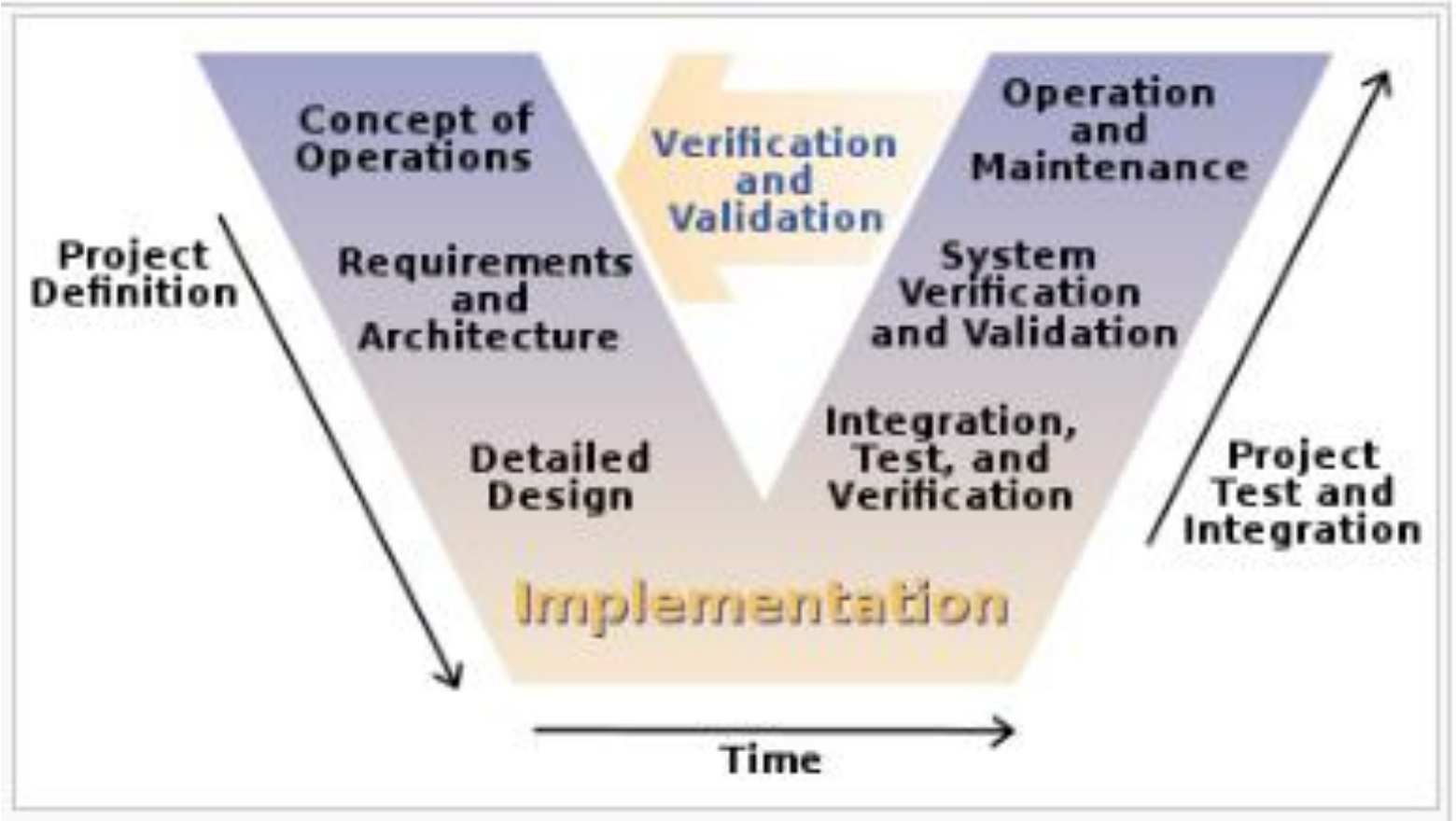
# Introduction to Systems Engineering

A **system** is a set of interacting or interdependent component parts forming a complex/intricate whole.

