Systems Thinking

"A journey in the realm of systems"

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Introduction to Systems Thinking

People, when initially introduced to structures, also referred to as Archetypes, often find them a bit overwhelming. They really aren't at all difficult once you get used to them. The following is an introduction to structures and how to read the stories associated with the diagrams.

The basic idea of structure(s) is to point out the influence one thing has on another. That is, how do things influence other things to change.

If I have two things, **thing 1** and **thing 2**, there are only two ways thing1 can influence thing2.

Figure 1: Add Relationship

As indicated in Figure 1, **thing 1** can add to **thing 2**, as indicated by a "+" sign, thus increasing **thing 2**.

Figure 2: Subtract Relationship

The alternative is that **thing 1** can subtract from **thing 2**, as indicated by the "-" sign in Figure 2, thus decreasing **thing 2**.

All this thingness may a bit difficult to connect with so let's consider a couple specific examples.

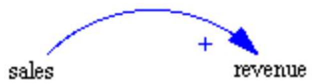

Figure 3: Sales Increases Revenue

Figure 3 indicates that **sales** adds to **revenue**. Even if **sales** decrease it will still add to **revenue**, just not quite as rapidly as before. On the other hand, if **sales** increases it will add even more readily to **revenue**.

Figure 4: Product Sales and Inventory

Figure 4 indicates that **product sales** subtracts from **finished goods inventory**. If **product sales** increase it will subtract even more from **finished goods inventory**. On the other hand, if **product sales** decrease it will still subtract from **finished goods inventory**, just not quite so much.

Within systems diagrams there are often items that are held constant within the context of what is being considered. These items will have neither a "+" nor a "-" attached to them.

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Figure 5: Constant Contribution

Figure 5 indicates that **resources** interact with **productivity** in such as way as to add to the **finished goods inventory**. The indication is that **resources** is a constant within the structure being considered so it neither adds to nor subtracts from, it just is. You might think of a constant as a catalyst for the result. If **productivity** increases it will interact with **resources** and add even more to **finished goods inventory**. If **productivity** decreases it will still interact with **resources** to add to **finished goods inventory**, just not so readily.

Now that we've covered connections, let's cover connections that complete to form loops. There are only two types of loops, reinforcing and balancing.

Reinforcing Loop

A reinforcing loop is one in which the interactions are such that each action adds to the other. Any situation where action produces a result which promotes more of the same action is representative of a reinforcing loop.

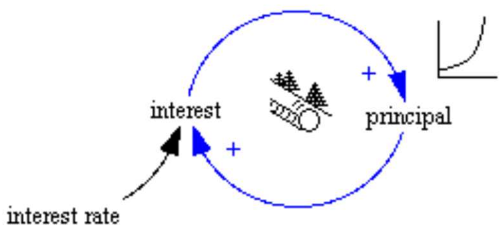

Figure 6: Reinforcing Loop

Figure 6 indicates what happens in a typical savings account. The **principal** in the savings account interacts with the **interest rate** and adds to the **interest**. Note that **interest rate** is considered to be a constant in this example. **Interest** then adds to the **principal**. This reinforcing action happens every so many months depending on the period over which the institution computes the **interest**. The snowball rolling down hill is your signal that the loop is a reinforcing loop. The small graph to the right of **principle** indicates that the growth of principal is exponential.

Typical examples of reinforcing loops are population growth and decline, uncontrolled nuclear reactions, snow balls rolling down hill of course, runs on banks, wall street market crashes, etc.

Balancing Loop

A balancing loop is one in which action attempts to bring two things to agreement. Any situation where one attempts to solve a problem or achieve a goal or objective is representative of a balancing loop.

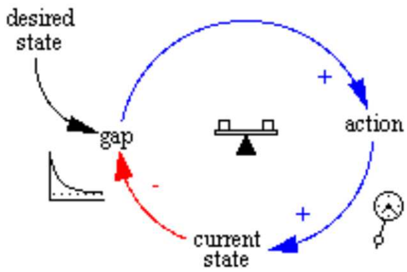

Figure 7: Balancing Loop

Figure 7 provides the basic form of the balancing loop. The **desired state** interacts with the **current state** to produce a **gap**. The **gap** adds to the **action** and the **action** adds to the **current state**. The **current state** then subtracts from the **gap**. The small clock to the right of the arc between **action** and **current state** indicates some time delay that it takes for the **action** to change the **current state**. As the **current state** gets closer to the **desired state** the **gap** gets smaller and smaller so it adds less and less to the **action**, which is adding to the **current state**. Once the **action** has moved the **current state** to a point where it equals the **desired state** the **gap** is zero and there's no more addition to the **action**, so there is no more action. The balance in the center of the loop is your indication that the loop is a balancing loop.

Typical examples of balancing loops are driving from location A to location B, developing a skill, building something, fixing a problem, etc.

Telling one Loop from Another

Initially you might consider it difficult to figure out one loop from the other, yet it's simply a matter of counting. All you need to do is count the number of minus signs around the loop. If there is an even number, or zero, minus signs then it is a reinforcing loop. If there is an odd number of minus signs then it's a balancing loop.

These two loops can combine in numerous ways resulting in typical situation characteristics we recognize in our daily lives. theWay of Systems matches situation descriptions to common combinations of reinforcing and balancing loops which have very distinct characteristics.

Now that wasn't so tough, was it? You may have been expecting there was more to it than this, yet there really isn't. When one thing affects another thing it can only add to or subtract from that which it affects, otherwise there would be no influence at all now would there.

Systems Thinking: An Operational Perspective of the Universe provides a more elaborate background than this initial introduction though theWay of Systems presents a more integrated view of the archetypes. Also, George Richardson's "Problems with causal-loop diagrams" is a marvelous read.

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