



INCOSE 2006

Foundational Systems Engineering (SE) Patterns for a SE Pattern Language

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Overview

- **Pattern Form**
- **General Systems Pattern**
- **Behavior Outcomes Matrix**
- **Exploring Relationships**
 - **Laws of Language**
 - **System Language Design Capability**
 - **Sequential Frameworks**
 - **Abstraction Stacks**
 - **Relationship Types**
- **Summary**

Pattern Form

Evocative Name

Problem Statement that presents difficulty, uncertainty in situation

Forces or tensions that influence pattern application

Context within which the pattern will be applied

Related Patterns may be connected in some way to current pattern

Solution that resolves the problem within the given context

General Systems Pattern

General Systems (GS)

Problem: Entropy and chaos exist for multiple facets of society as a result of increasingly complex activities

Forces: Different values in global community create tensions regarding inputs, outputs, boundaries, applicable transforms

Context: Complex sociotechnical, social, and industrial activities require shared approach to reduce entropy and chaos

Related Patterns: The general systems pattern will relate to all the patterns that are presented in this paper

Solution: Apply a systems approach to reduce entropy, complexity, and start to resolve core issues

Warfield – Behavior Outcomes Matrix

		Outcomes			
		Problem System		Solution System	
		Description	Diagnosis	Prescription (Design)	Implementation
Behavior	Process	<ul style="list-style-type: none"> Limits Triadic Necessity & Sufficiency Universal Priors 	<ul style="list-style-type: none"> Success & Failure Universal Priors 		<ul style="list-style-type: none"> Gradation Validation
	Individual	<ul style="list-style-type: none"> Limits Triadic Compatibility Small Displays 		<ul style="list-style-type: none"> Requisite Parsimony Requisite Saliency 	
	Group	<ul style="list-style-type: none"> Limits Uncorrelated Extremes 	<ul style="list-style-type: none"> Inherent Conflict Structural Underconceptualization Diverse Beliefs 	<ul style="list-style-type: none"> Requisite Variety Induced Groupthink 	
	Organizational	<ul style="list-style-type: none"> Limits Organizational Linguistics Vertical Incoherence 	<ul style="list-style-type: none"> 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)

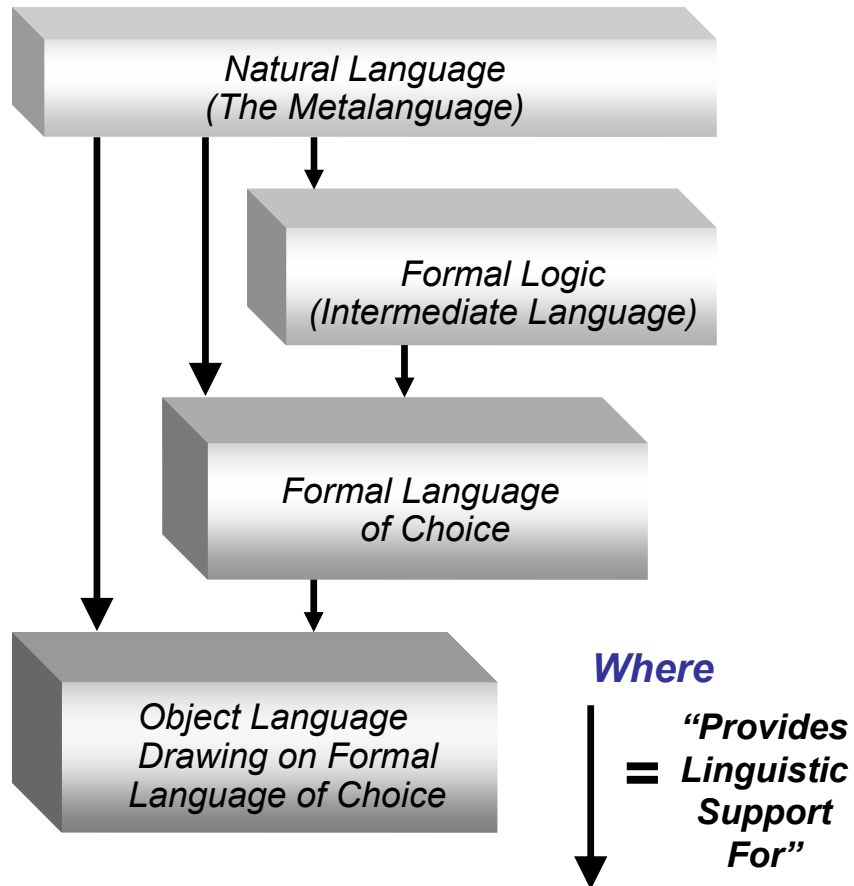
2. The Law of Variable Context

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.

