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Applying the Systems Engineering Principles to the Design Process of a Mobile Aquaponics System

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A Systems Engineering Approach to Designing and Building a Mobile Aquaponics System

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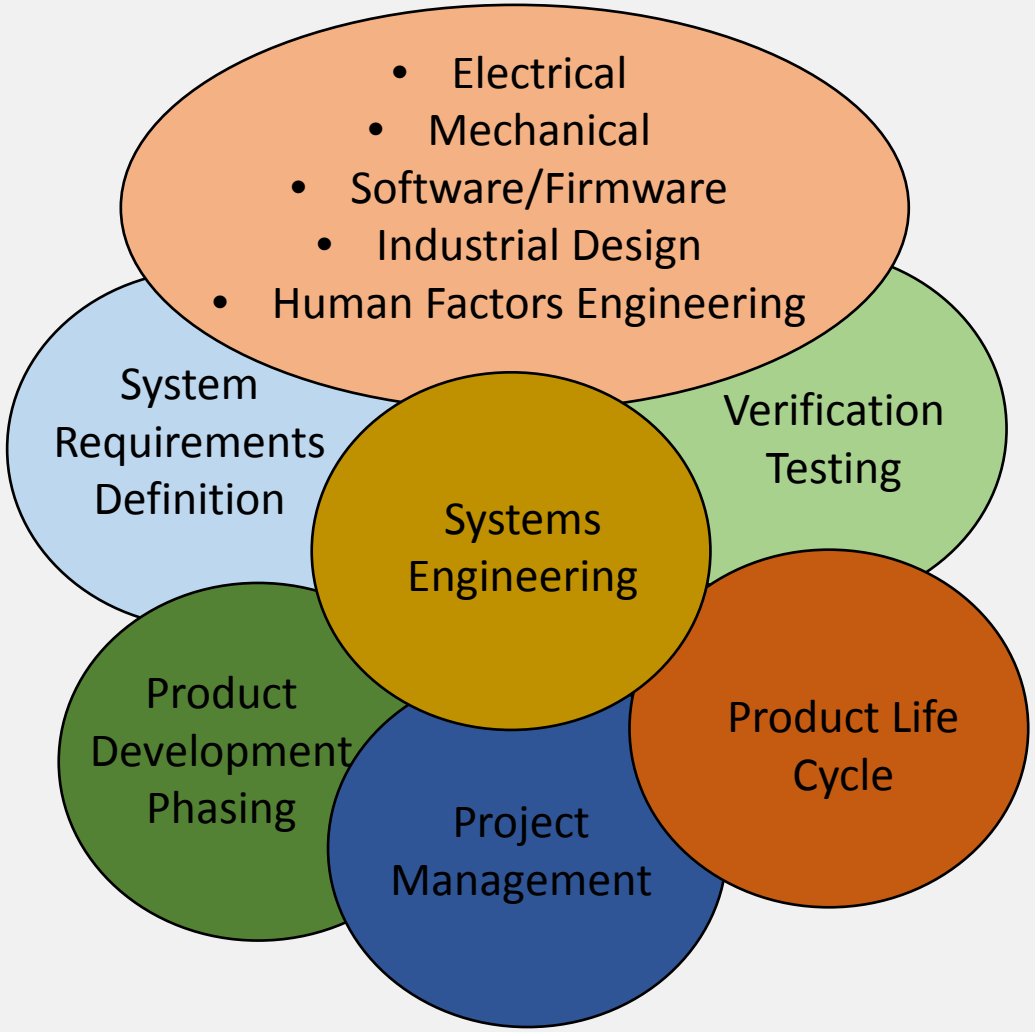
