Thriving Systems Theory & Design Quality

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Waltham Massachusetts

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Thriving Systems Theory and Metaphor-Driven Modeling

How is it that one system is more effective, appealing, satisfying and/or more beautiful than another to its stakeholder community? This question drove Christopher Alexander's fifty-year quest to explain great physical architecture and give birth to pattern-languages for building that underpin much of modern systems engineering.

How is it that so many individual stakeholders consistently recognize the same quality, the same beauty in a system? This question led George Lakoff to research the role of conceptual metaphor in human understanding.

What is essential to stakeholders' satisfaction with systems? Fred Brooks addressed this question in No Silver Bullet: Essence and Accidents of Software Engineering.

This monograph fuses these diverse streams of thought in proposing Thriving Systems Theory by translating Alexander's properties of physical design quality into the abstract domain of information systems and modeling. Metaphor-Driven Modeling incorporates the theory while examining its impact throughout the system life cycle: modeling, design and deployment. The result is holistic and innovative, a perspective on system quality invaluable to students, practitioners and researchers of software and systems engineering.

Les Waguespack is a computer science Ph.D., professor and chairperson of computer information systems at Bentley University, USA. Dr. Waguespack's experience as programmer, software engineer, software architect, database architect, project manager and systems consultant underpins 35 years of teaching and research, the last 20+ years teaching object-oriented modeling and systems engineering to undergraduates, graduate students and practicing professionals.

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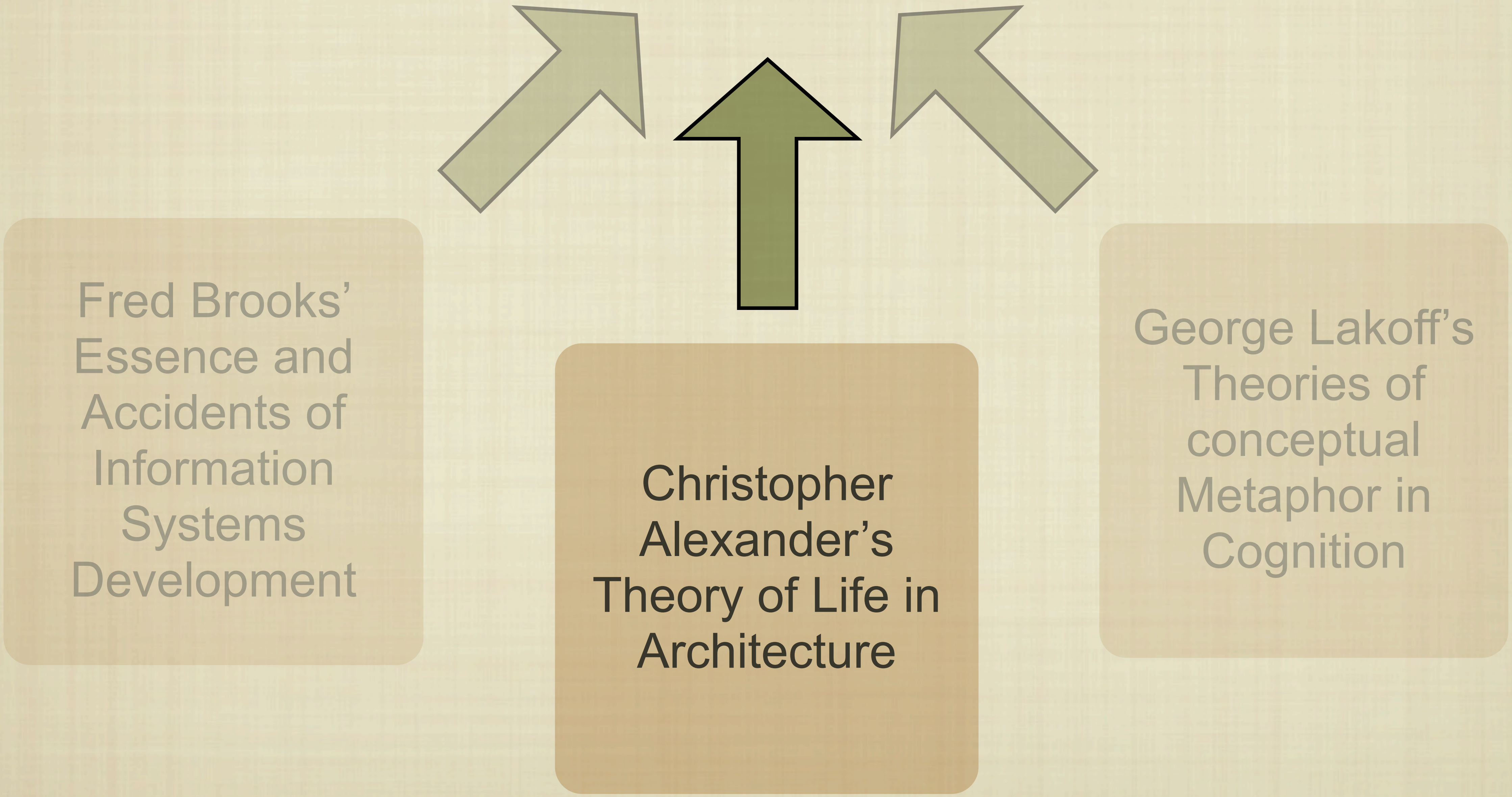

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"I believe the hard part of building software to be the specification, design, and testing of this conceptual construct, not the labor of representing it and testing the fidelity of the representation."

Brooks, Frederick P., "No Silver Bullet: Essence and Accidents of Software Engineering," *Computer*, Vol. 20, No. 4 (April 1987) pp. 10-19.

George Lakoff's Theories of Metaphor in Cognition

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- The physiology of the human brain is "hard-wired" to store, retrieve and correlate memory aided by categorization to a particular primary metaphor whose attributes are automatically ascribed to the new event (through immediate conceptual mapping via neural connections).
- Integrated in a spatial-motor sense of our surroundings (reaching for, moving toward or away from, being over, under, inside or outside of, surrounded by) the sensorimotor system of our experience is a continuous source of physical metaphors that frame our consciousness and our subjectivity.

Lakoff, G. and M. Johnson, Metaphors We Live By, University of Chicago Press, Chicago, IL, 1980.
Lakoff, G. and M. Johnson, Philosophy in the Flesh, Basic Books, New York, NY, 1999.
Lakoff, G. and R. Núñez, Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being, Basic Books, New York, NY, 2000.

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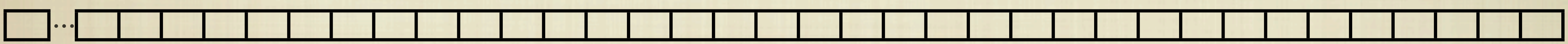
- "Alexander both commands respect and inspires controversy in his own discipline; he is the author of several books with long-running publication records,
  - the first recipient of the AIA Gold Medal for Research,
  - a member of the Swedish Royal Academy since 1980,
  - a member of the American Academy of Arts and Sciences,
  - recipient of dozens of awards and honors including:
    - the Best Building in Japan award in 1985,
    - the American Association of Collegiate Schools of Architecture Distinguished Award."

Threads of Theory in Design



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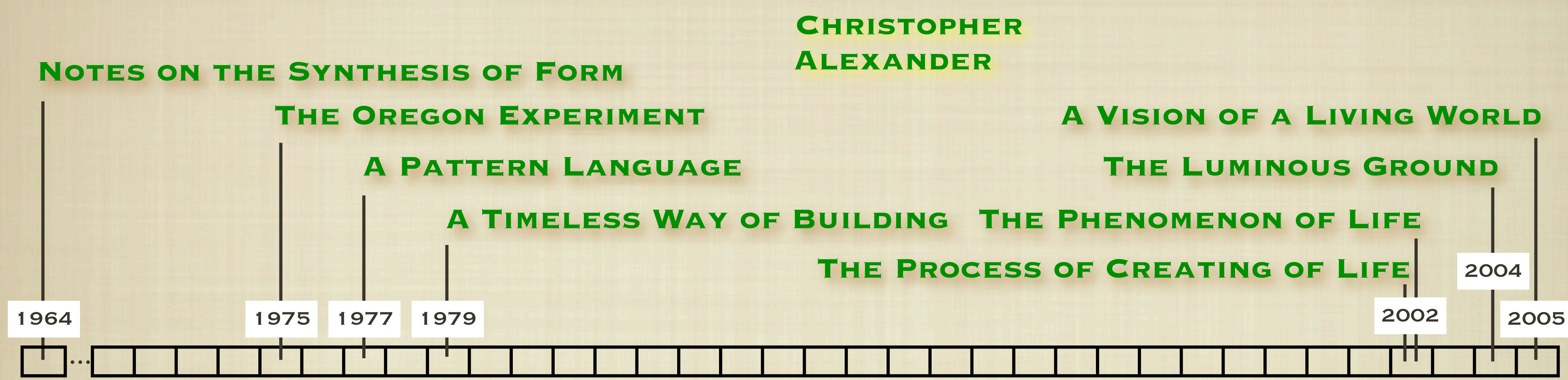

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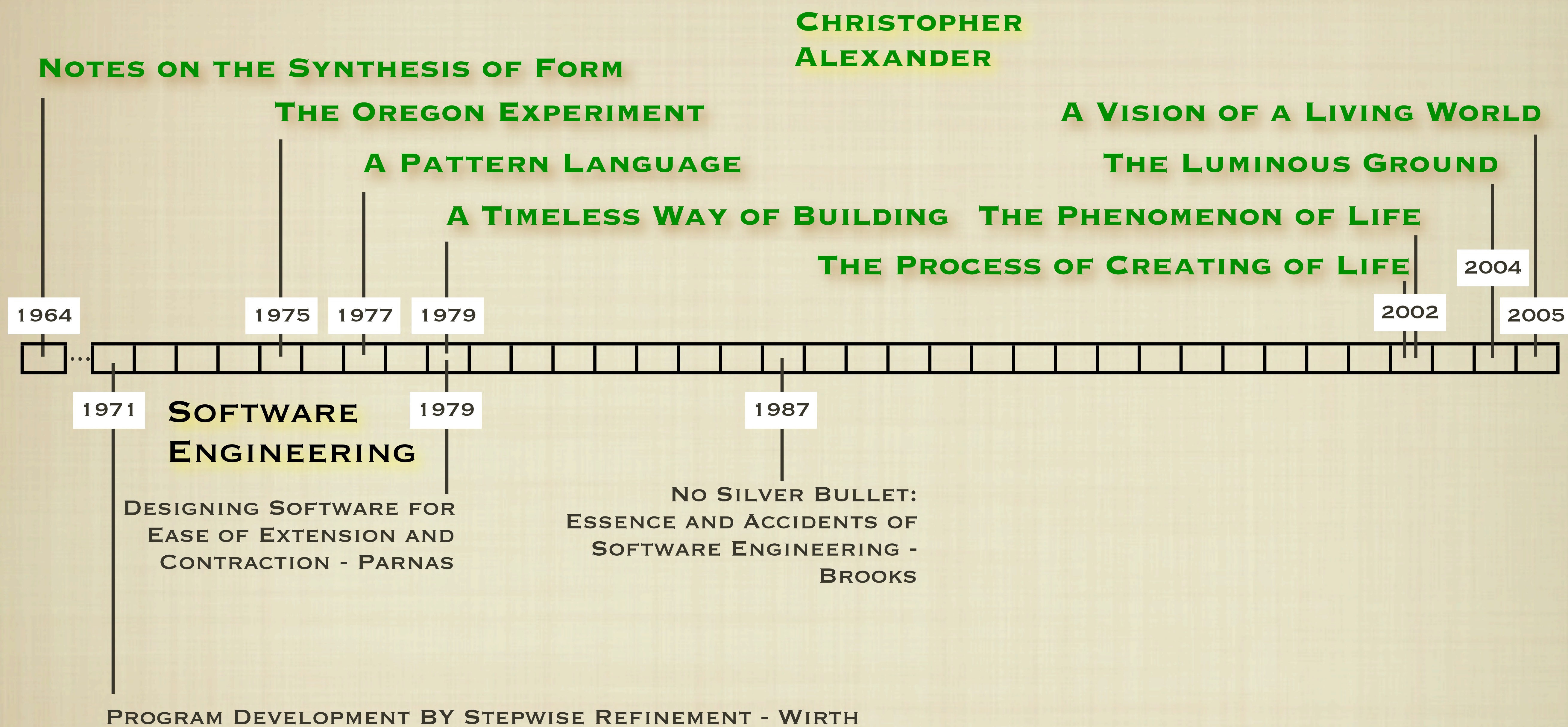

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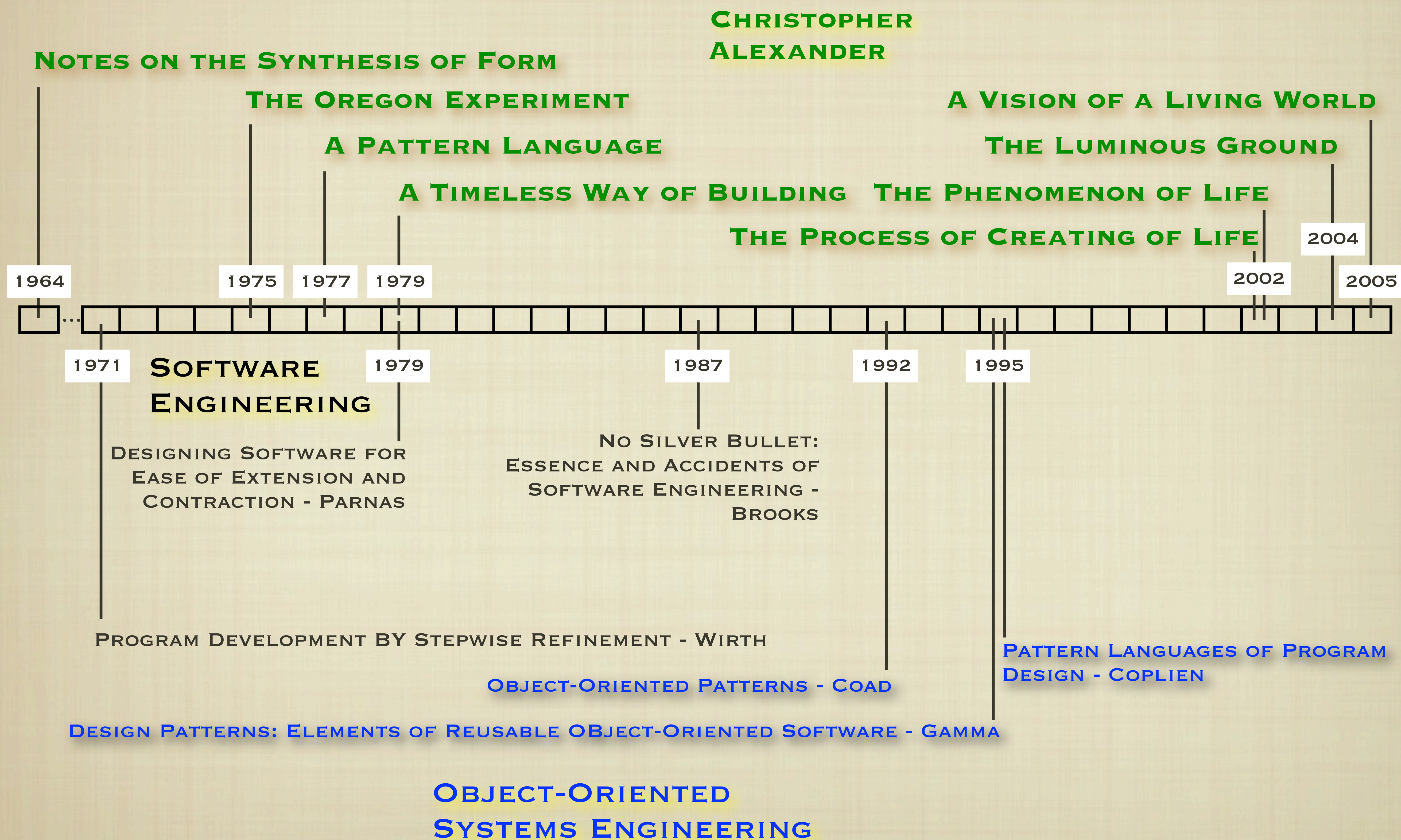

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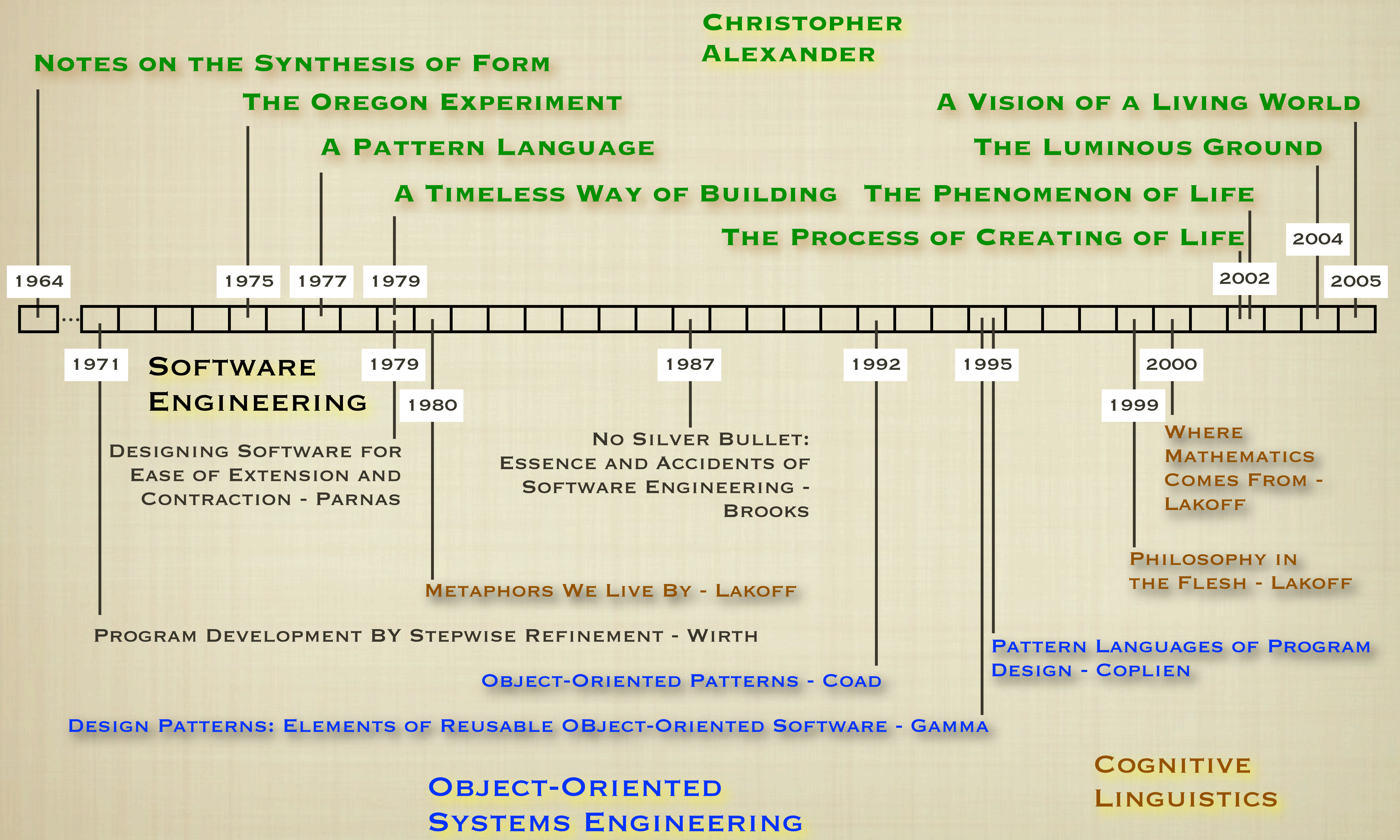

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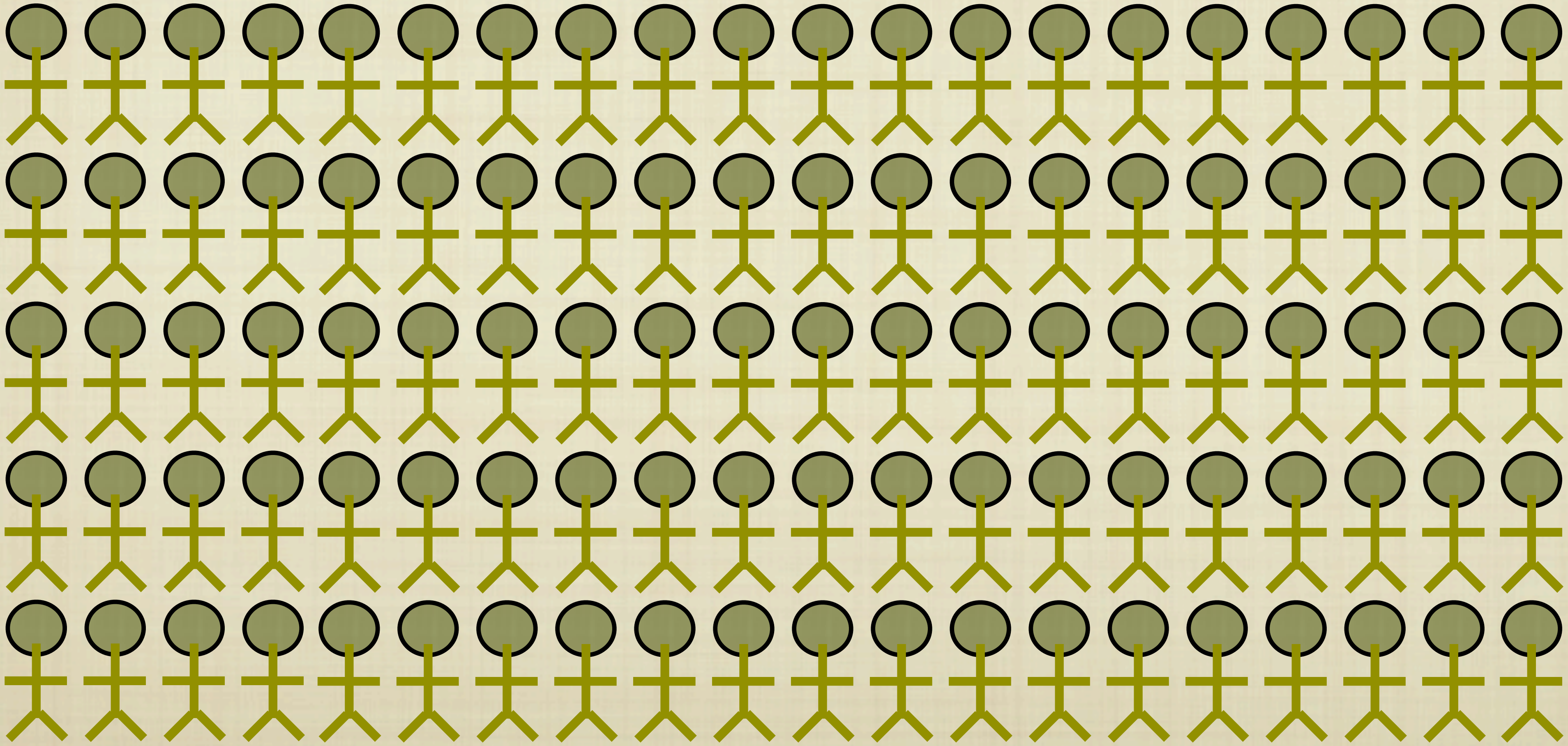

