

# THINKING IN SYSTEMS

## CHAPTER 1 : THE BASICS

"A system is more than the sum of its parts."

**SYSTEM** → An interconnected set of elements

↓ THAT IS

Coherently organised

↓ HOW

Interconnections → PHYSICAL FLOWS / FLOWS OF INFORMATION

Elements Function / Purpose → DEDUCED FROM BEHAVIOUR

**NOT A SYSTEM** → A conglomeration without any particular interconnection among its parts to notice our functions.

WHY? → Visible/tangible (mostly)

consists of an active set of mechanisms to maintain integrity over wholeness.

adaptive → goal-seeking → resilient → evolutionary → self preserving → self organising → self repairing

dynamic → respond to events

**CHARACTERISTICS OF A SYSTEM**

1. When INFLOW > OUTFLOW → LEADING TO STOCK WITHIN.

2. When INFLOW < OUTFLOW → LEADING TO STOCK DEPLETING.

3. When INFLOW = OUTFLOW → STOCK REMAINS CONSTANT.

"It is easier to learn about a system's elements than about its interconnections."

Systems can be nested within systems.

"Keeping sub-purposes and overall system purpose in harmony is an essential function of successful systems."

**SUBSYSTEMS** → Changes in one subsystem lead to changes in other subsystems.

**INTER-CONNECTIONS** → ELEMENTS → LEAST

least important in defining the unique characteristics of the system.

"Keeping sub-purposes and overall system purpose in harmony is an essential function of successful systems."

**FUNCTION / PURPOSE** → Changes in stock set the pace of the dynamics of systems.

**SYSTEM 1** → Changes in stock set the pace of the dynamics of systems.

**SYSTEM 2** → Changes in stock set the pace of the dynamics of systems.

**DOUBLING TIME** = Time taken for an exponentially growing stock to double in size =  $T_0 / \text{growth rate (expressed as a \%)} = T_0 / \text{growth rate}$

"Complex systems do much more than stay steady or explode exponentially or approach goals smoothly."

**FEEDBACK LOOP** → WHAT? Factors affecting the mechanism creating consistent behaviour patterns over a long period of time.

IS FORMED WHEN

It is a closed chain of causal connections from a stock, through a set of decisions or rules or physical laws or actions that are dependent on the level of the stock, and back again through a flow to change the stock.

**TYPES OF FEEDBACK LOOPS**

① BALANCING FEEDBACK LOOP  
WHAT?  
Equilibrating our goal-seeking structures in systems. Both sources of stability and sources of resistance to change.

CHANGES IN A STOCK AFFECT THE FLOWS INTO OR OUT OF THAT SAME STOCK THAT SAME STOCK

STOCK OUTFLOWS

CHARACTERISTICS

SOURCE

INFLOW

SINK

1. Sees/feels/counts/measures at any given time.

2. Does not have to be physical

3. Changes slowly.

4. Can act as delays, lags, buffers, ballast

5. Allows inflows & outflows to be decoupled and to be independent.

**FLOW** → WHAT? It changes stock over time  
CHARACTERISTICS → Can be turned on/off or higher/lower.

**DYNAMIC EQUILIBRIUM** → WHAT?  
They are self-enhancing, leading to exponential growth and runaway collapses over time.

**REINFORCING FEEDBACK LOOP (2)** → WHAT?  
OPPOSES WHETHER DIRECTION OF CHANGE IS IMPOSED ON THE SYSTEM

→ The change is faster at first and then slower as the discrepancy between the stock and the goal decreases.

BANK INTEREST +  
BALANCE R EARNED +  
HUNGER B -  
FOOD CONSUMPTION +

(stocks + mechanisms for regulating the levels in the stocks by manipulating flows).

MONICA PODDAR  
WEEK 7 : READING