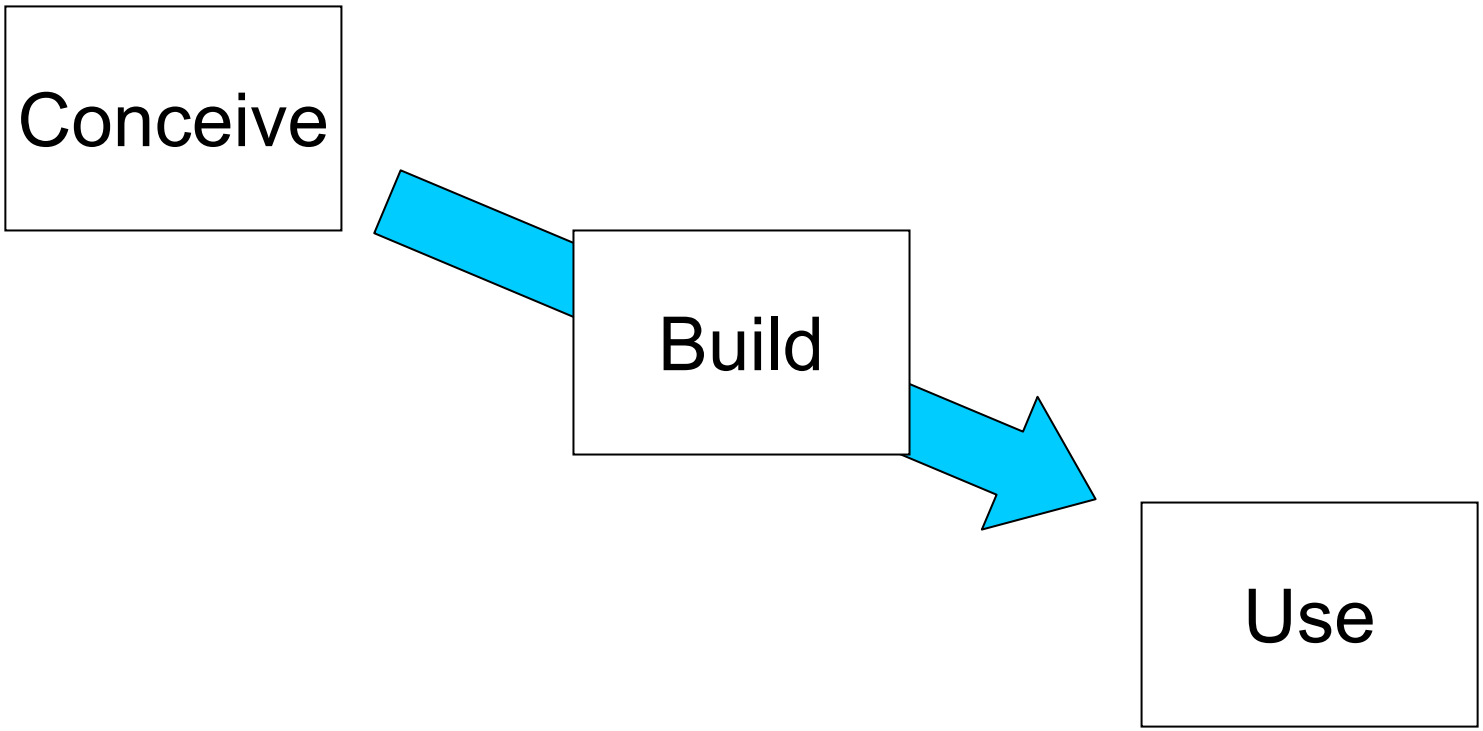


Agenda

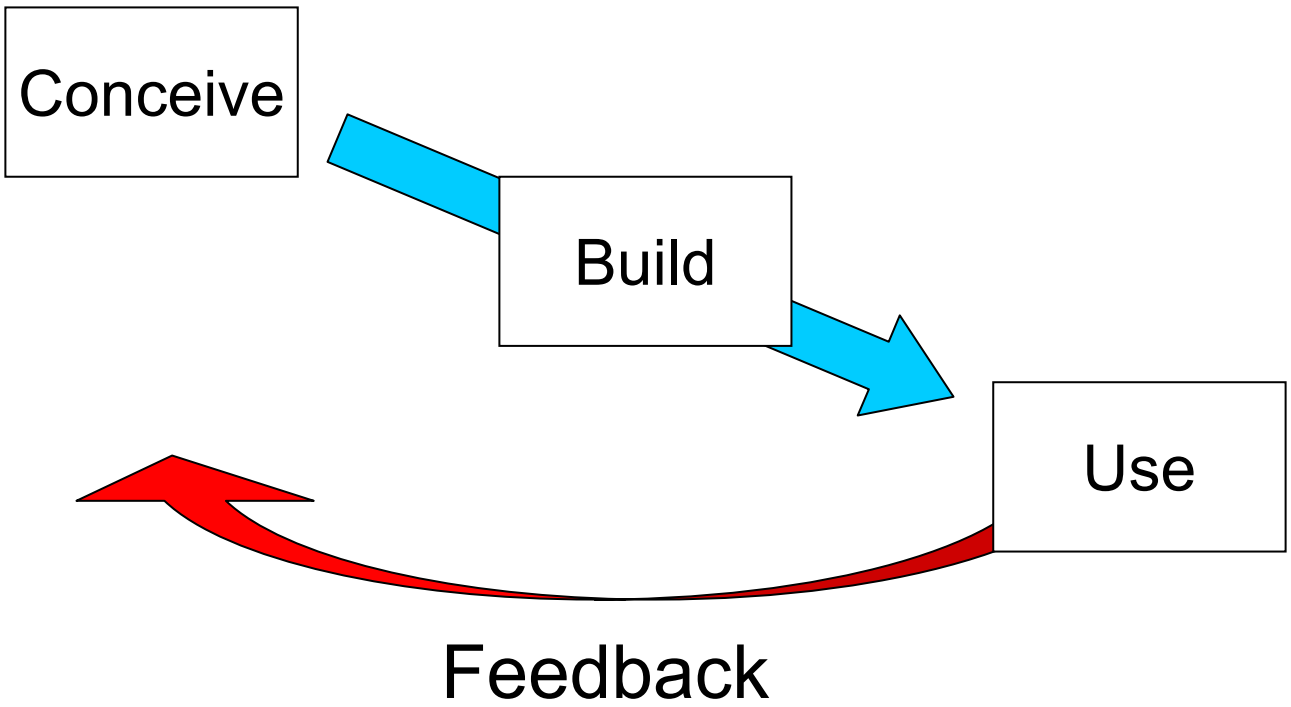
- Objective for Today:
  - Discussion of basic design processes
    - "How things get built"
  - Introduce "Functional Decomposition"
  - Discussion of Robotic Projects

The Most Basic Creative Process

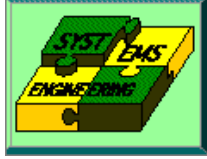


- Suitable for anything from stone chisels to ...

How Do Things Get Improved?



- By Feedback, where the use of the first version provides input to the second version.