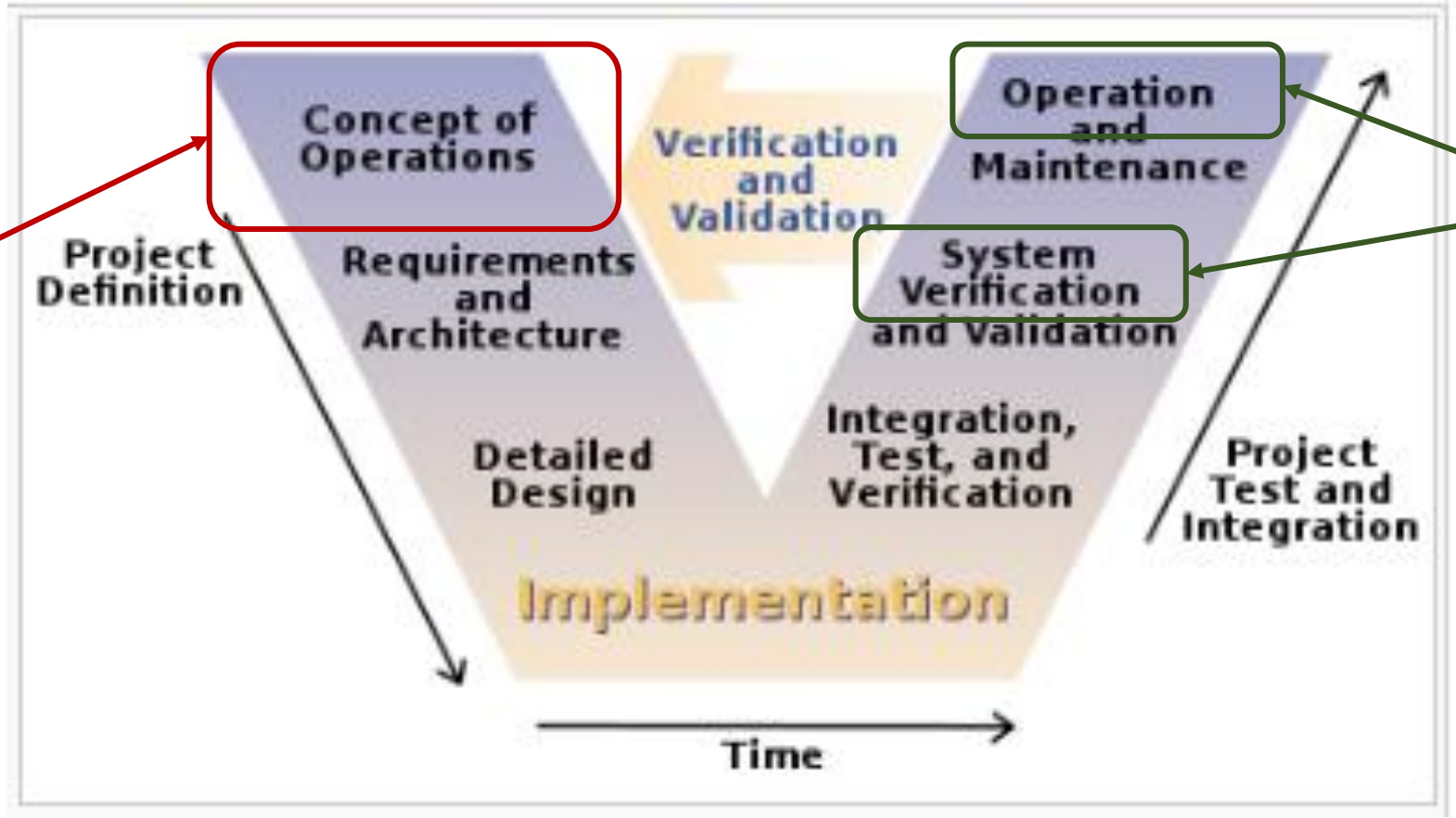
Systems Engineering V Diagram




**Definitions**:
**Architecture** - the complex or carefully designed structure of something
**Integration** - to put together parts or elements and combine them into a whole
**Verification** - the act or process of confirming or checking accuracy
**Validation** - to make something officially acceptable or approved

