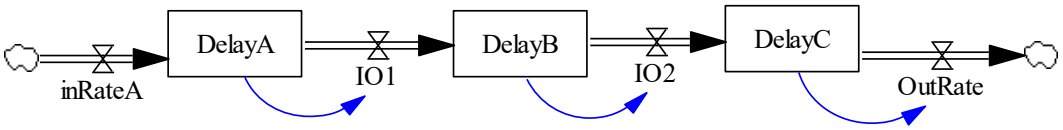
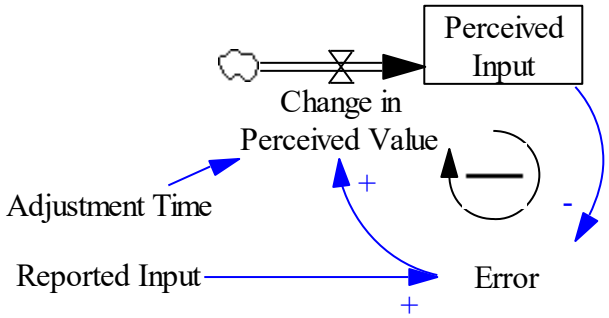
Business Dynamics chapter 11-Delays (2010/04/15)

- Delay: the time lag between input and output
  - Duration(average length of time): the average time the input stays in the stock before coming out from the output
  - Distribution: variations of delay around the average time
- Delay can be modeled by a stock or a sequence of stocks



  - Number of stocks = order of the delay (see p422, Fig. 11-8 and p434 Fig. 11-14 for examples of delay output)
    - Pipe line delay (∞ order)
    - N-th order delay
  - Material delay: should obey quantity conservation
  - Information delay:
- Materials in Transit (quantity of input reside in the delay)
    - Little's Law: For a equilibrium system with steady input, the material in transit for a delay is Delay*Input, regardless of the delay distribution
    - Case in the Electric Power Industry
    - Case of the toxic compounds accumulation in the food chain
- Example of Information Delay: Modeling Human Perceptions (see page 428)



  - A.k.a. the first order exponential smoothing, to reduce the sensitivity to short-term disturbances
  - similar to the concept of weighted moving average
- Delay time per se could be either exogenous or endogenous
- Estimating the Duration and Distribution of Delays
  - When numerical data are available:
    - derive the distribution from data,
    - use a delay function with proper order and delay time to mimic the distribution

- If not
  - decompose a long delay into interconnected smaller ones
  - Use judgments based on firsthand observations
    - Longer delay time leads to higher judgmental error
- Either way, walk down the line to verify the estimations

- The case of the Semiconductor Demand Forecasting
- Related Vensim functions
  - Delay, DelayI, Delay N, Delay Fixed
  - Smooth, SmoothI Smooth N
  - Delay Material, Delay Information
  - Pulse, Ramp, Step