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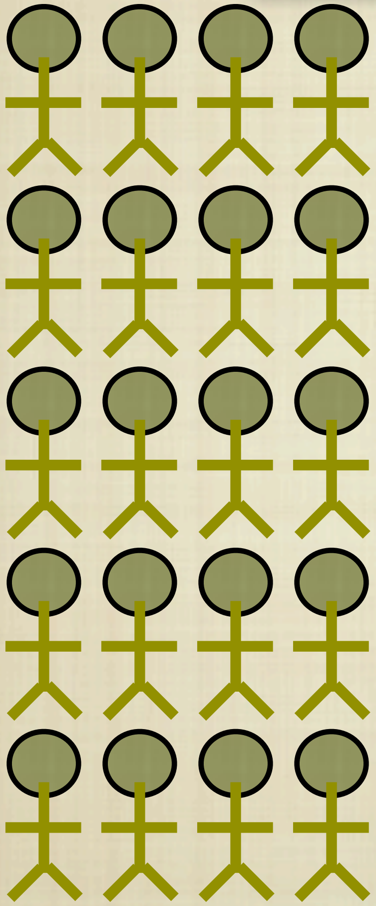

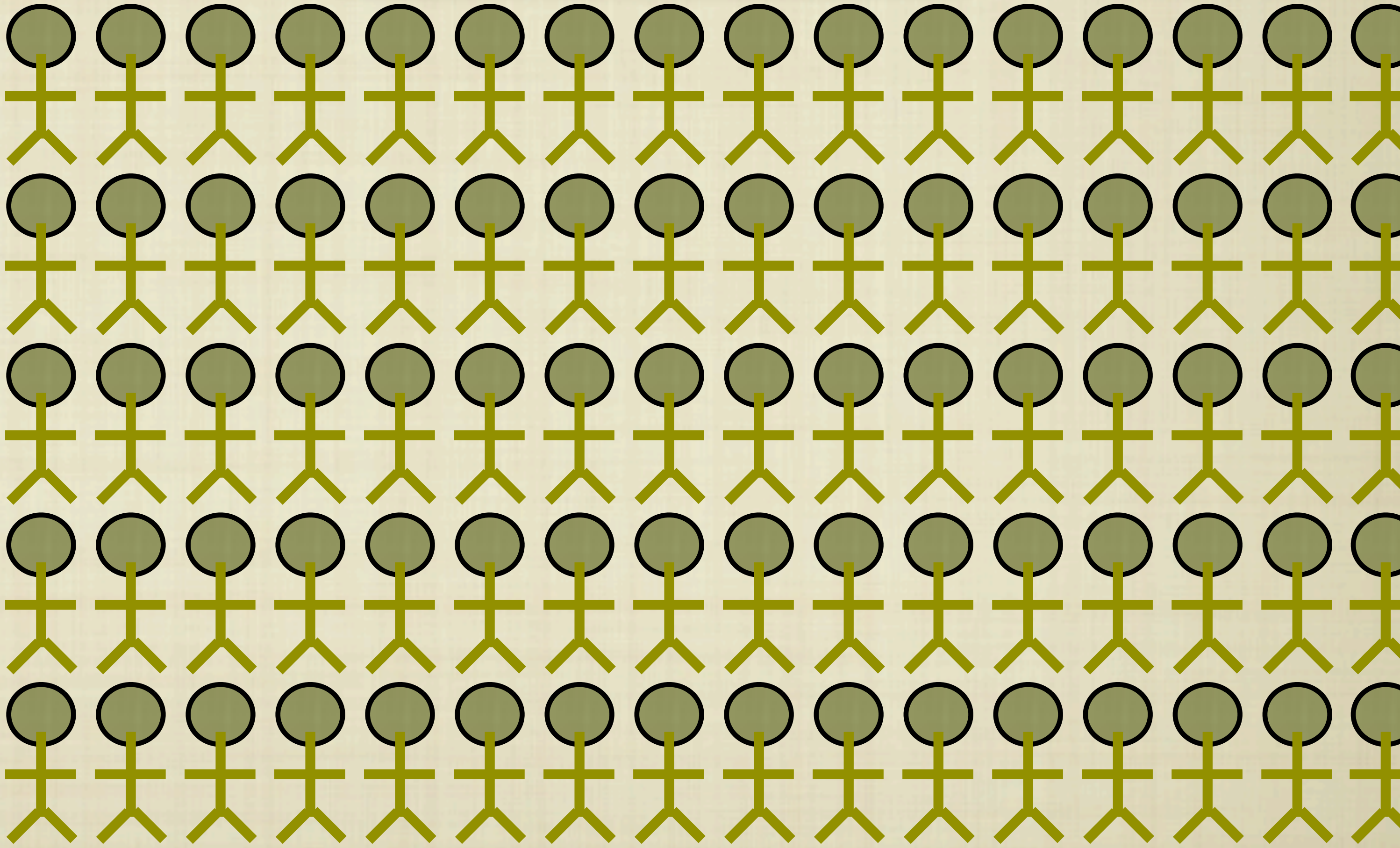

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"The concept extends to any space where objects & relationships are observed."

Alexander, Christopher, The Nature of Order An Essay on the Art of Building and the Nature of the Universe: Book I - The Phenomenon of Life, Berkeley, California: The Center for Environmental Structure, 2002.

The Nature of Order

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- Wholeness is stable, disorder is not!

Centers in Wholeness

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- "In any given region of space, some sub-regions have higher intensity as centers; others have less…or none. The overall configurations of their nested centers, together with their relative intensities, comprise a single structure – 'the' Wholeness of that region." (Alexander)

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Alexander's 15 Center Properties Expressing Architectural Quality

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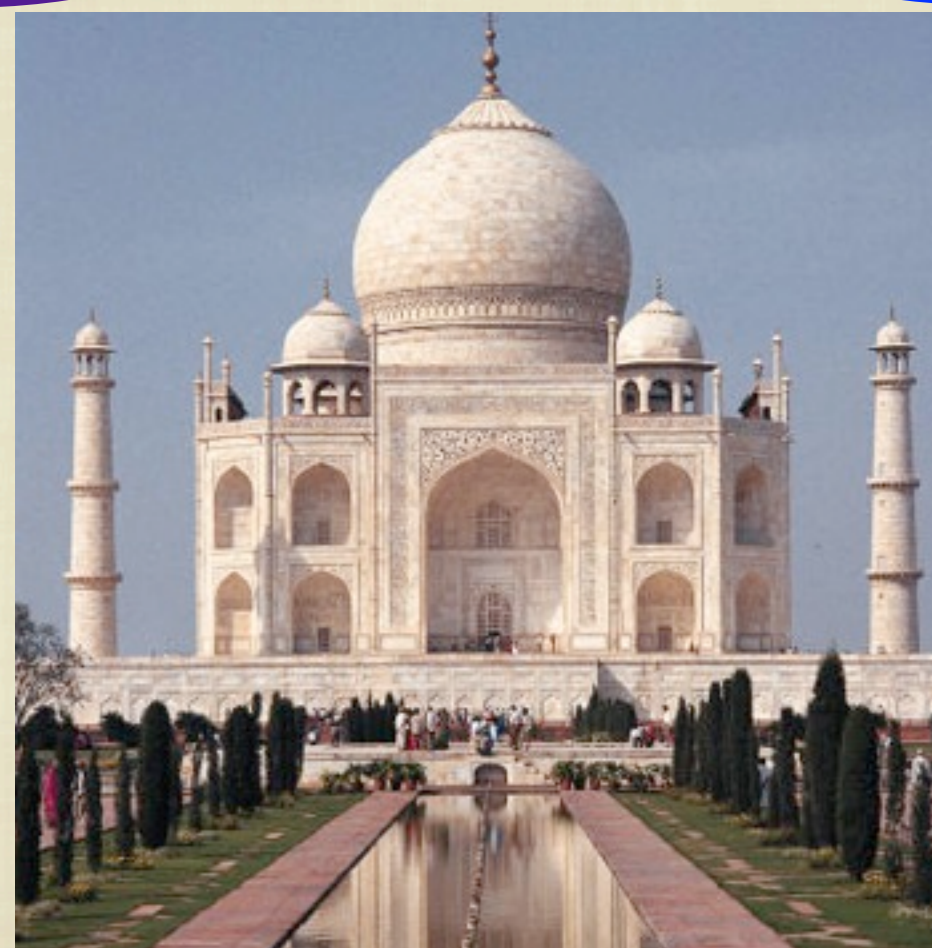
- Strong Centers
- Not Separateness
- Boundaries
- Levels of Scale
- Positive Space
- Gradients
- Deep Interlock and Ambiguity
- Roughness
- Good Shape
- Echoes
- Alternating Repetition
- Local Symmetries
- Simplicity and Inner Calm
- Contrast
- The Void



Levels of Scale: A strong center is made stronger partly by smaller strong centers contained in it, and partly by its larger strong centers which contain it. A balanced range of sizes is pleasing and beautiful.

Positive Space: A center should draw strength from the centers immediately adjacent. The background should reinforce rather than detract from the center.

Strong Centers: A strong center requires a field-like effect created by other centers. Good design offers areas of focus or weight.

Boundaries: The field-like effect is strengthened by the creation of a ring-like center. Outlines focus attention on the center.

Deep Interlock and Ambiguity: The intensity of a center can be increased when it is attached to nearby strong centers through a third set of strong centers that ambiguously belong to both. Looping, interconnected elements promote unity and grace.

Gradients: A center is strengthened by a graded series of different sized centers which then point to a new center. The proportional use of space and pattern creates harmony.

Local Symmetries: The intensity of a center is increased by the extent to which other smaller centers are themselves arranged in locally symmetrical groups. Organic, small-scale symmetry works better than precise, overall symmetry.

The Void: The intensity of every center depends on the existence of a still place – an empty center. Empty spaces offer calm and contrast.

Good Shape: The strength of a center depends on its actual shape. Its boundaries and the space around it must be made up of strong centers. Simple forms create an intense, powerful center.

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Roughness: The way a center draws its strength from irregularities in sizes, shapes and arrangements. Texture and imperfections convey uniqueness and life.

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Echoes: The strength of a given center depends on similarities of angle and orientation. Similarities should repeat themselves throughout a design.

Contrast: A center is strengthened by the sharpness of distinction between itself and the surrounding centers. Unity is achieved with visible opposites.

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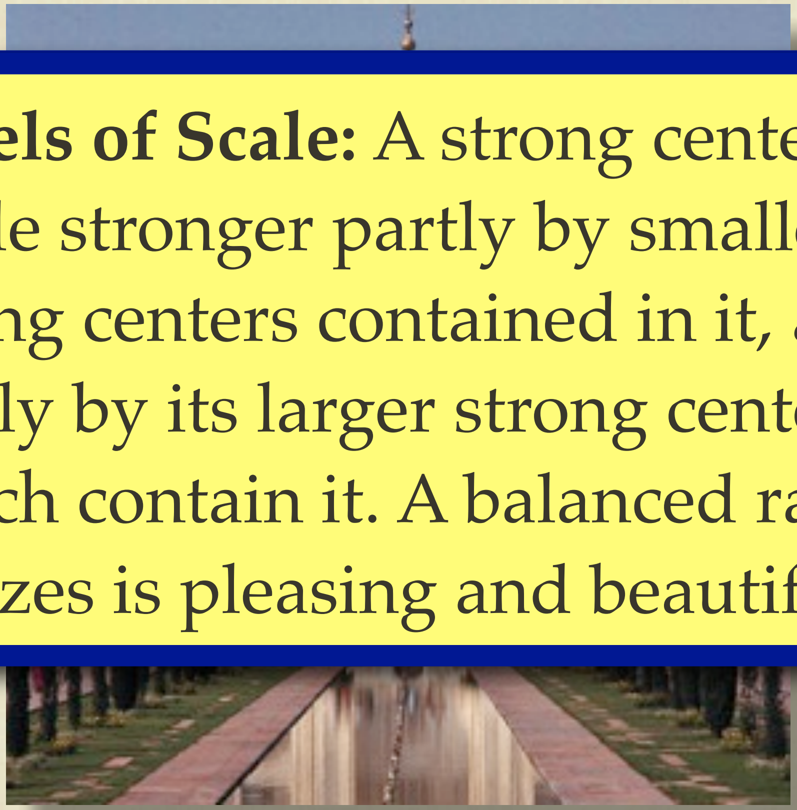

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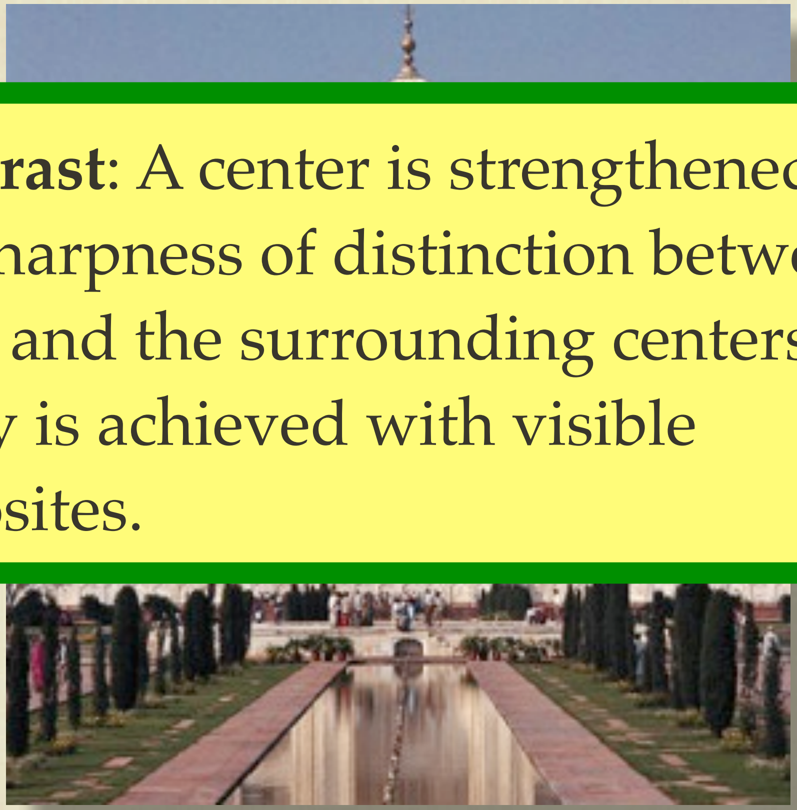

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Positive Space: A center should draw strength from the centers immediately adjacent. The background should reinforce rather than detract from the center.

Strong Centers: A strong center requires a field-like effect created by other centers. Good design offers areas of focus or weight.

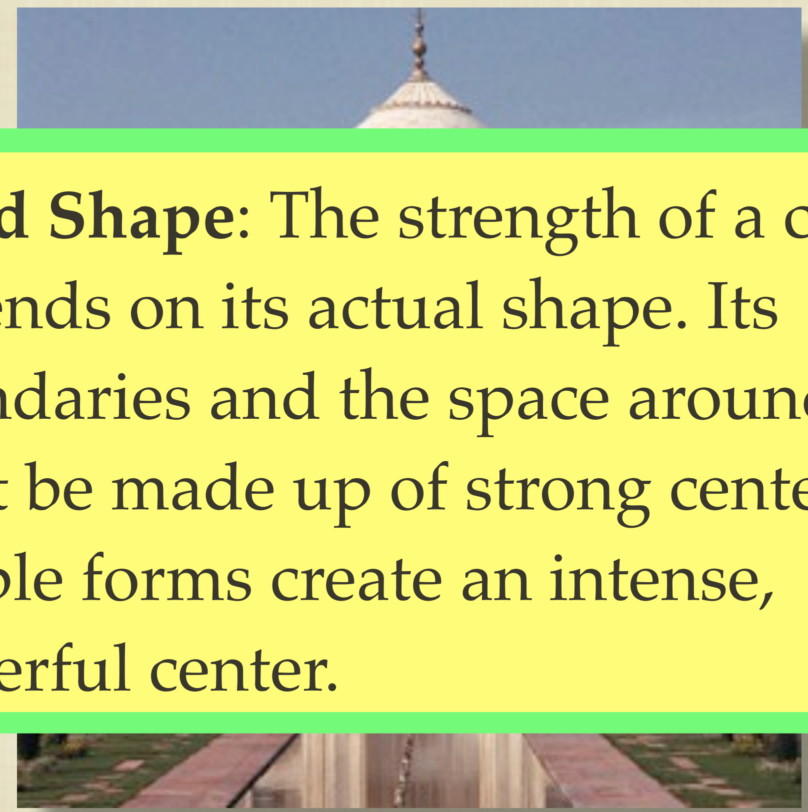
Boundaries: The field-like effect is strengthened by the creation of a ring-like center. Outlines focus attention on the center.

Deep Interlock and Ambiguity: The intensity of a center can be increased when it is attached to nearby strong centers through a third set of strong centers that ambiguously belong to both. Looping, interconnected elements promote unity and grace.

Gradients: A center is strengthened by a graded series of different sized centers which then point to a new center. The proportional use of space and pattern creates harmony.

Local Symmetries: The intensity of a center is increased by the extent to which other smaller centers are themselves arranged in locally symmetrical groups. Organic, small-scale symmetry works better than precise, overall symmetry.

The Void: The intensity of every center depends on the existence of a still place – an empty center. Empty spaces offer calm and contrast.



Good Shape: The strength of a center depends on its actual shape. Its boundaries and the space around it must be made up of strong centers. Simple forms create an intense, powerful center.

Contrast: A center is strengthened by the sharpness of distinction between itself and the surrounding centers. Unity is achieved with visible opposites.

Not Separateness: The strength of a center depends on the extent to which that center is merged smoothly with surrounding centers. Designs should be connected and complementary, not egocentric and isolated.

Good Shape: The strength of a center depends on its actual shape. Its boundaries and the space around it must be made up of strong centers. Simple forms create an intense, powerful center.

Roughness: The way a center draws its strength from irregularities in sizes, shapes and arrangements. Texture and imperfections convey uniqueness and life.

Alternating Repetition: Centers are strengthened when they repeat, by the insertion of other centers between them. Repeating various elements creates a sense of order and harmony.

Echoes: The strength of a given center depends on similarities of angle and orientation. Similarities should repeat themselves throughout a design.

Simplicity and Inner Calm: The strength of a center depends on its simplicity. Use only essentials and avoid extraneous elements.

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Center Properties

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Contrast
Gradients
Roughness
Echoes
The Void
Simplicity and Inner Calm
Not Separateness

a taxonomy / vocabulary of design elements that evoke the experience of quality in architecture,

"The Nature of Order"
discernible in physicality.

Observable / Attainable

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Strong Centers
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observable: as in assessing the characteristics of an artifact

attainable: as in manipulation through design choices

"Order, Wholeness"

can be pursued in design!

“The concept extends to any space where objects & relationships are observed.”

Alexander

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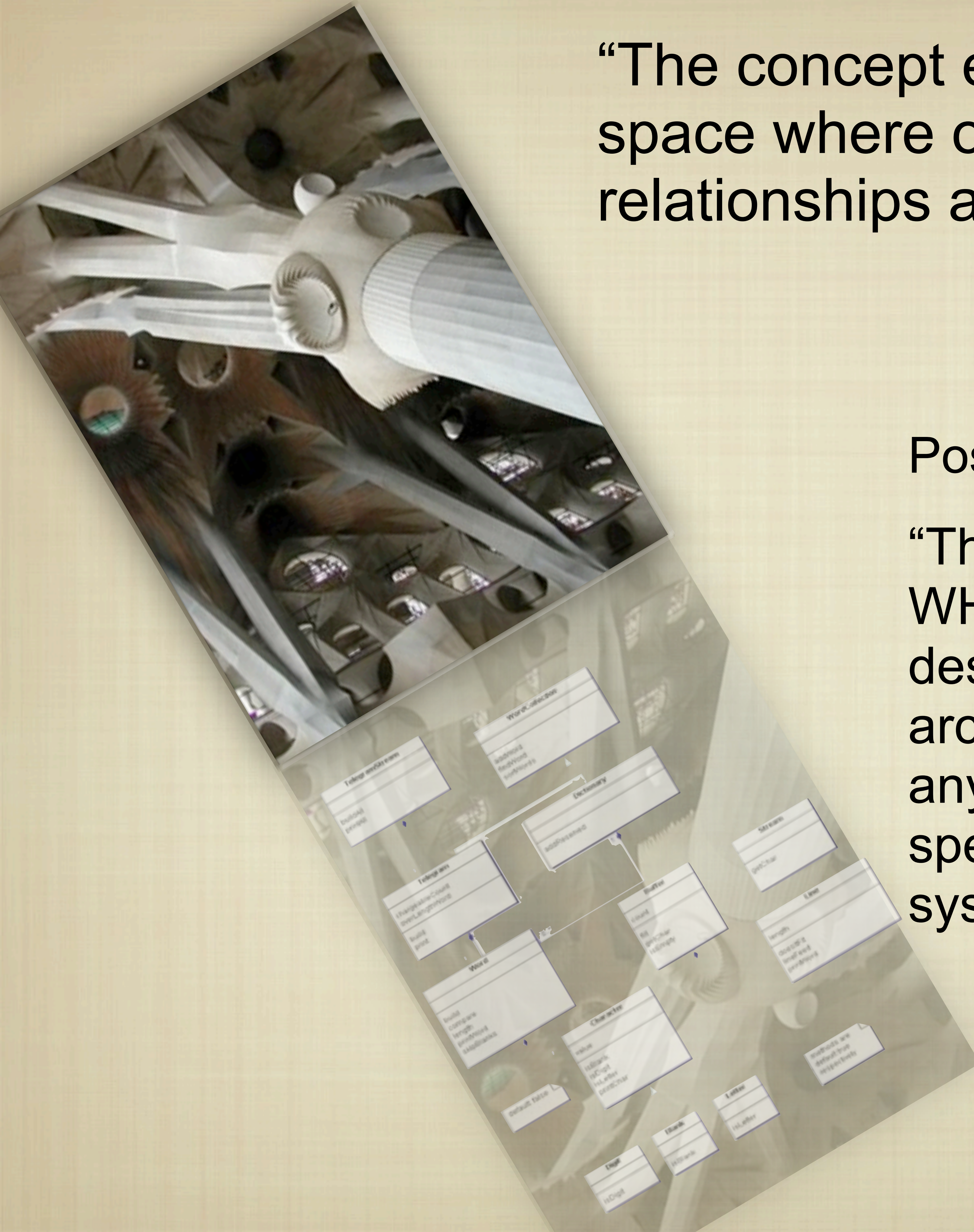
Alexander



“The concept extends to any space where objects & relationships are observed.”

Alexander

Postulation:

“The elements of order, the WHOLENESS, that Alexander describes for physical architecture are perceptible in any architectural system – specifically information systems.”

Waguespack

Centers in the conceptual World

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- To apply Alexander's concepts of visible, physical structure to information systems they must first be translated from a language and vocabulary of physical space to a language and vocabulary of cognitive space.

