HANDOUT

Drawing Causal Loop Diagrams

Causal loop diagrams map out the patterns of relationships within dynamic systems. We can use these diagrams to both understand and predict a system's behaviors.

How to Draw Causal Loop Diagrams:

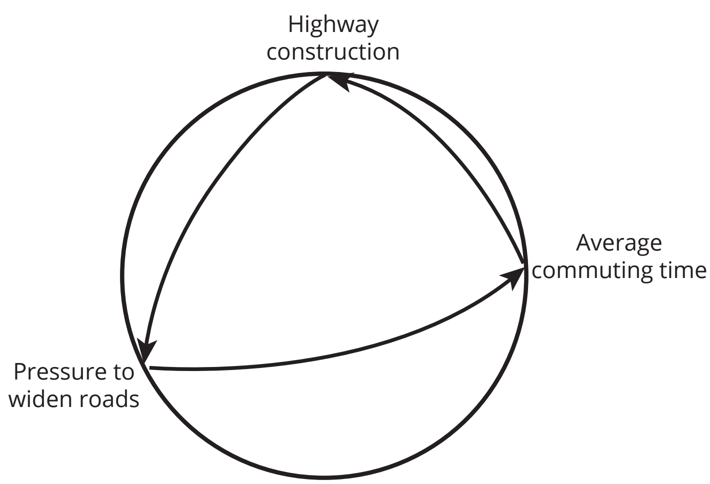
1. **Name the important variables:** Write down the names of the important variables in the system. They should represent parts of the system that can increase or decrease. Use nouns or noun phrases to name your variables.

   Let's follow an example about road construction: What happens when you build or widen a highway from the city to outlying areas? Does this reduce traffic problems for commuters? Or are there, sometimes, unintended consequences? To understand this system behavior, your list of variables might include:

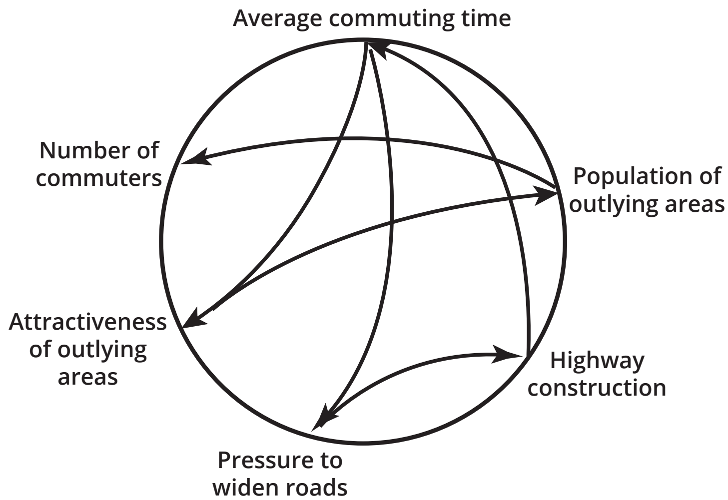
   - average commuting time
   - pressure to widen roads
   - amount of new highway construction
   - attractiveness of outlying areas
   - population of outlying areas
   - number of commuters

2. **Trace cause and effect:**

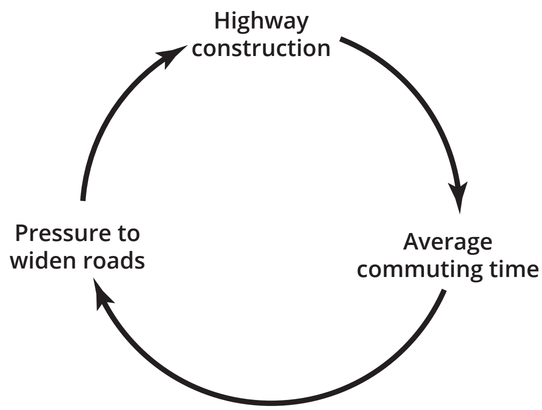
a. Choose a variable to start. Ask yourself: What other variable from your list does this one affect, and how does it affect the second one? Write the names of the two variables as points on a circle and draw an arrowed arc from the cause to the effect.



b. Consider the second variable: Does it have a direct effect back on the first variable when it changes? Or does it have an effect on another variable on your list? Continue to add variable names onto your circle diagram and connect the variables with arrowed arcs.



3. **Close the feedback loop:** Determine whether the chain of cause and effect eventually comes back to your beginning variable. This might happen in just two steps or in several steps. If so, close the loop!



4. **Identify the direction of the effects:** Identify whether the second variable changes in the same direction as the first or in the opposite direction. For example, if an increase in the first variable causes an increase in the second variable, the change is in the same direction (S). If an increase in the first variable causes a decrease in the second one, the change is in the opposite direction (O).

Change in the SAME direction

A → **B** **s** (or "+")

Population of outlying areas →(**s**) Number of commuters →(**s**) Average commuting time

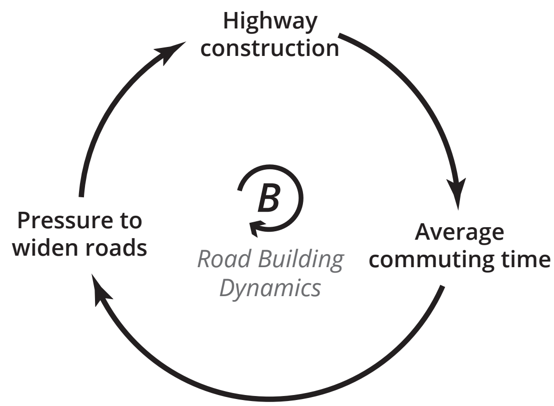
Change in the OPPOSITE direction

A → **B** **o** (or "-")

Number of commuters →(**s**) Average commuting time →(**o**) Attractiveness of outlying areas

5. **Determine whether a loop is balancing or reinforcing:** Count the number of *O*s in the loop. An odd number of *O*s indicates a balancing loop, and an even number or zero *O*s indicates a reinforcing loop. In the middle of the circle, label your loops as Reinforcing (with an R) or Balancing (with a B).