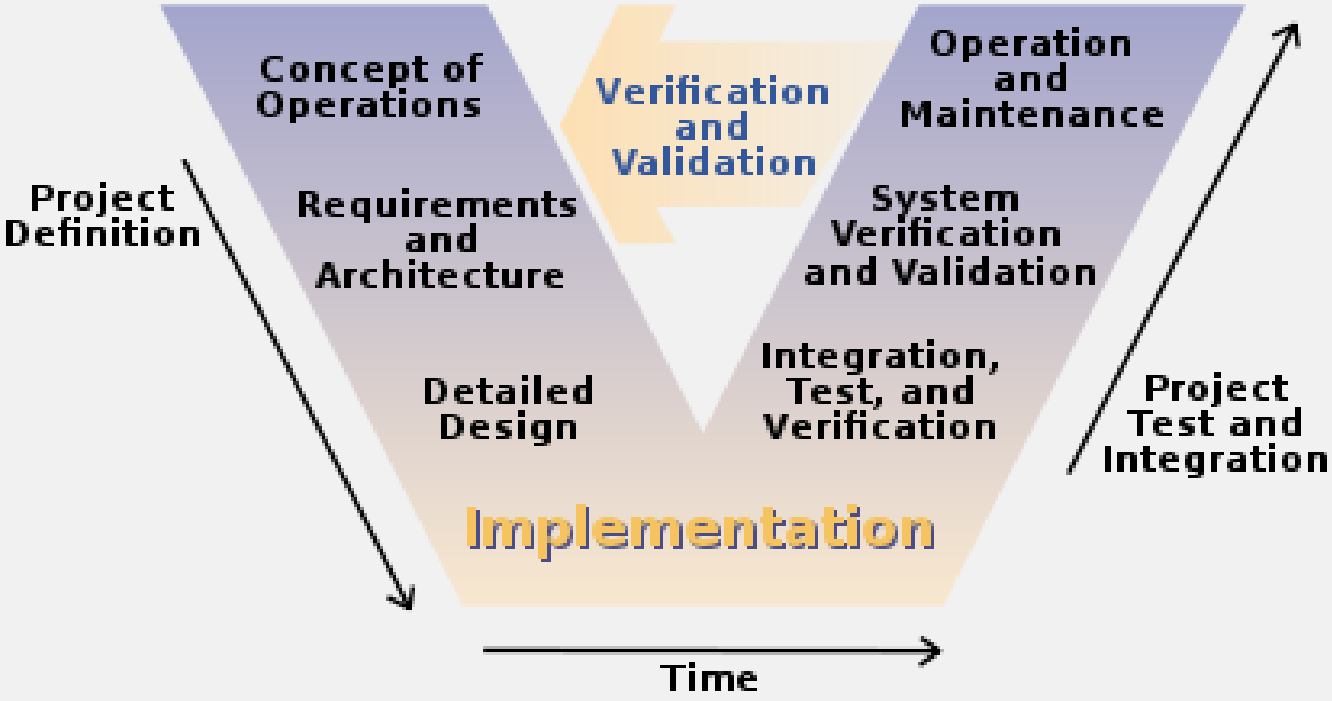
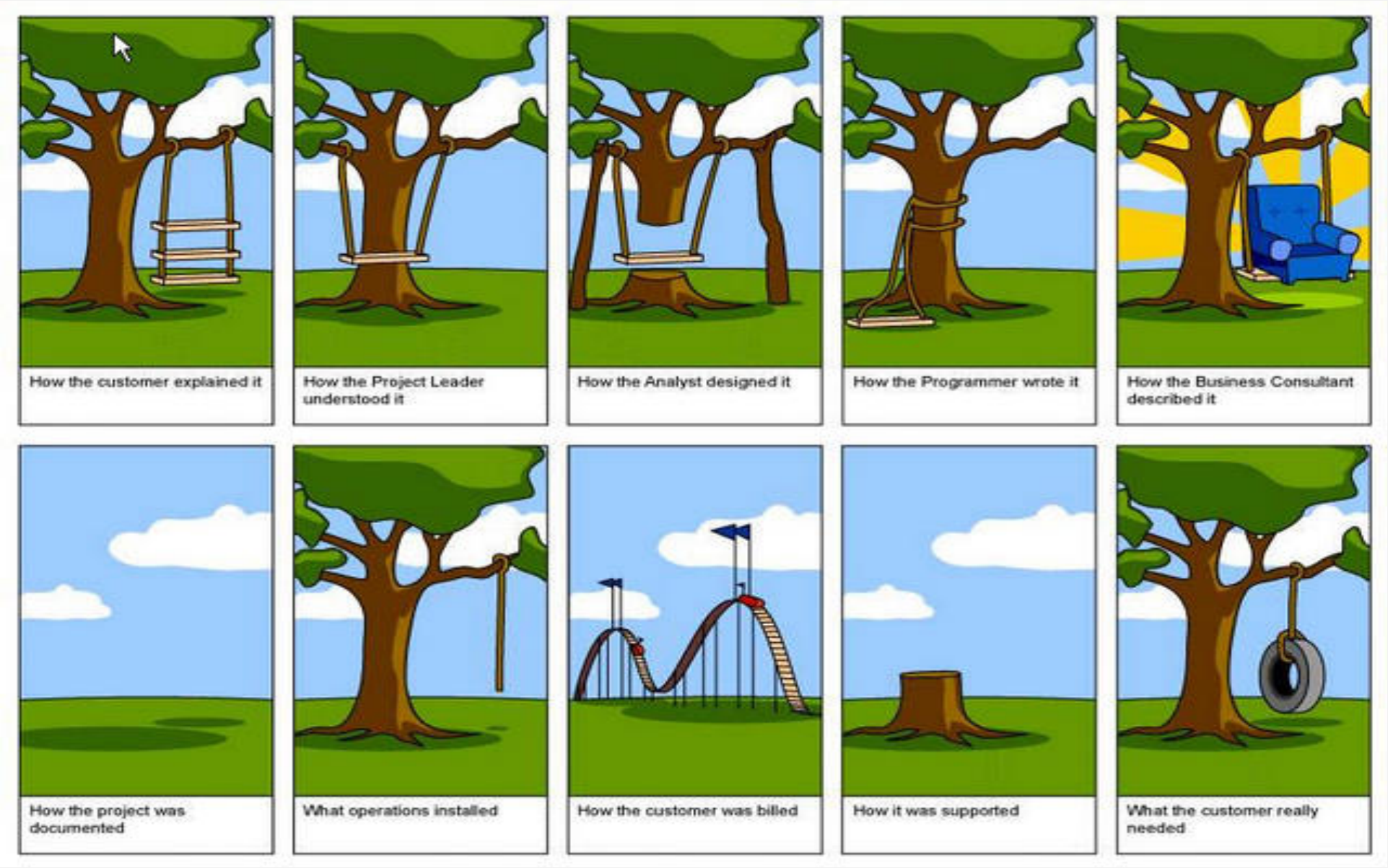
Systems Engineering is an interdisciplinary approach to product development.

