

# SYSTEMS ENGINEERING

## Systems Analysis & Design

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# Outline

- 1 Basic Concepts
- 2 Human Activities
- 3 Cibernetics and Technology
- 4 Teams-Based Structure as a System



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# What is Systems Engineering?

- **Systems Engineering** is a discipline that studies the design, implementation, and maintenance of complex systems.
- This discipline is based on interdisciplinary fields, such as control engineering, industrial engineering, software engineering, mechanical engineering, electrical engineering, organizational studies, project management, and others.
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- A **Systems Engineer** is a professional who is responsible for designing, implementing, and maintaining complex systems.
- A **Systems Engineer** must have a broad understanding of engineering, mathematics, science, and technology.
- A **Systems Engineer** must be able to analyze and solve problems in a systematic and holistic way.



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- **Systems Engineering** can be applied to understand, analyze, and improve human activities.
- **Systems Engineering** can help us design and manage complex systems such as organizations, cities, economies, and societies.



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- **Organizations** can be **viewed** as: a **rational system**, a **natural system**, or an **open system**.
- A **rational system** is a formal organization that is designed to achieve specific goals as a machine.
- A **natural system** is an informal organization that is emergent and adaptive based on human interactions.
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# Synergy

- **Synergy** is a simple but powerful concept: **the whole is greater than the sum of its parts.**
- 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.**
- One of the main concepts is the **theory of computation**. Based on graphs, you could define a computational machine.

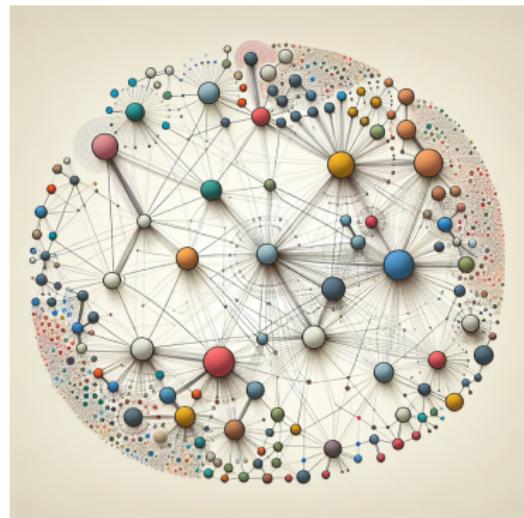


Figure: Prompt: Define a draw of clusters in social networks.



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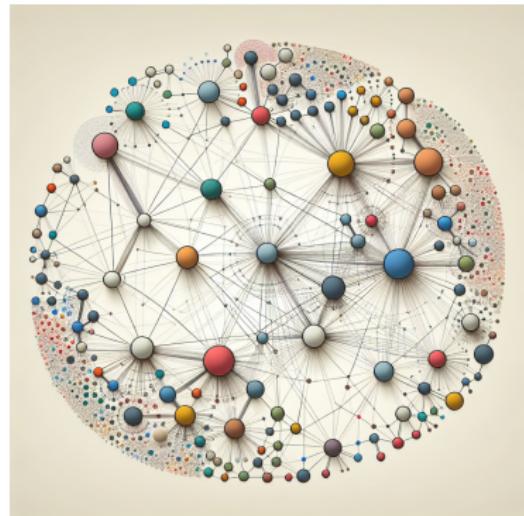
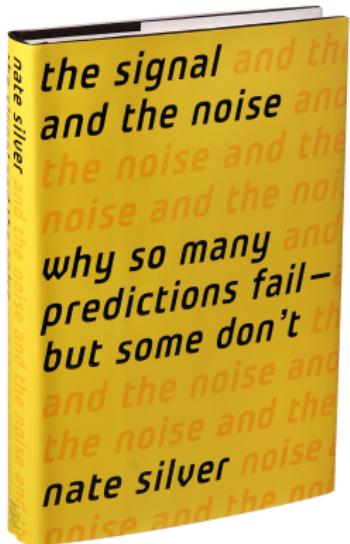


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# Synergy: Money Ball



# Talking with Machines!

- **Alan Turing** proposed a hundred years ago an **Universal Machine**, capable of take any **algorithm** defined as a **state machine**, and process it in a **binary language**.
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# Programming Languages

- **Programming Languages** with more **capabilities**, easier **comprehension** had been created. Also, more people start to **code** into specific **domain** programming languages.

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# Applications of Systems Engineering

- **Systems Engineering** can be applied to understand, analyze, and improve complex systems.
- **Systems Engineering** can be applied to design and manage complex systems such as organizations, cities, economies, and societies.
- **Systems Engineering** can be applied to design and manage complex systems such as software, hardware, and networks.



