

Chapter 2

Review Questions

1. Suppose an automatic pool cleaner is not working properly. One way to understand what is wrong is to take apart the pool cleaner and examine each part individually to see if it is broken. Describe how to use a systems thinking approach to troubleshoot for the same automatic pool cleaner.

The above-described approach is from a reductionist perspective. Adopting a systems thinking approach, the problem is considered in a view of the whole system, which takes into account the interactions of the system components and how the system interacts with its environment. We should attempt to understand the operation of the pool cleaner in its entirety and understand its operation in its environment – the pool. For example, perhaps the pool cleaner has difficulties with the corners in the pool or it has insufficient suction from the pump. These are interactions with its operating environment. Additionally, the troubleshooting should look for emergent properties of how several parts interact together. The analysis should consider the relationship and interactions of its parts and then look at the structure that creates its operation. In the automatic pool cleaner, some parts may not have apparent functions singularly, but when put together they function with other parts to provide the automatic cleaning.

2. List all the types of items that can cross the boundary of an enterprise. Select one of these items and describe it.

The boundaries of an enterprise are defined where its control over resources ends; basing boundaries on ownership may not be wise from a system's view point. Items that may cross the boundary of an enterprise are raw materials, information (sales orders, purchase orders, marketing reports, and so forth), finished goods, people (employees, customers, partners), money, and knowledge (see Section 2.4.1).

3. Explain what it means to say an enterprise is purposeful.

When it is said an enterprise is purposeful, this means that the enterprise exists to fulfill a purpose, which is usually defined through the mission statement of the enterprise. An enterprise has the capability of goal seeking and state maintaining systems except it also exhibits free will, which is the ability to also change its goals. Enterprises have the option of what goal to pursue and what means to use to work towards the goal.

4. Identify a system and list one or more emergent properties that system exhibits.

A personal computer system can be thought of as a system, as we know a PC is comprised of many parts that only through their interaction can we notice some of their emergent properties, such as the ability to surf the Internet. It is only through the relationship of the system parts of network card or wireless network card, web browser, RAM, and other parts that a PC is able to allow users to visit Websites.

5. List and describe examples of a goal-seeking system, a state-maintaining system, and a purposeful system.

A goal-seeking system cannot change its goal; it does react differently to events but always in pursuit of the particular goal. A state-maintaining system is system that can react to its environment but only in a predefined manner; it has no learning and it cannot alter its actions. A purposeful system has the capability of goal seeking and state maintaining systems except it also exhibits free will, which is the ability to also change their goals. An example state-maintaining system is a thermostat or the cruise

control on a car. In both cases, the control system has no choice in actions (its reaction is predefined). A goal-seeking system has choice of means, for example a plant seeks the sun so if it is in shade it might grow at an angle toward the sun instead of the normal straight up.

Examples:

- a. Airport Security System is a Goal Seeking System - The threats and security measures can be different but the goal of keeping travelers safe always remains the same.
- b. Ballistic missile system is goal-seeking because it has a goal (the target) and it pursues that goal regardless of the obstacles in its way. It reacts differently to each type of obstacle.
- c. Deep Blue, the chess computer that won against Kasparov in 1997, is an example of a goal-seeking system. This computer has only one goal which can't be changed and is to defeat a human chess player. Even when it has memory and may respond differently to different events, his particular outcome is to win the game.
- d. Robots developed for various industrial needs are goal-seeking. They are designed to adapt to their environment in pursuit of a particular goal. Depending on the environment, they will react differently in seeking the goal.

6. Name a system property and describe how it applies to an enterprise.

Section 2.1 lists system properties of boundaries, consisting of subsystems, holism, open or closed, purposefulness, feedback and control, complexity, dynamic, and equifinality.

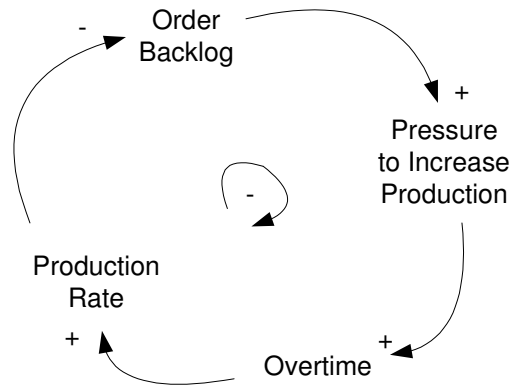
For example, one property of an enterprise is the idea of holism. Holism is the view that the whole is more than the sum of its parts. A system displays what is known as emergent properties that only hold value when they are applied to the system as a whole. Holism is the view that emergent properties cannot be deduced from the part's properties; a system displays properties that cannot be related to its parts. Holism suggest we need to carefully examine the relationships between subsystems because the emergent properties can only be fully comprehended by appreciating how the parts interact to provide that property.

7. Think of a process in an enterprise you are familiar with and explain how the feedback control principles can be applied to that process.