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- Center ==> Choice

Translating the Properties from Centers to Choices

Translating the Properties from Centers to Choices

Alexander's 15 Center Properties	Vocabulary of Choice Properties
Levels of Scale	Stepwise Refinement
Strong Centers	Cohesion
Boundaries	Encapsulation
Alternating Repetition	Extensibility
Positive Space	Modularization
Good Shape	Correctness
Local Symmetries	Transparency
Deep Interlock and Ambiguity	Composition of Function
Contrast	Identity
Gradients	Scale
Roughness	User Friendliness
Echoes	Patterns
The Void	Programmability
Simplicity and Inner Calm	Reliability
Not Separateness	Elegance

	Choice Property	Modeling Action	Action Rendition
1	Stepwise Refinement	elaborate	develop or present (a theory, policy, or system) in detail
2	Cohesion	factor	express as a product of factors
3	Encapsulation	encapsulate	enclose the essential features of something succinctly by a protective coating or membrane
4	Extensibility	extend	render something capable of expansion in scope, effect, or meaning
5	Modularization	modularize	employing or involving a module or modules as the basis of design or construction
6	Correctness	align	put (things) into correct or appropriate relative positions
7	Transparency	expose	reveal the presence of (a quality or feeling)
8	Composition of Function	assemble	fit together the separate component parts of (a machine or other object)
9	Identity	identify	establish or indicate who or what (someone or something) is
10	Scale	focus	(of a person or their eyes) adapt to the prevailing level of light [abstraction] and become able to see clearly
11	User Friendliness	accommodate	fit in with the wishes or needs of
12	Patterns	pattern	give a regular or intelligible form to
13	Programmability	generalize	make or become more widely or generally applicable
14	Reliability	normalize	make something more normal, which typically means conforming to some regularity or rule
15	Elegance	coordinate	bring the different elements of (a complex activity or organization) into a relationship that will ensure efficiency or harmony

	Choice Property
1	Stepwise Refinement
2	Cohesion
3	Encapsulation
4	Extensibility
5	Modularization
6	Correctness
7	Transparency
8	Composition of Function
9	Identity
10	Scale
11	User Friendliness
12	Patterns
13	Programmability
14	Reliability
15	Elegance

These choice properties propose a coherent, descriptive language including:

- a vocabulary for describing and comparing aspects of system components and structures, and
- design actions to guide design choices leading to desirable system characteristics.

Choice Properties applied Where / how?

Choice Properties applied Where / how?

- Choice Properties in Extant Systems

Choice Properties applied Where / how?

- Choice Properties in Extant Systems
  - APACHE web server (Design Principles & Practices)

Apache HTTP Web Server

	Choice Property	Modeling Action	Action Definition	Apache Exemplars of Choice Property Strength
1	Stepwise Refinement	**elaborate**	develop or present (a theory, policy, or system) in detail	**Filter chains (2.0)**
2	Cohesion	**factor**	express as a product of factors	**Resources pools**
3	Encapsulation	**encapsulate**	[illegible]se the [illegible]ial fe[illegible] of so[illegible]ing [illegible]c[illegible]ly by [illegible]rot[illegible]tive [illegible]oat[illegible] or [illegible]	**Platform independence (2.0)**
4	Extensibility	**extend**	[illegible]m[illegible]ing [illegible]apa[illegible] o[illegible] [illegible]xpa[illegible]ion in s[illegible]e, e[illegible]ct, m[illegible]ng	**Apache server API's (public)**
5	Modularization	**modularize**	employing o[illegible] involving a module or modules a[illegible] the basis of design or construction	**Apache server API's (private)**
6	Correctness	**align**	put (thi[illegible]) i[illegible] correct o[illegible] appropria[illegible] relati[illegible] [illegible]itions	**HTTP implementation**
7	Transparency	**expose**	r[illegible]eal [illegible]e pres[illegible]ce of (a [illegible]ality or [illegible]elin[illegible]	**Apache portable runtime (2.0)**
8	Composition of Function	**assemble**	fit togeth[illegible] the [illegible]parat[illegible] compone[illegible] parts o[illegible] [illegible]achine or [illegible]her objec[illegible]	**Filter chains (2.0)**
9	Identity	**identify**	establish o[illegible] indicate who or what (so[illegible]eone o[illegible] something) is	**Management interfaces (2.0)**
10	Scale	**[illegible]ocus**	(of a person or their eyes) a[illegible]pt to the prevailing level of light [illegible]bstraction] and [illegible]e able to see clearly	**Core elements of server**
11	User Friendliness	**[illegible]**	[illegible]it in with t[illegible] wishes o[illegible] nee[illegible]s o[illegible]	**[illegible]le [illegible]guration & [illegible]ana[illegible]ment (2.0)**
12	Patterns	**pa[illegible]**	[illegible]ve a reg[illegible] or [illegible]ellig[illegible]le f[illegible]m	**[illegible]od[illegible]le [illegible]esign patterns**
13	Programmability	**generalize**	make or become more widely or generally applicable	**[illegible]ierarchical & layered configuration**
14	Reliability	**normalize**	make something more normal, which typically means conforming to some regularity or rule	**Process lifecycle & resource management**
15	Elegance	**coordinate**	bring the different elements of (a complex activity or organization) into a relationship that will ensure efficiency or harmony	**Configuration change management**

	Choice Property	Modeling Action	Action Definition	Apache Exemplars of Choice Property Strength
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2	Cohesion	**factor**	express as a product of factors	**Resources pools**
3	Encapsulation	**encapsulate**	enclose the essential features of something succinctly by a protective coating or membrane	**Platform independence (2.0)**
4	Extensibility	**extend**	render something capable of expansion in scope, effect, or meaning	**Apache server API's (public)**
5	Modularization	**modularize**	employing or involving a module or modules as the basis of design or construction	**Apache server API's (private)**
6	Correctness	**align**	put (things) into correct or appropriate relative positions	**HTTP implementation**
7	Transparency	**expose**	reveal the presence of (a quality or feeling)	**Apache portable runtime (2.0)**
8	Composition of Function	**assemble**	fit together the separate component parts of (a machine or other object)	**Filter chains (2.0)**
9	Identity	**identify**	establish or indicate who or what (someone or something) is	**Management interfaces (2.0)**
10	Scale	**focus**	(of a person or their eyes) adapt to the prevailing level of light [abstraction] and become able to see clearly	**Core elements of server**
11	User Friendliness	**accommodate**	fit in with the wishes or needs of	**Flexible configuration & management (2.0)**
12	Patterns	**pattern**	give a regular or intelligible form to	**Module design patterns**
13	Programmability	**generalize**	make or become more widely or generally applicable	**Hierarchical & layered configuration**
14	Reliability	**normalize**	make something more normal, which typically means conforming to some regularity or rule	**Process lifecycle & resource management**
15	Elegance	**coordinate**	bring the different elements of (a complex activity or organization) into a relationship that will ensure efficiency or harmony	**Configuration change management**

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  - ☑ APACHE web server (Design Principles & Practices)

Choice Properties applied Where / how?

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  - [x] APACHE web server (Design Principles & Practices)
  - [ ] network architecture

Choice Properties applied Where / how?

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  - ☐ network architecture
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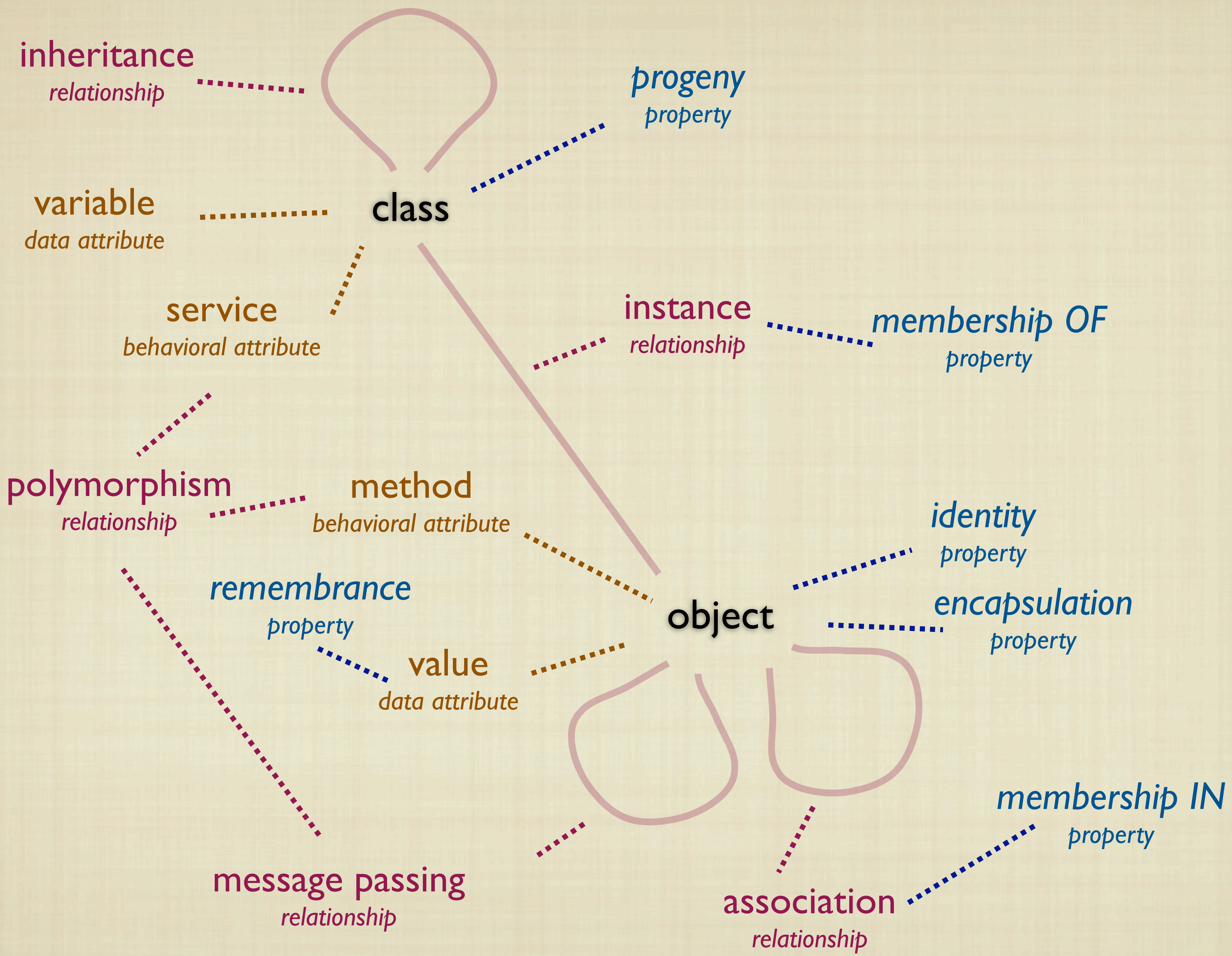
  - ☑ object-oriented modeling (monograph Ch12)

Object-Oriented Ontology



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Choice Properties applied Where / how?

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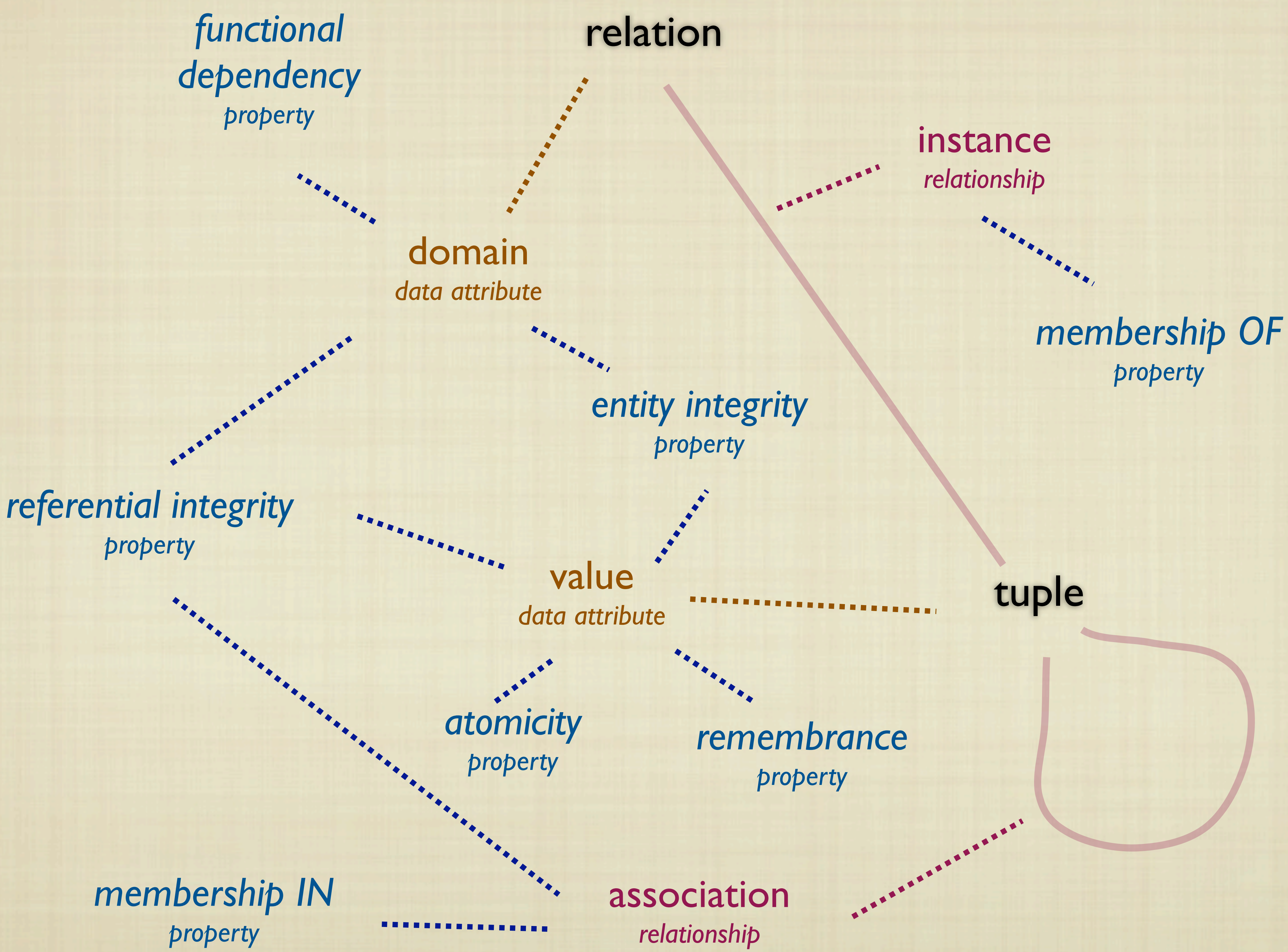
  - ☐ network architecture
- Choice Properties Mapped to Modeling
  - ☑ object-oriented modeling (monograph Ch12)
  - ☑ relational modeling (monograph Ch13)

Relational Ontology



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  - ☐ network architecture
- Choice Properties Mapped to Modeling
  - ☑ object-oriented modeling (monograph Ch12)
  - ☑ relational modeling (monograph Ch13)

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  - ☐ network architecture
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  - ☑ relational modeling (monograph Ch13)
  - ☐ business process modeling

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  - [ ] network architecture
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  - [x] object-oriented modeling (monograph Ch12)
  - [x] relational modeling (monograph Ch13)
  - [ ] business process modeling
- Other System Domains

Choice Properties applied Where / how?

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  - ☐ network architecture
- Choice Properties Mapped to Modeling
  - ☑ object-oriented modeling (monograph Ch12)
  - ☑ relational modeling (monograph Ch13)
  - ☐ business process modeling
- Other System Domains
  - ☐ music

Choice Properties applied Where / how?

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  - ☑ APACHE web server (Design Principles & Practices)
  - ☐ network architecture
- Choice Properties Mapped to Modeling
  - ☑ object-oriented modeling (monograph Ch12)
  - ☑ relational modeling (monograph Ch13)
  - ☐ business process modeling
- Other System Domains
  - ☐ music
  - ☐ english composition

Toward a Vision of Thriving Systems

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- ***"The Nature of Order"*** is evident in choice properties observable in information systems!

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Toward a Vision of Thriving Systems

- ***"The Nature of Order"*** is evident in choice properties observable in information systems!
- The translated properties denote design features that may appear to be discrete.
- Might property strength and interaction resonate as quality?
- Might a taxonomy of quality emerge?

Choice Properties

2. Cohesion

1. Stepwise Refinement

3. Encapsulation

5. Modularization

8. Composition of Function

10. Scale

7. Transparency

11. User Friendliness

13. Programmability

12. Patterns

6. Correctness

15. Elegance

9. Identity

14. Reliability

4. Extensibility

Property Interaction

	Alexander's Property Support Intersection Row item supported by column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Levels of Scale															
2	Strong Centers															
3	Boundaries															
4	Alternating Repetition															
5	Positive Space															
6	Good Shape															
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13	The Void															
14	Simplicity and Inner Calm															
15	Not Separateness															

Property Interaction

	Alexander's Property Support Intersection Row item supported by column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Levels of Scale		•	•			•			•						
2	Strong Centers				•			•		•	•			•		•
3	Boundaries		•		•			•	•	•	•					
4	Alternating Repetition		•			•	•		•	•						•
5	Positive Space	•	•	•			•	•		•		•		•		
6	Good Shape	•	•			•			•		•		•		•	
7	Local Symmetries	•				•				•				•		
8	Deep Interlock and Ambiguity				•	•				•		•	•			•
9	Contrast			•		•			•		•			•		•
10	Gradients	•	•					•		•		•	•			•
11	Roughness		•			•	•				•				•	•
12	Echoes	•					•	•			•	•				•
13	The Void	•		•		•		•		•					•	
14	Simplicity and Inner Calm						•	•					•	•		•
15	Not Separateness			•		•			•		•	•		•	•	

Property Interaction

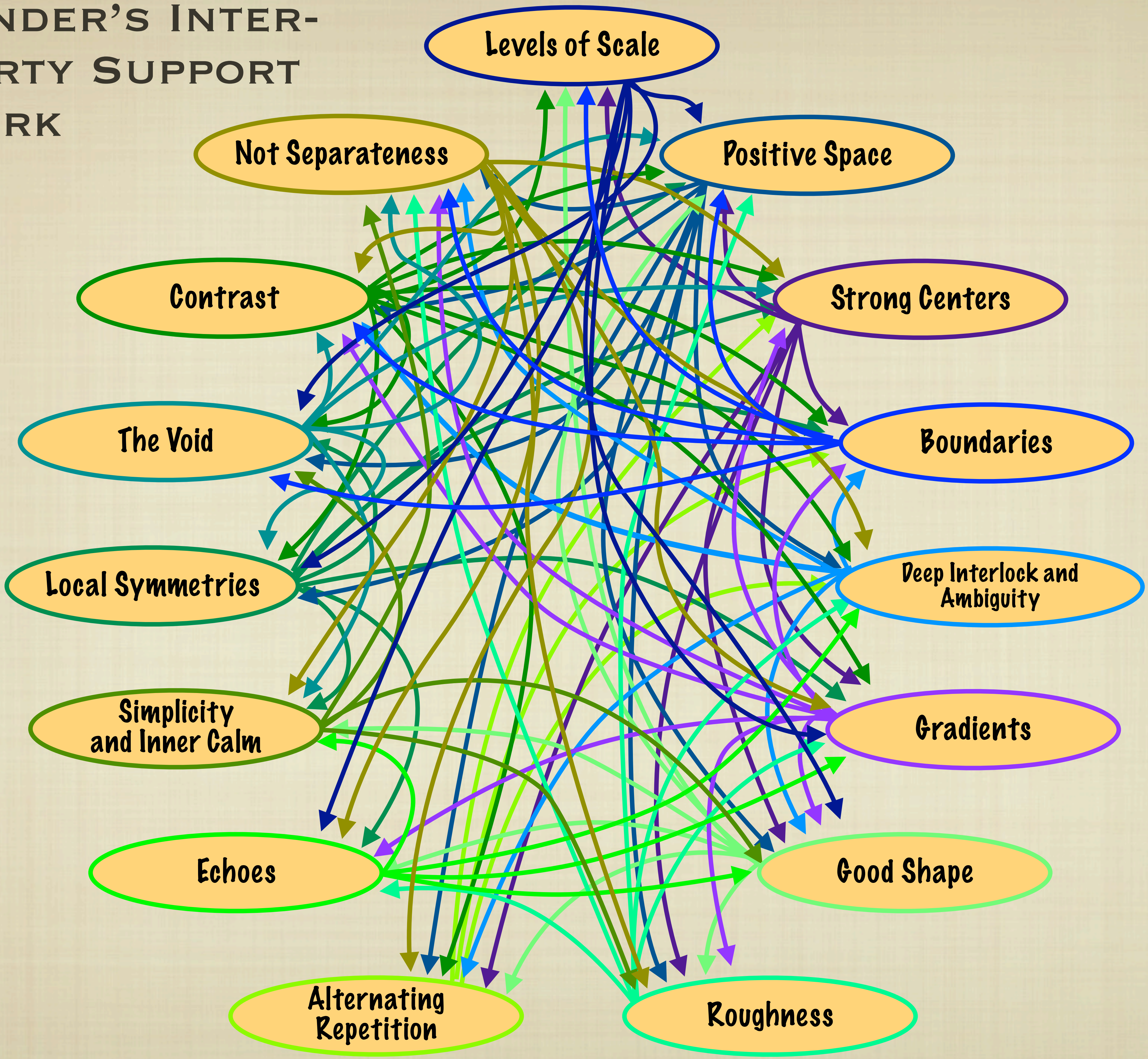
	Alexander's Property Support Intersection Row item supported by column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Levels of Scale		•	•			•			•						
2	Strong Centers				•			•		•	•			•		•
3	Boundaries		•		•			•	•	•	•					
4	Alternating Repetition		•			•	•		•	•						•
5	Positive Space	•	•	•			•	•		•		•		•		
6	Good Shape	•	•			•			•		•		•		•	
7	Local Symmetries	•				•				•				•		
8	Deep Interlock and Ambiguity				•	•				•		•	•			•
9	Contrast			•		•			•		•			•		•
10	Gradients	•	•					•		•		•	•			•
11	Roughness		•			•	•				•				•	•
12	Echoes	•					•	•			•	•				•
13	The Void	•		•		•		•		•					•	
14	Simplicity and Inner Calm						•	•					•	•		•
15	Not Separateness			•		•			•		•	•		•	•	