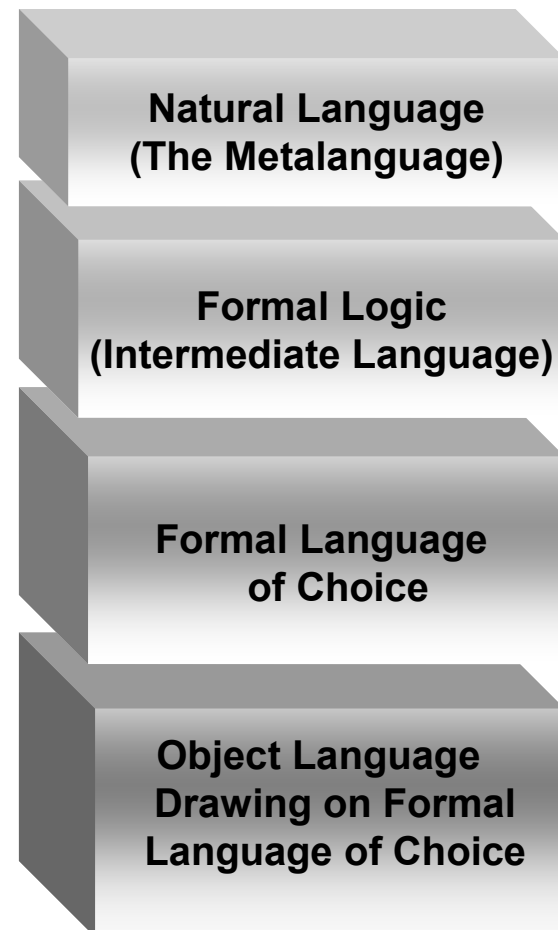
Alexander Gross <http://language.home.sprynet.com/>

Systems Language Design Capability

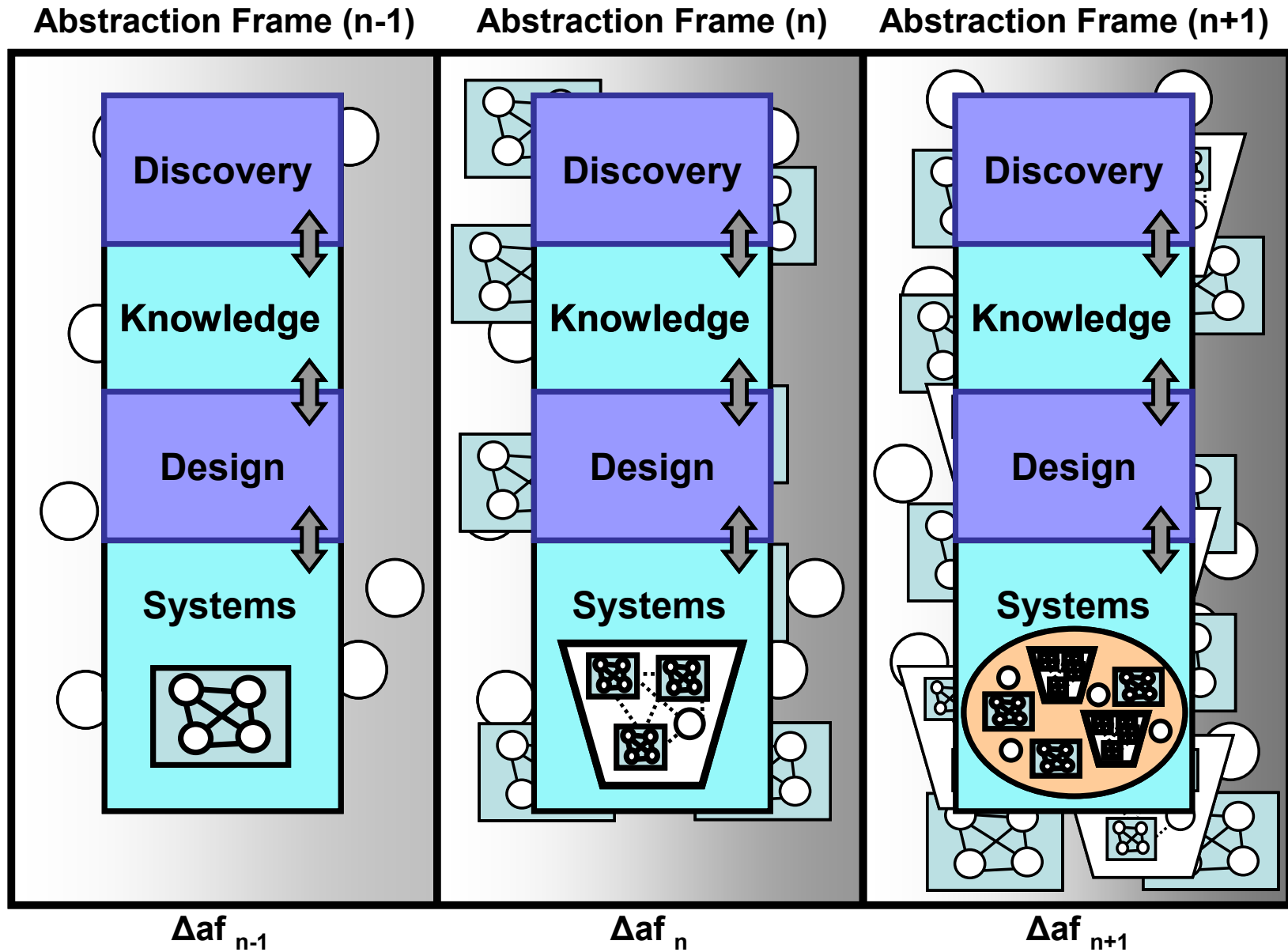
Initial Inter-Relationships Defined: “Pattern of Infrastructure”