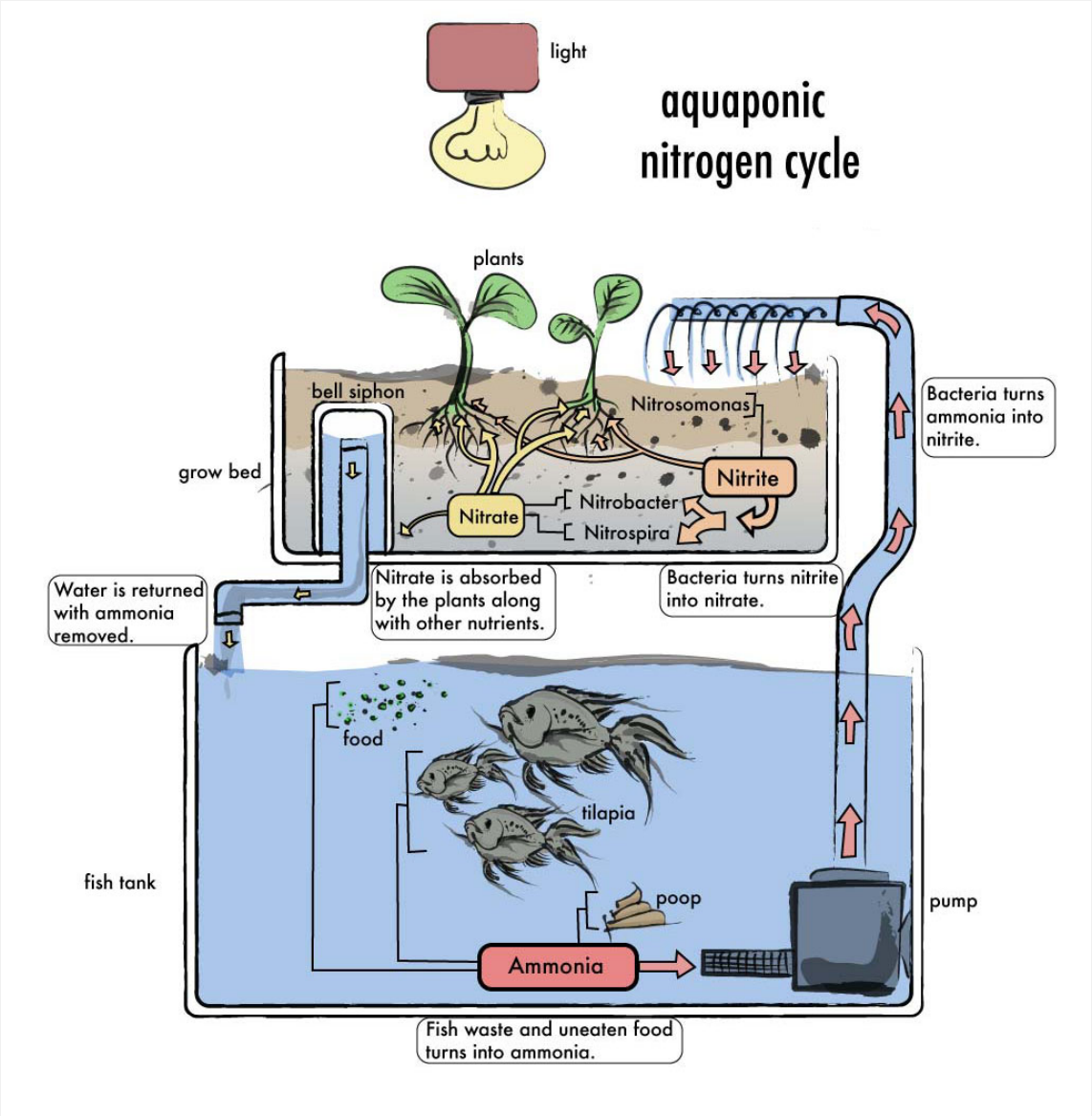




Systems Engineering pulls the entire design together.

