JOHNS HOPKINS
BLOOMBERG SCHOOL
of PUBLIC HEALTH

Tutorial on How to Develop Stock-and-Flow Diagrams using Vensim

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Objectives

- Introduce Vensim
- Demonstrate the development of a stock-and-flow diagram in Vensim through a public health example

Software

- Vensim (www.vensim.com)
  - PLE version (FREE) can be used to build causal loop diagrams, stock-and-flow diagrams, and to conduct basic modeling and analysis
- More advanced versions available for purchase, with discounts for academic use
- See http://www.vensim.com/comparison.html for comparison of features of different Vensim versions
- Other software available to draw stock-and-flow diagrams (e.g., STELLA, AnyLogic)

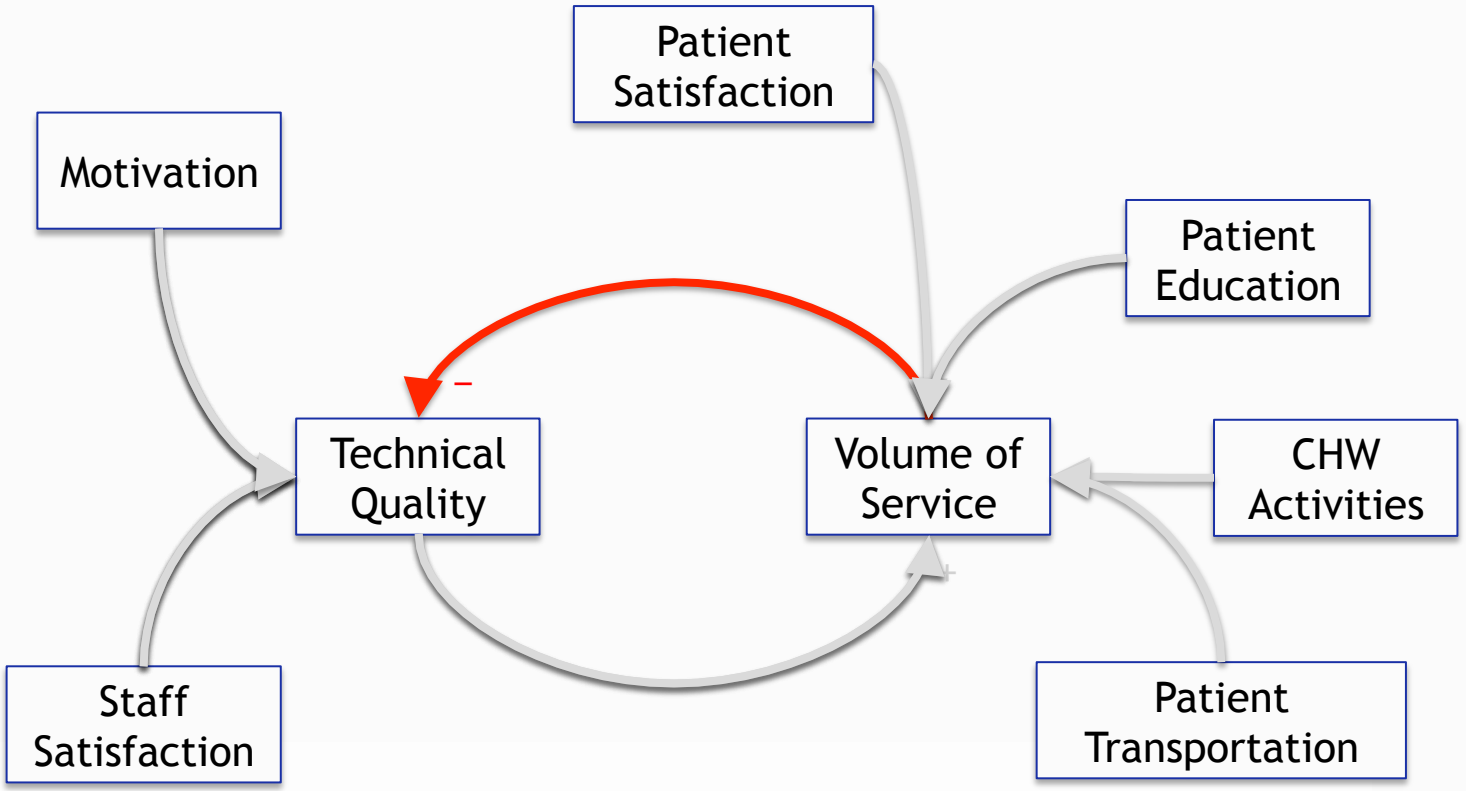
Tutorial Scenario

- A simple scenario
  - Improvements in technical quality lead to greater volume of services
  - After some time, the high volume of services erodes at technical quality
  - A reward is introduced to improve technical quality
  - The higher the technical quality, the greater the reward

Figures courtesy of Prof. Tak Igusa, based on the experience of the Future Health Systems project in Afghanistan

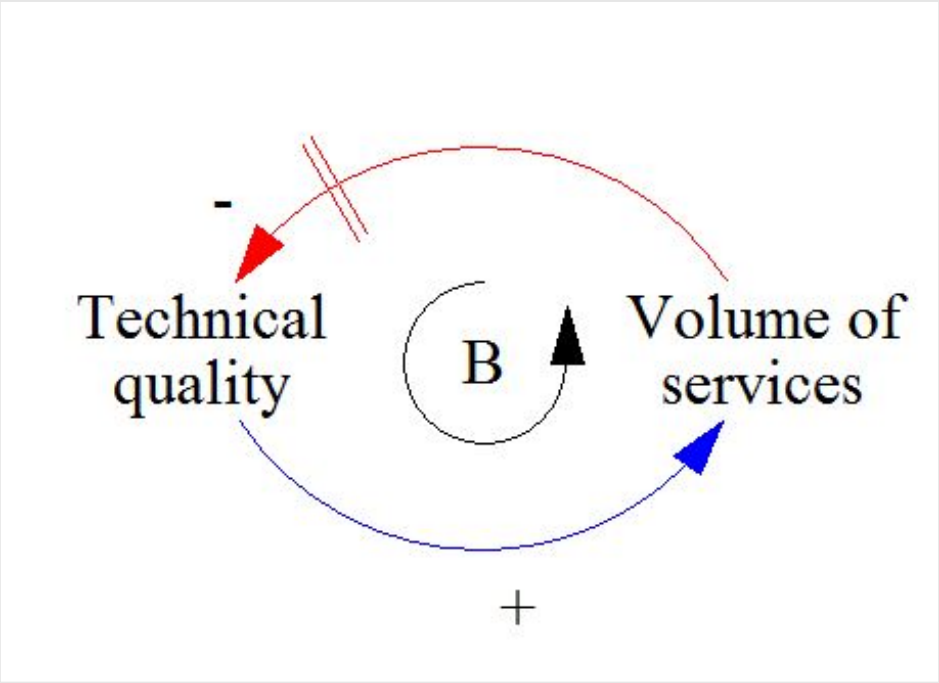
From Causal Loop Diagram to Stock-and-Flow Diagram