In Terms of an Abstraction Stack

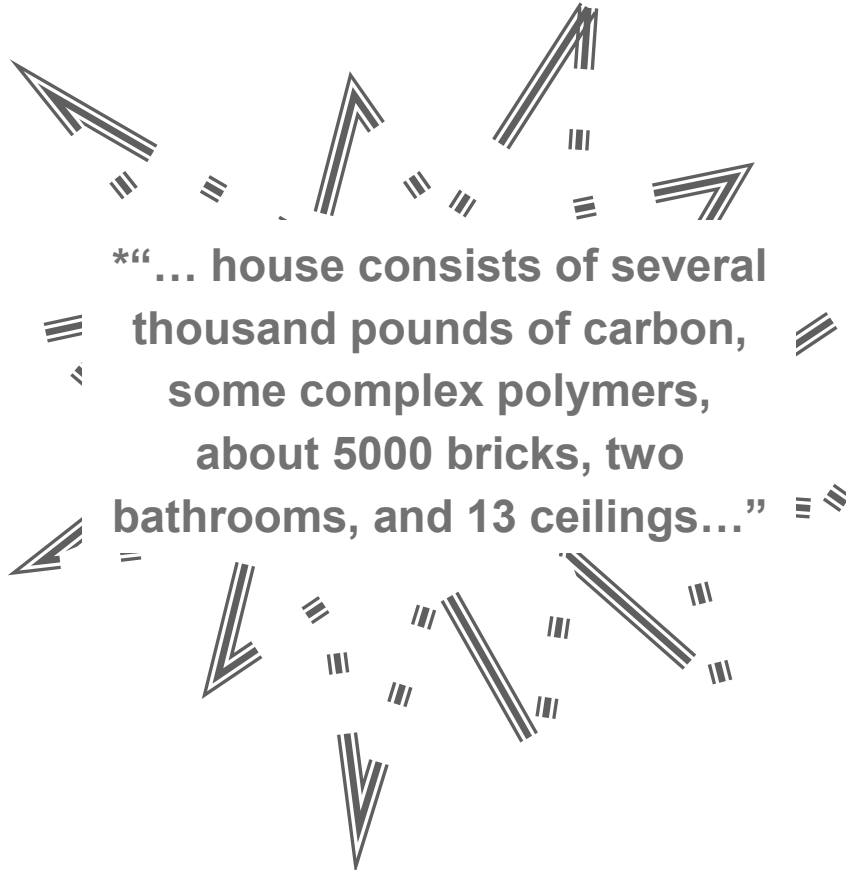


Sequential Frameworks

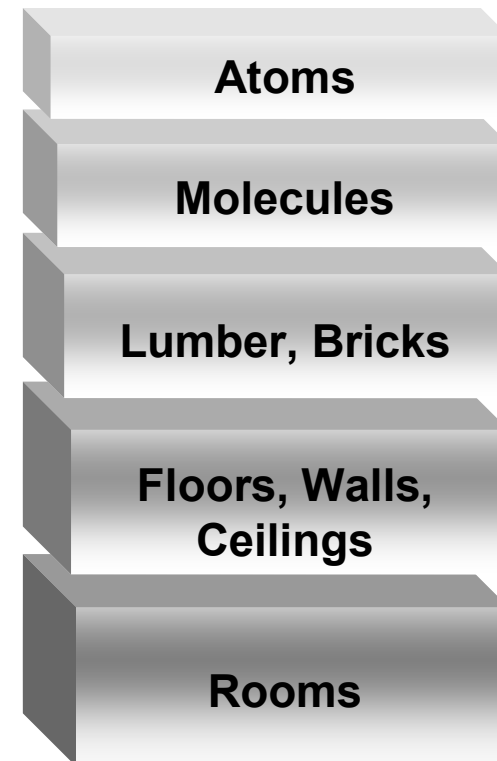


Abstraction Stacks

A House Consists of:

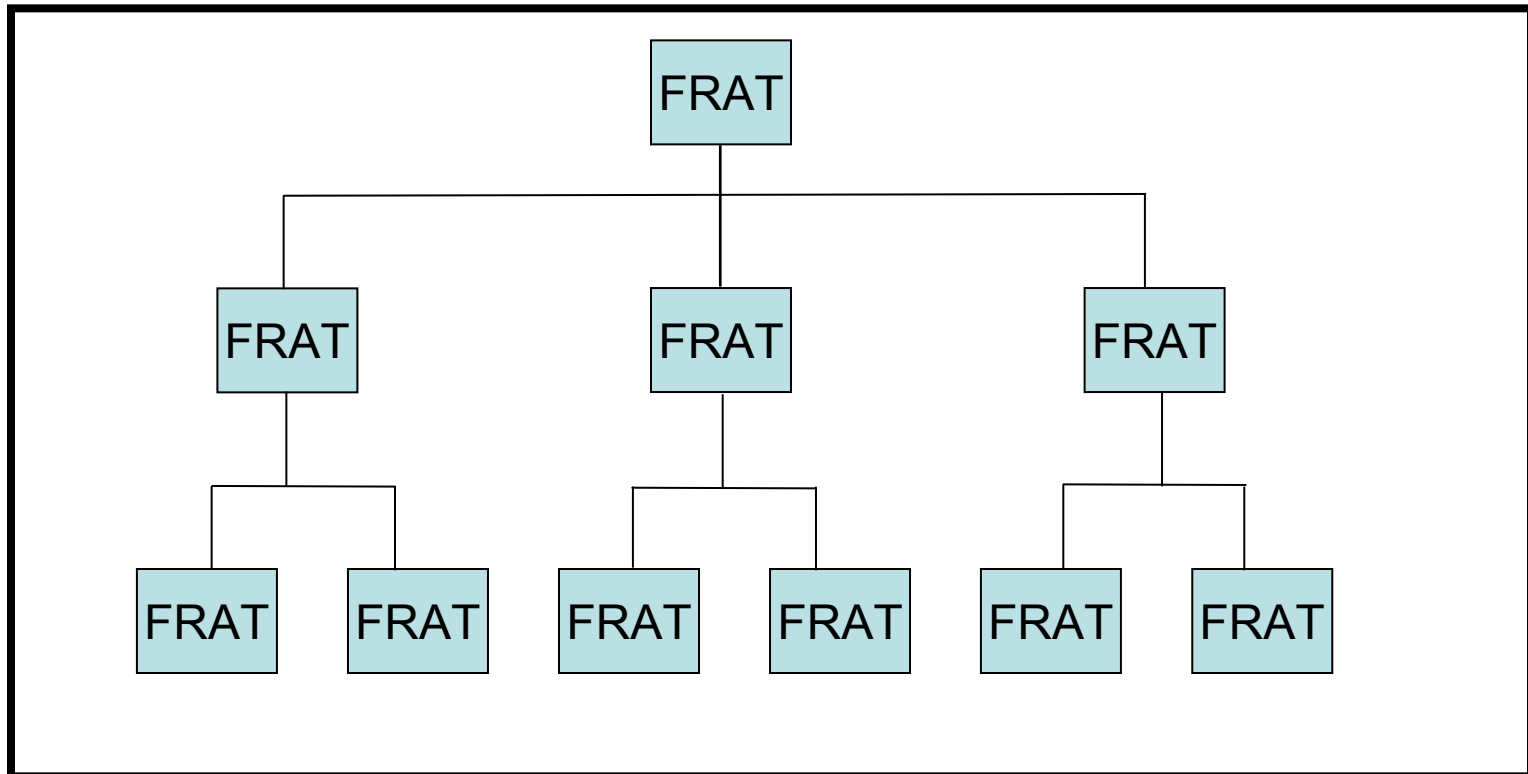


Use of Abstraction ‘Stacks’



