CSER 2006 – Conference on Systems Engineering Research

Systems Engineering (SE) Patterns and Pattern Language

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Overview

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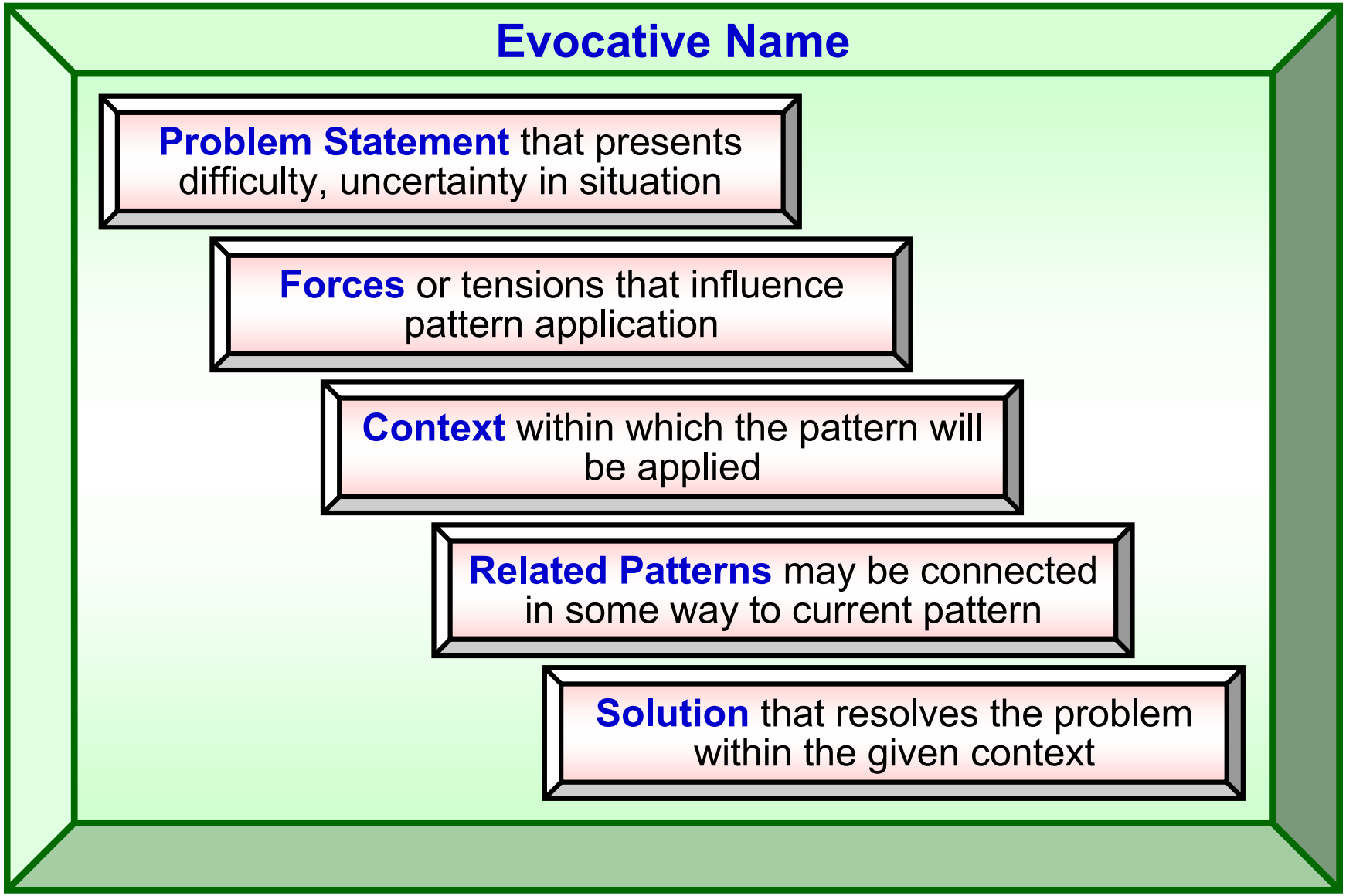
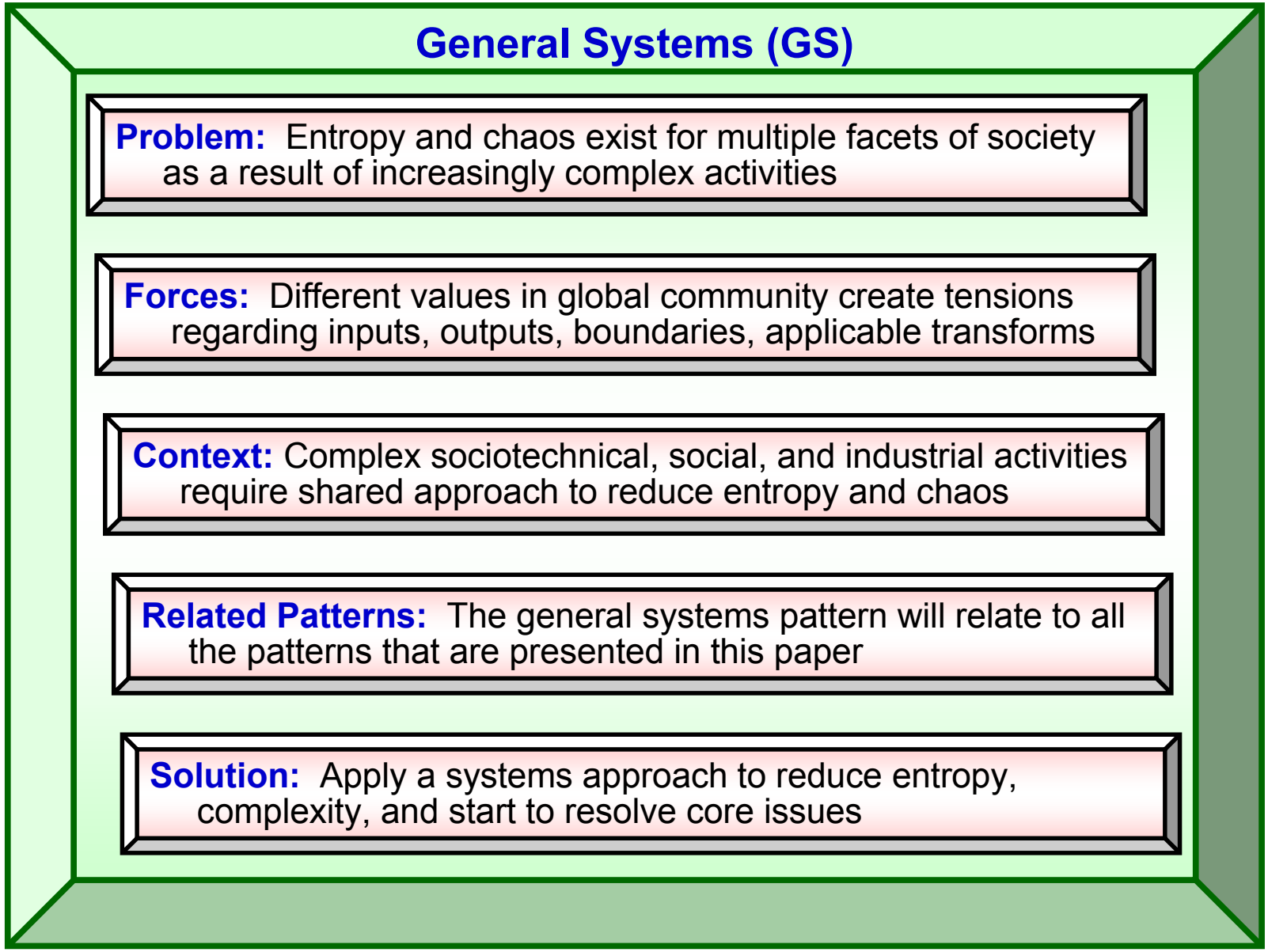
- General Systems Pattern
- Representative Patterns
  - Problem vs. Solution
  - Three System Minimum
  - FRAT
- Behavior Outcomes Matrix
- Exploring Relationships
  - Laws of Language
  - System Language Design Capability
  - Sequential Frameworks
  - Abstraction Stacks
  - Relationship Types
- Summary