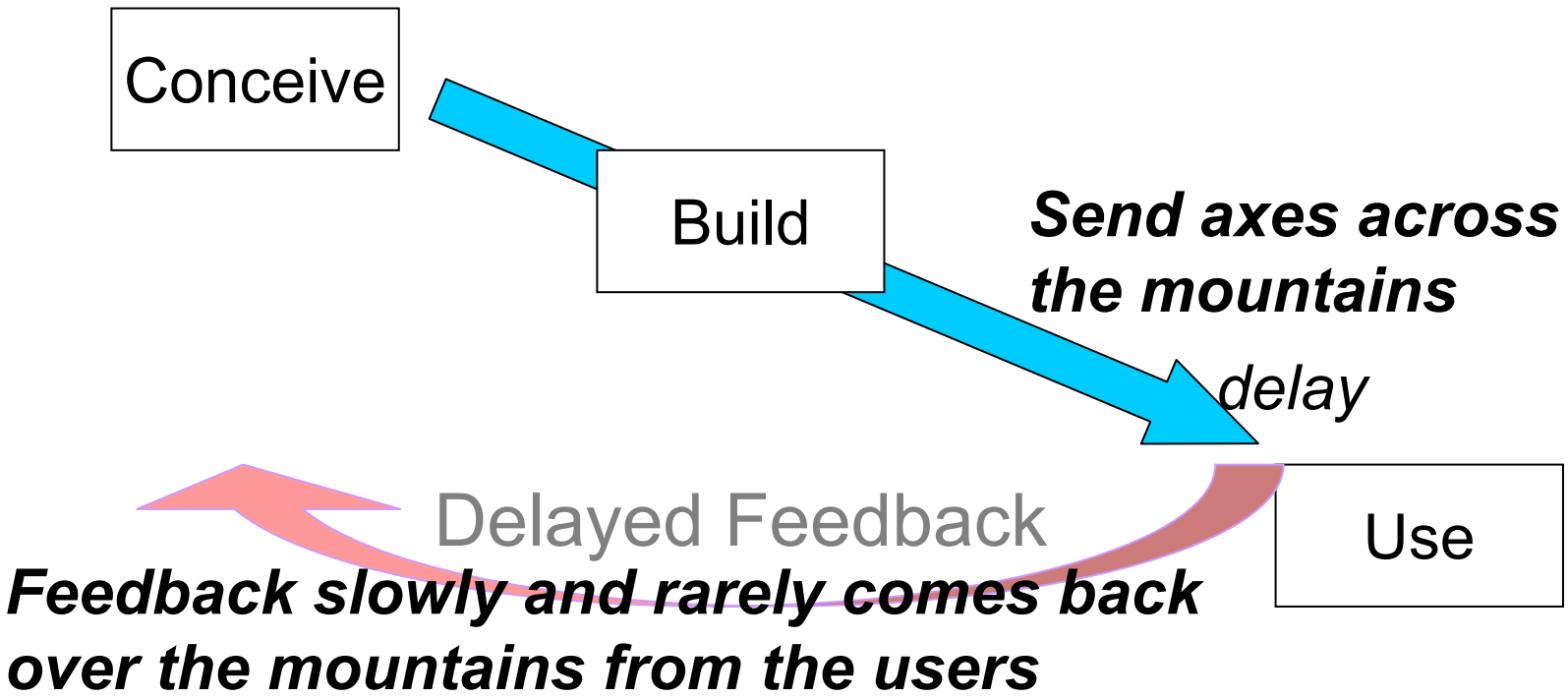


So...

- You make your first stone axe,
- It works okay, but it could be better,
- You make your second stone axe,
- You are a happier consumer.

Altering the Feedback Loop

- What happens when the feedback is inefficient or significantly delayed?



