Lecture 12 - Approaches to Conceptualization

I. FishBanks model drafts

A. Questions?
B. Areas to note
1. Fish Net Growth
a) Note that Meadows handouts give a rate vs level graph for Fish Net Growth.
b) Can use that function as Fish Net Growth, but it would be better to formulate Fish Net Growth as a product and to design the FishNetGrowthFraction graph to produce the rate vs level graph that Meadows gives.
2. Profit per boat
a) Can compute total profit in the fleet and then divide by boats, but then probably have to deal with "simulaneous equations," i.e., a loop with no level. Have to put a SMOOTH somewhere in the loop, and assign an initial value to the SMOOTH.
b) Or, can compute profit per boat directly from revenue per boat and operating costs per boat.
3. Boat purchasing
a) How did people make these decisions in the game? What were they looking at?
b) Could use Cash available (minus a safety cushion?) to determine how many boats *could be bought* from existing cash. (Subtlety: could actually borrow money to buy boats, so could buy more boats than Cash could support. Maybe use some multiple of Cash available, or maybe a Net Worth that banks would use to determine how much of a loan to extend.)
c) Could use something like Profit per Boat or the Pay-Back Period to determine what fraction of the boats that *could be* bought would actually be bought. (When the revenues fall far enough, people won't buy boats even though they have the money to do so.)
d) Other approaches?
4. Two fish sectors
a) Get one fish sector working and showing the right dynamics first.
b) Cut and paste to create the second fish population, but remember to change the parameters to represent the characteristics of the new sector.
c) Now the model has a second decision to make -- where to fish. You will formulate the *fractions* of the boats that are fishing that will go to the deep sea and the coast.
(1) Those fractions must add to one.
(2) What would actors in the system be looking at to make this decision?
d) Note the sequence of decisions:
(1) How many boats to send out? (That is, what fraction to send out, and what fraction to keep in the harbor. these fractions add to one.)
(2) Of those boats sent out, what fraction goes to the deep sea, and what fraction goes to the coast?
(3) (What would actors in the system be looking at to make this

decision?)

II. Approaches to conceptualization

A. Quick guidelines for conceptualization (slide)
   1. Focus on a problem.
      a) Don’t try to build a model of a system.
   2. Graph dynamics of key variables.
      a) Focus on patterns of behavior over time, not events
      b) Distinguish obvious stocks and flows from other quantities.
   3. Set model boundaries.
      a) Temporal: the time horizon
      b) Conceptual: what’s included and excluded
      c) Causal: what’s endogenous and exogenous
   4. Develop loop diagrams.
      a) Explain the problem behavior in terms of feedback structure.
      b) Start simply. Build to complexity and completeness.

B. Stages of conceptualization (slide and Assignment 12)
   1. *Problem focus
   2. *Problem dynamics
   3. *Context
   4. *Audience
   5. *Model purposes
   6. Model boundaries
      a) Temporal - what's the time horizon?
      b) Conceptual - what's included and what's excluded?
      c) Causal - what's endogenous and what's exogenous?
   7. Aggregation
   8. Reference modes
   9. Initial policy options
   10. Model sectors
   11. Important processes in each sector
   12. Important levels and associated rates in each process and/or sector
   13. Apparently important feedback loops
   14. Next steps

C. Each of the steps in detail with examples from
   1. Urban models
   2. Epidemic model
   3. Commodities model
   4. World models
   5. FishBanks model

D. Diagrams for conceptualization (slides)
   1. Sector diagrams
   2. Policy structure diagrams
   3. Causal-loop diagrams (no explicit stocks)
   4. Stocks-and-flows and words-and-arrows

E. Important authors and papers
   1. Randers, Guidelines for Model Conceptualization (MFM)

2. Saeed, Slicing a Complex Problem for System Dynamics Modeling (MFM)
3. Richardson and Pugh, *Introduction to System Dynamics Modeling with DYNAMO*
4. Richmond, STELLA and iThink manuals
5. Wolstenholme, A Case Study in Community Care using Systems Thinking (MFM)

III. Project ideas from students