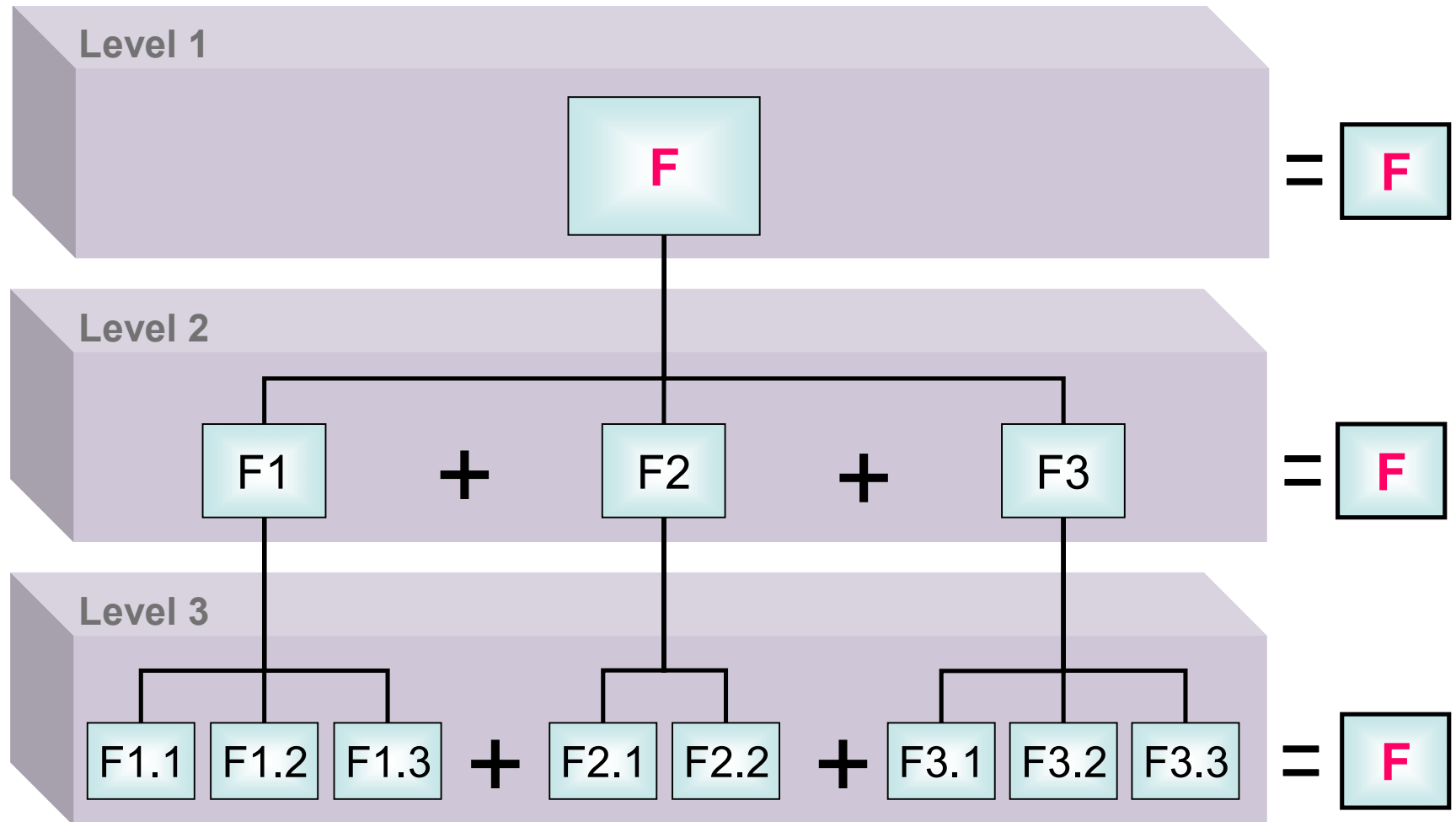
Relationship Types

Hierarchical 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.*



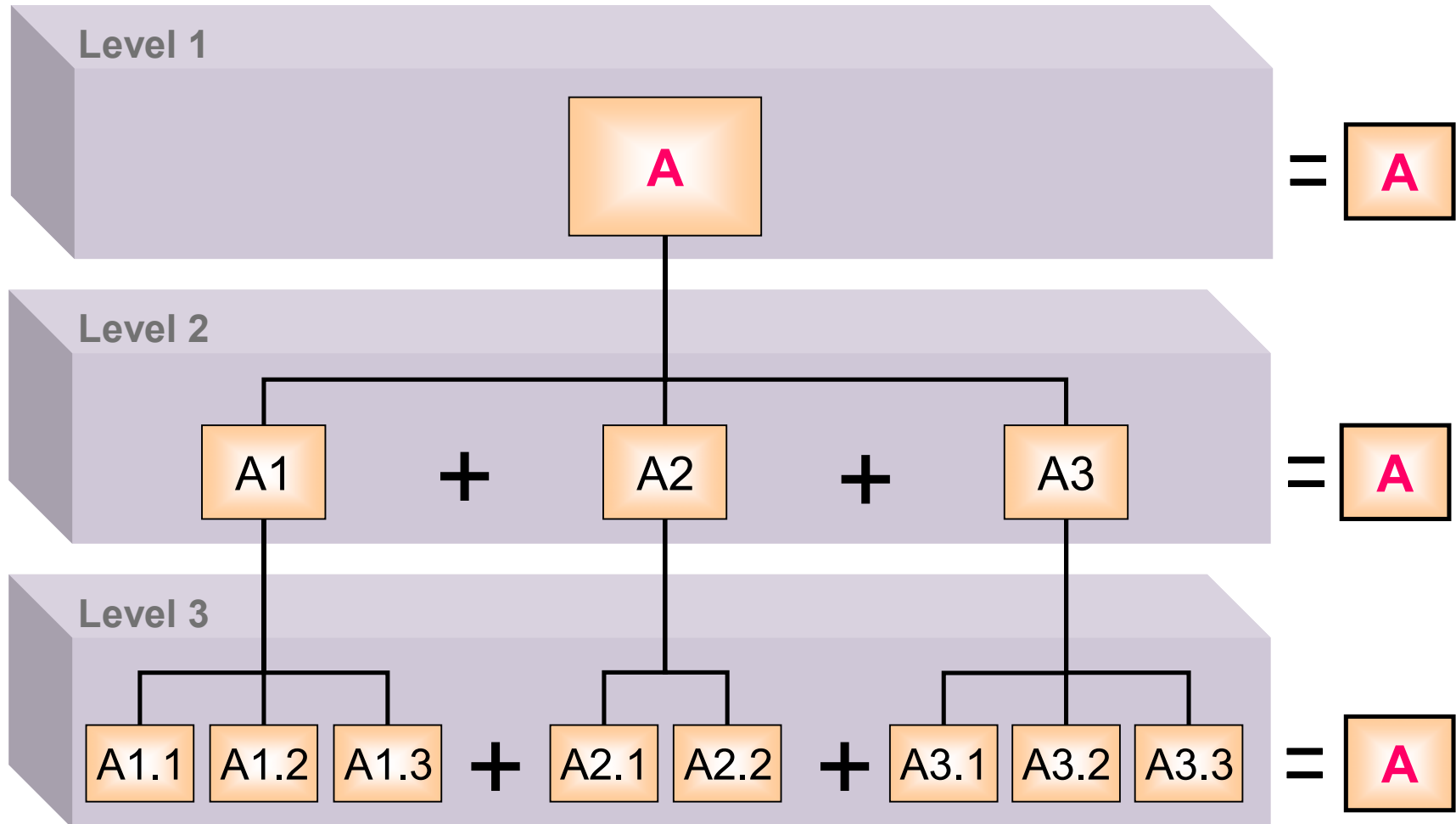
Functional Decomposition

Functions at each level are equivalent



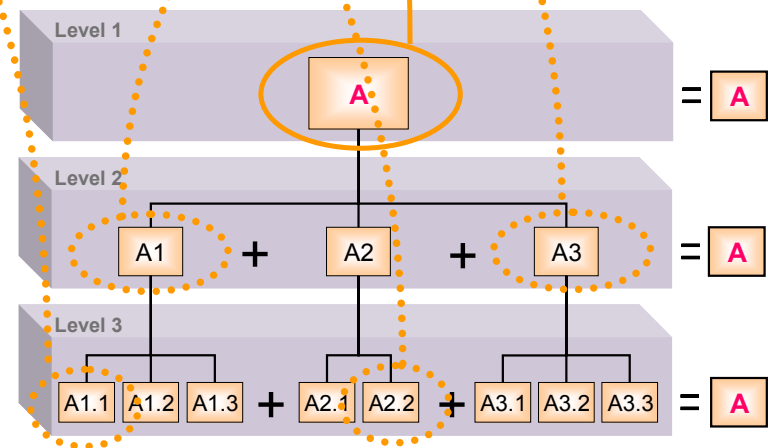
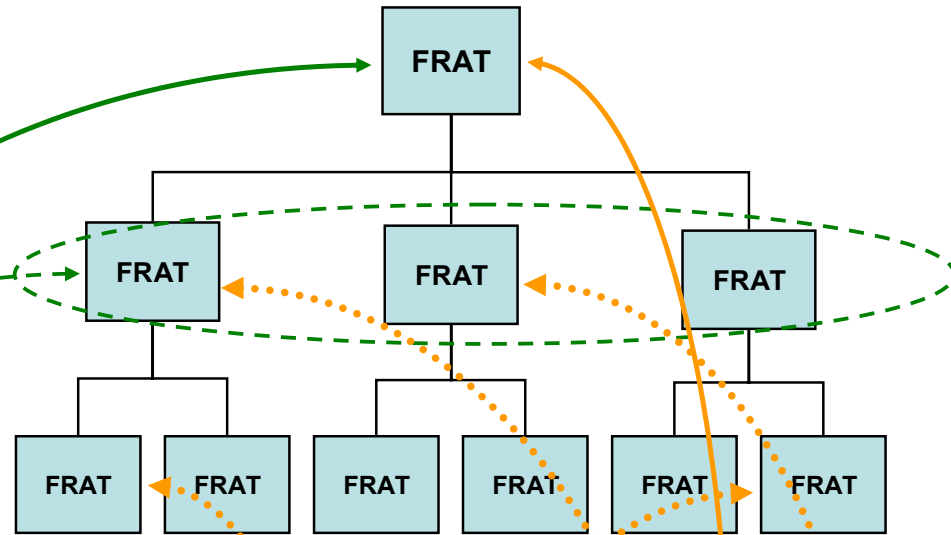