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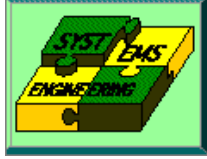
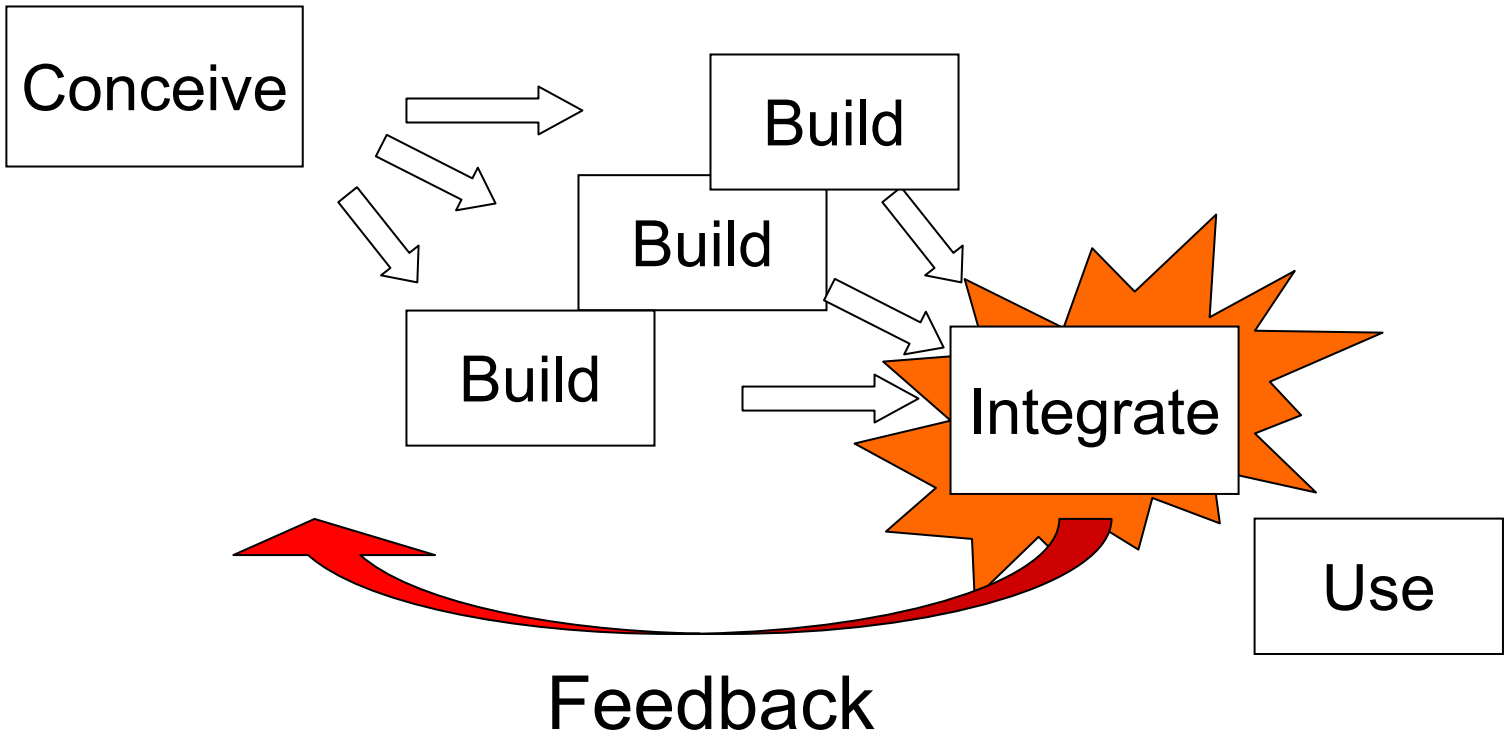


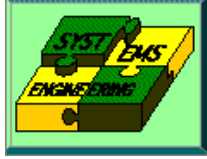
Result

- You keep making things the way you always did.
- Product improvement is slow, erratic, if at all.

A More Complex Build Process

- Our product now has three parts, built separately, that we need to fit together...





Integration Step

- If clear, unambiguous instructions haven't been given to each component builder, then integration doesn't go very well.