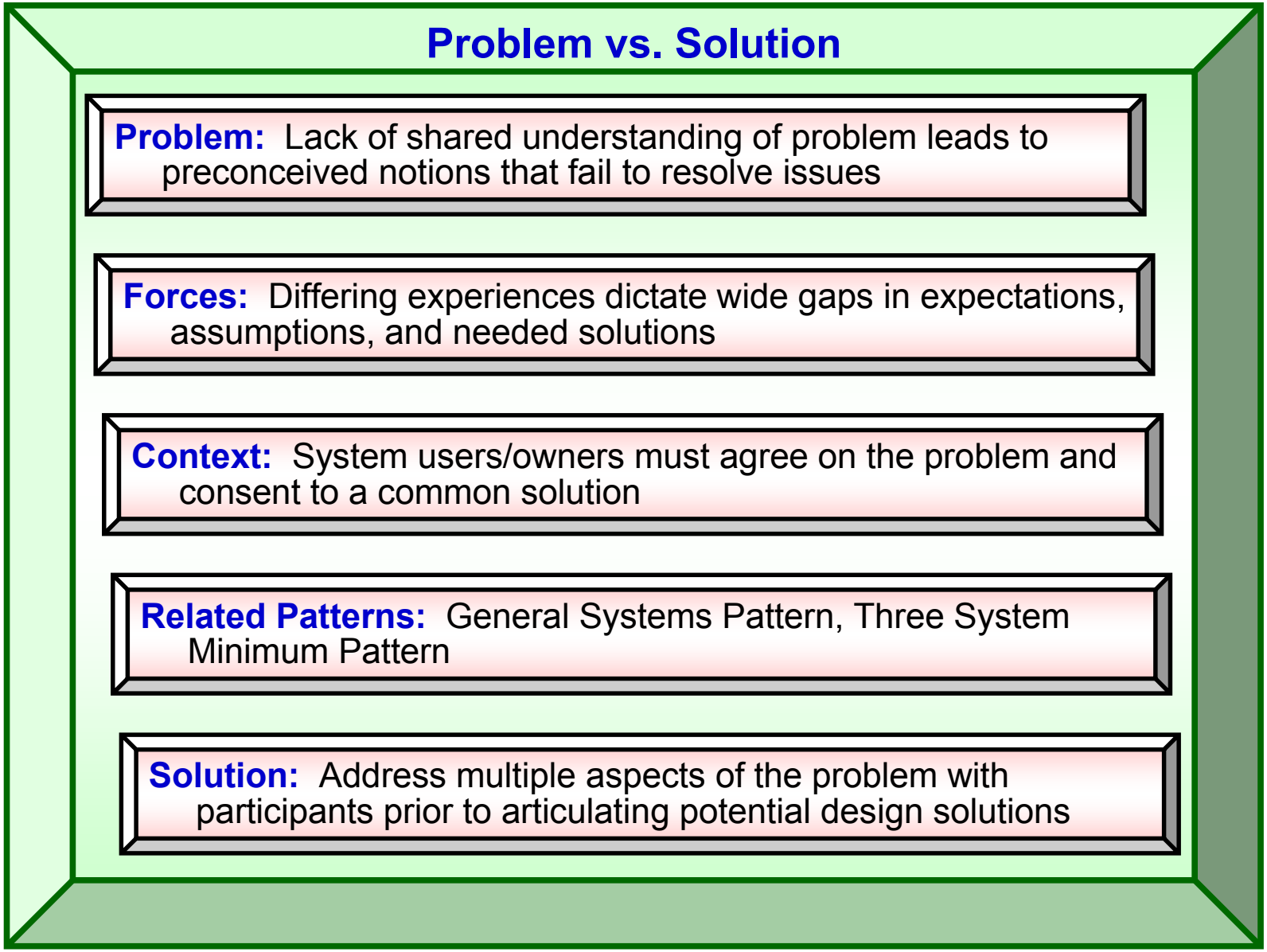
Pattern Form



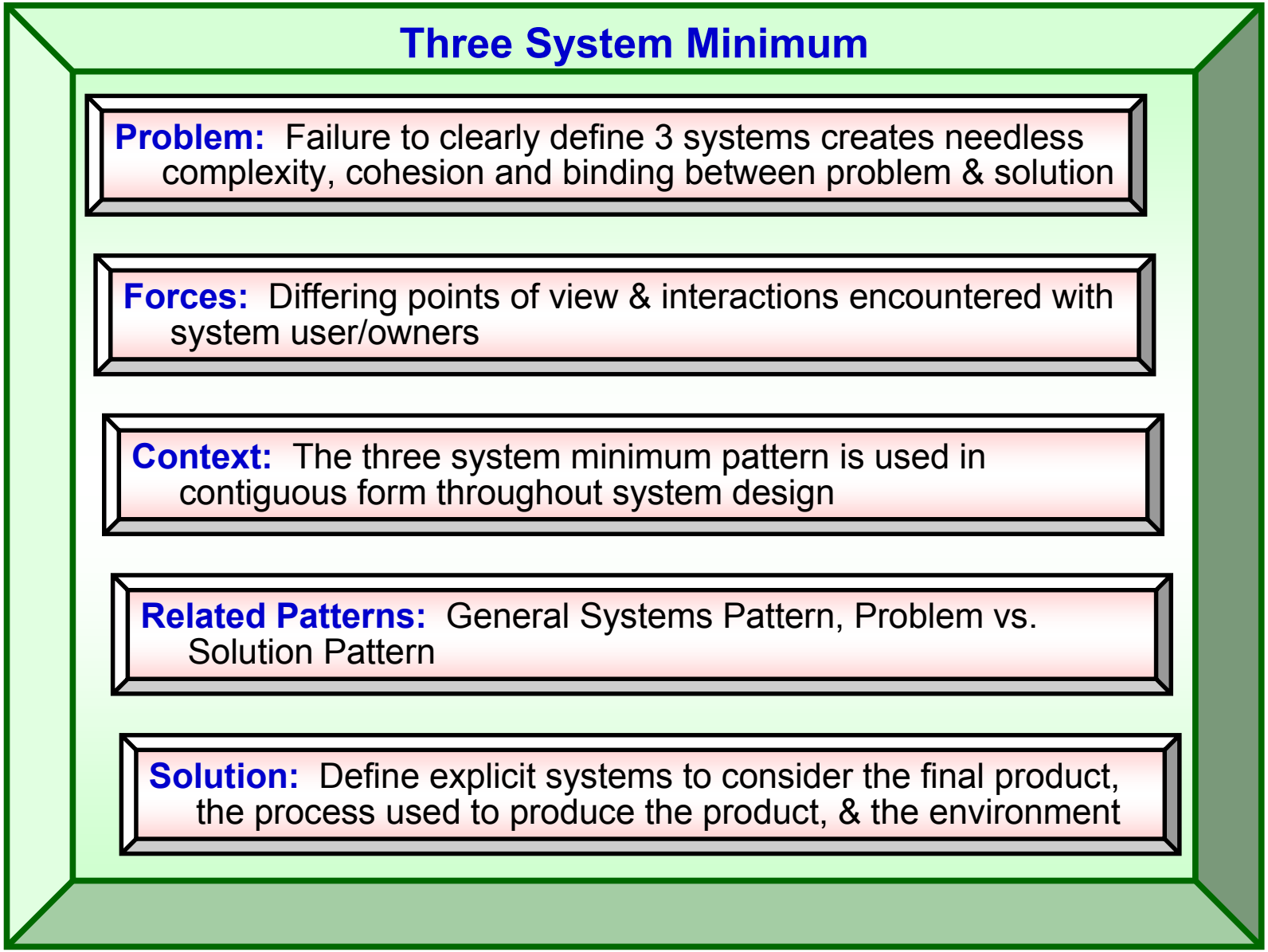
General Systems Pattern



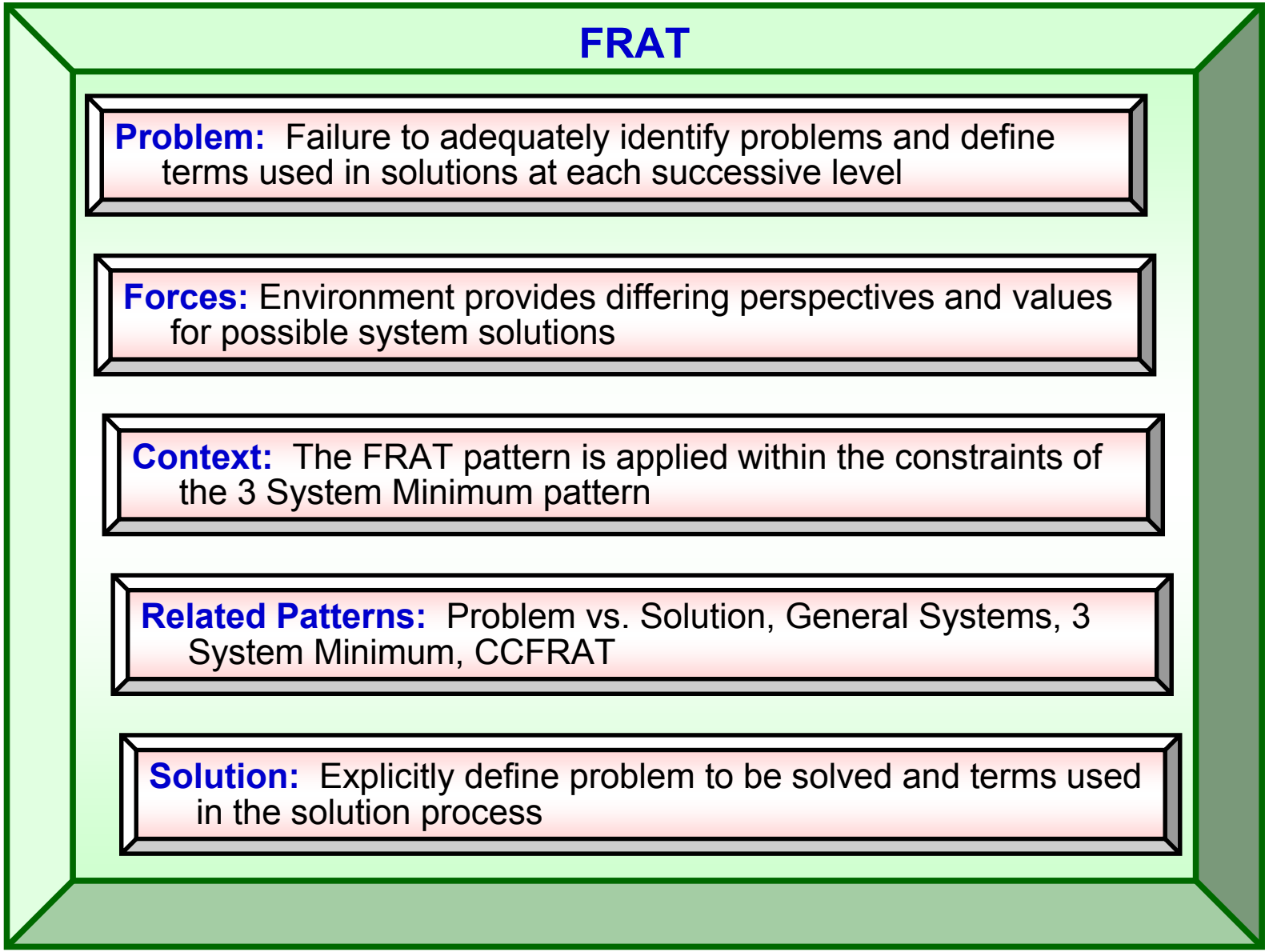
Problem vs. Solution Pattern



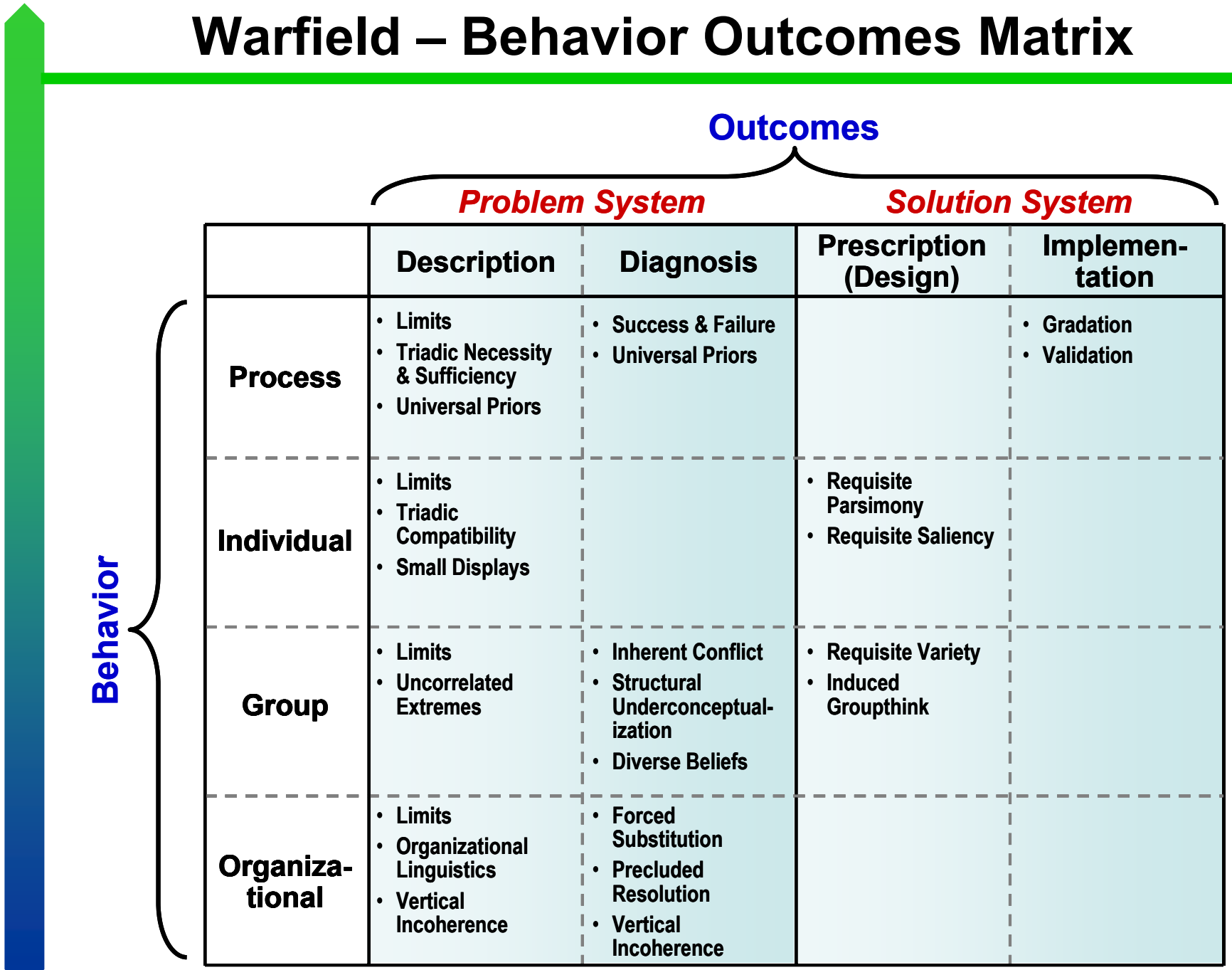
Three System Minimum Pattern



FRAT Pattern



Warfield – Behavior Outcomes Matrix



	Description	Diagnosis	Prescription (Design)	Implementation
Process	• Limits • Triadic Necessity & Sufficiency • Universal Priors	• Success & Failure • Universal Priors		• Gradation • Validation
Individual	• Limits • Triadic Compatibility • Small Displays		• Requisite Parsimony • Requisite Saliency	
Group	• Limits • Uncorrelated Extremes	• Inherent Conflict • Structural Underconceptual-ization • Diverse Beliefs	• Requisite Variety • Induced Groupthink	
Organiza-tional	• Limits • Organizational Linguistics • Vertical Incoherence	• Forced Substitution • Precluded Resolution • Vertical Incoherence		