# Systems Engineering Training

**What** do we need the Robot to do?




**How** well does the Robot perform?

# Features and Functions

**Definitions**:
**Features** - a distinctive attribute or aspect of something
**Functions** - an activity or purpose natural to or intended for a person or thing

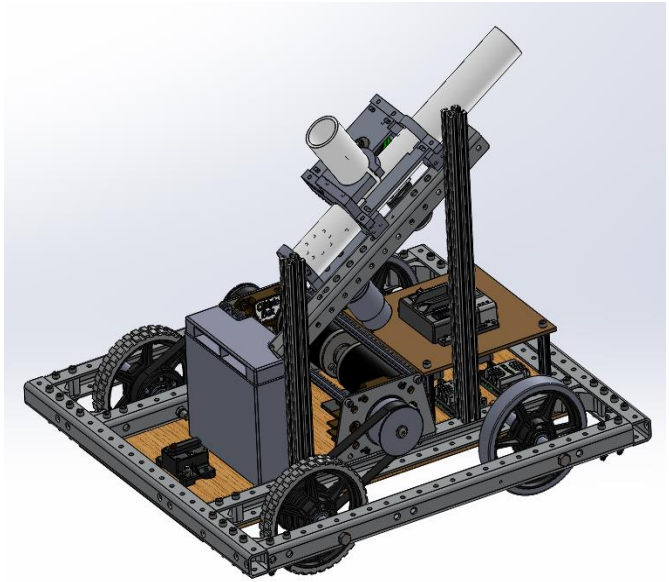
Examples:
"the hotel **features** a large lounge, a sauna, and a large swimming pool"
"bridges perform the **function** of providing access across water"

**What are the key features and functions of the Yr 1 Robot?**

# Features and Functions

What are the key features and functions of the Yr 1 Robot?

- Controllable by wireless joystick controller
- Drives forward, backwards, left, or right
- Follows a white line autonomously
- Shoots ping pong balls at a target
- . . . .



What are the key features and functions of the Yr 1 Robot **Shooter**?

- Shoots ping pong balls at a target
- Holds 4 or more ping pong balls
- . . . .

What are the key features and functions of the Yr 1 Robot **Line Tracker**?

- Follows a white line on the floor
- Robust attachment to bottom of the robot
- . . . .