Property Interaction

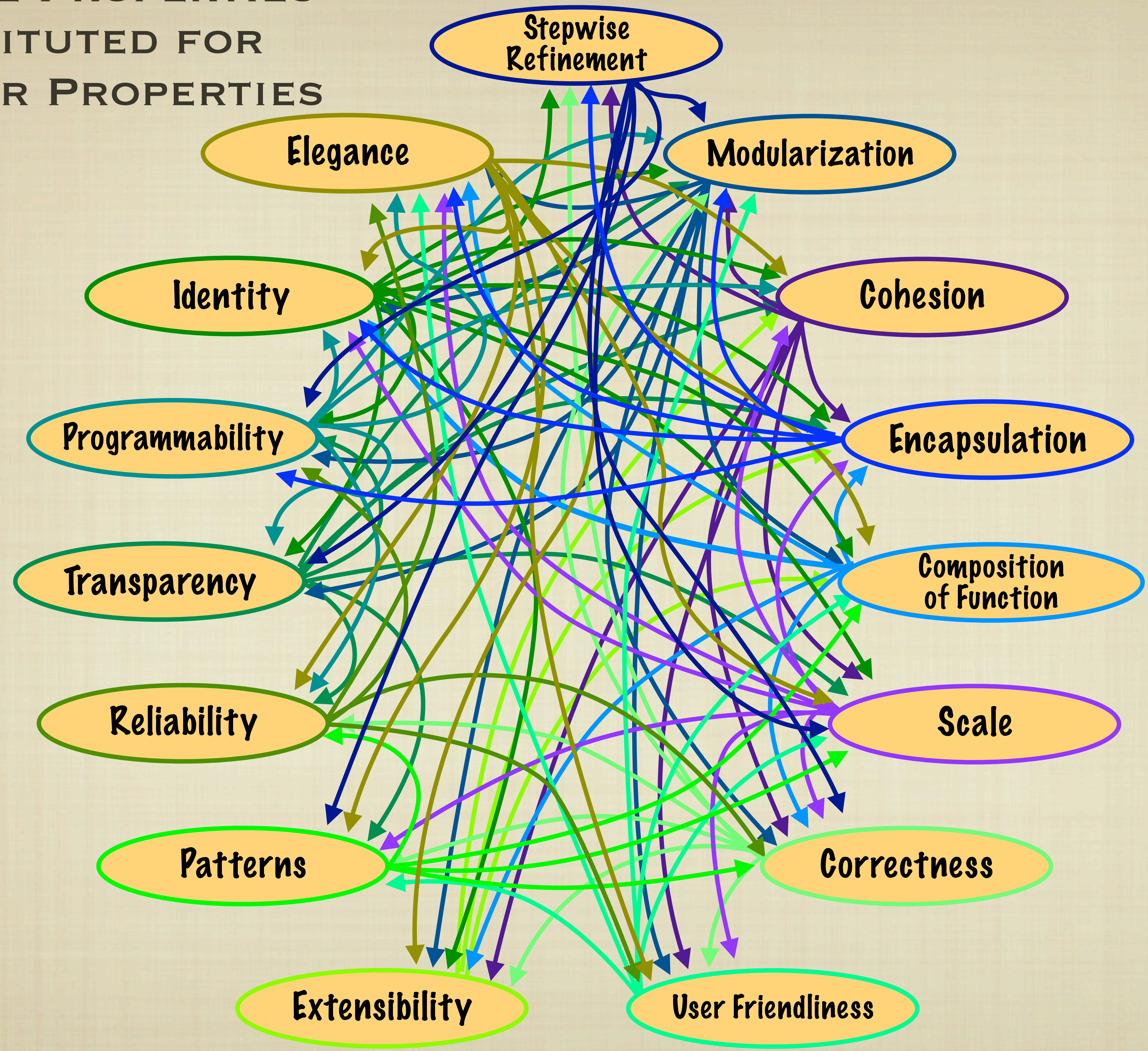
	Alexander's Property Support Intersection Row item supported by column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Levels of Scale		•	•			•			•						
2	Strong Centers				•			•		•	•			•		•
3	Boundaries		•		•			•	•	•	•					
4	Alternating Repetition		•			•	•		•	•						•
5	Positive Space	•	•	•			•	•		•		•		•		
6	Good Shape	•	•			•			•		•		•		•	
7	Local Symmetries	•				•				•				•		
8	Deep Interlock and Ambiguity				•	•				•		•	•			•
9	Contrast			•		•			•		•			•		•
10	Gradients	•	•					•		•		•	•			•
11	Roughness		•			•	•				•				•	•
12	Echoes	•					•	•			•	•				•
13	The Void	•		•		•		•		•					•	
14	Simplicity and Inner Calm						•	•					•	•		•
15	Not Separateness			•		•			•		•	•		•	•	

Alexander's Inter-Property Support Network

Alexander's Inter-Property Support Network



Choice Properties Substituted for Center Properties



Coherence Analysis

Center Properties		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Levels of Scale	1	0.00														
Strong Centers	2	1.58	0.00													
Boundaries	3	1.17	0.67	0.00												
Alternating Repetition	4	0.75	1.33	1.00	0.00											
Positive Space	5	0.50	1.13	1.13	1.13	0.00										
Good Shape	6	1.25	1.71	1.13	0.83	1.25	0.00									
Local Symmetries	7	1.50	1.17	1.58	1.17	0.88	1.25	0.00								
Deep Interlock and Ambiguity	8	1.58	1.00	1.33	1.00	1.42	1.42	1.17	0.00							
Contrast	9	1.58	1.00	1.33	1.00	1.42	1.13	1.17	1.33	0.00						
Gradients	10	1.21	1.07	1.07	1.07	0.66	1.20	1.21	0.76	1.69	0.00					
Roughness	11	1.17	1.33	1.33	0.67	1.42	0.54	1.58	1.33	1.00	1.38	0.00				
Echoes	12	1.58	1.00	1.33	1.33	0.83	1.13	1.58	1.33	1.33	0.76	1.00	0.00			
The Void	13	1.17	1.33	1.33	1.33	0.83	1.13	0.75	1.33	1.33	1.07	1.33	1.33	0.00		
Simplicity and Inner Calm	14	1.55	0.90	1.63	1.27	1.03	1.35	1.55	1.27	1.27	0.97	1.27	0.90	1.63	0.00	
Not Separateness	15	1.61	1.38	1.38	1.38	1.20	0.93	1.21	1.38	0.45	1.71	1.07	1.38	1.07	1.66	0.00

Coherence is the sum of the fraction of supporting properties that mutually overlap between two properties (0 ≤ ç ≤ 2). The distance is (2 - ç).

Coherence Analysis

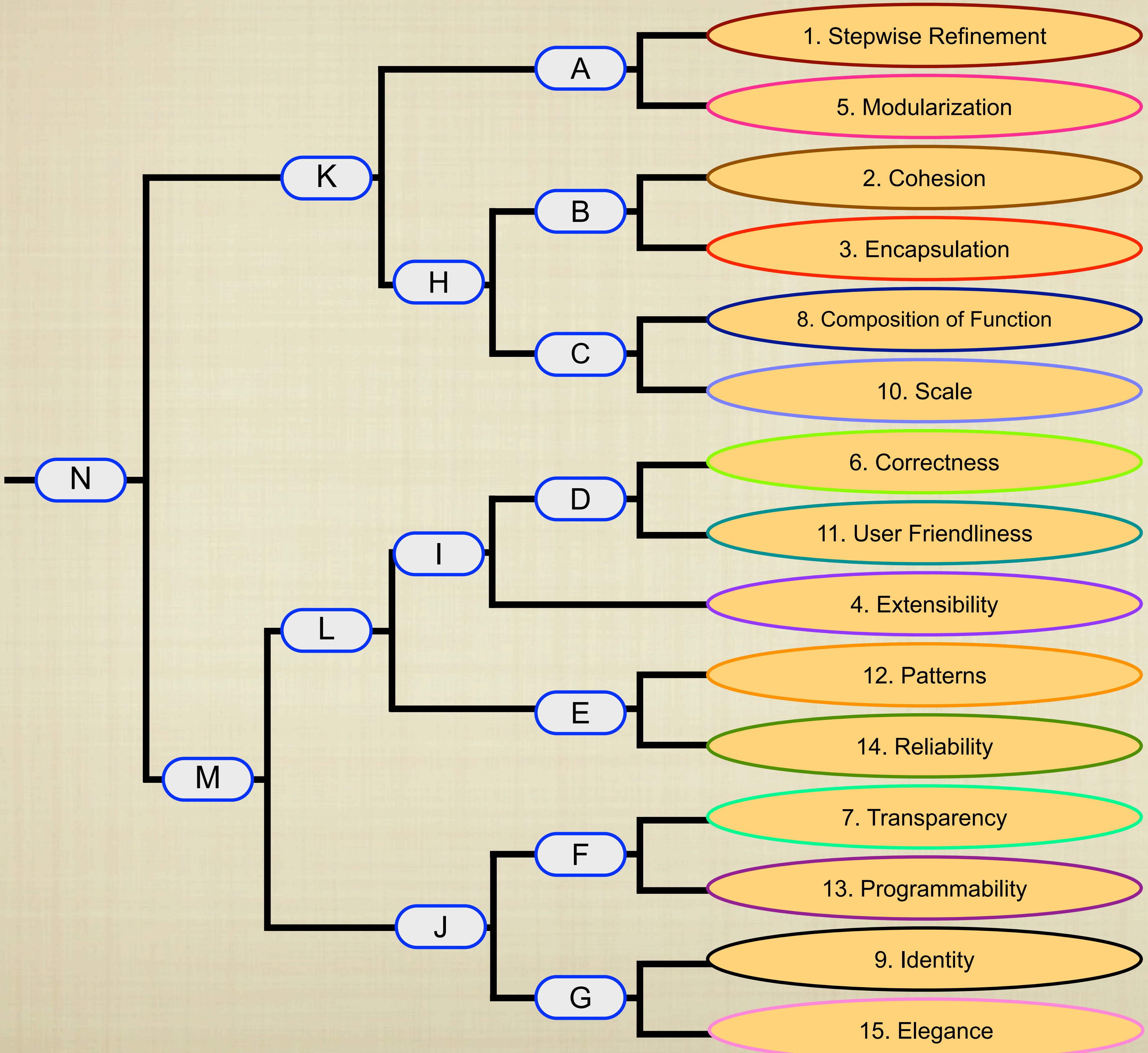
Choice Properties		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Stepwise Refinement	1	0.00														
Cohesion	2	1.58	0.00													
Encapsulation	3	1.17	0.67	0.00												
Extensibility	4	0.75	1.33	1.00	0.00											
Modularization	5	0.50	1.13	1.13	1.13	0.00										
Correctness	6	1.25	1.71	1.13	0.83	1.25	0.00									
Transparency	7	1.50	1.17	1.58	1.17	0.88	1.25	0.00								
Composition of Function	8	1.58	1.00	1.33	1.00	1.42	1.42	1.17	0.00							
Identity	9	1.58	1.00	1.33	1.00	1.42	1.13	1.17	1.33	0.00						
Scale	10	1.21	1.07	1.07	1.07	0.66	1.20	1.21	0.76	1.69	0.00					
User Friendliness	11	1.17	1.33	1.33	0.67	1.42	0.54	1.58	1.33	1.00	1.38	0.00				
Patterns	12	1.58	1.00	1.33	1.33	0.83	1.13	1.58	1.33	1.33	0.76	1.00	0.00			
Programmability	13	1.17	1.33	1.33	1.33	0.83	1.13	0.75	1.33	1.33	1.07	1.33	1.33	0.00		
Reliability	14	1.55	0.90	1.63	1.27	1.03	1.35	1.55	1.27	1.27	0.97	1.27	0.90	1.63	0.00	
Elegance	15	1.61	1.38	1.38	1.38	1.20	0.93	1.21	1.38	0.45	1.71	1.07	1.38	1.07	1.66	0.00

Coherence is the sum of the fraction of supporting properties that mutually overlap between two properties (0 ≤ ç ≤ 2). The distance is (2 - ç).

Choice Properties

- 2. Cohesion
- 13. Programmability
- 1. Stepwise Refinement
- 3. Encapsulation
- 5. Modularization
- 8. Composition of Function
- 10. Scale
- 7. Transparency
- 11. User Friendliness
- 12. Patterns
- 15. Elegance
- 6. Correctness
- 9. Identity
- 14. Reliability
- 4. Extensibility

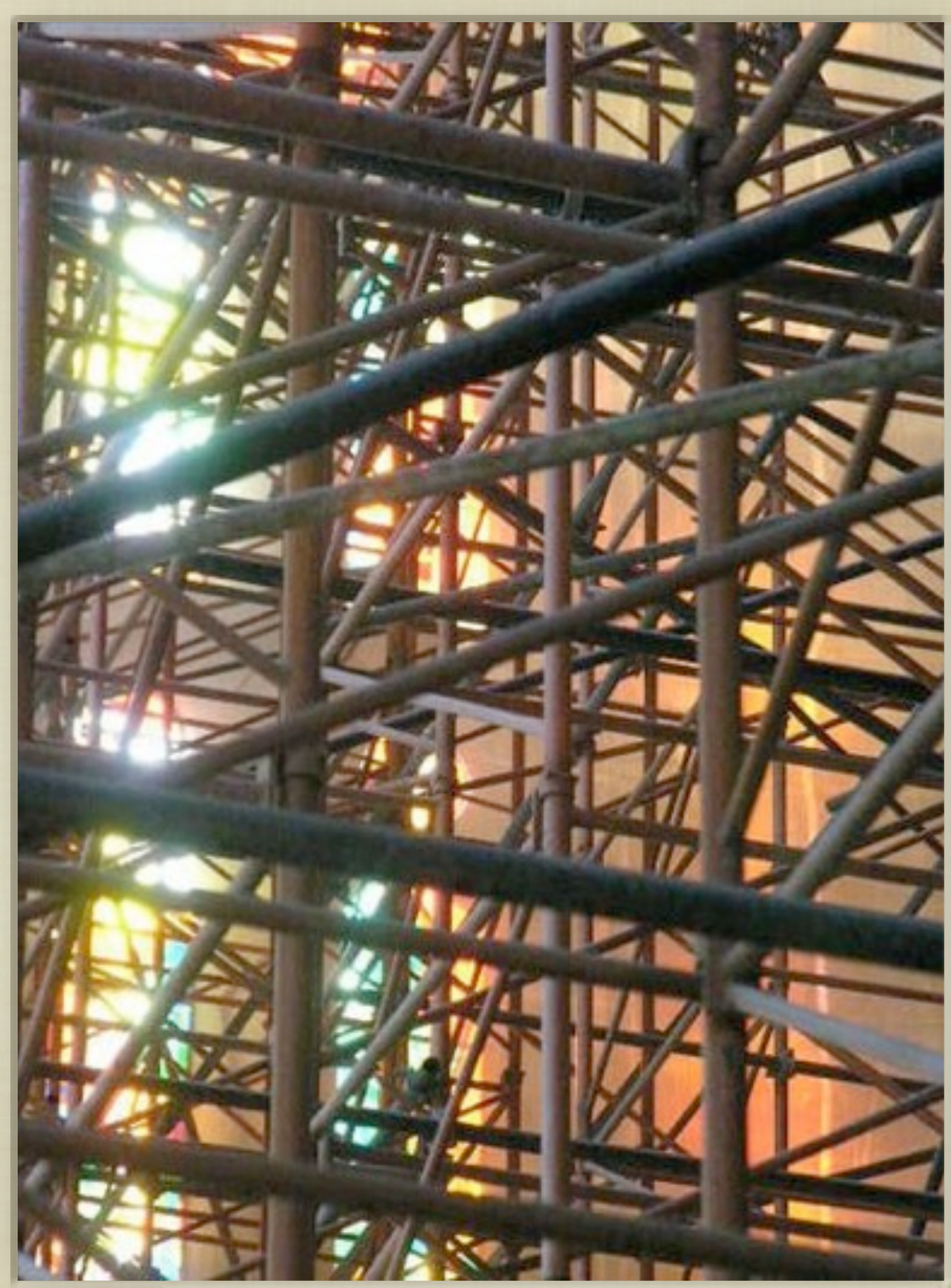
Choice Clusters



Clusters with Supporting Properties

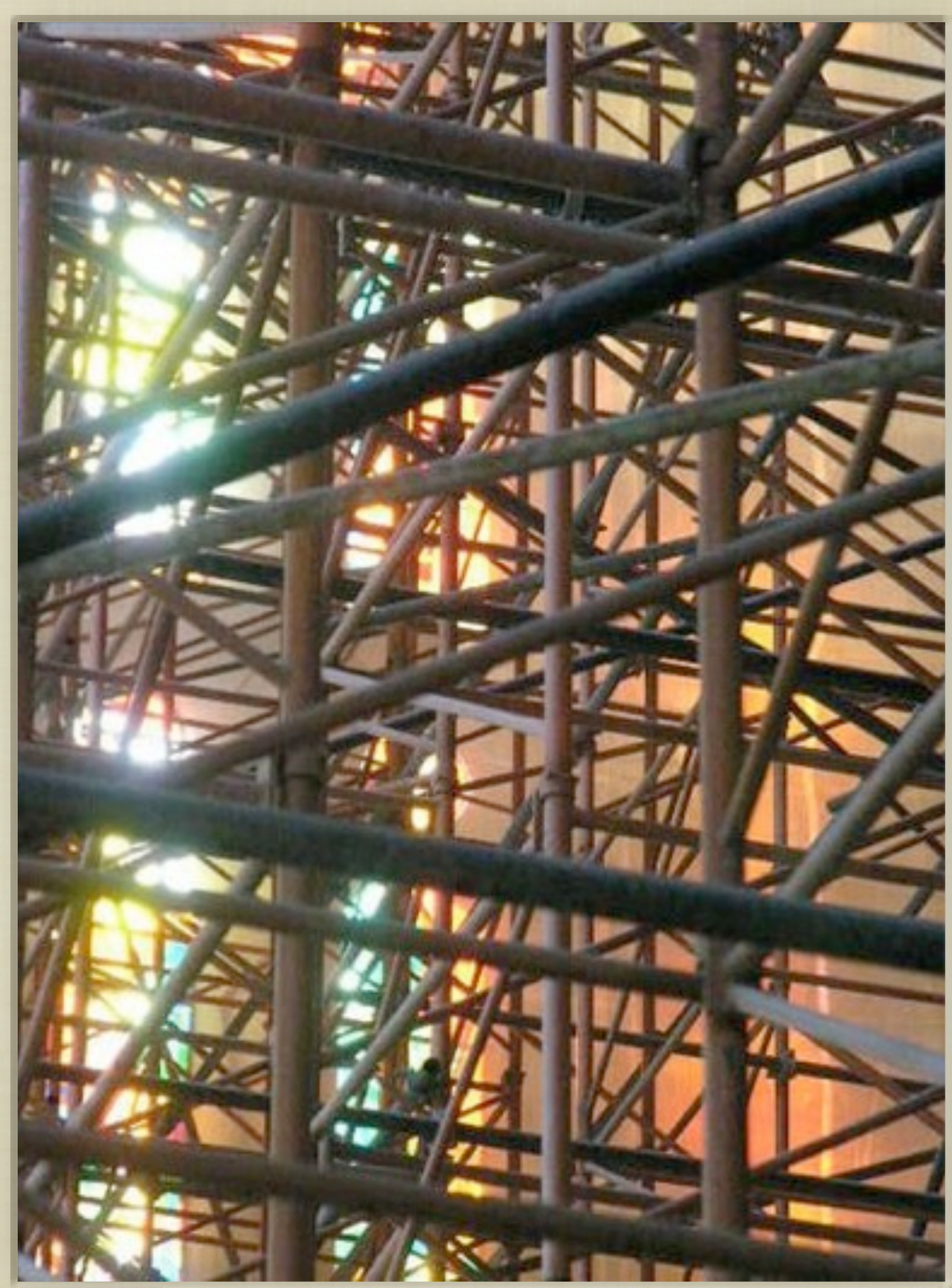
Cluster	#	Property	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	1	Stepwise Refinement		2	3			6			9						
	5	Modularization	1	2	3			6	7		9		11		13		
B	2	Cohesion				4			7		9	10			13		15
	3	Encapsulation		2		4			7	8	9	10					
C	8	Composition of Function				4	5			8	9		11	12			15
	10	Scale	1	2					7		9		11	12			15
D	6	Correctness	1	2			5	6		8		10		12		14	
	11	User Friendliness		2			5	6				10				14	15
E	12	Patterns	1					6	7			10	11				15
	14	Reliability						6	7					12	13		15
F	7	Transparency	1				5				9				13		
	13	Programmability	1		3		5		7		9					14	
G	9	Identity			3		5			8	9	10			13		15
	15	Elegance			3		5			8		10	11		13	14	
H	2	Cohesion				4			7		9	10			13		15
	3	Encapsulation		2		4			7	8	9	10					
	8	Composition of Function				4	5			8	9		11	12			15
	10	Scale	1	2					7		9		11	12			15
I	4	Extensibility		2			5	6		8	9						15
	6	Correctness	1	2			5	6		8		10		12		14	
	11	User Friendliness		2			5	6				10				14	15
J	7	Transparency	1				5				9				13		
	9	Identity			3		5			8	9	10			13		15
	13	Programmability	1		3		5		7		9					14	
	15	Elegance			3		5			8		10	11		13	14	
K	1	Stepwise Refinement		2	3			6			9						
	2	Cohesion				4			7		9	10			13		15
	3	Encapsulation		2		4			7	8	9	10					
	5	Modularization	1	2	3			6	7		9		11		13		
	8	Composition of Function				4	5			8	9		11	12			15
	10	Scale	1	2					7		9		11	12			15
L	4	Extensibility		2			5	6		8	9						15
	6	Correctness	1	2			5	6		8		10		12		14	
	11	User Friendliness		2			5	6				10				14	15
	12	Patterns	1					6	7			10	11				15
	14	Reliability						6	7					12	13		15
M	4	Extensibility		2			5	6		8	9						15
	6	Correctness	1	2			5	6		8		10		12		14	
	7	Transparency	1				5				9				13		
	9	Identity			3		5			8	9	10			13		15
	11	User Friendliness		2			5	6				10				14	15
	12	Patterns	1					6	7			10	11				15
	13	Programmability	1		3		5		7		9					14	
	14	Reliability						6	7					12	13		15
	15	Elegance			3		5			8		10	11		13	14	
N	1	Stepwise Refinement		2	3			6			9						
	2	Cohesion				4			7		9	10			13		15
	3	Encapsulation		2		4			7	8	9	10					
	4	Extensibility		2			5	6		8	9						15
	5	Modularization	1	2	3			6	7		9		11		13		
	6	Correctness	1	2			5	6		8		10		12		14	
	7	Transparency	1				5				9				13		
	8	Composition of Function				4	5			8	9		11	12			15
	9	Identity			3		5			8	9	10			13		15
	10	Scale	1	2					7		9		11	12			15
	11	User Friendliness		2			5	6				10				14	15
	12	Patterns	1					6	7			10	11				15
	13	Programmability	1		3		5		7		9					14	
	14	Reliability						6	7					12	13		15
	15	Elegance			3		5			8		10	11		13	14	