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# Cibernetics

- **Cibernetics** is the study of **systems**, **control**, and **communication** in *animals, machines, and organizations*.
- **Cibernetics** is a transdisciplinary field that combines engineering, mathematics, biology, psychology, and philosophy.
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# Technology: AI

- **Artificial Intelligence** is a *field* of computer science that *studies* how to **design** and **implement** intelligent agents.
- Artificial Intelligence is the key to *designing* and *managing* complex systems such as smart-organizations, smart-cities, smart-economies, and smart-societies.

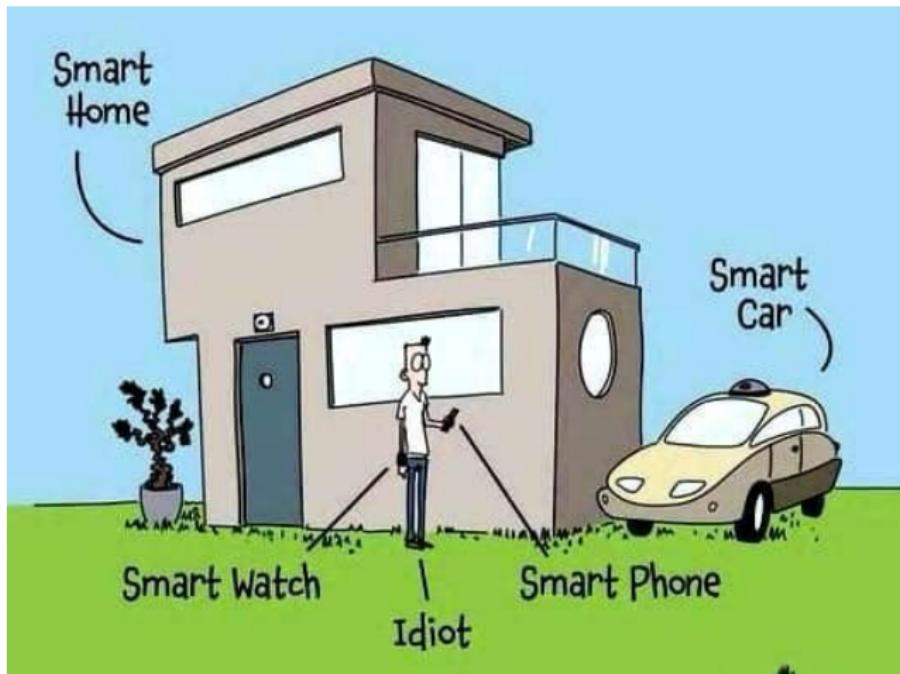


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# Artificial Intelligence **not** as a System



# Cibernetics & Technology in Systems Context

- **Cibernetics** and **technology** are the **foundation** of systems engineering and **information technology**.
- **Cibernetics** and **technology** are the **foundation** of artificial intelligence and **smart systems**.



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# Team-Based Structure Organizations

- **Team-based structure organizations** are a way to **organize work** and **people** in **teams** that are **self-managed** and **cross-functional**.
- Each team is **responsible** for a specific task or project and has the authority to make decisions and solve problems.
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# Teams as a System

- **Teams** are a **system** where collaboration (synergy) and communication are **key** to **success**.
- Defining and automating the **processes** and **procedures** within the **team** is a **challenge** to **improve team** performance.
- **Teams** are like **pieces** in a **puzzle**, where each **piece** has a **specific role** and **responsibility**.



# Soft Skills

- **Soft skills** are **personal attributes** that enable someone to interact effectively and harmoniously with other **people**.
- Typical Soft Skills:
  - **Communication** skills (verbal and written).
  - **Teamwork** and collaboration.
  - **Problem-solving** and critical thinking.
  - **Adaptability** and flexibility.
  - **Time management** and organization.
  - **Leadership** and management.
  - **Emotional intelligence**.
  - **Creativity** and innovation.
  - **Conflict resolution**.
  - **Networking** and relationship building.
  - **Customer service** and client management.



# Computer Analyst

- **Skills:**

- Business process modeling and documentation.
- Data analysis and interpretation.
- Requirements gathering and management.
- Stakeholder management.