Feedback control is explained in Section 2.1.6.

Exercises

1. As the order backlog increases, then there is greater pressure to increase production. So the production manager uses more overtime. As the production increases, then the order backlog decreases. Draw the causal loop diagram for this scenario. Show variables, whether the relationships are positive or negative, and the polarity of the loop.



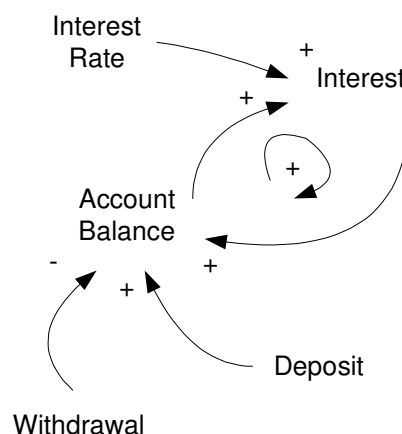
2. Suppose you are tasked with a project to design a new patient scheduling system for a healthcare clinic. Explain the process of how you would go about defining the boundaries for the project?

The boundary for such a system would encompass elements of a health care system that are controlled by the scheduling system. To establish the system boundaries I would interview the clinic management and understand their expectations and requirements.

For this particular project, the boundaries would include appointment demands which include follow up, patient initiated, and referrals. Also the system would need to take into account appointment delays, service rate, no show rates as well as patient satisfaction, waiting time, overtime and walk in capacity.

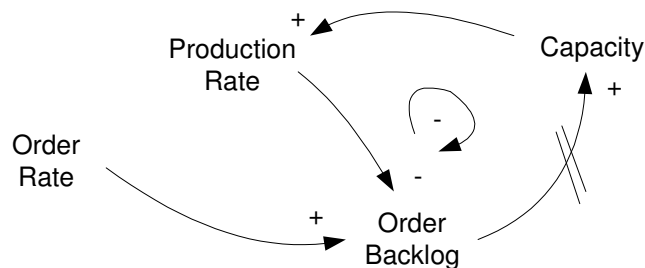
3. Present and explain at least three real-life systems, describing the elements that make this system complex. Take into account the definition of complexity from the book in order to describe characteristics of the models. Models must be different from those presented in the book.

4. Construct a causal loop diagram for a bank savings account. You have an account balance that is increased by interest earned at the prevailing interest rate. You can make both withdrawals and deposits on the account.



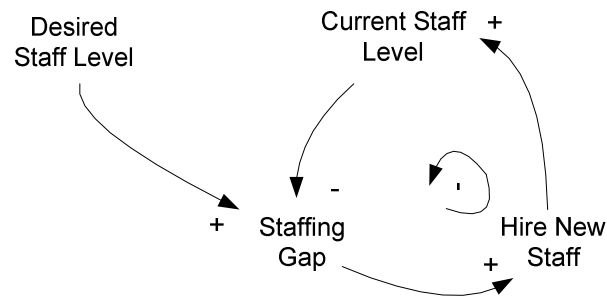
5. Construct a causal loop diagram for a process with the following behaviors. A company receives customer orders at a known Order Rate. The company has limited Capacity to fill those orders at the Production Rate. The Order Backlog is the accumulation of orders that are awaiting fulfillment; it is the

difference between the Order Rate and the Production Rate. When the Backlog grows too large, management will increase capacity, but there is a delay before this happens.



*Notice that it says the Order Backlog is the difference between the Order Rate and the Production Rate. This indicates that both variables have a causal relationship on the Order Backlog shown as arrows pointing to it.

6. Construct a causal loop diagram for a process with the following behaviors. A company has a Desired Staff Level. If the Staffing Gap, which is the difference between the Desired Staff Level and the Current Staff Level, is positive, then the company hires new staff members.



7. Review the list below and identify each variable as either a stock, a flow, or both depending on context. If you select both a stock and a flow, then provide an example of each instance.

- (a) Inventory - stock
- (b) Orders - flow
- (c) Employees - flow
- (d) New Hires – could be modeled as both
- (e) Net Income - stock
- (f) Revenue - stock
- (g) Assets - stock
- (h) Booked Reservations – stock
- (i) Reservation Requests - flow
- (j) Perceived Quality - stock
- (k) Defect Rate - flow