Property Cluster ==>
Design Quality



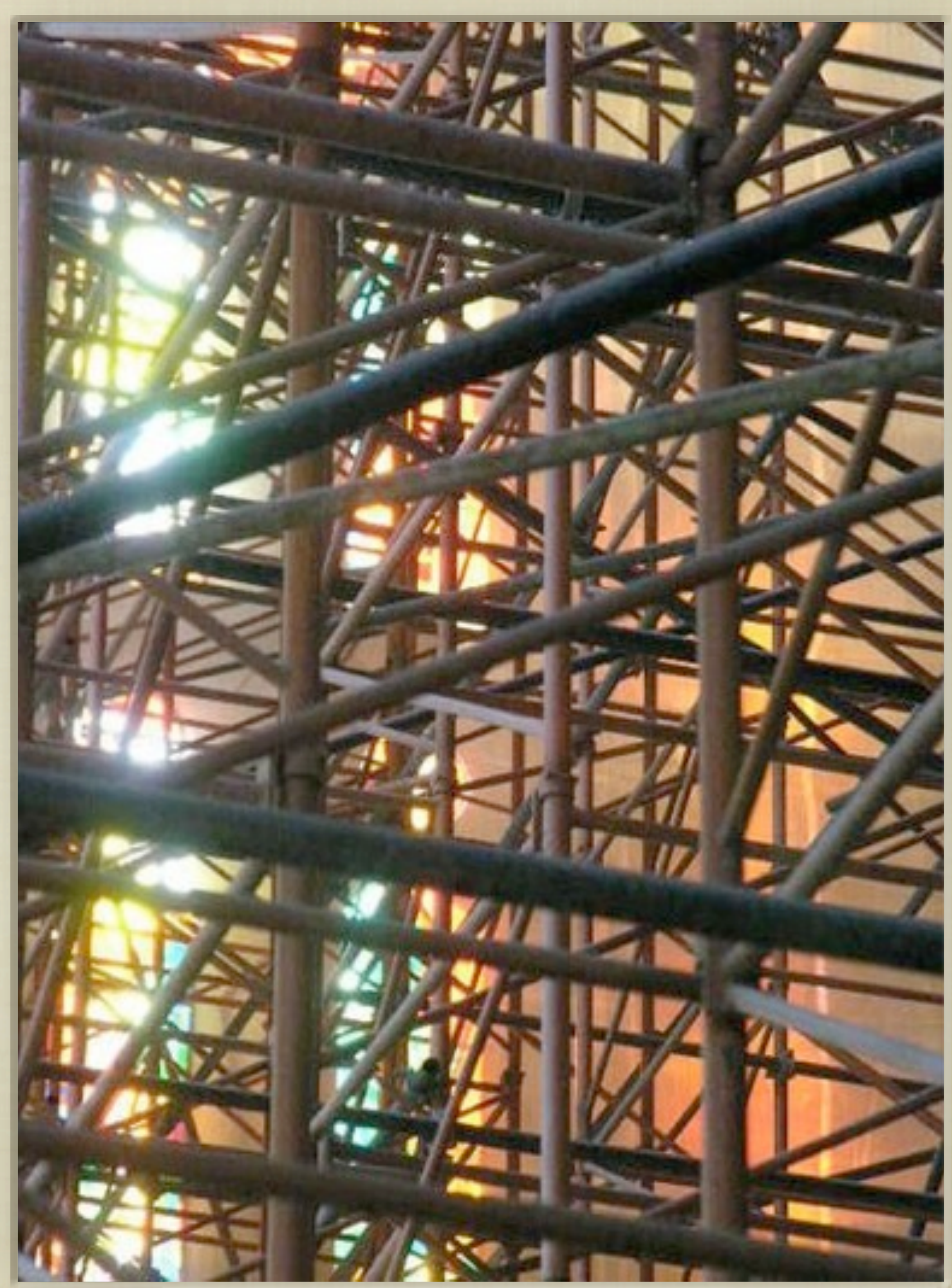
Property Cluster ==> Design Quality

- Each cluster reflects a unique blend of property resonance



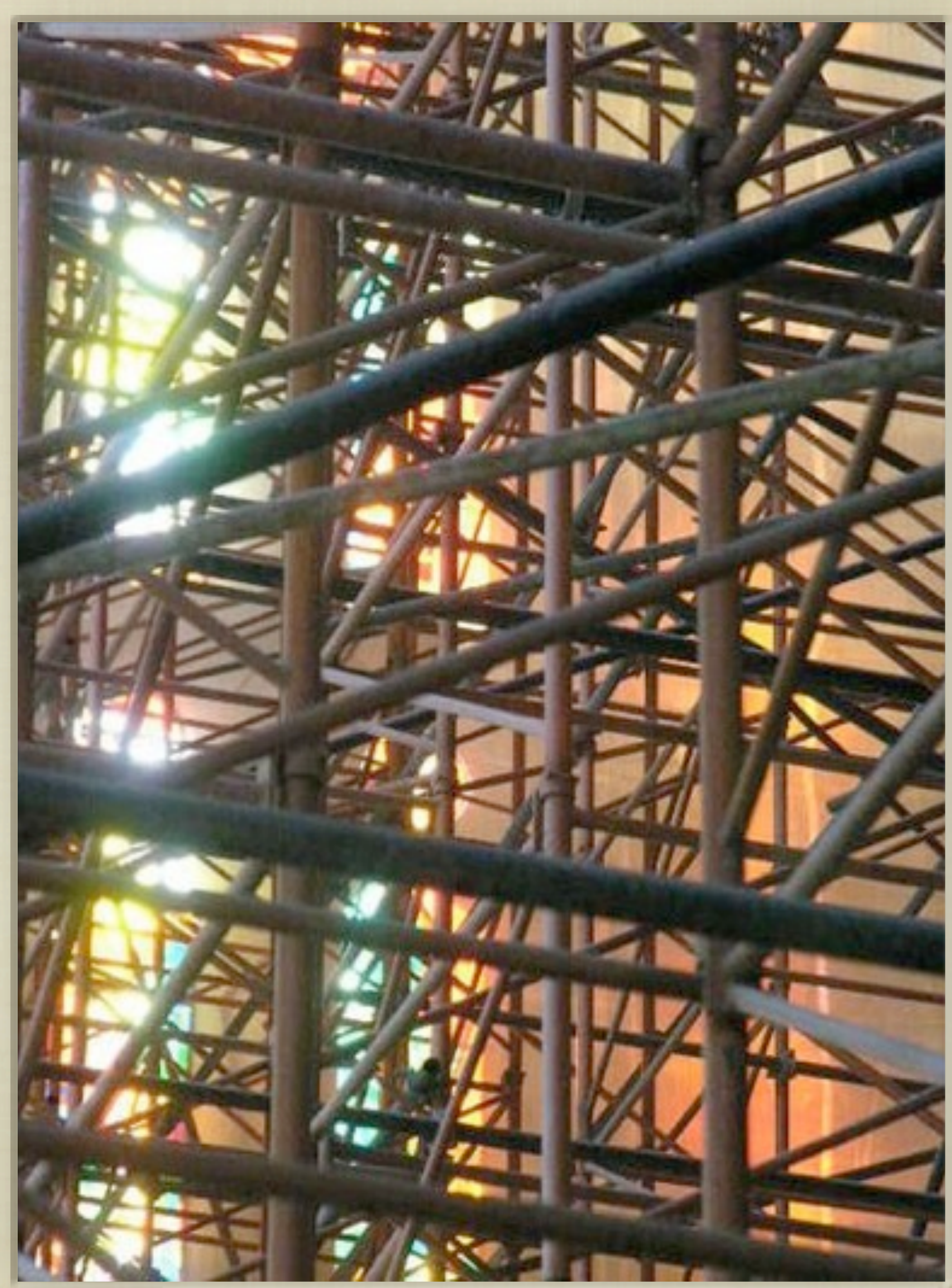
Property Cluster ==> Design Quality

- Each cluster reflects a unique blend of property resonance
- Each cluster explains a particular quality of design



Property Cluster ==> Design Quality

- Each cluster reflects a unique blend of property resonance
- Each cluster explains a particular quality of design
- Each cluster describes a goal set in design that responds to stakeholder intentions



Design Quality Naming

Design Quality Naming

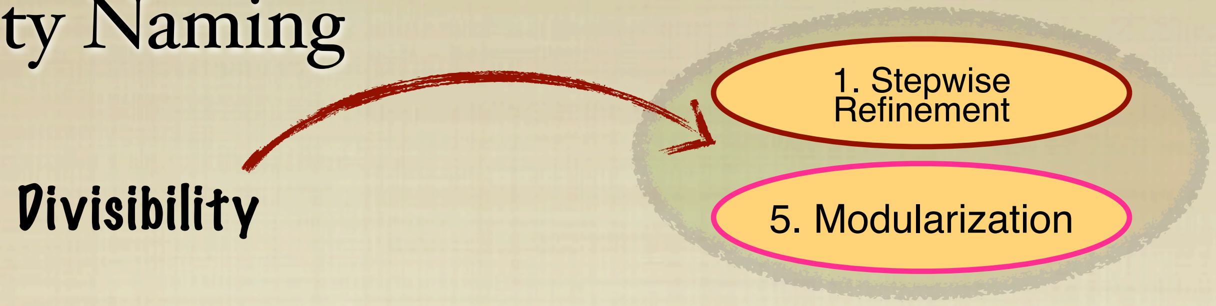
1. Stepwise Refinement

5. Modularization

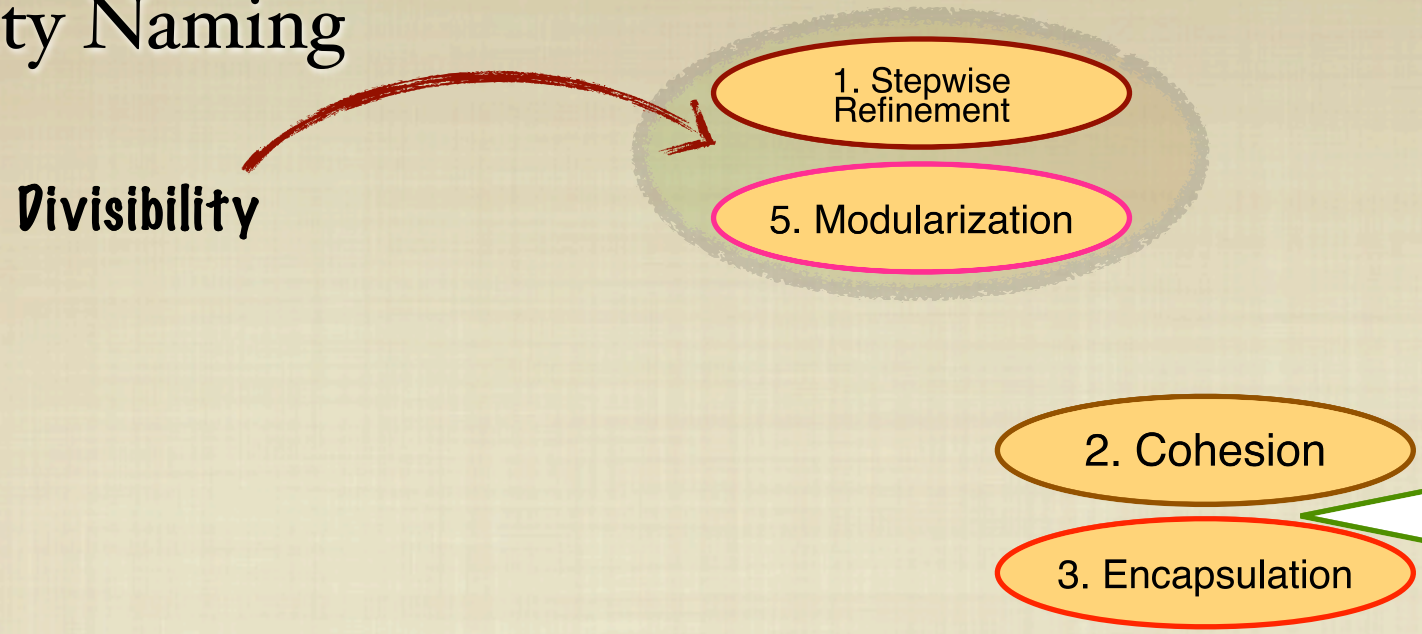
goal-directed decomposition reflects stakeholder perception of relationships among concepts

parts are essential to the distribution and tolerance of complexity

Design Quality Naming



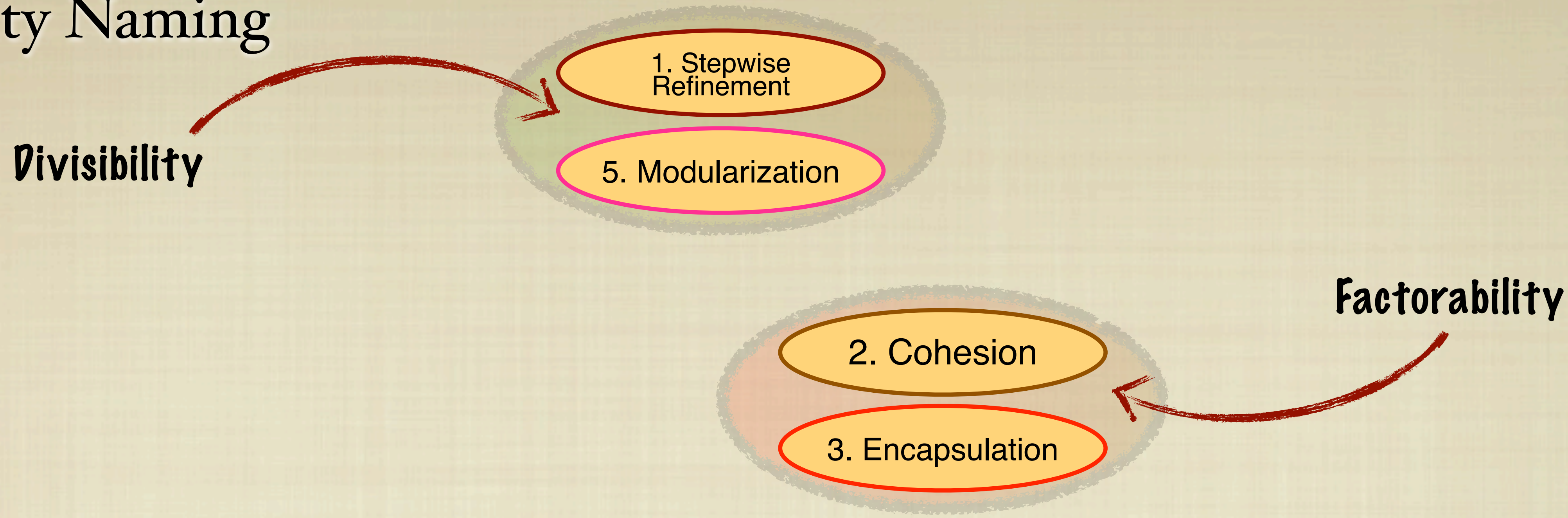
Design Quality Naming



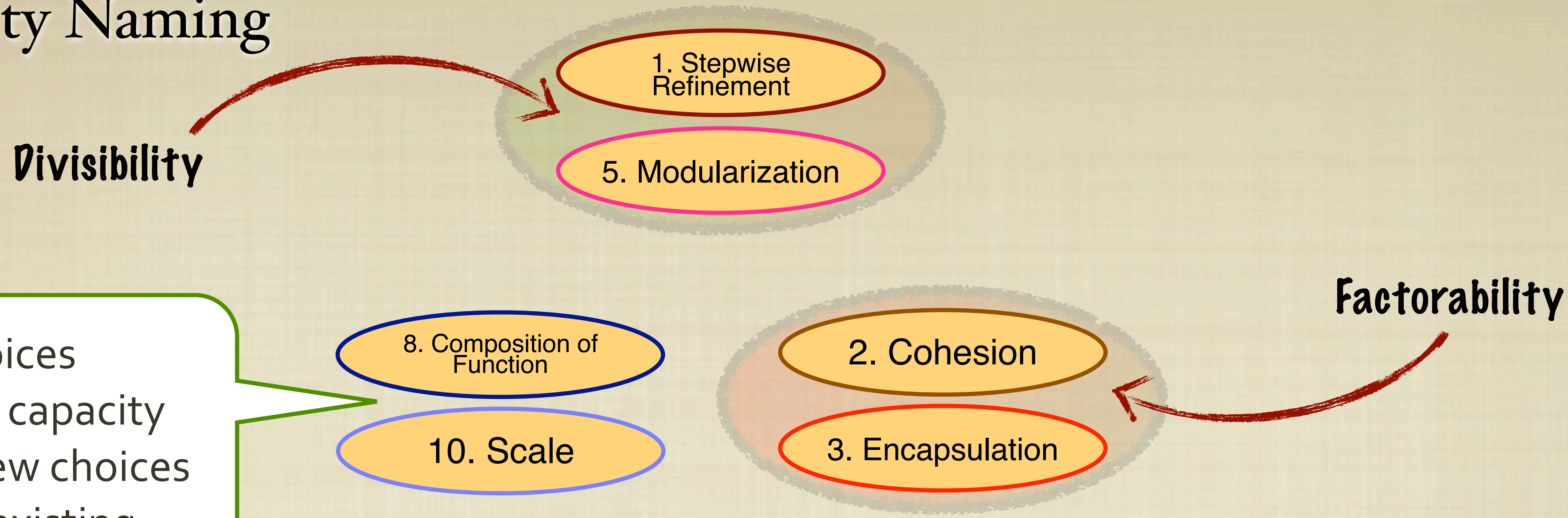
cohesion reflects choice self-sufficiency: well-formed with cogency

encapsulation bounds but also interfaces the choice to the surrounding collection

Design Quality Naming



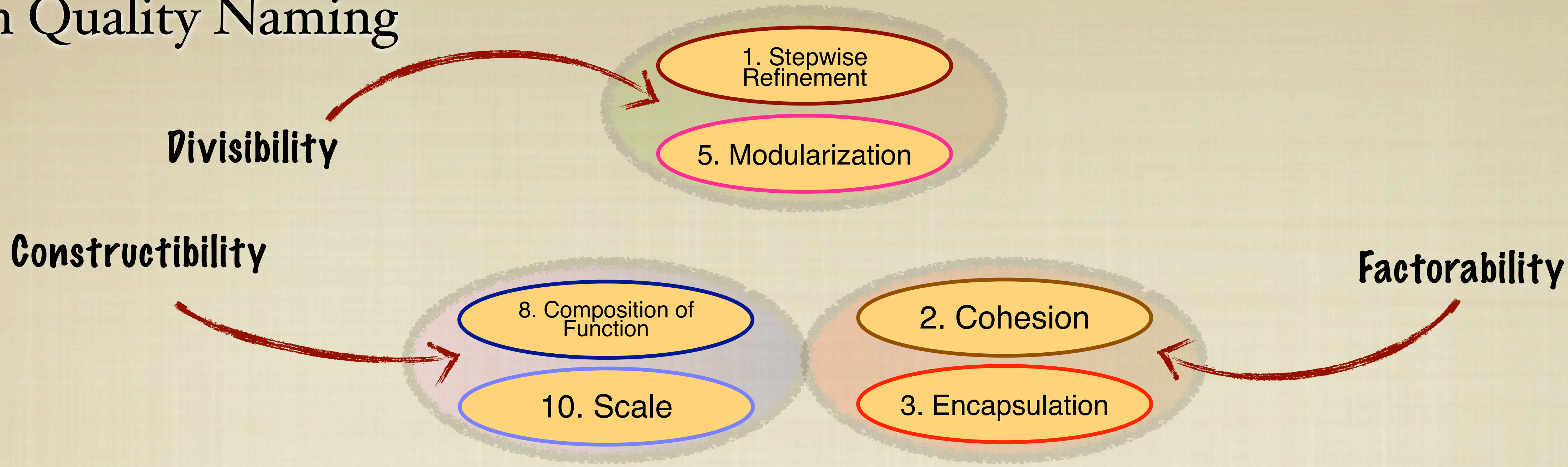
Design Quality Naming



composable choices enable growth in capacity or complexity; new choices composed from existing ones

scale reflects a useful granularity of attention or focus

Design Quality Naming



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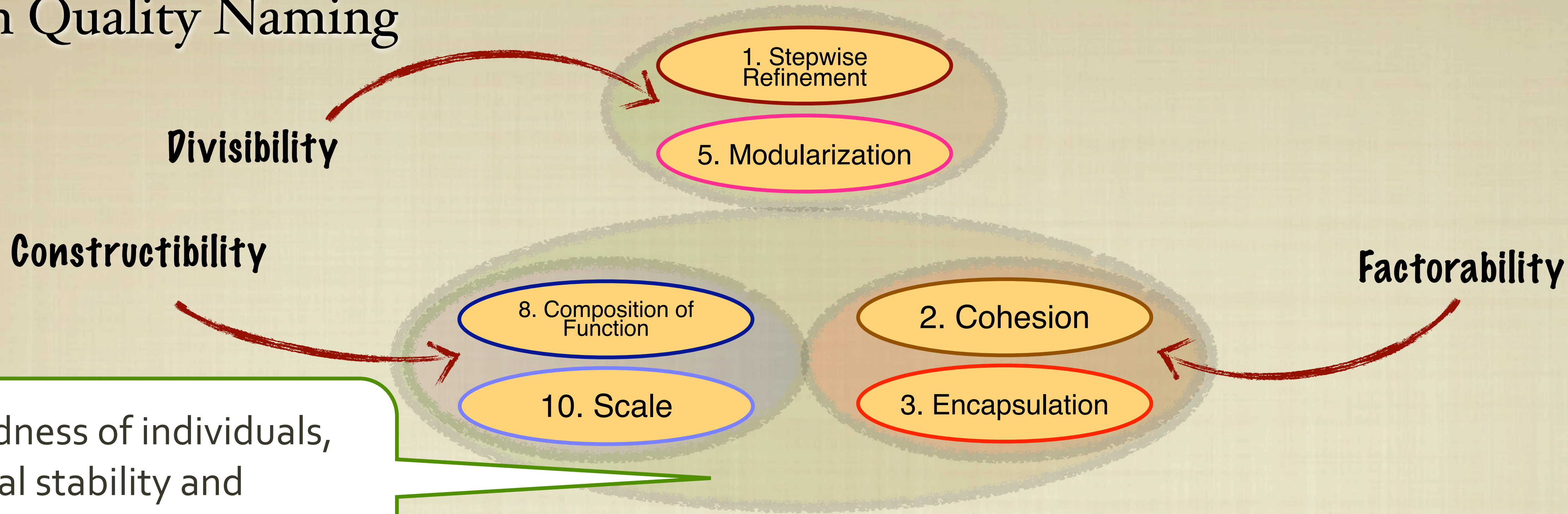
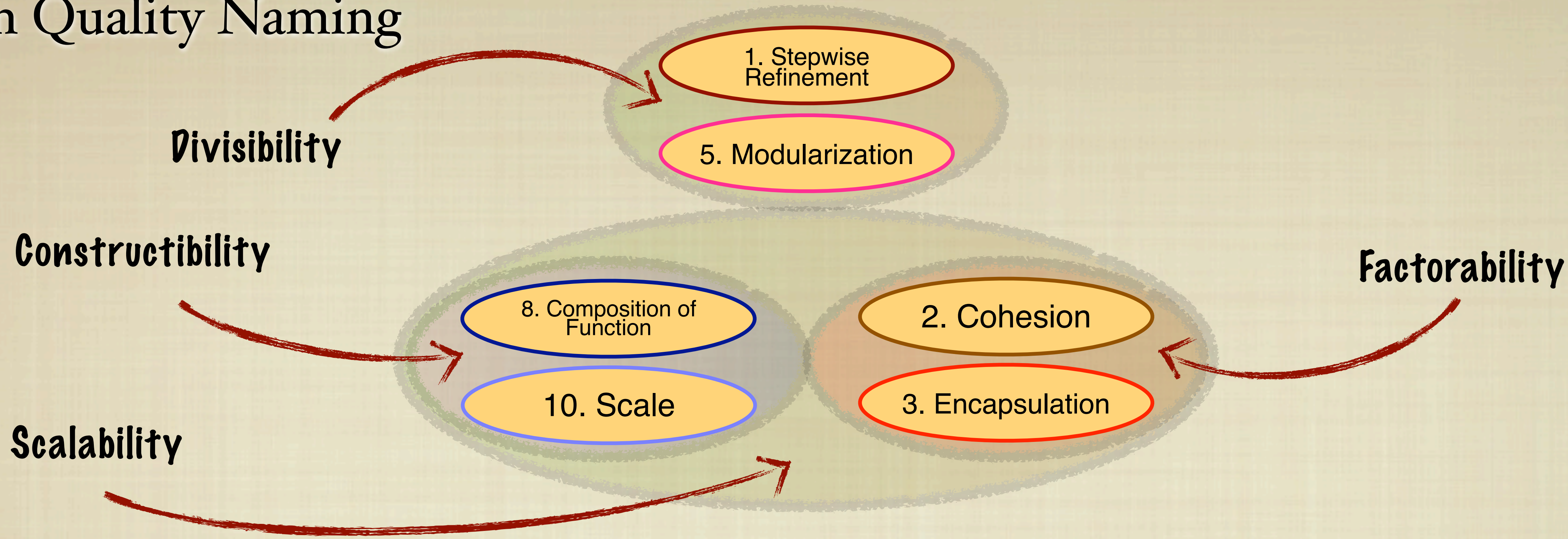