First and Second Laws of Language

1. **All communication takes place in shared contextual space**, subject to a fairly complex process of disambiguation, depending on the conditions inherent in the other five Laws. (Six laws total)

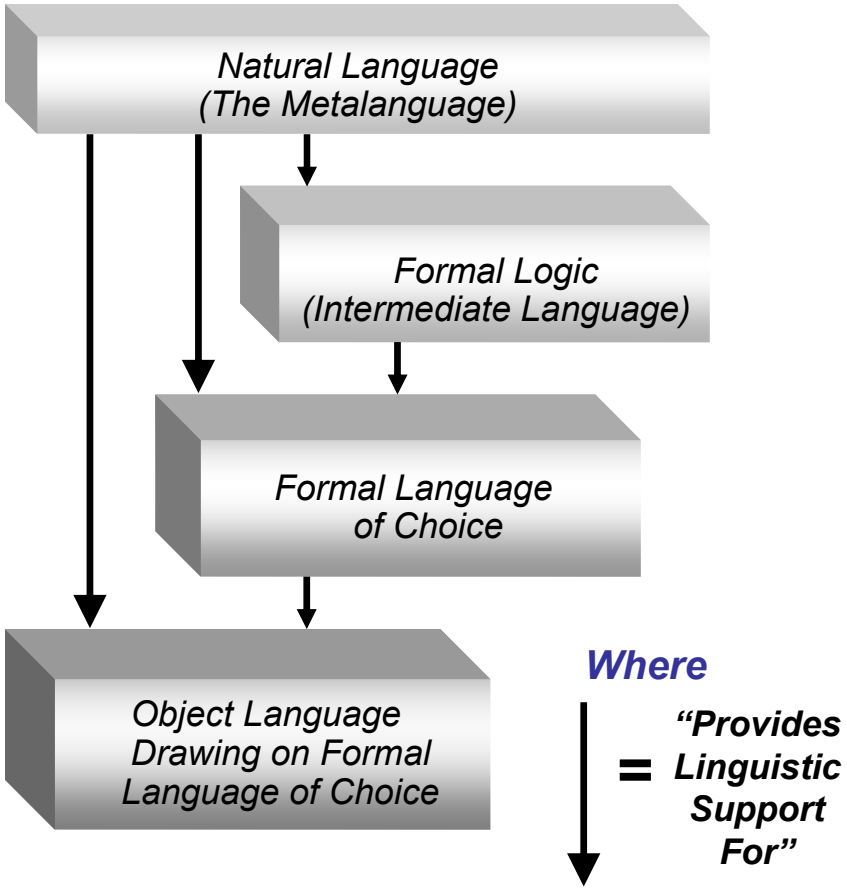
2. **The Law of Variable Context**

   If two people share sufficient context, almost any words, including sheer nonsense--or no words at all--will suffice for them to communicate with each other. If two people do not share sufficient context, then not all the words in the world may be enough for them to grasp each other's meaning. Where intermediate degrees of partial, fragmented, or otherwise limited or "noise-distorted" context are shared, communication will be proportionately difficult and/or unsuccessful.

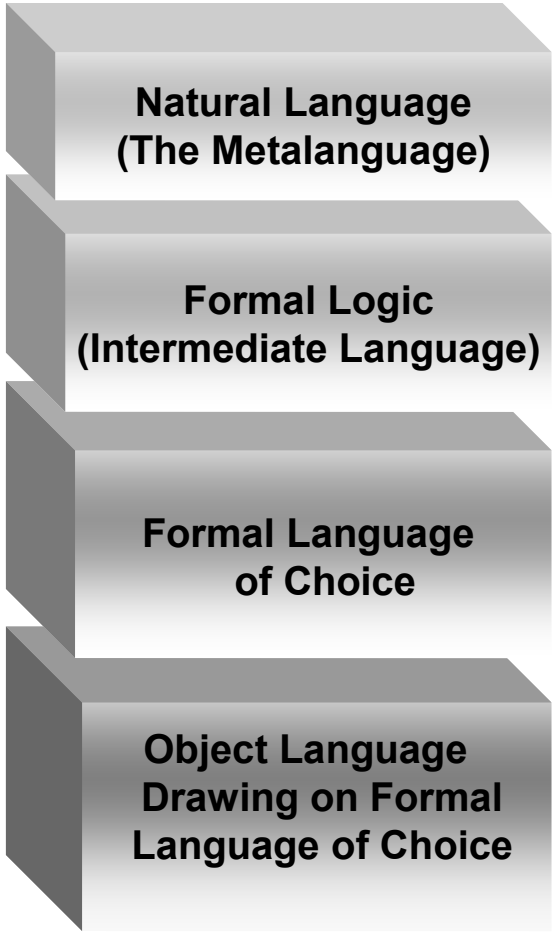
Alexander Gross http://language.home.sprynet.com/