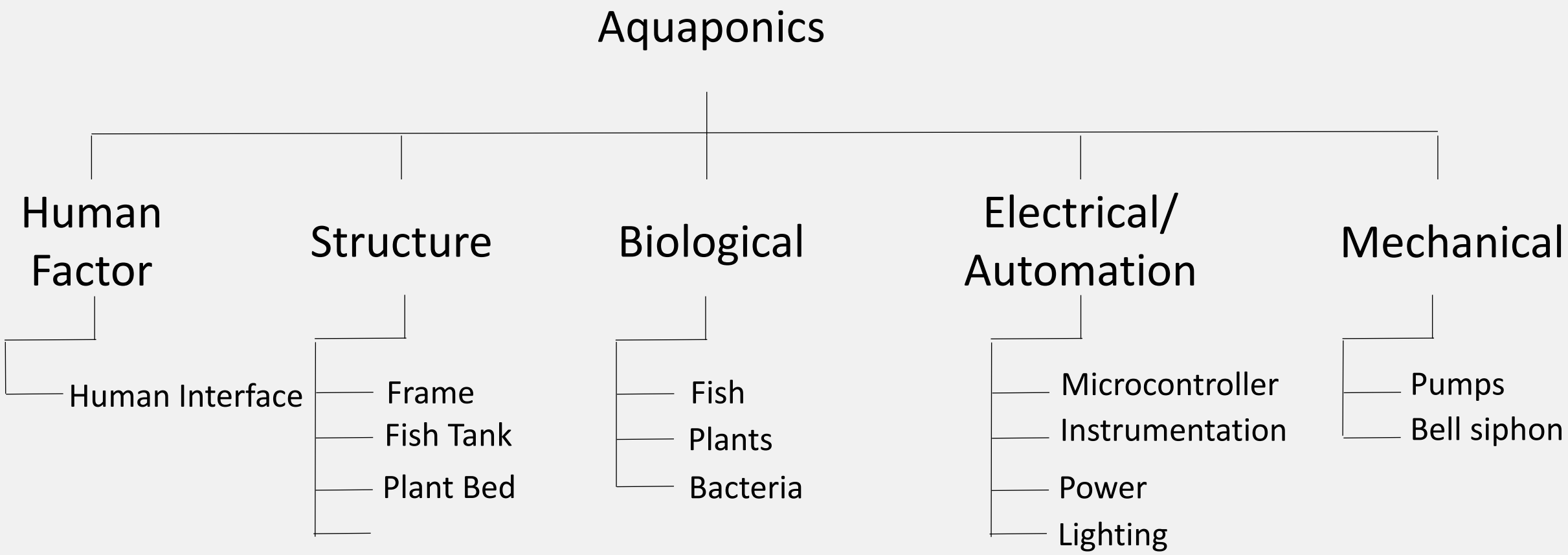


Aquaponics is a food production system that ecologically integrates aquaculture and hydroponics.



Project Purpose

Aquaponics Subsystems



Requirements

Level 1

$15/month operating budget

Level 2

System shall operate of budget of $15.00/month

Level 3

∑ monthly operating costs shall not exceed $15.00

- Fish food- $1.00
- Electricity- $9.00
- Water- $1.00
- Water testing supplies- $2.00
- Repair fund- $2.00 (should this be separate from cost of components?)

Requirements Example Tracing/Allocating

Customer Requirements		
Requirement ID	Requirement	Rationale
CR1	**Operations**	
CR1.1	The monthly system operating budget is $15.00 or less	Customer's defined budget

Functional Requirements				
Requirement ID	Requirement	Rationale	Tracing	Allocated To
FR1	**Operation**			
FR1.1	The system shall operate for $15.00 a month or less	Customer defined	CR1.1	
FR1.1.1	Fish food ≤ $1.00	calculated		Biological
FR1.1.1	Electricity ≤ $9.00	calculated		Electrical
FR1.1.3	Water ≤ $1.00	Calculated		Biological
FR1.1.4	Water Testing Supplies ≤ $2.00	Calculated		Biological
FR1.1.5	Repair Fund = $2.00	Calculated		Structural

Integration

Subsystem Testing and Integration

Mathematical model of lighting cost of fluorescent bulbs

$$2\ bulbs * \frac{20W}{bulb} * \frac{1kW}{1000W} * \frac{24\ hour}{1\ day} * \frac{30\ days}{1\ month} * \frac{\$0.08}{kW*hr} = \$2.30/\text{month}$$