soundness of individuals, internal stability and structural independence

opportunity of combining to build larger/more capable arrangements

Design Quality Naming



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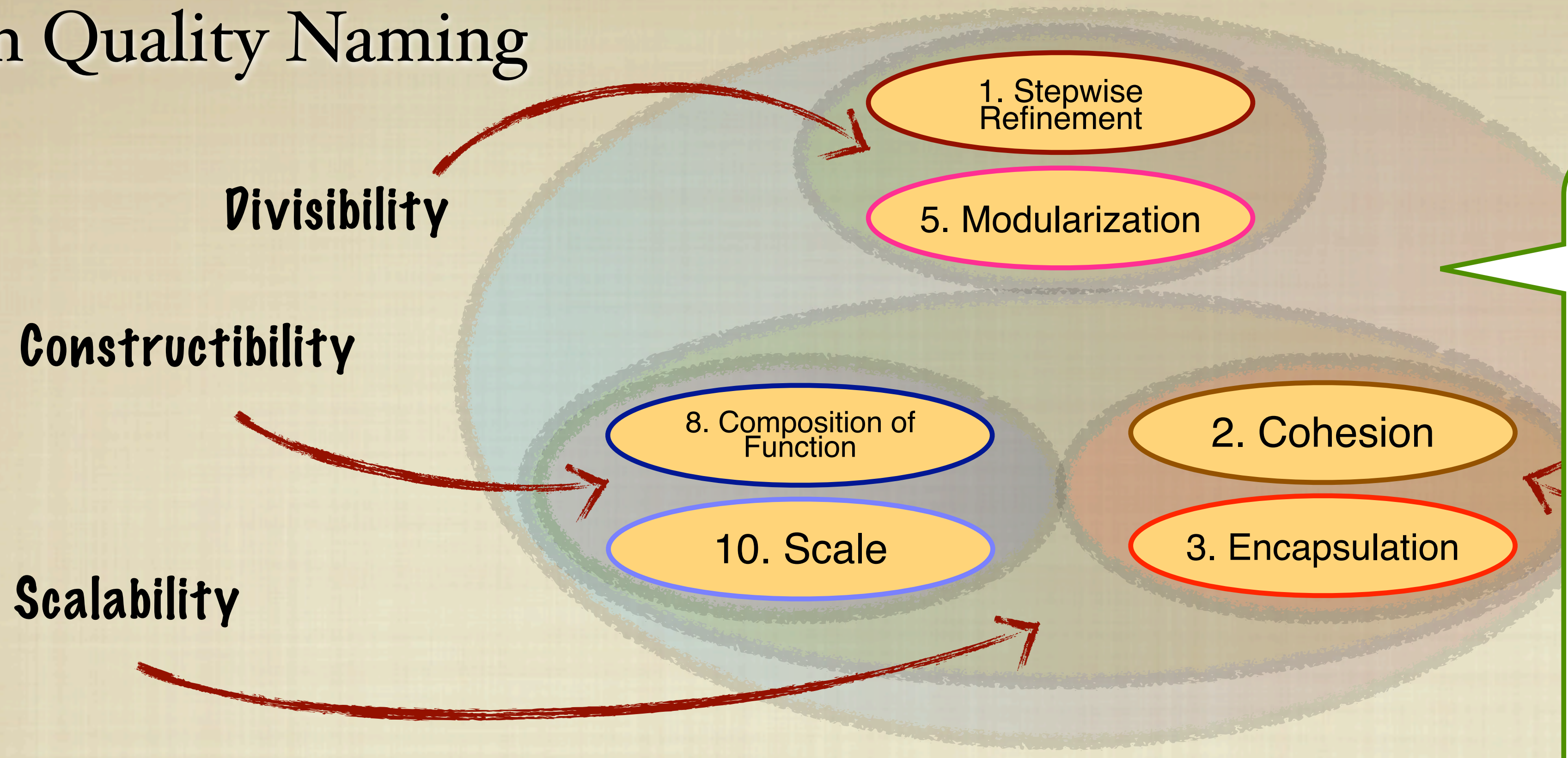
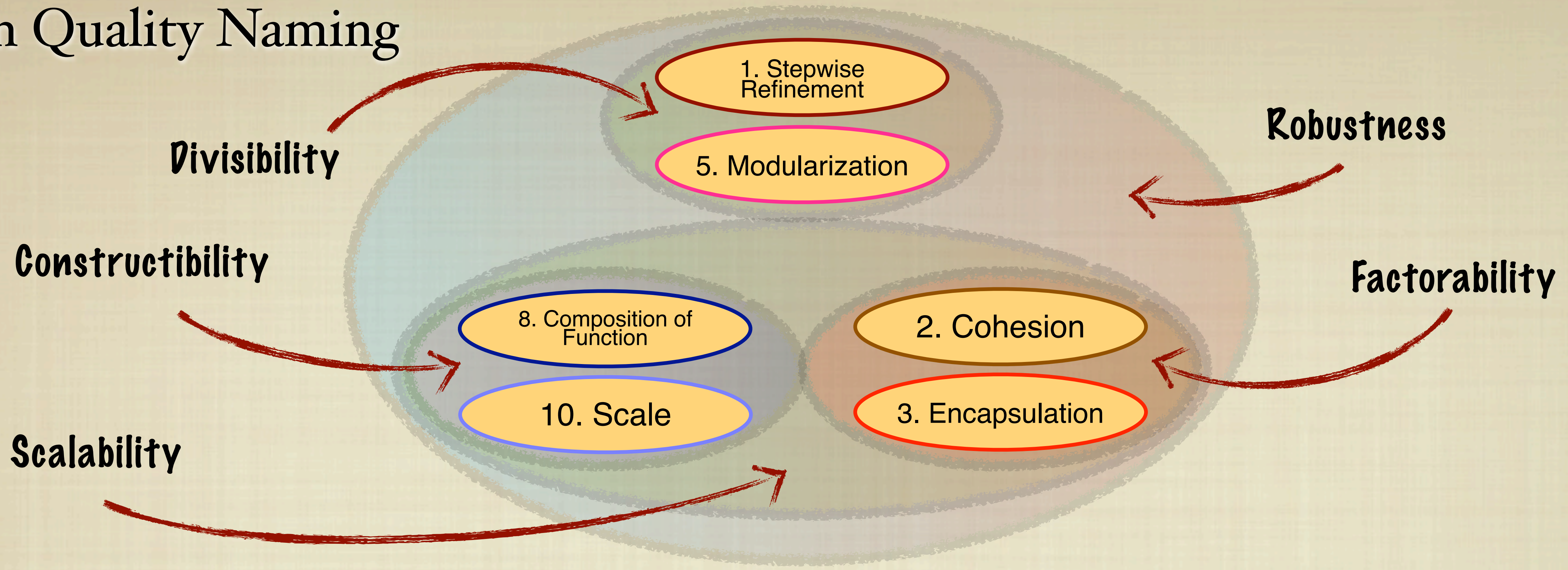


divisible, sound, static structure: building blocks; iteratively decomposed and assembled, separating and insulating concerns

scalability enabling composition, fusing independent self-sufficiency to span the breadth and width of stakeholder intentions

Design Quality Naming



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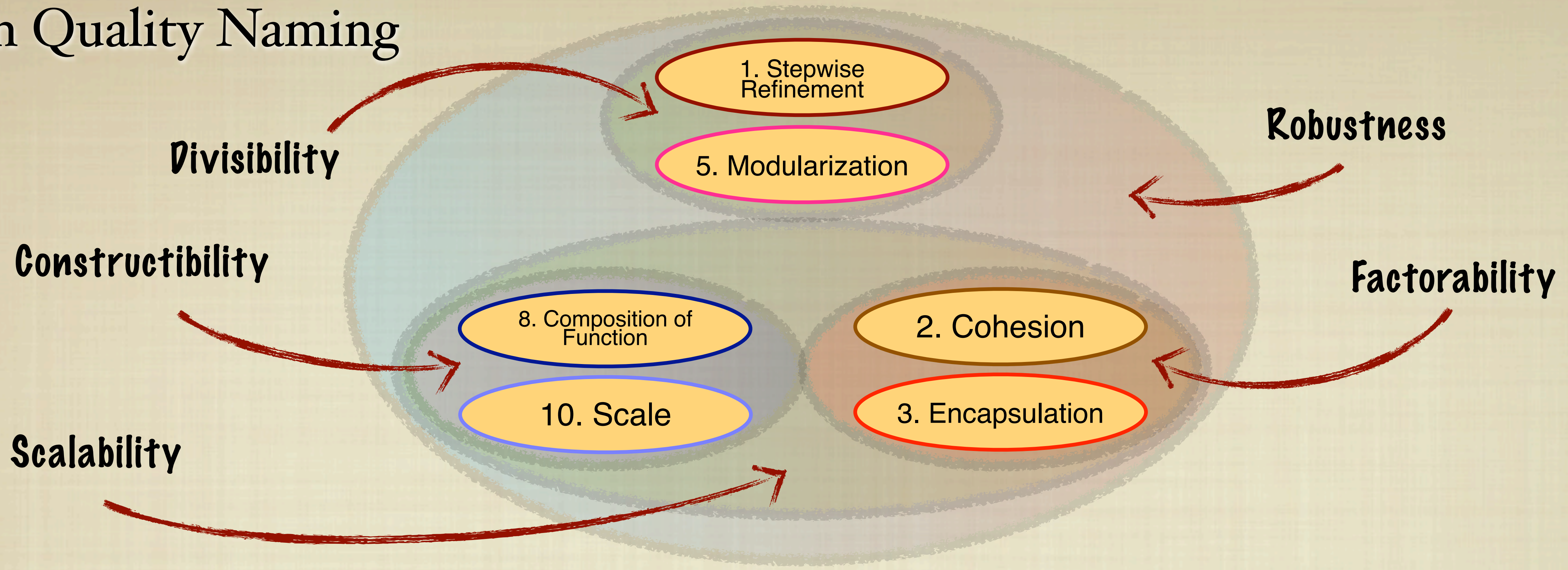
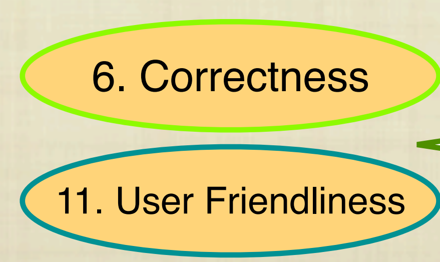
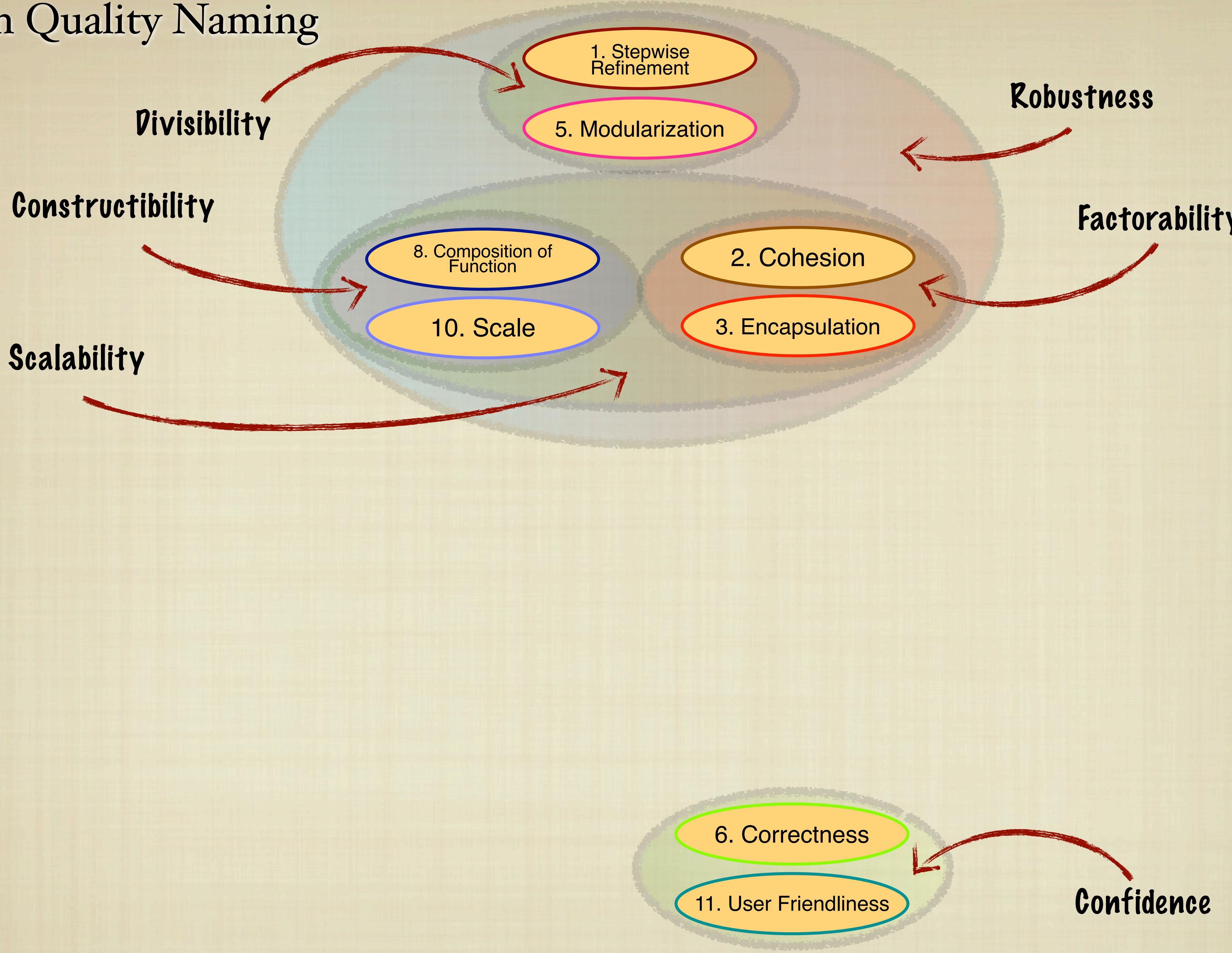




choice alignment with intentions (dynamically)

a perception of “what is natural,” “seeing” what you expect reinforces reliance and trust

Design Quality Naming



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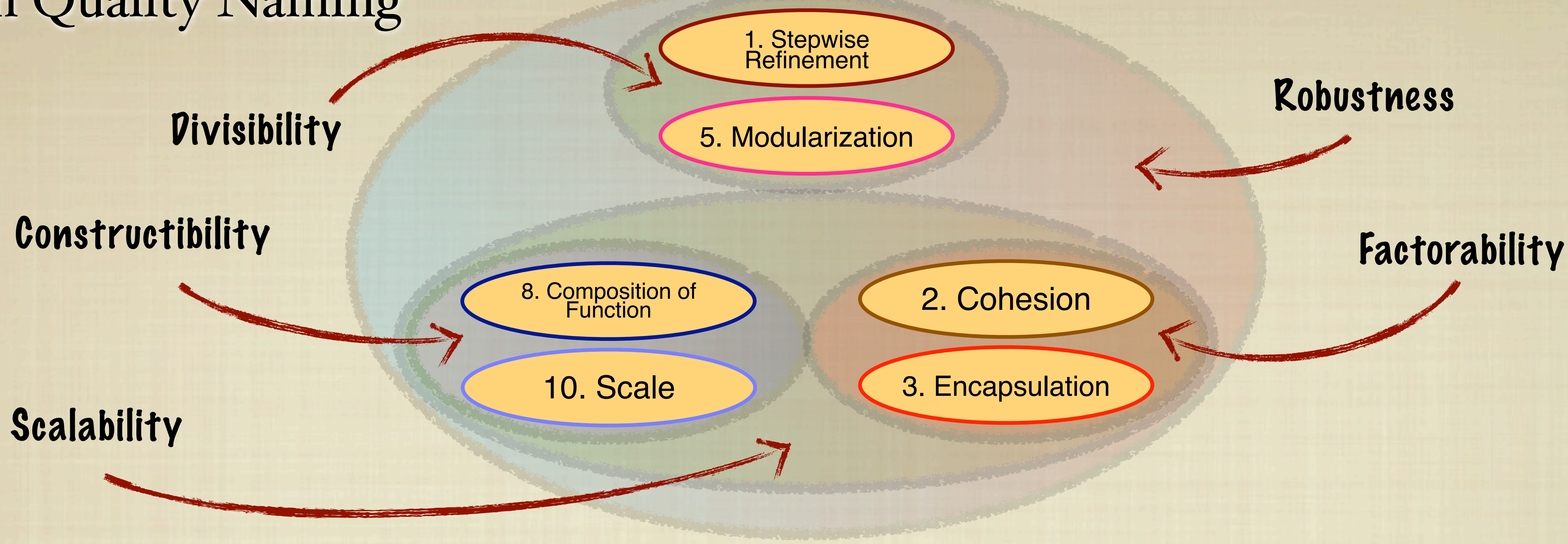
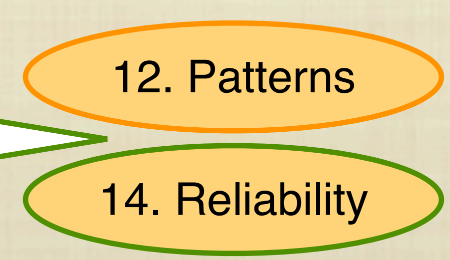
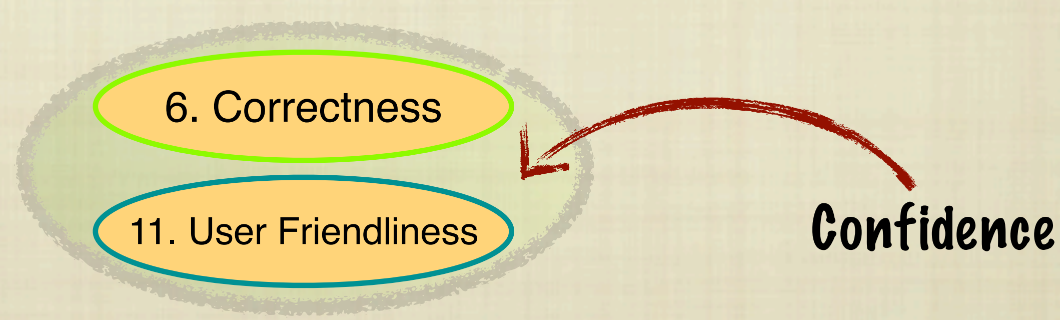


proven formulae or techniques enable repeatable success

consistently safe practice continues success with compatible challenges





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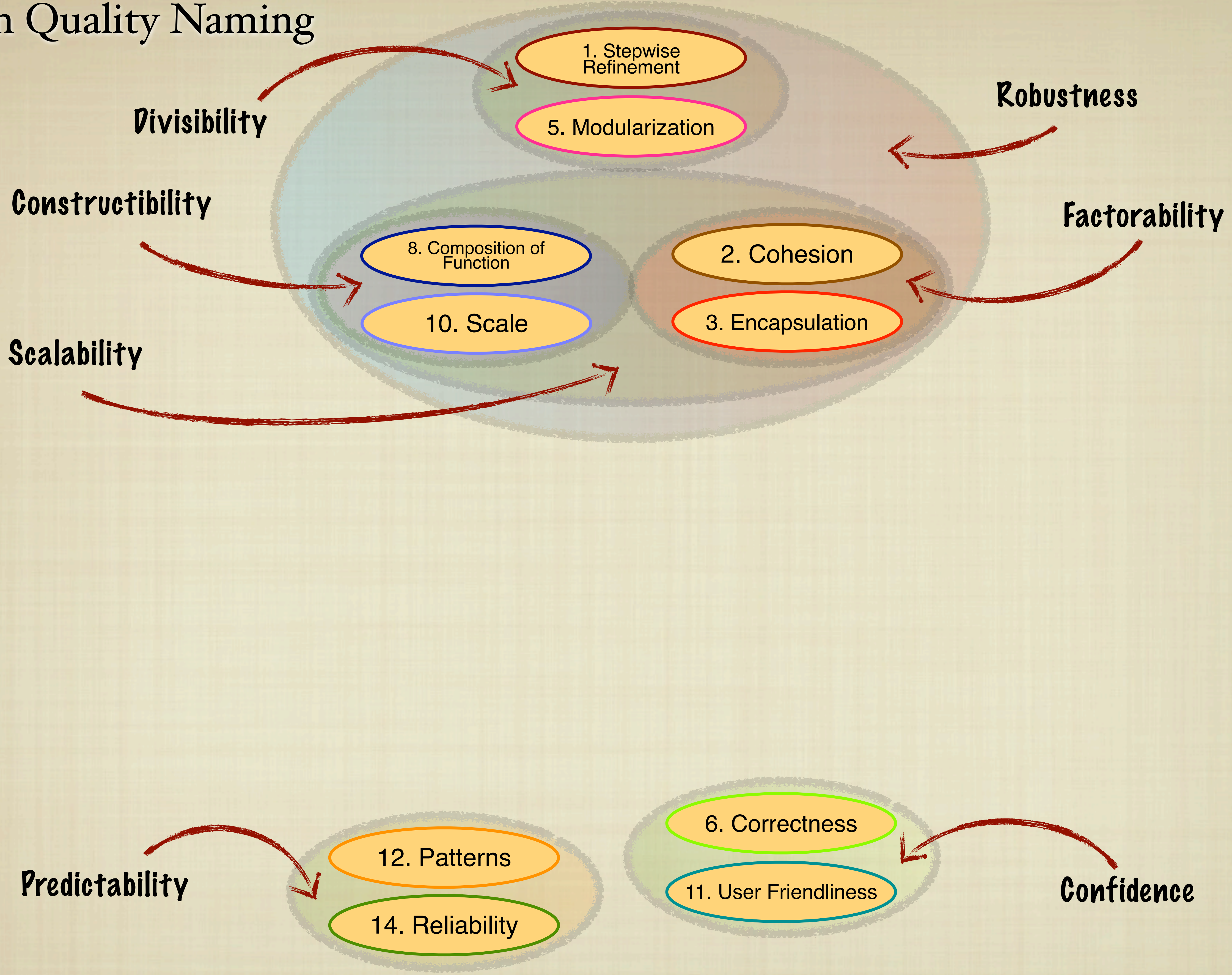