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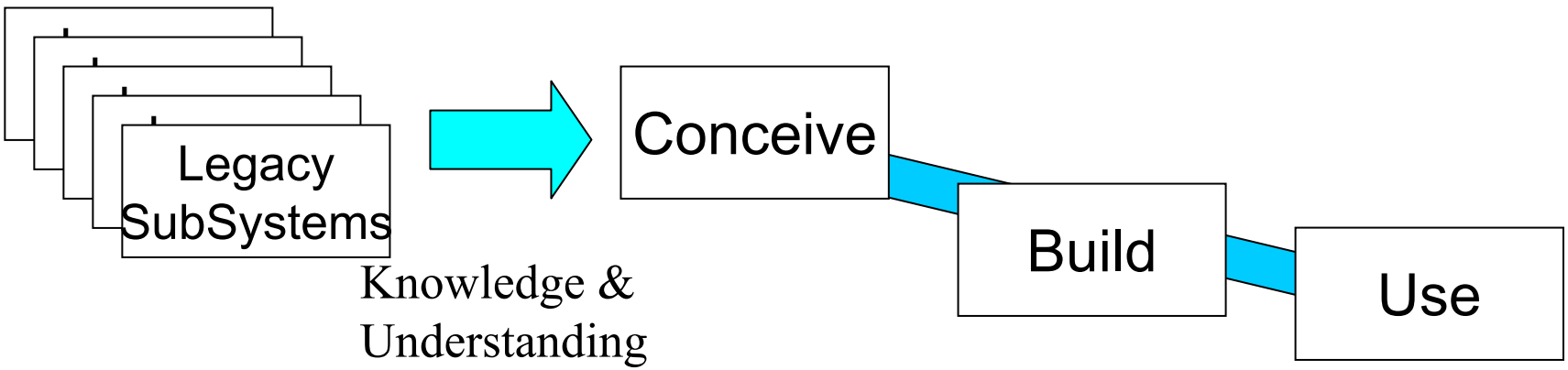
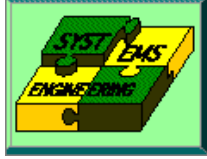
Fusion

- A New System is envisioned that joins existing, independent pieces into a new kind of system.
- Somewhat like a jigsaw puzzle, seeing how these pieces can fit together.





"Legacy"

- In the sense of "inherited" from your ancestors. What has been left to you by those who have gone before.
- Systems or components that
  - already exist,
  - cannot be easily changed,
  - must be included in or connected to your new system.

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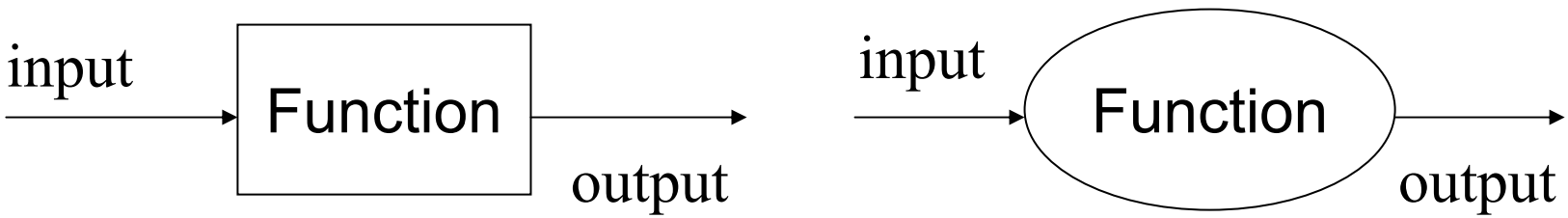
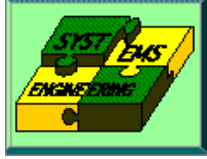
Processes, Activities, Functions

- All are essentially mean the same thing.
- A function *does* something.
- A function has *inputs* and *outputs*.
- Often graphically represented as a box or ellipse.