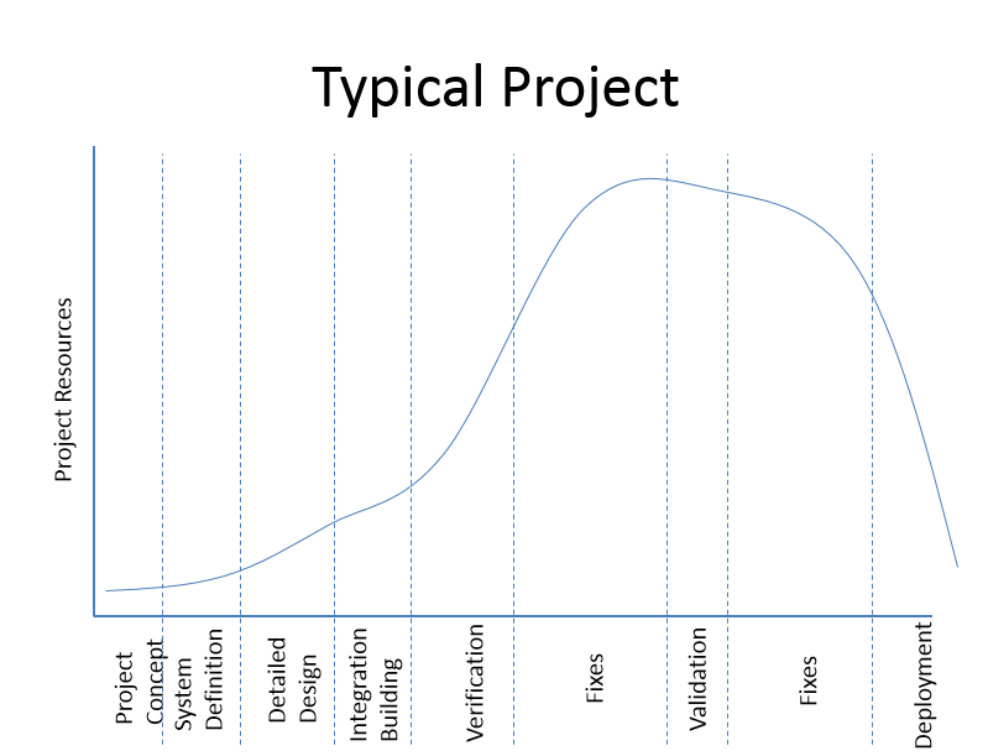
System Verification

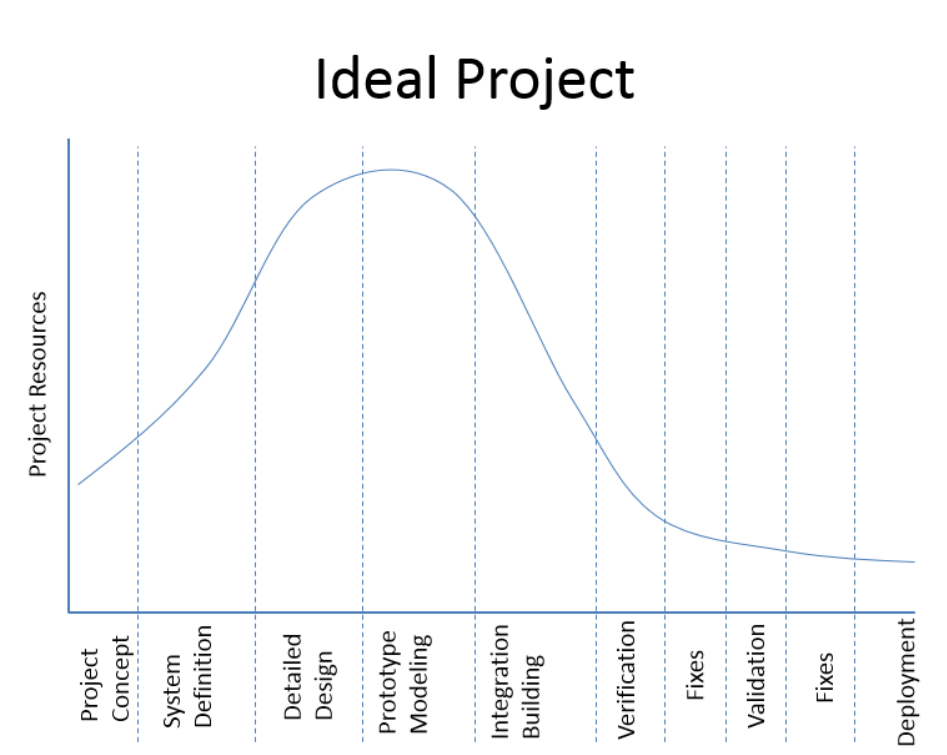
Actual lighting cost fits within the total system requirements

Operation & System Validation

Validated by the customer

Results


Typical Project
Project Resources
Project Concept
System Definition
Detailed Design
Integration Building
Verification
Fixes
Validation
Fixes
Deployment


Ideal Project
Project Resources
Project Concept
System Definition
Detailed Design
Prototype Modeling
Integration Building
Verification
Fixes
Validation
Fixes
Deployment