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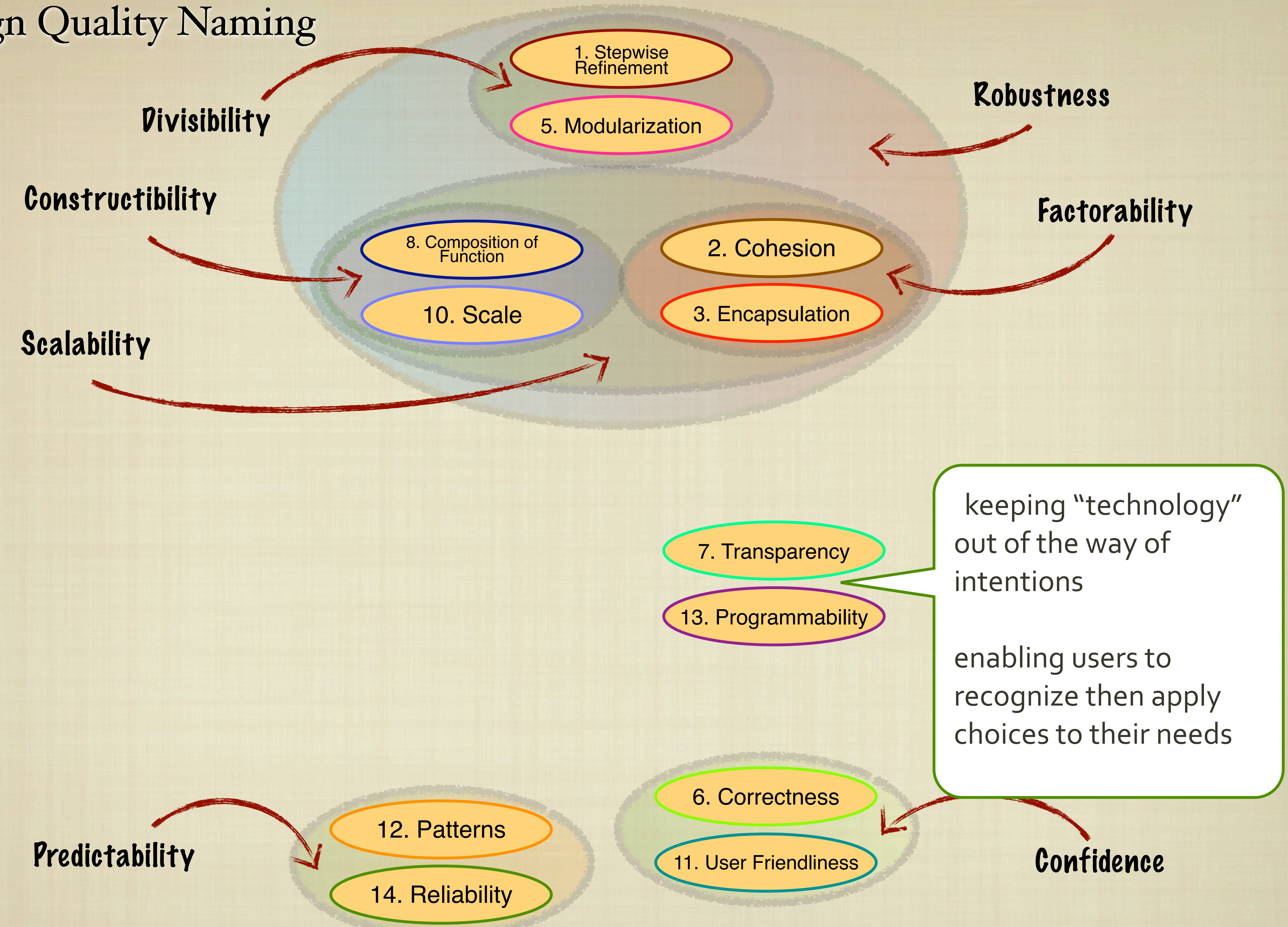

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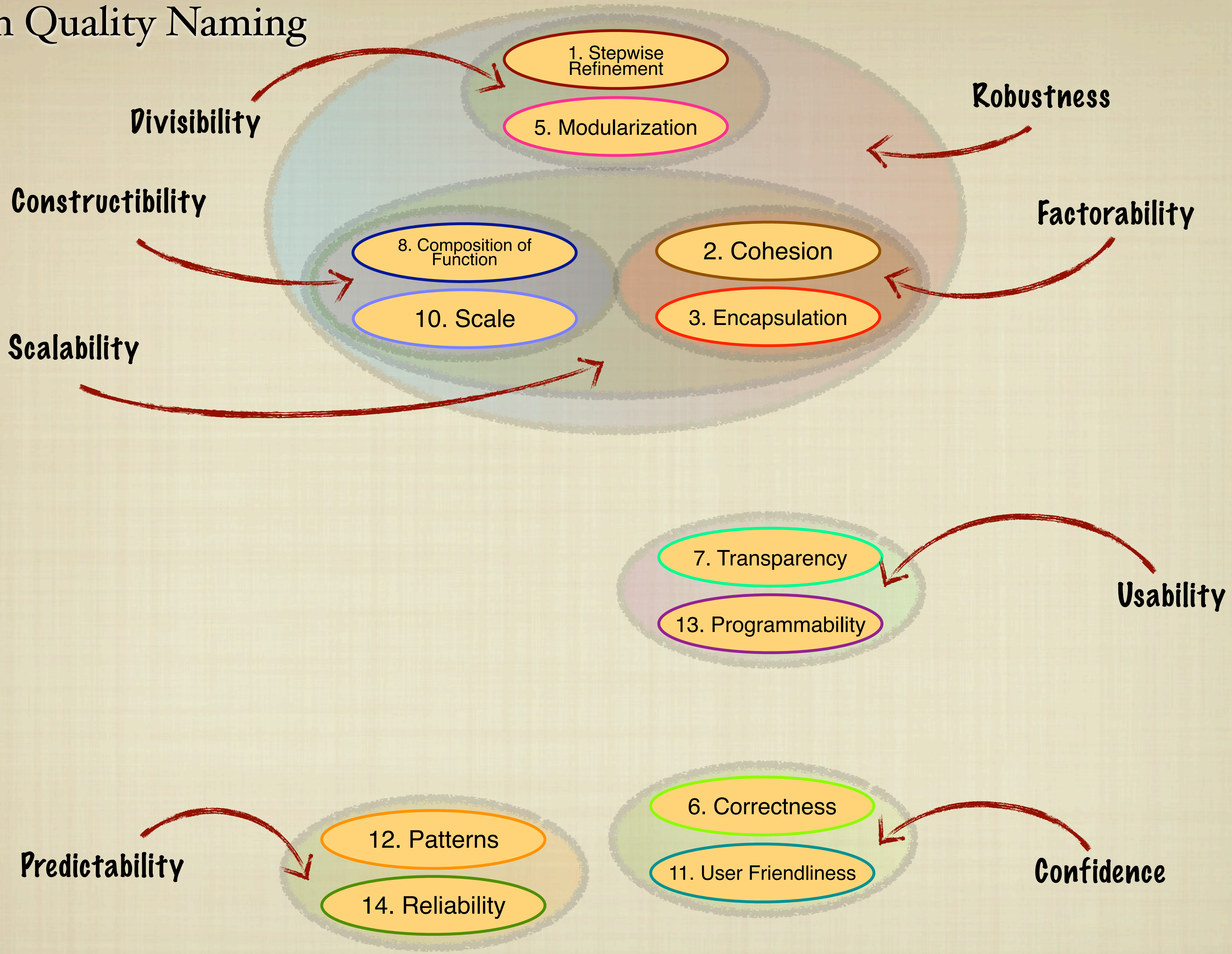

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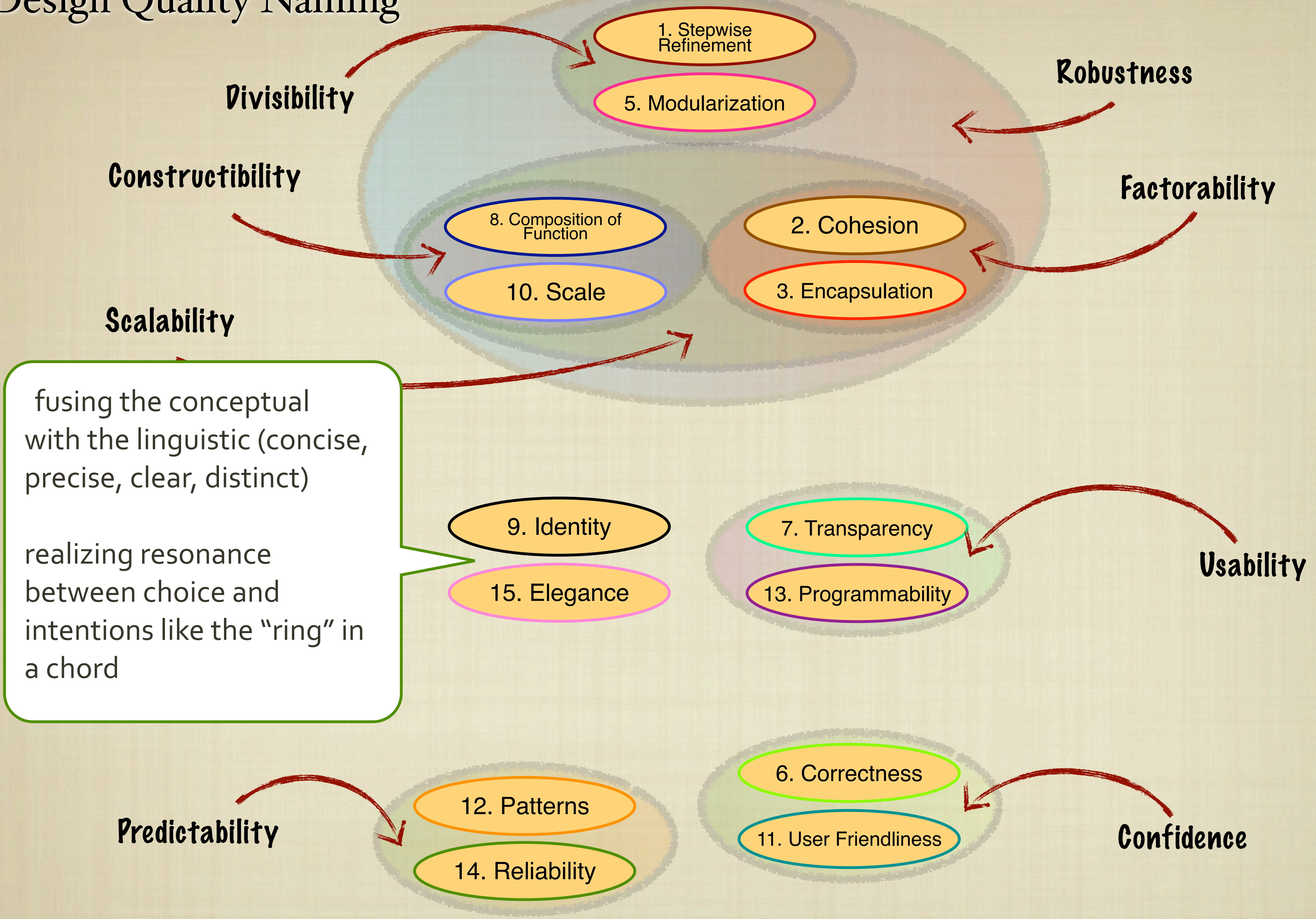

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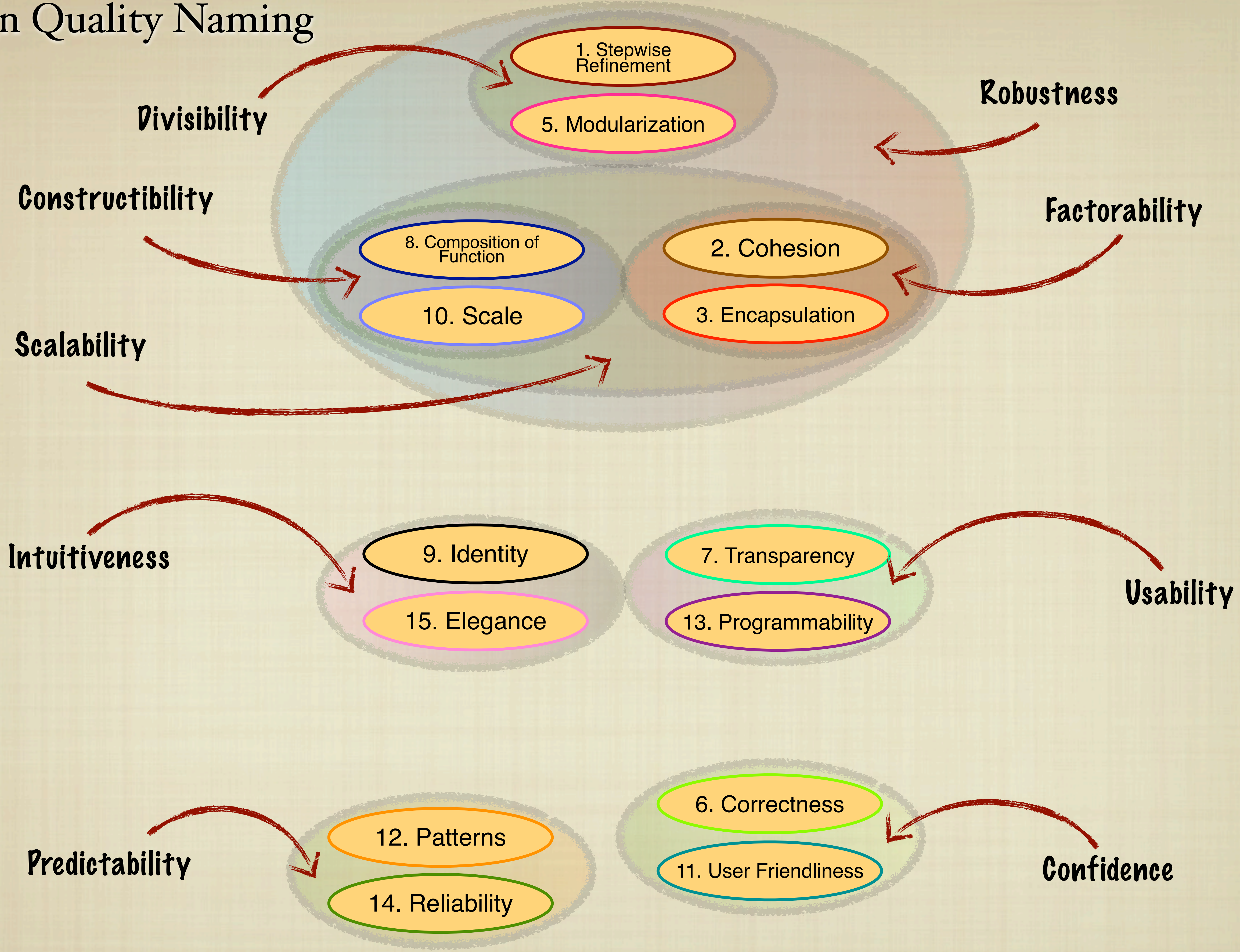

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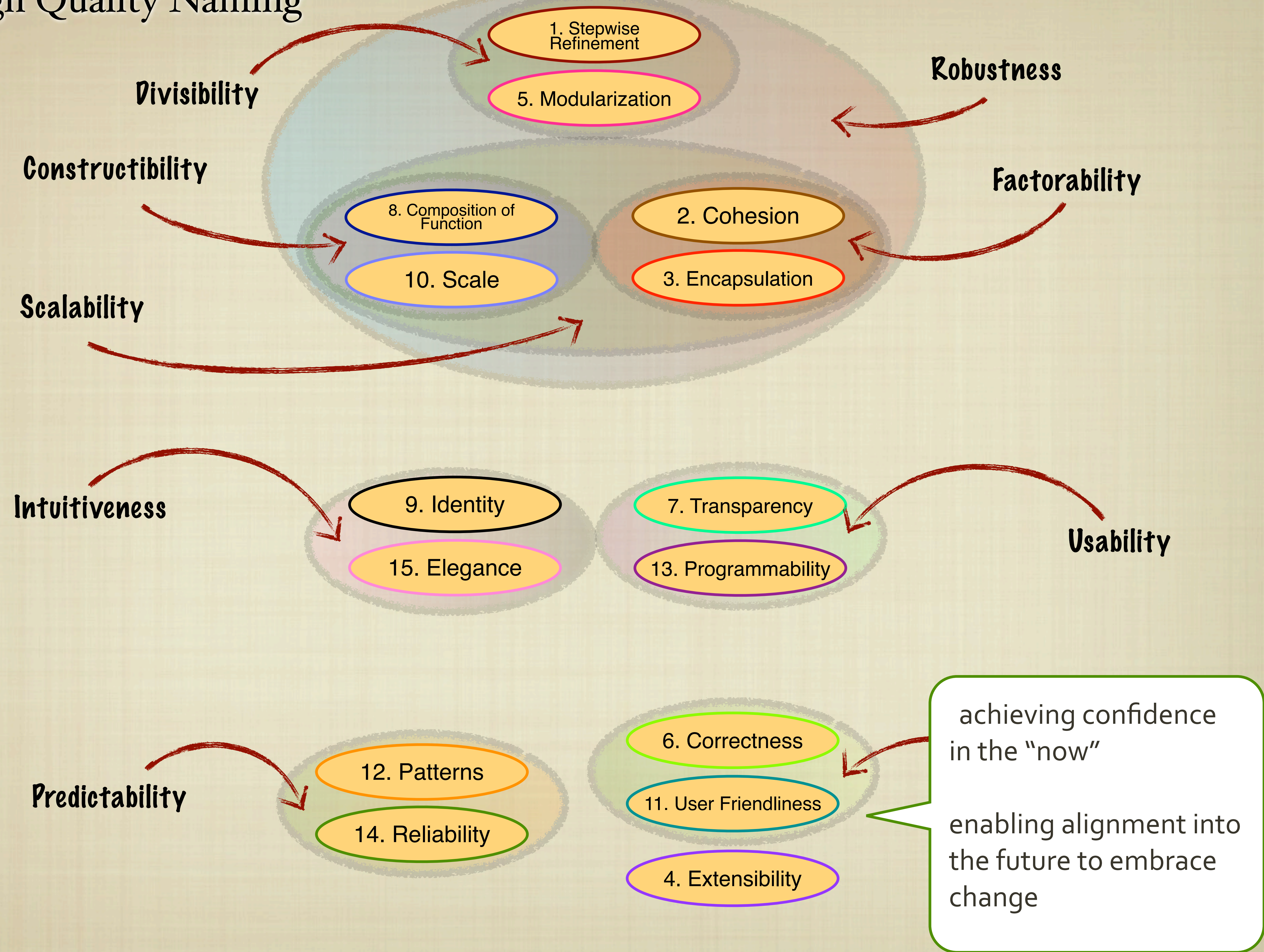

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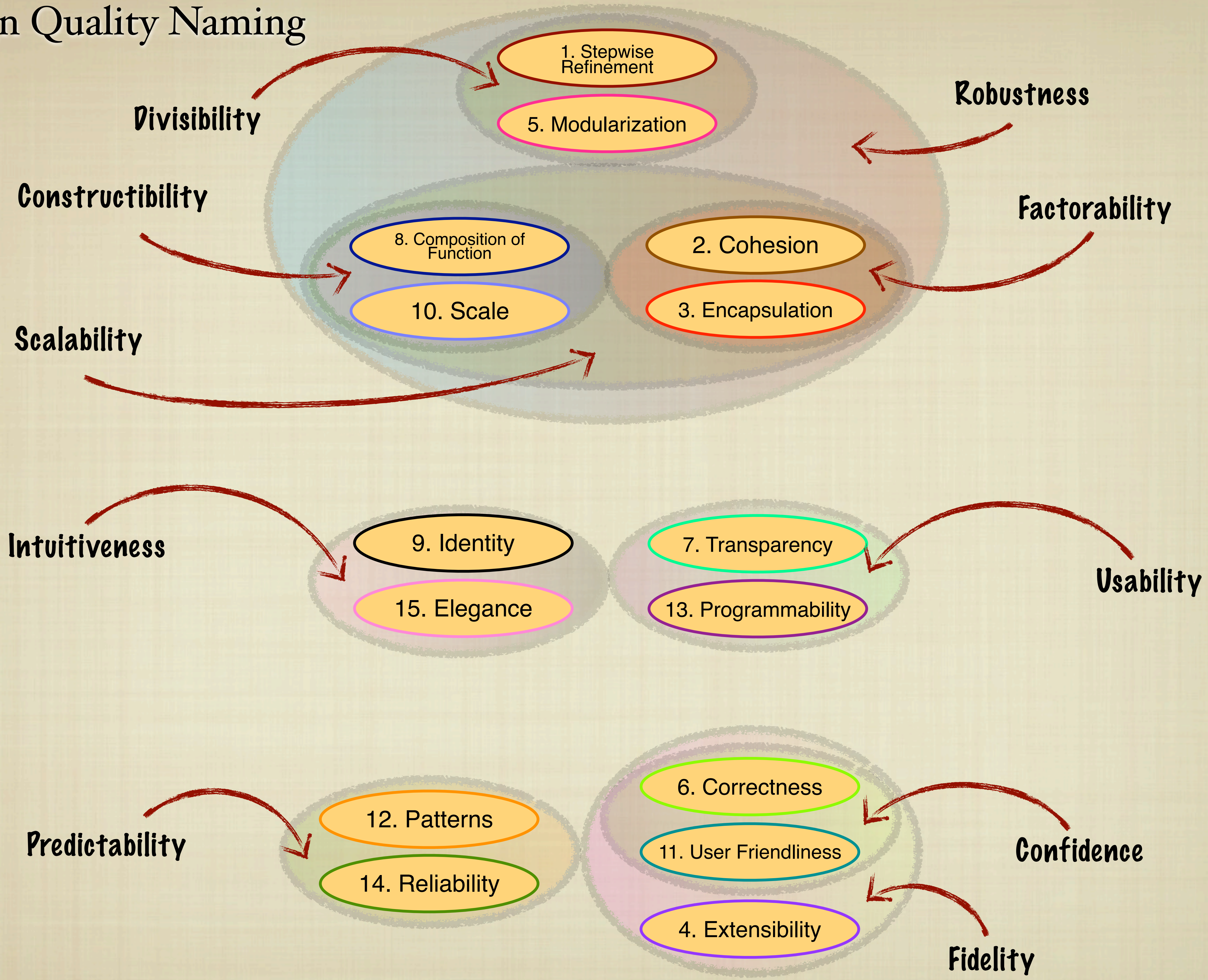

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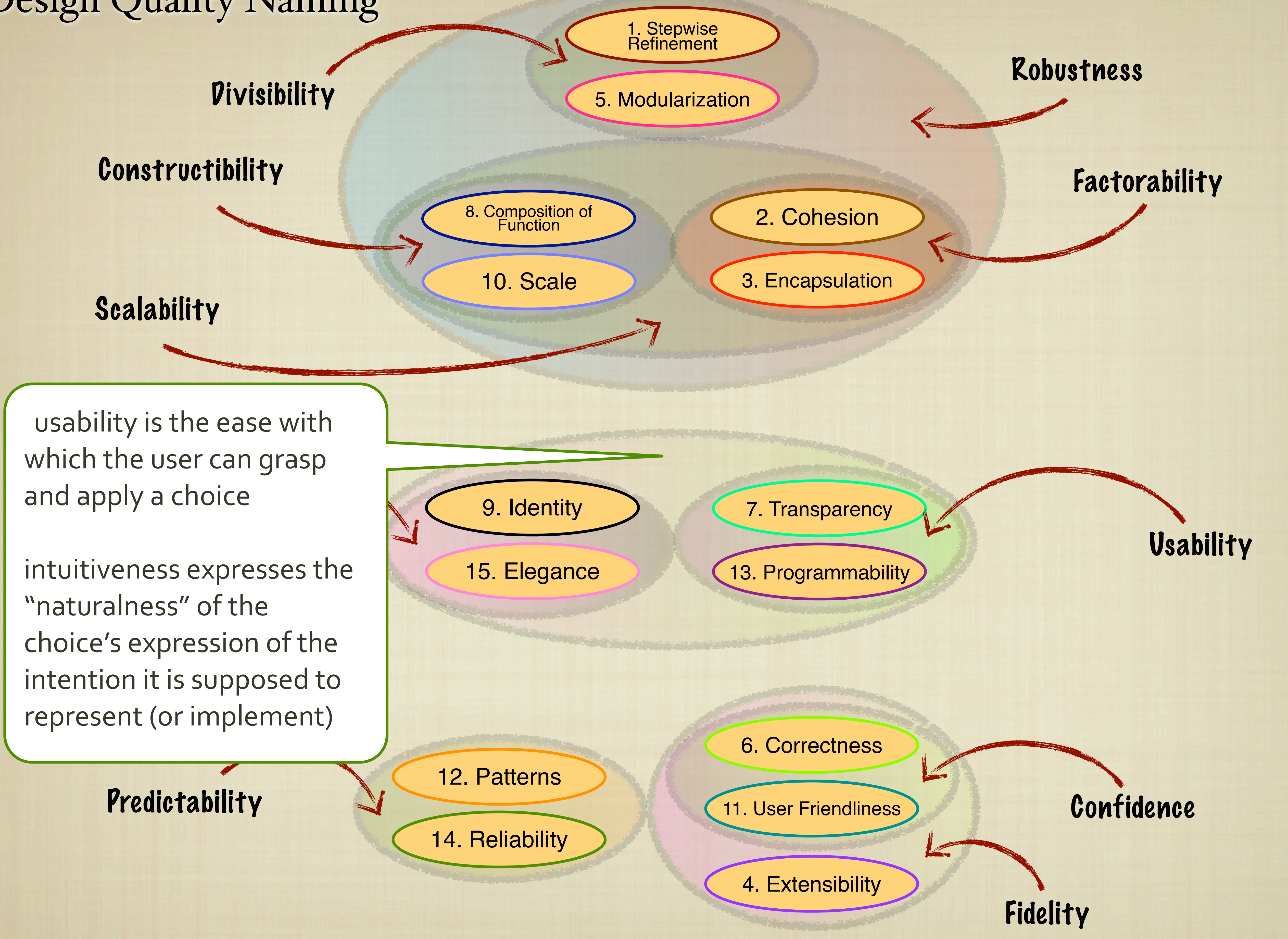

