

SYSTEMS THINKING

Systems Analysis

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Outline

1 Introduction to Systems Thinking

2 General Systems Theory

3 Human Organizations



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Introduction to Systems Thinking I

- A **system** is just a set of elements interconnected with a common purpose.
- Not all elements must be connected to each others, but every **connection** should be meaningful.
- The more the **connections**, the more the system **complexity**. Representation must be feasible.
- Each element must have at least one connection. Isolated elements makes no sense in a System.

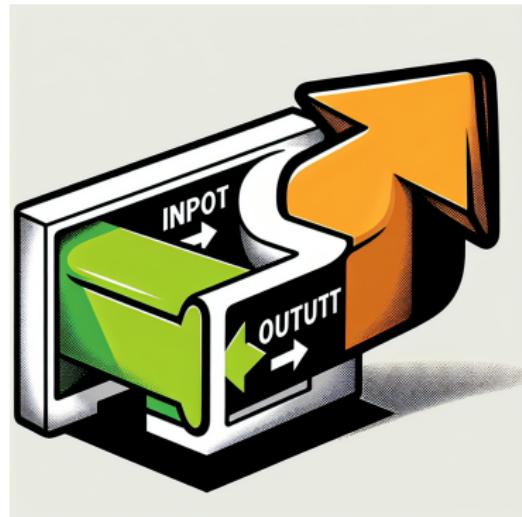


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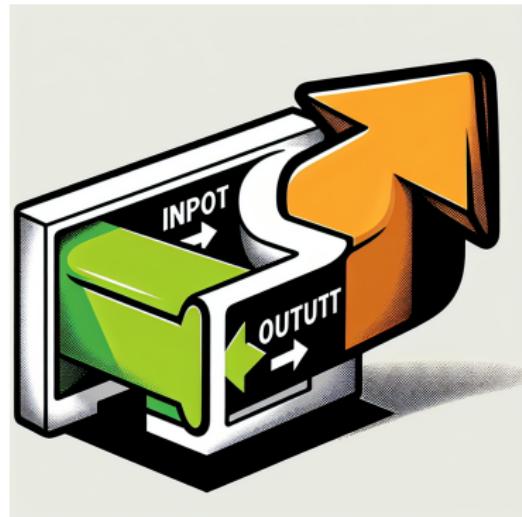


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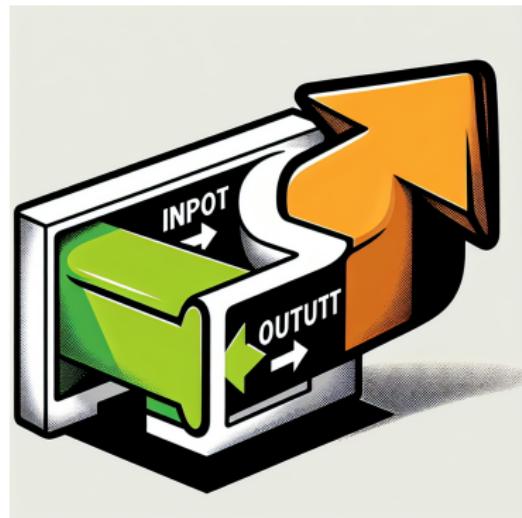


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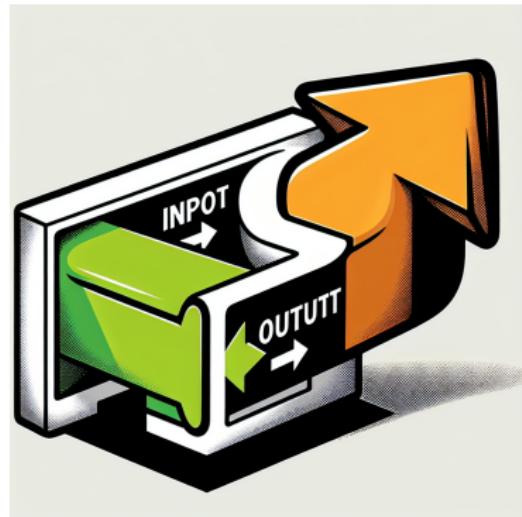


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Complexity on Systems



Introduction to Systems Thinking II

- In **systems thinking**, if you just **split** parts and forget relationships, you will **lost the full picture**.
- It is called **holistic** approach, try to see all the picture with all the meaning details.
- Define the **box boundaries** is sometimes tricky, as we said, not too complex, not too simple. It is like the desired universe balance of Thanos.



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- Another important concept is the **homeostasis**, it means to put a system in an **equilibrium state**. That is hard, **systems** are both **not in equilibrium** and **resilient to change**. **Chaotic attractors** study is useful here.
- A **system** is more than the **sum of the parts**. It means, relationships, behaviors, recovery capacity, are forgotten when you see the system just as its parts.



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Introduction to Systems Thinking IV

- **Systems thinking** is a way to understand and represent problems in order to find the best possible solution.
- Think in a problem as a system lets you understand details, involved elements, relevant information.
- Systems should be viable, auto-sostenible, provides internal feedback loops, and also looks like a whole live-entity.



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- **Computation** helps to **represent behaviors** in a mathematical way. Also, it lets to **find patterns** and information, simplify process; an example of all this is the **Artificial Intelligence**.
- **Top-Down** approach is useful when you want to **see the full picture**, and then split it into parts.
- **Bottom-Up** approach is useful when you want to **see the parts** and then connect them to get the full picture.