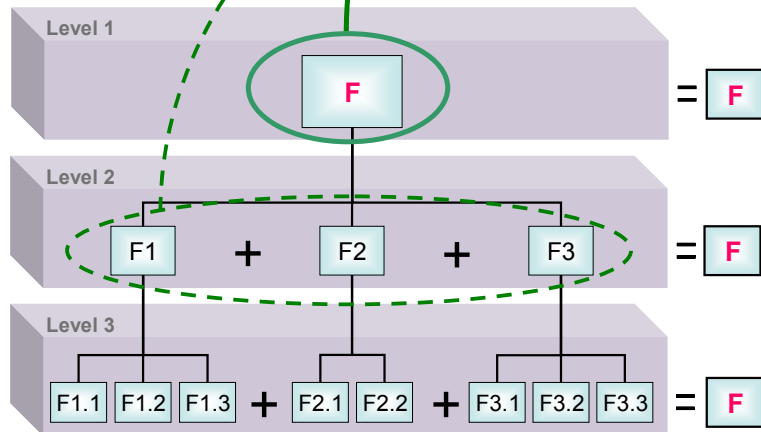
Physical Architecture Decomposition

Physical architecture parts at each level are equivalent



FRAT Hierarchal Relationships

When



Summary

- Well established and understood SE patterns provide the foundation for the communication of complex systems concepts.
- 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.
- A core set of SE patterns is presented in the paper to stimulate the development and discussion of SE patterns.
- SE patterns are one of the first steps in the representation of shared SE context. The greater the span and depth of the shared SE context, the greater the potential for precise SE communications.