- **Responsibilities:**

- Analyzing business processes and identifying areas for improvement.
- Gathering and documenting business requirements.
- Collaborating with stakeholders to define project scope and objectives.
- Creating and maintaining project documentation, such as functional specifications and use cases.
- Facilitating communication between business users and technical teams.
- Participating in system testing and user acceptance testing.
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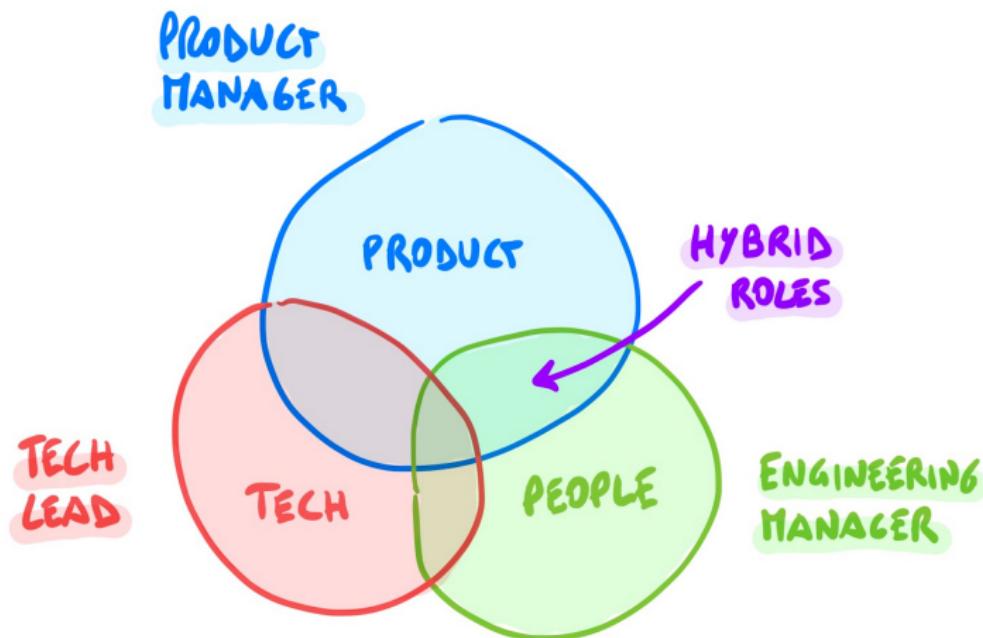
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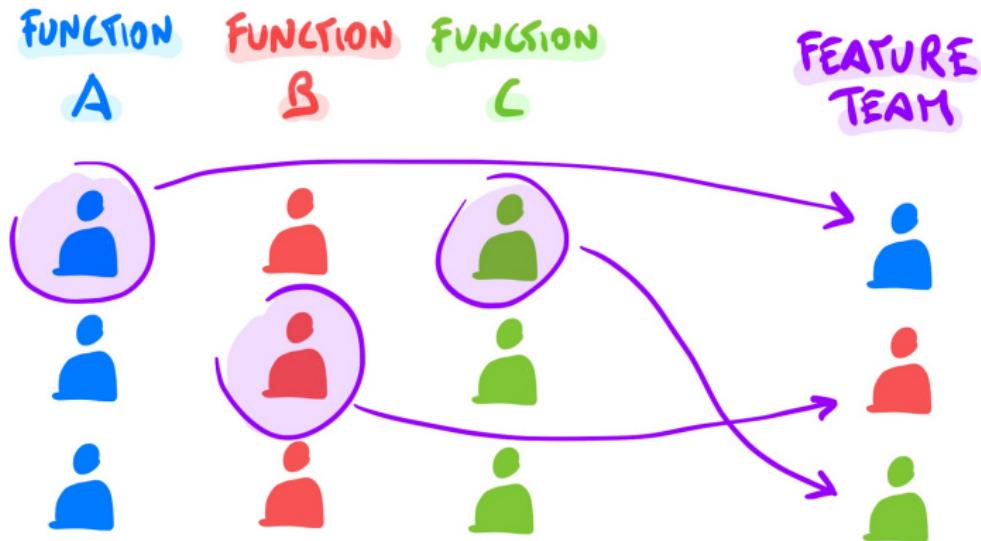
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# Tech Company Typical Structure



# Feature Teams



# What is to be a leader? I

- **Leading** a team is not a **role**. It is a decision, you could be a **leader** anytime and anywhere.
- Teamwork culture is pretty **important**. It creates habits, open communication, safety spaces for inclusion.
- Psychological safety is a key point to have an effective team. You could develop *technical skills*, but **it is not enough**.
- Hierarchy is very important. Anarchism tends to fail. Hierarchy exists by status and power.
- In a hierarchy **experts lead** to make better decisions. However, anyone must be careful to not leave people behind.