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Introduction to Systems Thinking VI

- It is important to understand the **sensitivity** of the problem, because it leads to make **better decisions**.
- The most simple **system definition** is: for some **inputs**, after apply them a designed process, you will get some **outputs**.
- In a **deterministic** world the same inputs get the same outputs. Real-life is not deterministic.



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- **Stochastic processes** make use of probability, and this gets a better real-world behaviors representation.
- Here **Chaos Theory** becomes a useful tool. To make it simple, chaos could be defined as a harmonic balance between **rules** and **randomness**.



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Systems Structure



Study Case: Transportation System



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General Systems Theory I

- In **general systems theory** the idea is to see a problem since different autonomous **study areas**, it helps to create a better **full-picture** of a problem or situation.
- Systems are **dynamical**, for that reason you need to define boundaries and **constraints** to control analysis. Also, some systems are **highly susceptible** to changes from the environment.



Figure: Prompt: Draw systems at different levels in the context of astronomy.



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- A biologist call **Ludwig Von Bertallanfy** created the **General Systems Theory** around seventy years ago.
- His idea was to understand and represents in a very simple way some **individuals** and **populations behaviors**, also the **interactions** or different elements in nature.



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However, more you **go dive** to understand the problem, more the **complexity arises**.
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- The human body is a **system**, and inside the are a lot of **subsystems**. Every **subsystem** is basically connected to each other, and if one fails, it is like a domino effect.



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- Remember **concepts** as:
snowball effect, butterfly effect,
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Representation of a System



General Systems Theory VIII

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- **Black-box** is a type of model when you want to get the desired output based on specific input, but yo don't want to expose the **process** to achieve it.



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- Critical Systems Practice is a methodology to deal with **Critical Systems Thinking** study field. CSP has 4 main stages: *Explore, Produce, Intervene, and Check — EPIC.*



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Human Organizations I

- **Sinergy** is a simple but powerful concept: **the aim of the parts is more than the parts itself.**
- It means the **interactions** could boost the capabilities of the parts of the **system**. Also, it lets both understand **emergent behaviors** and define improvements in **systems**.
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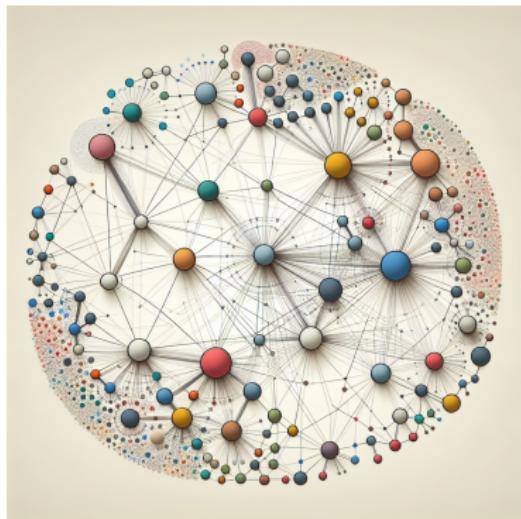


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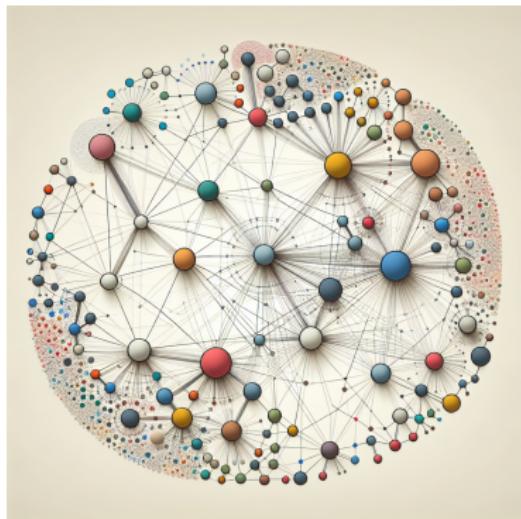


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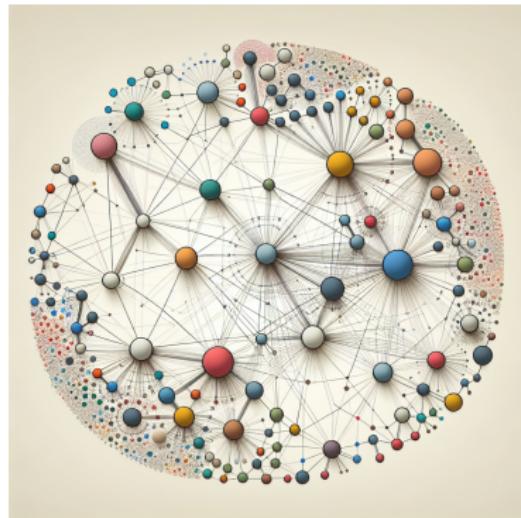


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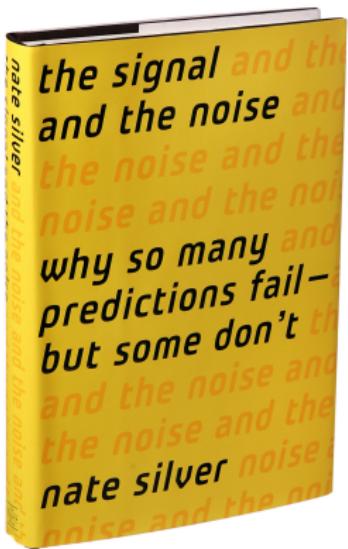


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Synergy: Money Ball



TheSignal and
TheNoise



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Thanks!

Questions?



Repo: <https://github.com/EngAndres/ud-public/tree/main/courses/systems-analysis>