The CLD proposes which variables are related



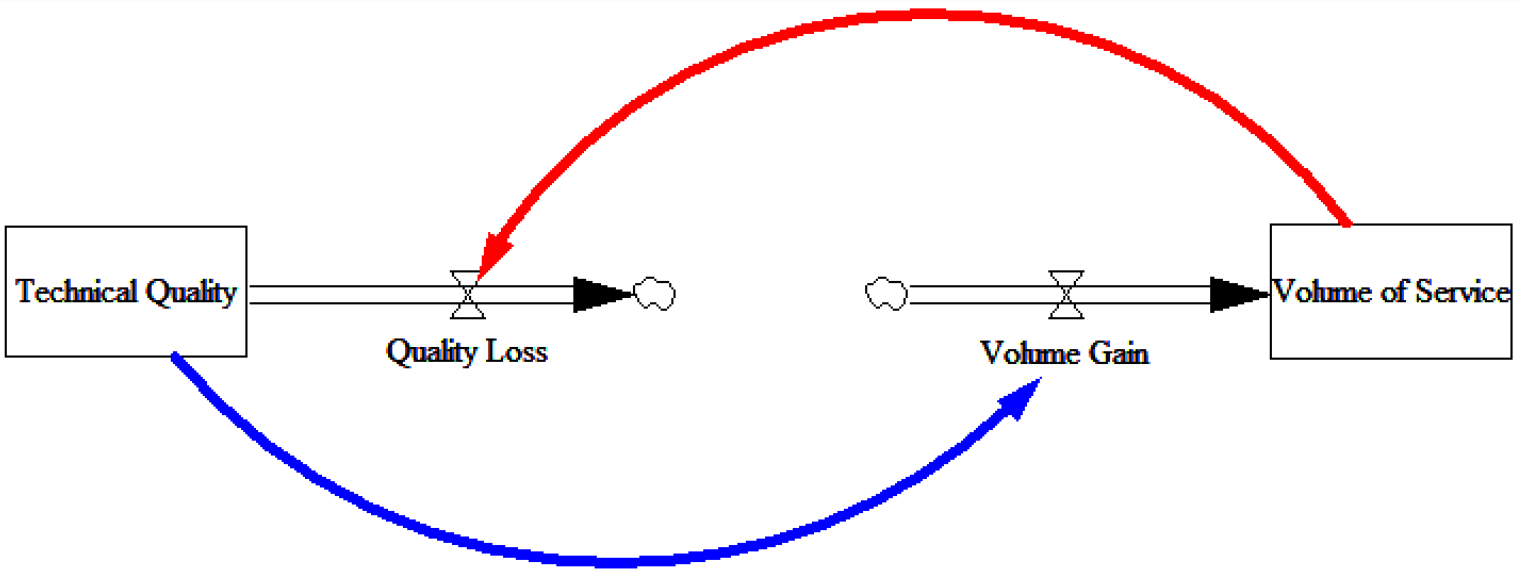
Courtesy of Prof. Tak Igusa

From Causal Loop Diagram to Stock-and-Flow Diagram



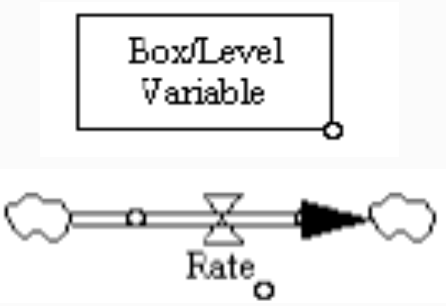
From Causal Loop Diagram to Stock-and-Flow Diagram

- The stock and flow diagram explains how variables are related
  - Some variables accumulate; some are inflows/outflows; some are descriptors