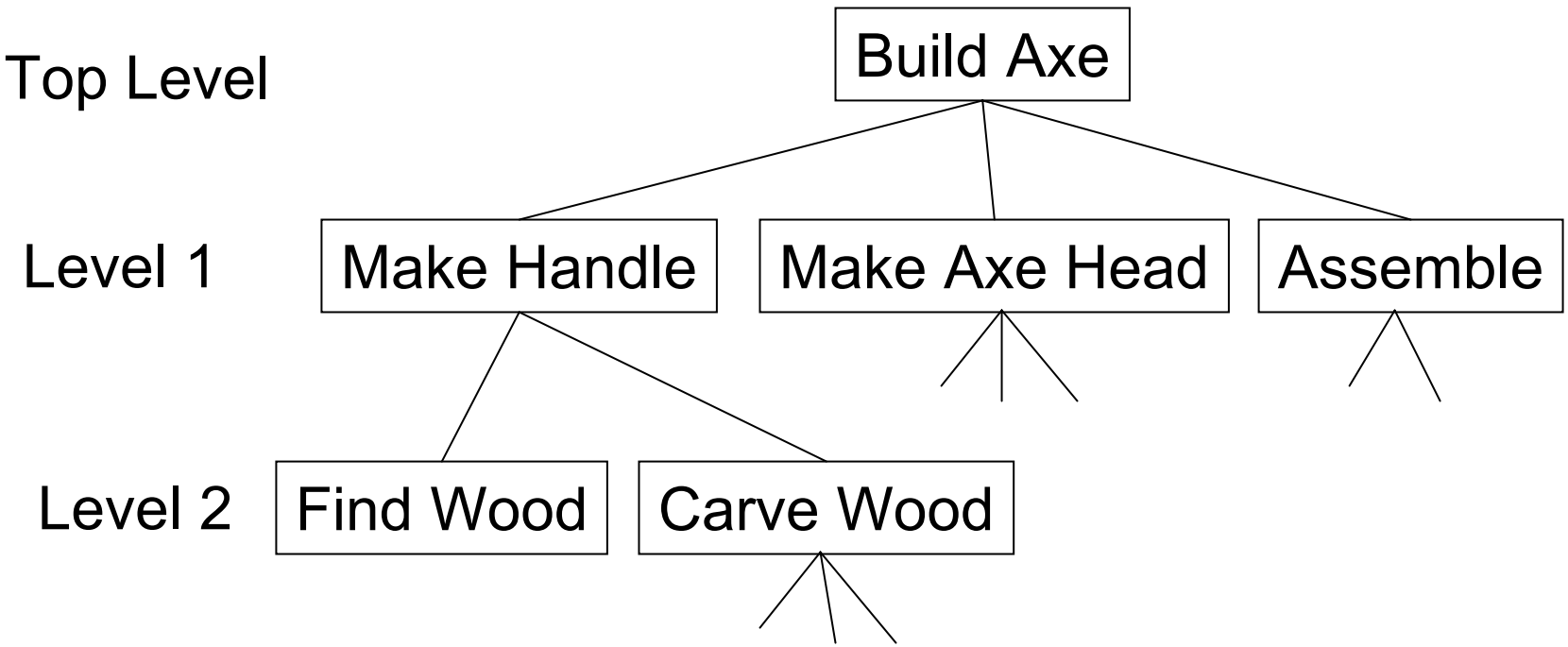


Functional Decomposition

- Any activity can usually be broken down, or decomposed, into smaller activities.
- And those are broken down into more detailed activities, and so on...
- And the result is a hierarchical “decomposition” tree of functions

Details of “Build Axe”

- The hierarchy branches out as it gets more detailed, resembling an upside-down tree.