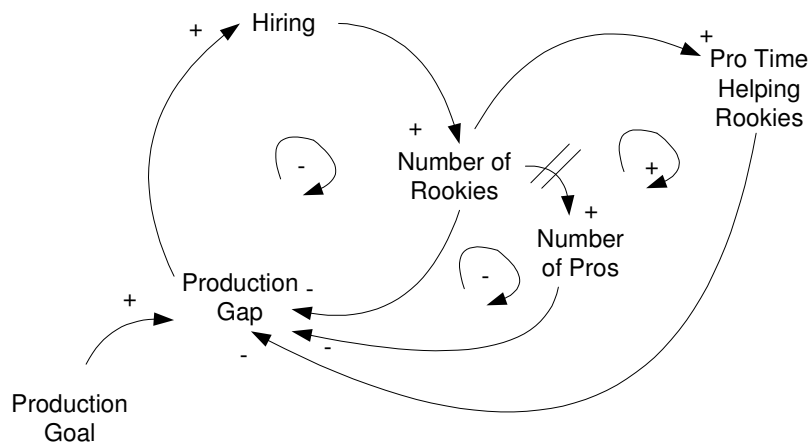
8. Your client is the CEO and Director of HR for Acme Inc., whose business is a highly labor-intensive production of the ubiquitous widget. The staff includes 1000 people, with a production rate of 6200 tasks/month. The assumption is held that staff increases are made through hiring only.

From an interview with the CEO:

“Three months ago, we were producing at around 6200 tasks per month, but needed to ramp up to 7500. Because of the gap between the production rate and our goal for the production rate, we hired new people – about 20% more. After a delay, inexperienced people, or rookies, arrived on the job. These rookies, with a good amount of training and mentoring from the pros, take some time to mature into pros. The more workers we have, the greater production we have. I expected production to climb up to the new level fairly quickly. But now it is three months later and the new people are on staff, but production is worse, not better. Maybe we hired the wrong people, or maybe they’re just slacking off. I don’t know. We can’t exactly figure out what has happened, and what we can do to avoid it in the future.”

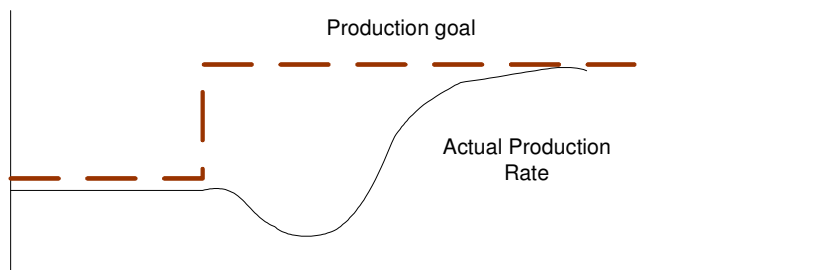
Hint: If rookies are trained by the Pros, then this means the Pros have less time to do production.

(a) Construct a causal loop diagram.



It is helpful to identify how the loops polarity is done. You must trace a complete loop from any variable in the loop and understand the relationships. Starting at Number of Rookies: if the number of rookies increases, then after a delay the number of pros will increase because rookies become pros. When the number of pros increases, then the production gap decreases. If the production gap decreases then hiring decreases. Hiring decreases then the number of rookies decreases. The number of rookies decreases then the number of pros decrease. So the loop is Negative because after completing the circuit we find the change will be negative when the initial assumption was an increase.

(b) Sketch a graph of the desired production rate.



According to the CEO the actual production rate initially drops, but as rookies become pros the rate will increase to the production goal.

Chapter 3

Review Questions

1. Explain a benefit of models.

Models simplify the system being studied so it is easier to analyze and design. Another benefit of models is their ability to help communicate complex ideas between stakeholders. Many models are graphical, and it is easier for many people to visualize how a system is designed from a drawing than if it was described in words. Models are an economic means to analyze enterprise systems. It is less expensive to experiment with a model than to do it with the actual process. They can also be used to analyze and explore the different alternatives and ideas in ways that cannot be done with the actual system.

2. You attend a seminar by a software salesman who makes the statement, “A model shows an absolute view of the system.” Argue whether the statement above is correct, incorrect, or partially correct.

There is no “absolute” view of a system because any complex system such as an enterprise can be viewed from multiple perspectives. In this regard, the salesman’s statement is incorrect. The “absolute” or “correct” model depends on the purpose of the model, and can only be evaluated with respect to the model’s purpose. Finally, most systems are too complex to depict all their features in a model, so no model can in this sense be complete.

3. Explain the difference between verification of a model and validation of a model?

Verification determines whether a model is correct in that it models the system as intended. Thus, verification is with regard to the designer’s intent for the model. Validation determines whether the model represents the actual system sufficient for the model’s purpose.

4. List four common purposes of enterprise models.

We can broadly identify four possible purposes of a model:

1. Understand the enterprise system. The purpose of the model can be to better understand the system structure, key factors, and system behavior. The model can facilitate continuous improvement projects to improve the system. Also, the model can be used to document the system for training or other purposes.
2. Analyze enterprise system problems. The model purpose can be to understand an enterprise system problem and arrive at a solution to better the system. The model can be used to specify requirements for implementation of an information system or other system.
3. Design enterprises. The model purpose can be to create a blueprint of a new proposed system.
4. Manage and control the enterprise. The model purpose can be to understand the system behavior so that it can be managed and controlled.

See Section 3.6.2.

5. Explain the difference between analytical models and non-analytical models and when each is