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# What is to be a leader? II

- With **crystal-clear communications** and clarity about **business goals** and achievements, people feel **more comfortable** pursuing the same **goals as a team**.
- A **good leader** should focus on **outcomes** rather than **outputs**. This helps bring **business value** rather than just complete tasks.
- Failure** is always an option. Learn how to **deal** with setbacks; do not punish — just fix and learn.
- Some believe you're born a leader, while others think that a leader can be developed over time. Either way, **context** and **the desire** for self-growth are vital.
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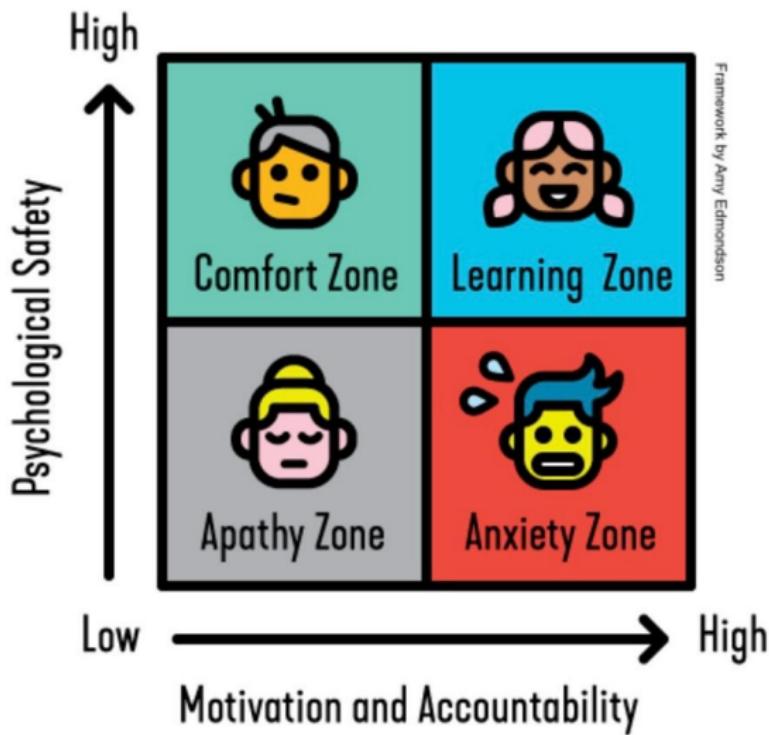


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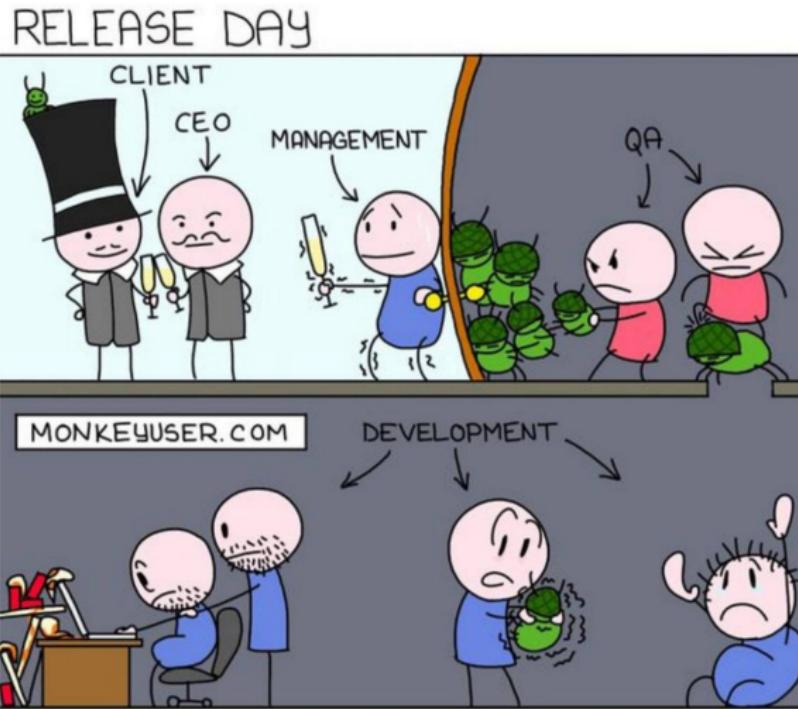
# Working Zones



Framework by Amy Edmondson



# Real World!



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# Thanks!

## Questions?



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