Systems Language Design Capability

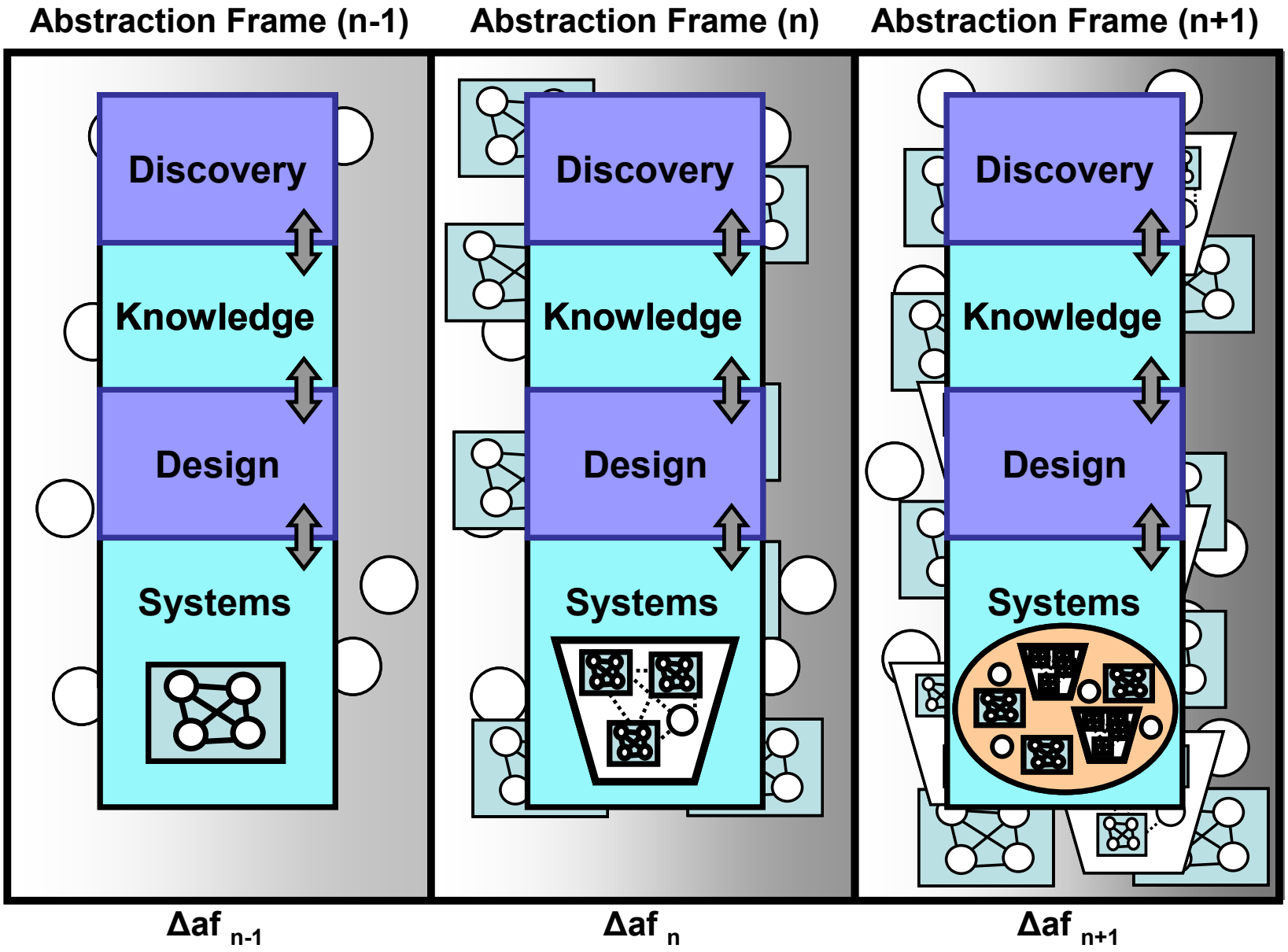
Initial Inter-Relationships Defined: "Pattern of Infrastructure"



In Terms of an Abstraction Stack



Sequential Frameworks

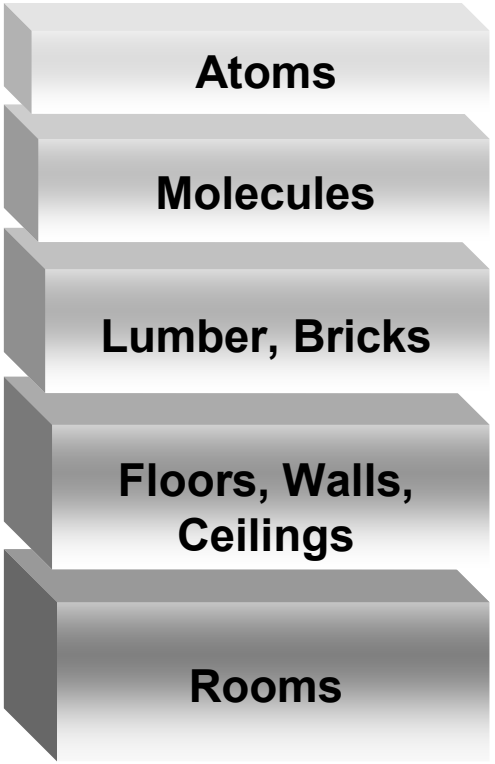


Abstraction Stacks

A House Consists of:

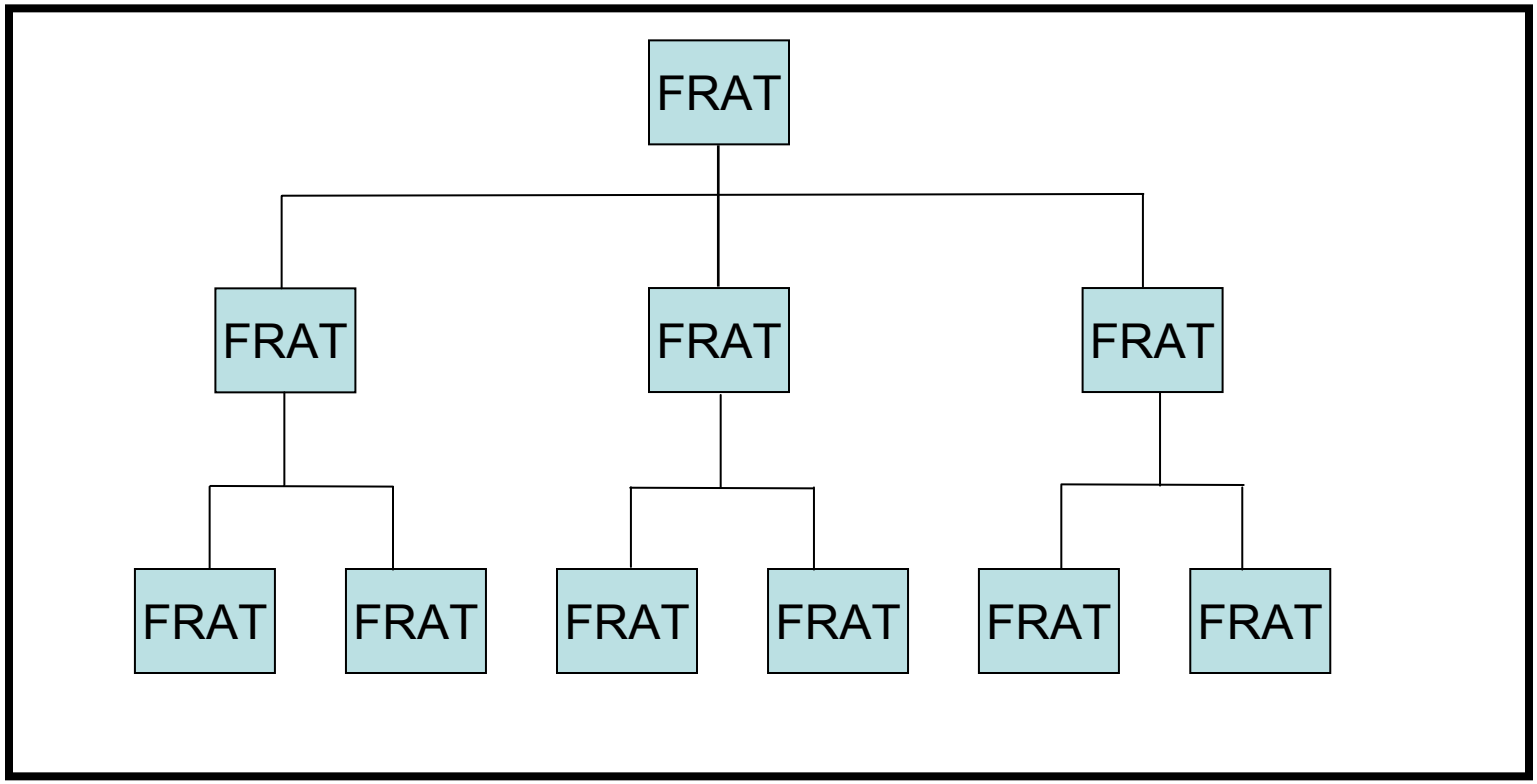
*"… house consists of several thousand pounds of carbon, some complex polymers, about 5000 bricks, two bathrooms, and 13 ceilings…"

Use of Abstraction 'Stacks'



Relationship Types

Hierarchal Relationship Type: "..content can be almost completely disassociated from a hierarchy, but there does not seem to be any way to disassociate structure from it and still portray it." *Warfield 2003*.



Summary

Well established and understood systems engineering patterns provide the foundation for the communication of complex systems concepts. A core set of systems engineering patterns has been presented to stimulate the development and discussion of systems engineering patterns. The 'related patterns' component is a necessary component of the pattern template and provides the basis for the construction of pattern languages using these related patterns.

Systems engineering patterns are one of the first steps in the representation of shared systems engineering context. The greater the span and depth of the shared systems engineering context, the greater the potential for precise systems engineering communication.