**How do last year's Robots compare to each other relative to the key features and functions?**

# What is a Functional Measure?

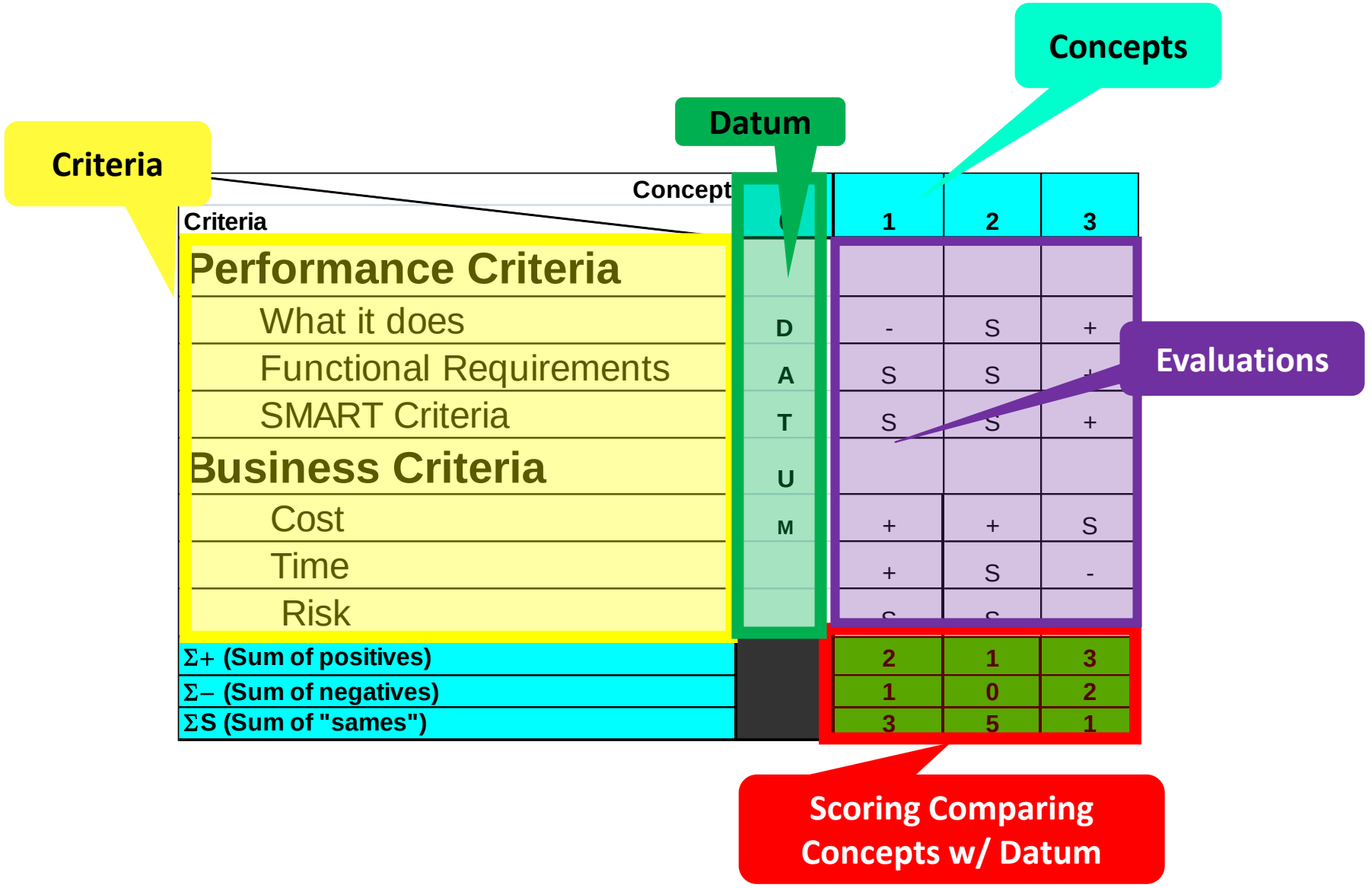
- **A Functional Measure describes *what the system does*.**
- **It is *not* a description of *what the system is*.**
- **A functional measure is a measure of system performance.**
- **Be careful to focus on a measure of performance (e.g. how much force) and not how to achieve the performance (e.g. use a spring).**

- Use **S.M.A.R.T.** criteria to assist in selecting or evaluating functional measures
  - **Specific** – unambiguous (clear) outcome or deliverable.
  - **Measurable** – impact on customer (result) is clear and measurable.
  - **Actionable** – can be accomplished by you and your team with available (or attainable) resources.
  - **Relevant** – clearly moves toward achieving customer satisfaction.
  - **Time Bound** – can be measured during development when results can affect the design solution before release

# Criteria for the Evaluation

- Identify Evaluation Criteria
  - How well does it perform its intended function?
    - Use the Functional Requirements
- You may choose to rank order the criteria
  - How well it performs is most important
- Reach consensus on the criteria

# Pugh Concept Template




| Concept / Criteria | | 1 | 2 | 3 |
|---|---|---|---|---|
| **Performance Criteria** | | | | |
| What it does | D | - | S | + |
| Functional Requirements | A | S | S | + |
| SMART Criteria | T | S | S | + |
| **Business Criteria** | U | | | |
| Cost | M | + | + | S |
| Time | | + | S | - |
| Risk | | S | S | |
| Σ+ (Sum of positives) | | 2 | 1 | 3 |
| Σ– (Sum of negatives) | | 1 | 0 | 2 |
| ΣS (Sum of "sames") | | 3 | 5 | 1 |