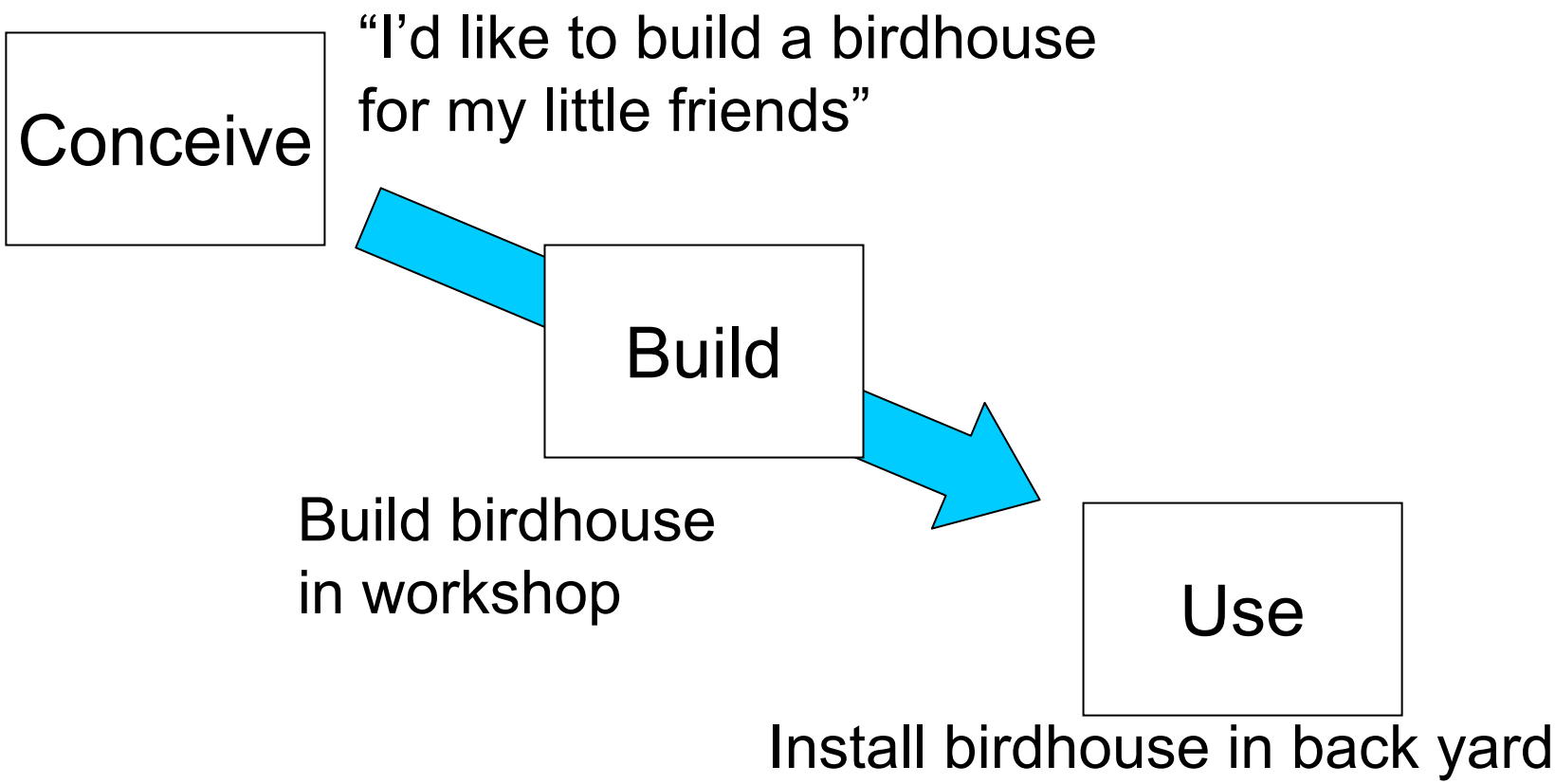


Applicability

- This “decomposing” of a job into smaller and smaller jobs (functions, activities) is key to
  - Systems engineering
  - Business process re-engineering
  - Biological life
  - Government
  - ...

Example: Building a Birdhouse

- Each phase will be broken down



Birdhouse Concept

- "Birdhouse" by itself is not specific enough.
- Need to ask questions before a design can begin.
- What kind of bird?
  - Large? Small?
  - Solitary nest or big group?
- House on a pole, or in a tree?

Concept to Design

- A well-conceived idea (i.e., a well defined concept) can then be turned into a design.
- Design: a plan, drawings, a definition of the parts and their inter-relationships.

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Lego Mindstorms

- Kits contain:
- Software on CD
  - Install to your own computer
- Infrared transmitter & Cable
- Mindstorms CPU (the yellow brick)
- Motors, sensors & cables
- Lots of Lego parts - bricks, axles, wheels, etc.

Assignments

- Reading
  - Petroski: Invention By Design, Chapters 1 and 2
    - Ch. 1 is a very short introduction
    - Ch. 2 manages to make paper clips interesting!
- Homework
  - Petroski, exercise on pg. 28. Just draw your results, please don't turn in prototypes. ;-)