6. Name the loop: Give your loop a name!



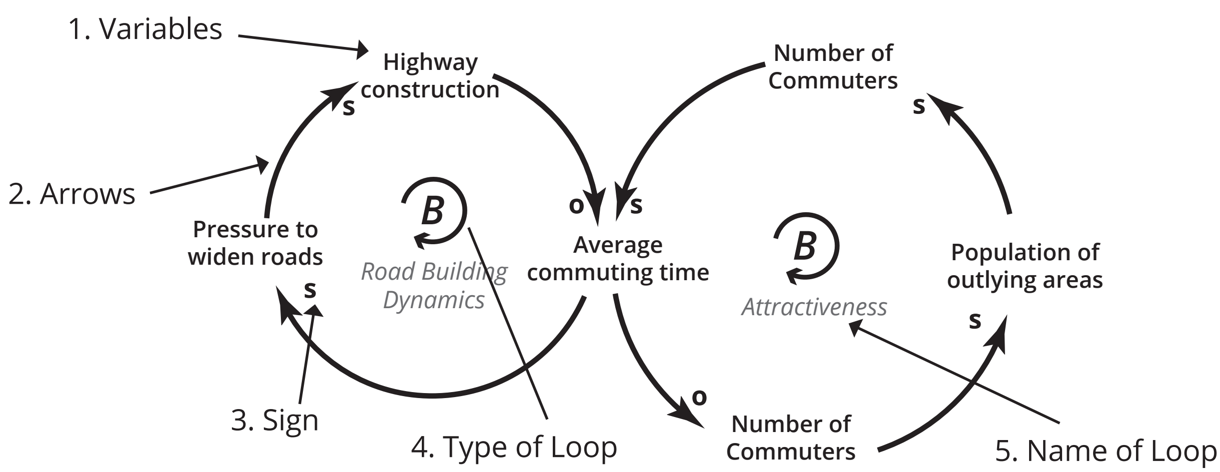
7. **Test and share your loops:** Read the diagram as if you were telling a story. "As average commuting times goes up, pressure to widen roads or add lanes goes up. As this pressure increases, the amount of new highway construction goes up. With more roads/lanes added, average commute time goes down. When commuting time improves, the pressure to widen or add more roads decreases, as does the quantity of new highway construction. "

8. **Variations on your loops:**

a. Add in another loop:

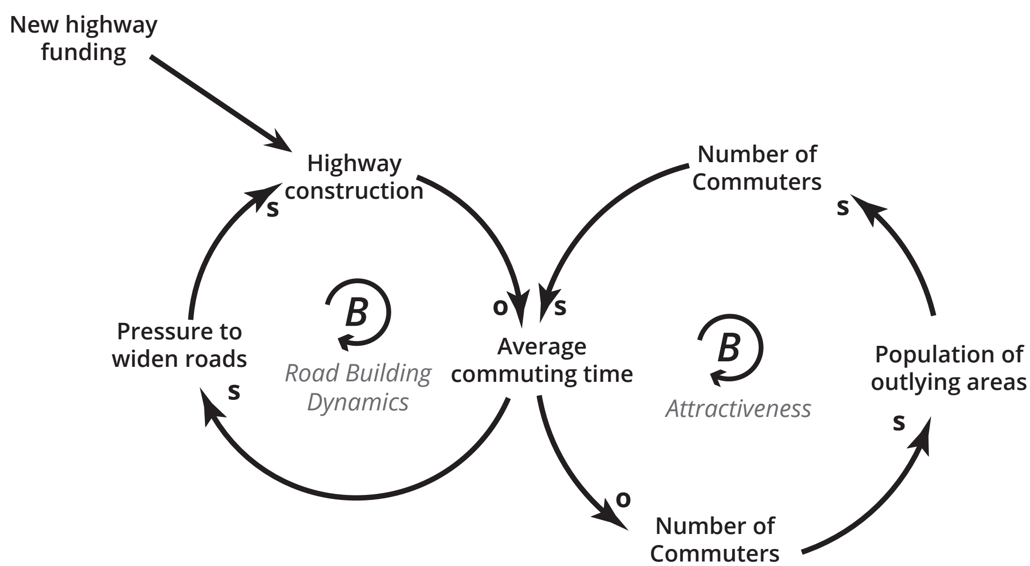
Consider whether there are one or more additional closed loops operating in your system. One of the variables may affect another aspect of the system, or in turn, be affected by it. The two loops will connect to each other through their common variable.

For example, over time, if the outlying areas now considered to be within reasonable commuting time are attractive, more people may move there. As more people move there and crowd onto existing roads, average commuting time may once again increase.



b. Consider other inputs:

Consider whether there are events or actions that influence the system, but are beyond the initial boundaries you set. Represent these inputs with an arrow coming in toward the variable that is most directly influenced. For example, if a state passes a new highway-funding bill, that law may be an input into the road building system.



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