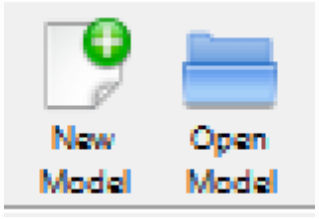
Stock-and-Flow Diagram Elements Review

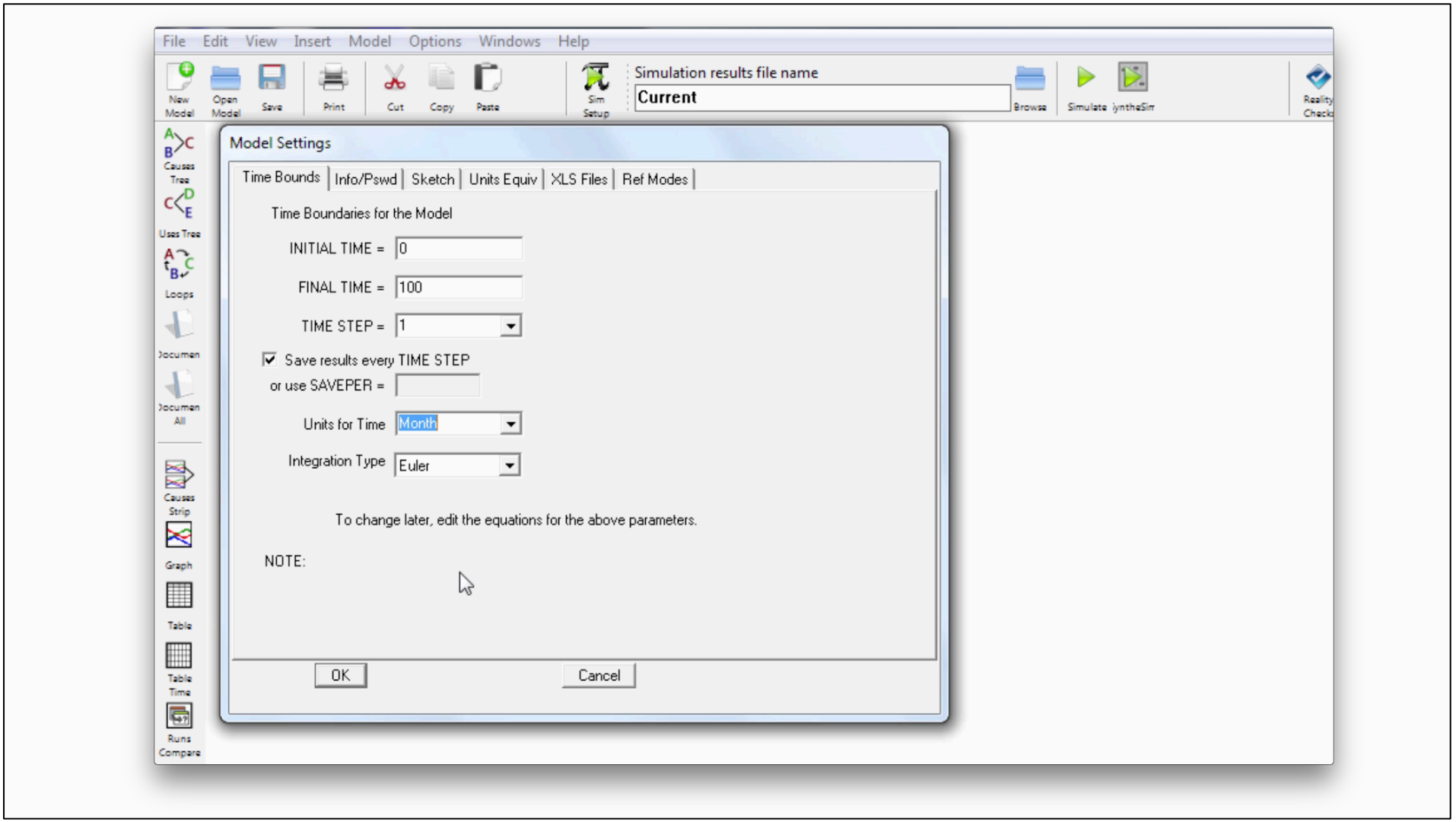
Component	Definition
Box/level variable	Quantities that can accumulate
Rate	Changes in quantity over time
Auxiliary variable	Constants or other parameters
Connectors	Illustrate dependencies between variables



Getting Started with Vensim

- Download version Vensim PLE from http://www.vensim.com/freedownload.html
- Open Vensim on your computer

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Behind-the-Scenes Documentation Is Critical

- Document iterations to research question and objectives, as dynamics emerge
- Document rationale for including variables
- Not covered in this tutorial
  - How to export the data and analyze it
  - How to run sensitivity analyses

Resources and References

- Sterman, J. (2000). *Business dynamics: Systems thinking and modeling for a complex world*. Irwin/McGraw Hill.
- Pruyt, E. (2013). *Small system dynamics models for big issues: Triple jump towards real-world dynamic complexity*. TU Delft Library: Delft, The Netherlands.
- Additional tutorials on www.youtube.com
- Vensim User Guide

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