Modeling System Dynamics

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What Is Sustainment?

- Sustainment: Everything that happens to a system after the production line is closed down (product maintenance, infrastructure)
- Hardware: Repair, Remove corrosion, Replace worn parts
- Software
  - Corrective Maintenance (Bug fixes)
  - Adaptive (fix for changed environment, e.g., other systems, operating system…)
  - Perfective (New requirements)
  - Preventive (reliability/maintainability fixes)

All software sustainment is engineering work

Why Model Sustainment Dynamics?

Sustainment has

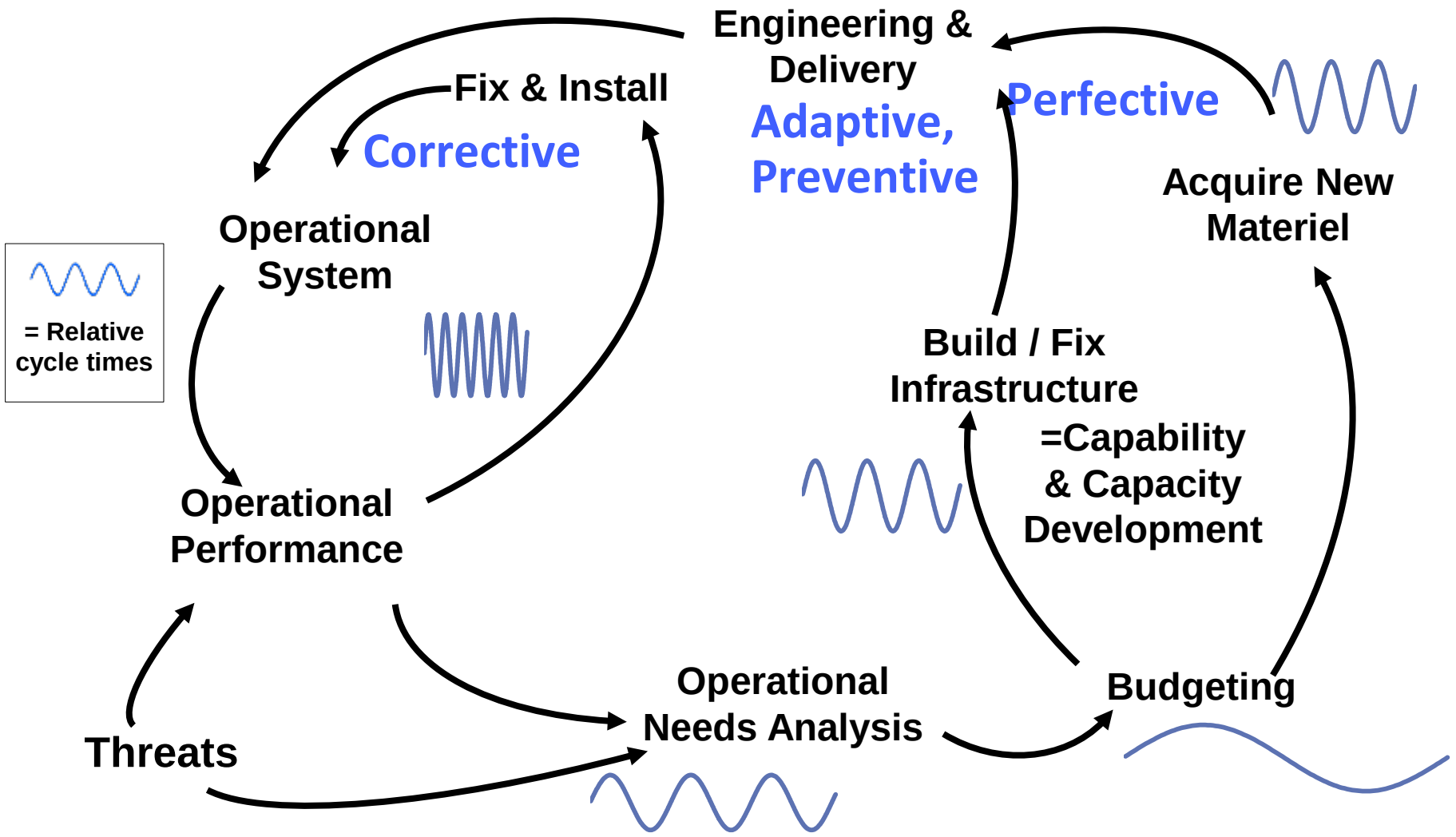
- Many loops
  - bug fixes, small enhancements, large enhancements
- Many stakeholders
  - operational forces, programs, sustainment organizations
- Many funding sources
  - O&M, program procurement, modernization procurement

Simple cost/benefit models fail to capture dynamic nature

- Varying time cycles for decisions
- Dramatic consequences: Funding delays can cause a “tipping point”: recovery very expensive

Dynamic model allows exploration of funding scenarios

Sustainment Cycles



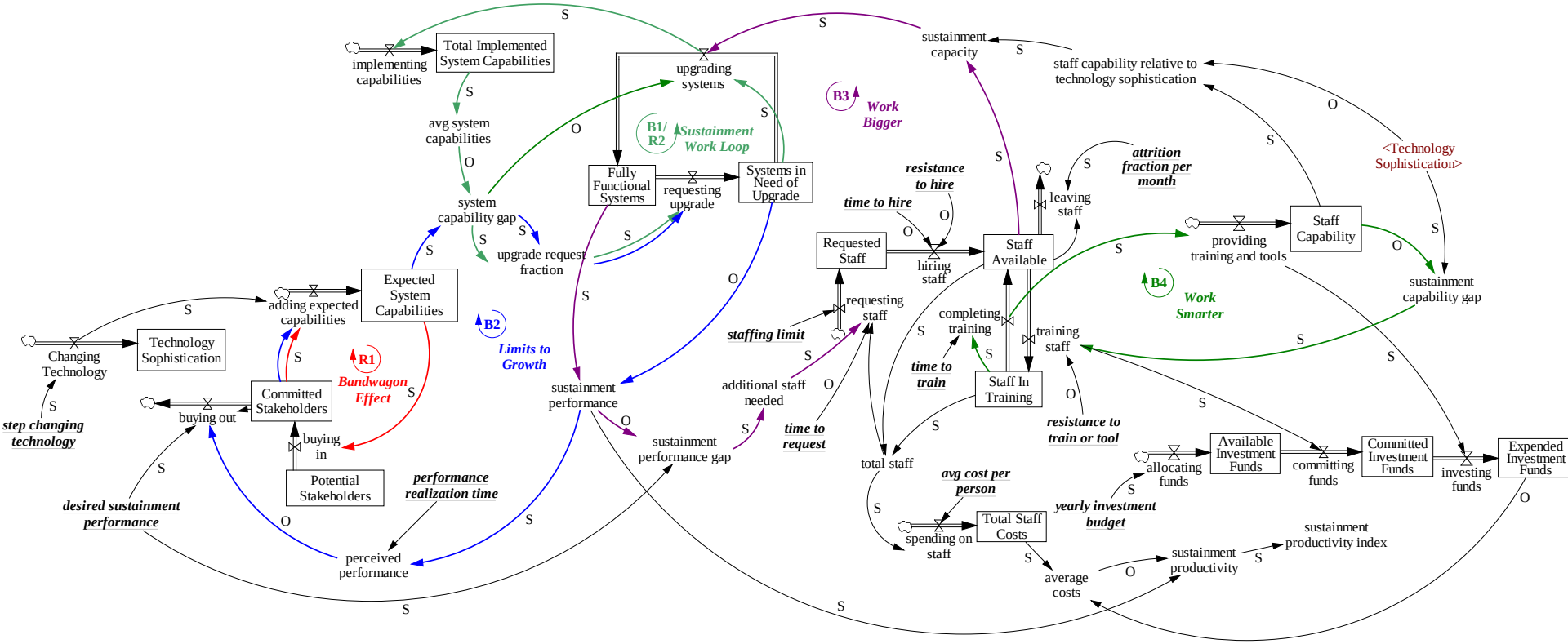
Factors to Model

- ***Sustainment Capability***
  - skills and knowledge held by staff
- ***Sustainment Capacity***
  - amount of sustainment work the staff can do
  - = # staff * capability
- ***Performance***
  - amount of work the staff does, compared to needed
- ***Productivity***
  - amount of work done per unit cost
- ***Desired output***
  - sustained systems, number of system capabilities added

Systems Dynamics Modeling

- Create causal loop diagram
  - Stocks (quantities with an amount)
  - Flows (change the amount in stocks)
  - Relationships (and auxiliary variables)
- Simulate
  - Establish equilibrium
  - Pulse
  - Understand results
- Finalize
  - Calibrate
  - Publish
  - Productize

Sustainment Systems Dynamics Diagram



R1: Represents the need for additional missions and additional capability

B1/R2: Demand for sustaining work and development

B2: Sustainment performance vs. System performance and gaps

B3: Efforts to work overtime and do more with less

B4: Building additional capability and capacity to sustain

Not a loop but lower right: Effects of delayed funding decisions and commitment

Conclusion

- Determined sustainment variables
- Dynamic relationships
- Calibrating with customer now
- Can calibrate to your organization

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Modeling Sustainment Dynamics

BACKUP CHARTS

Calibration and Validation

Comparing performance to goals