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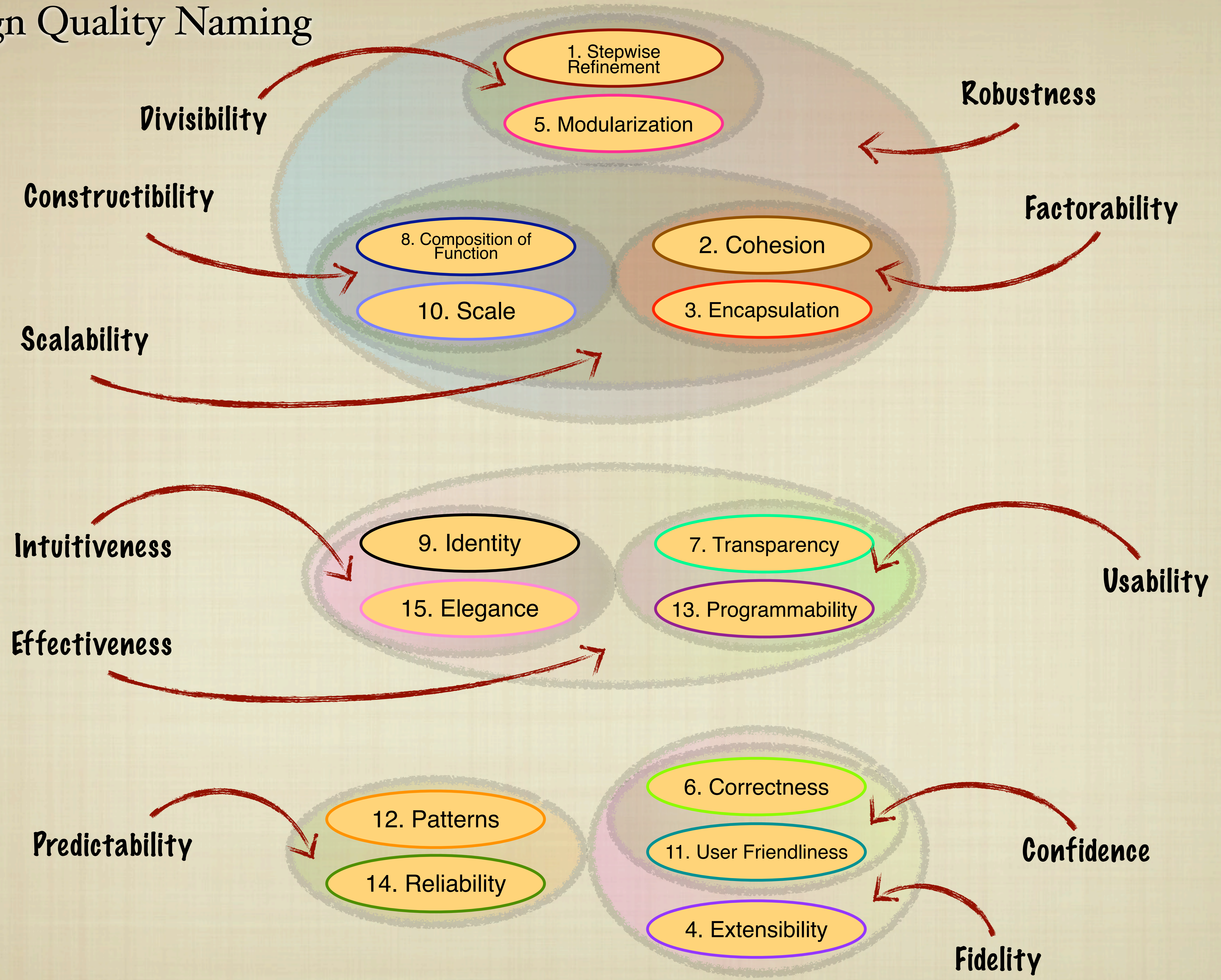

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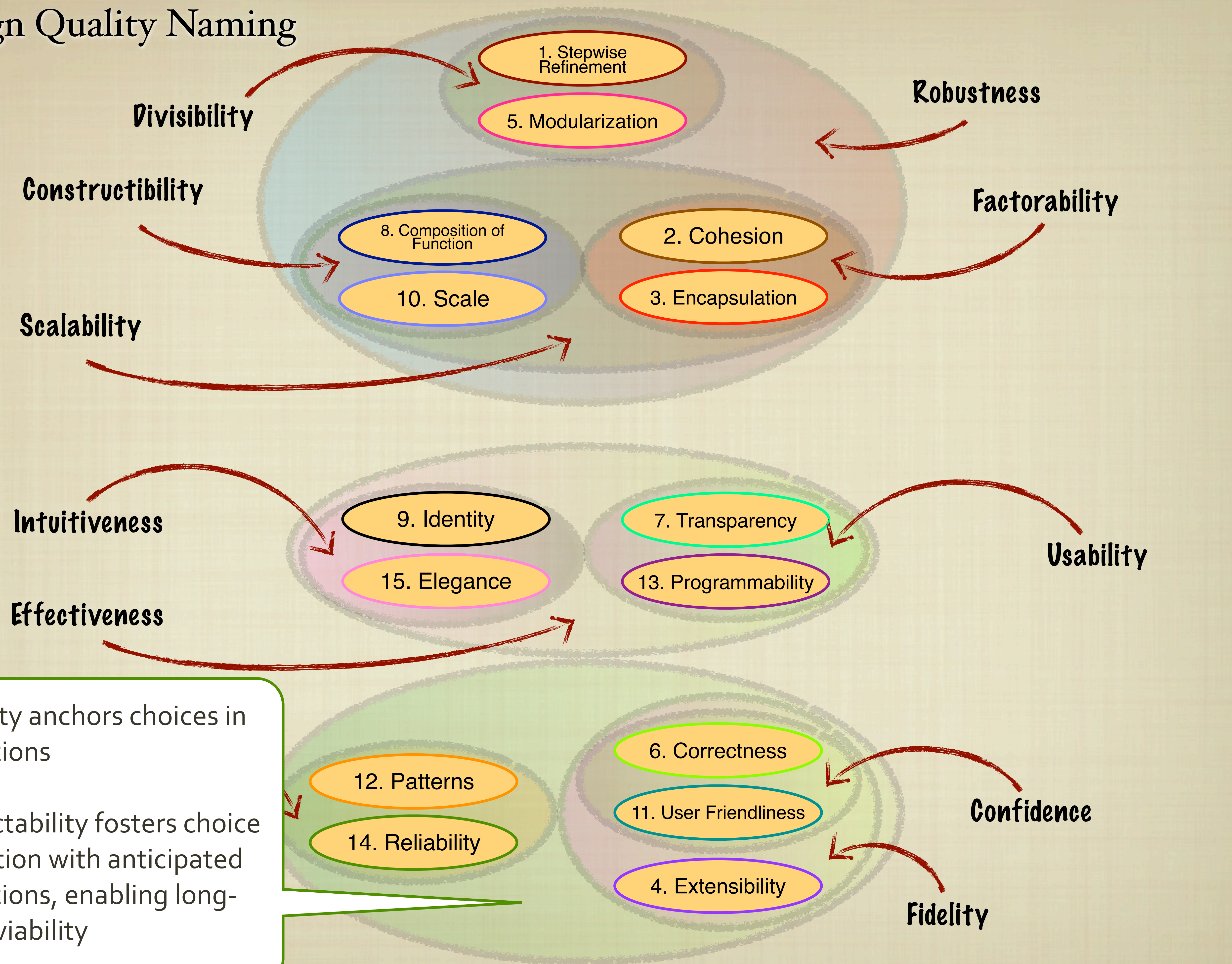
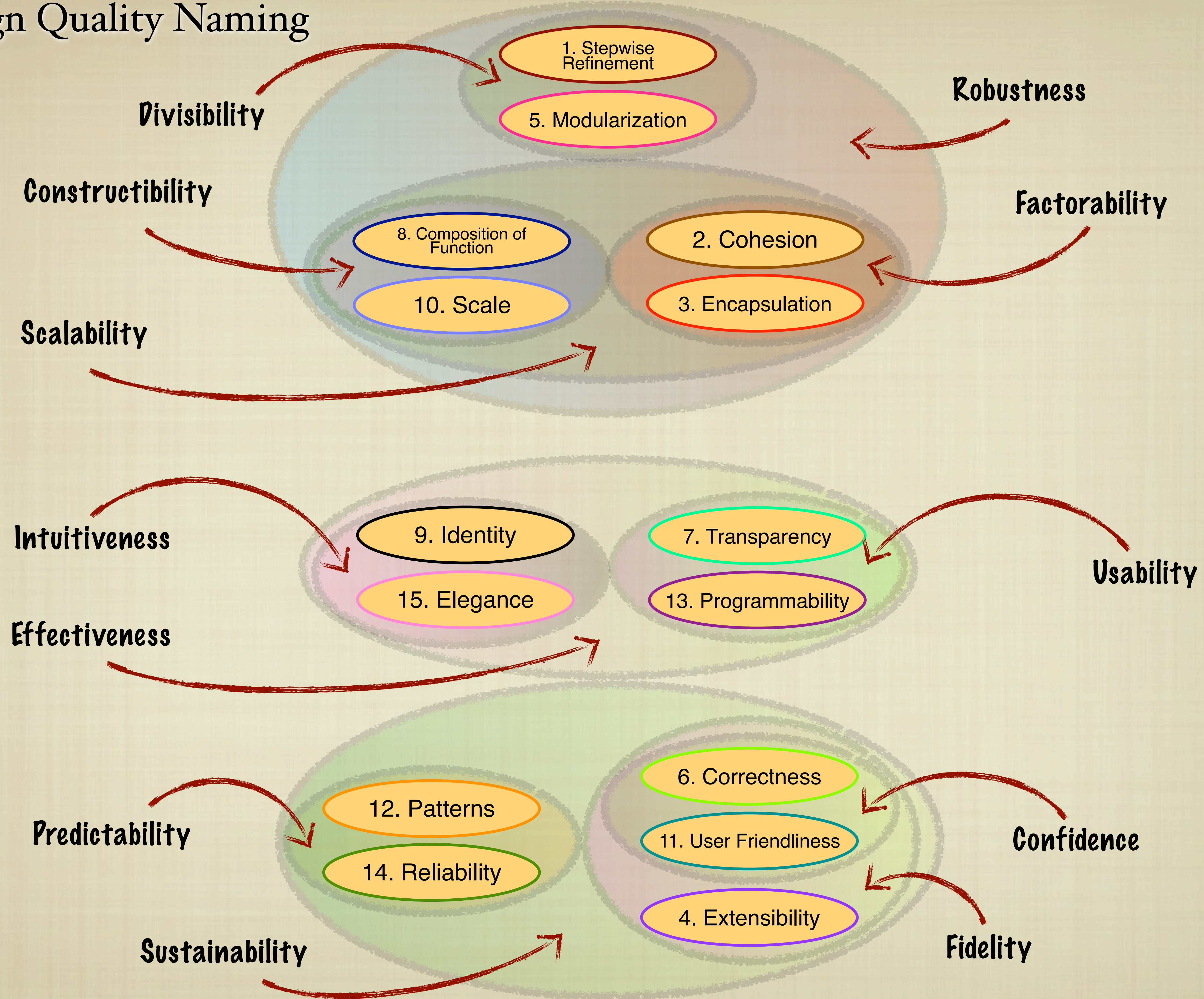


fidelity anchors choices in intentions

predictability fosters choice evolution with anticipated intentions, enabling long-term viability

Design Quality Naming



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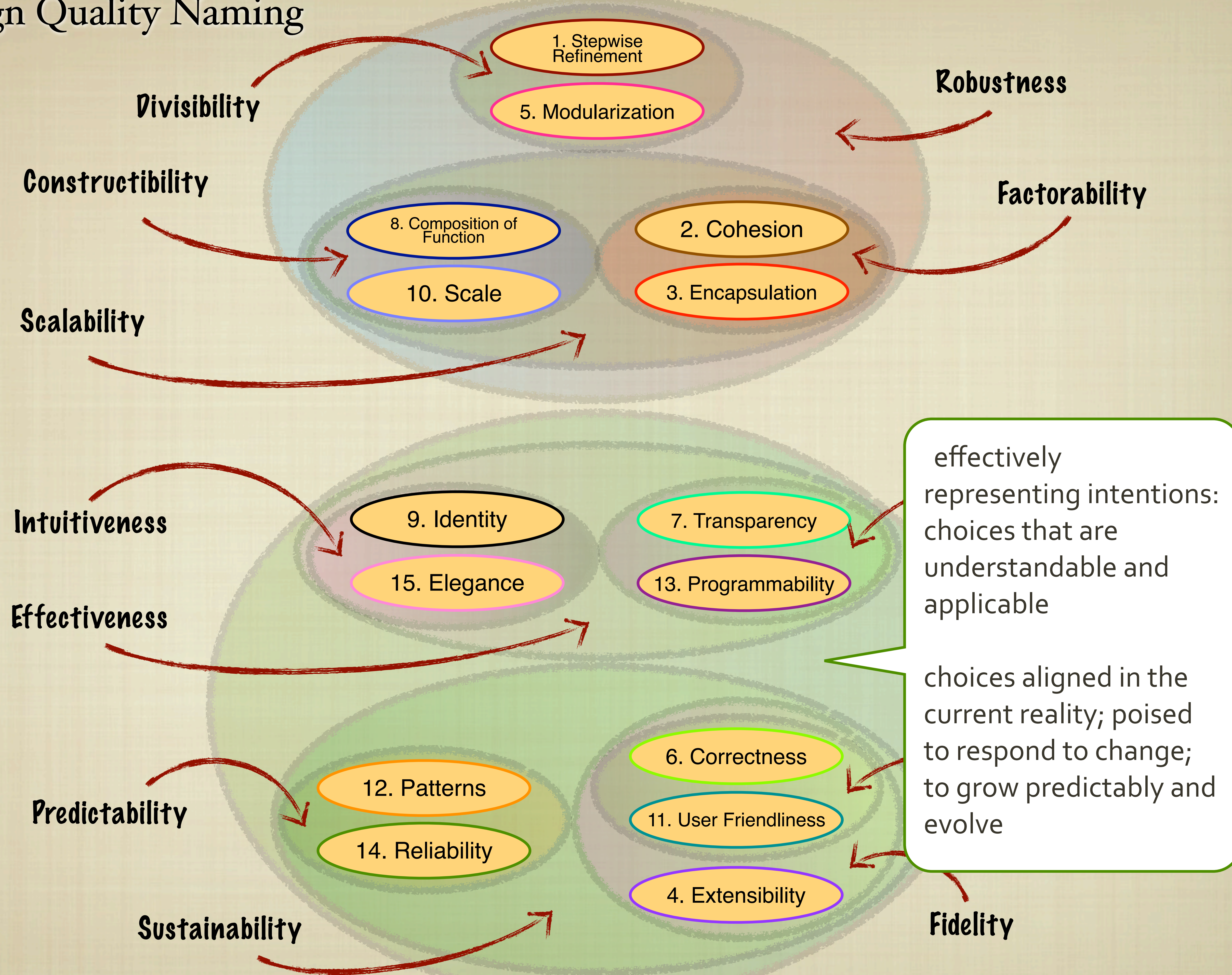

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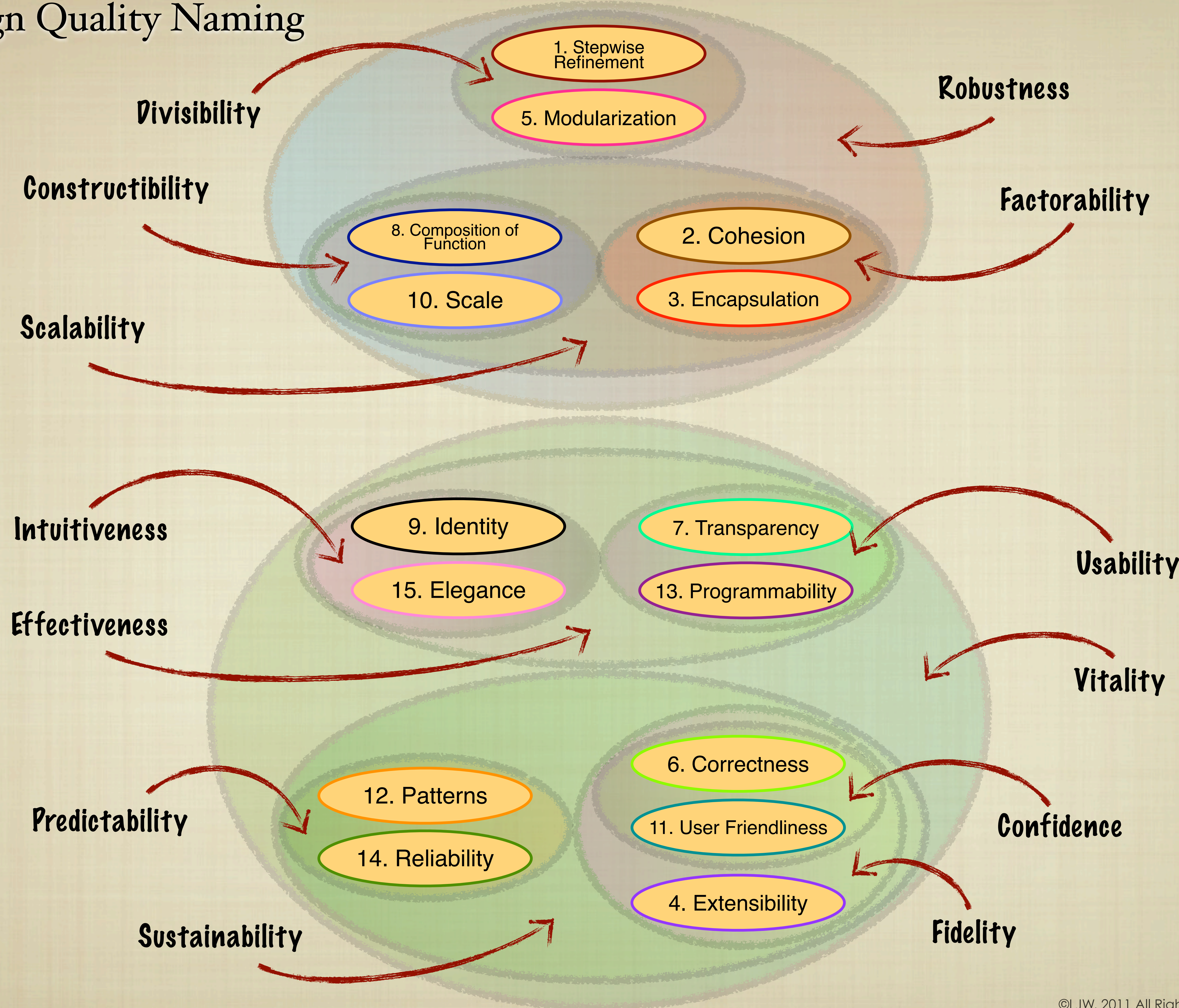

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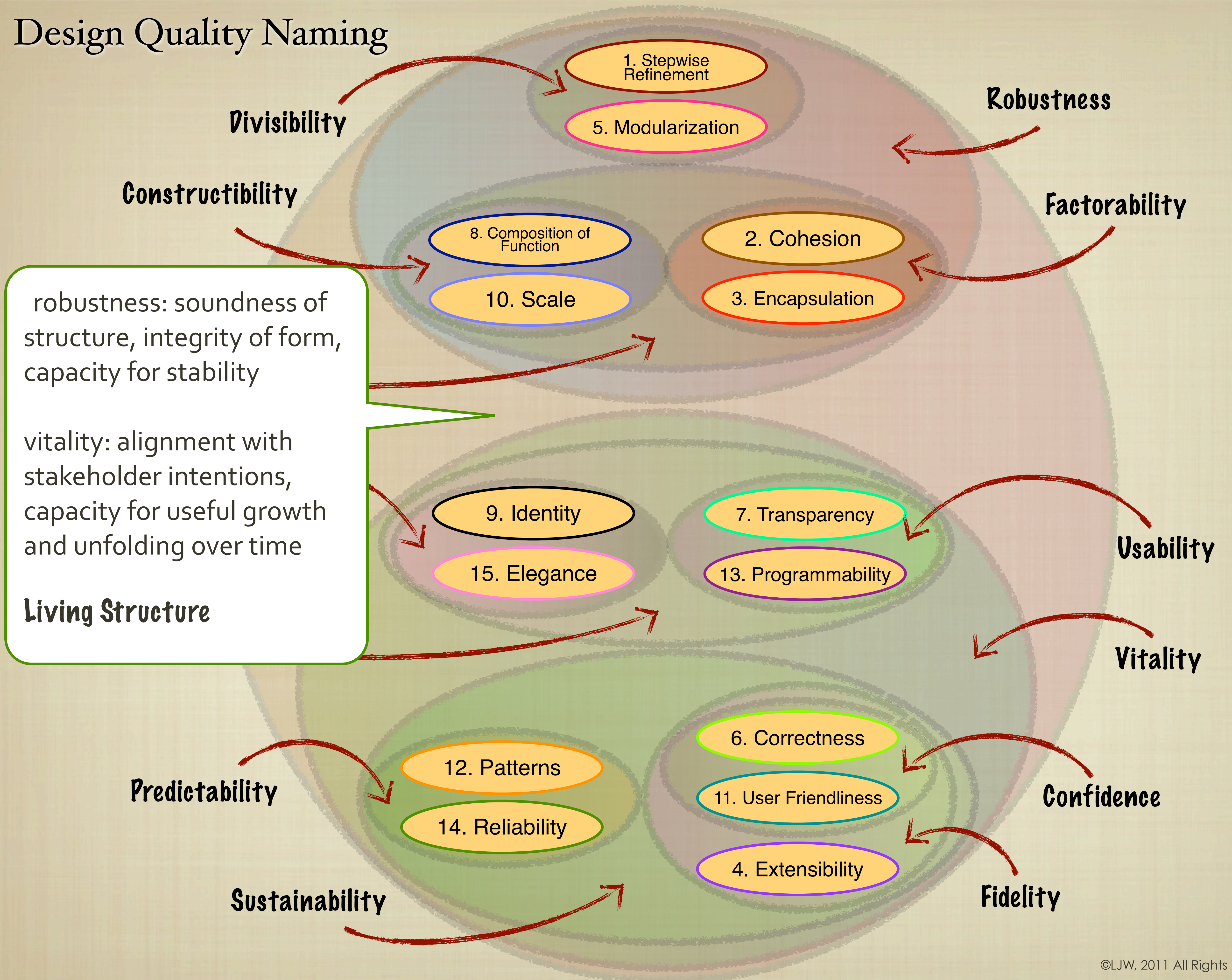

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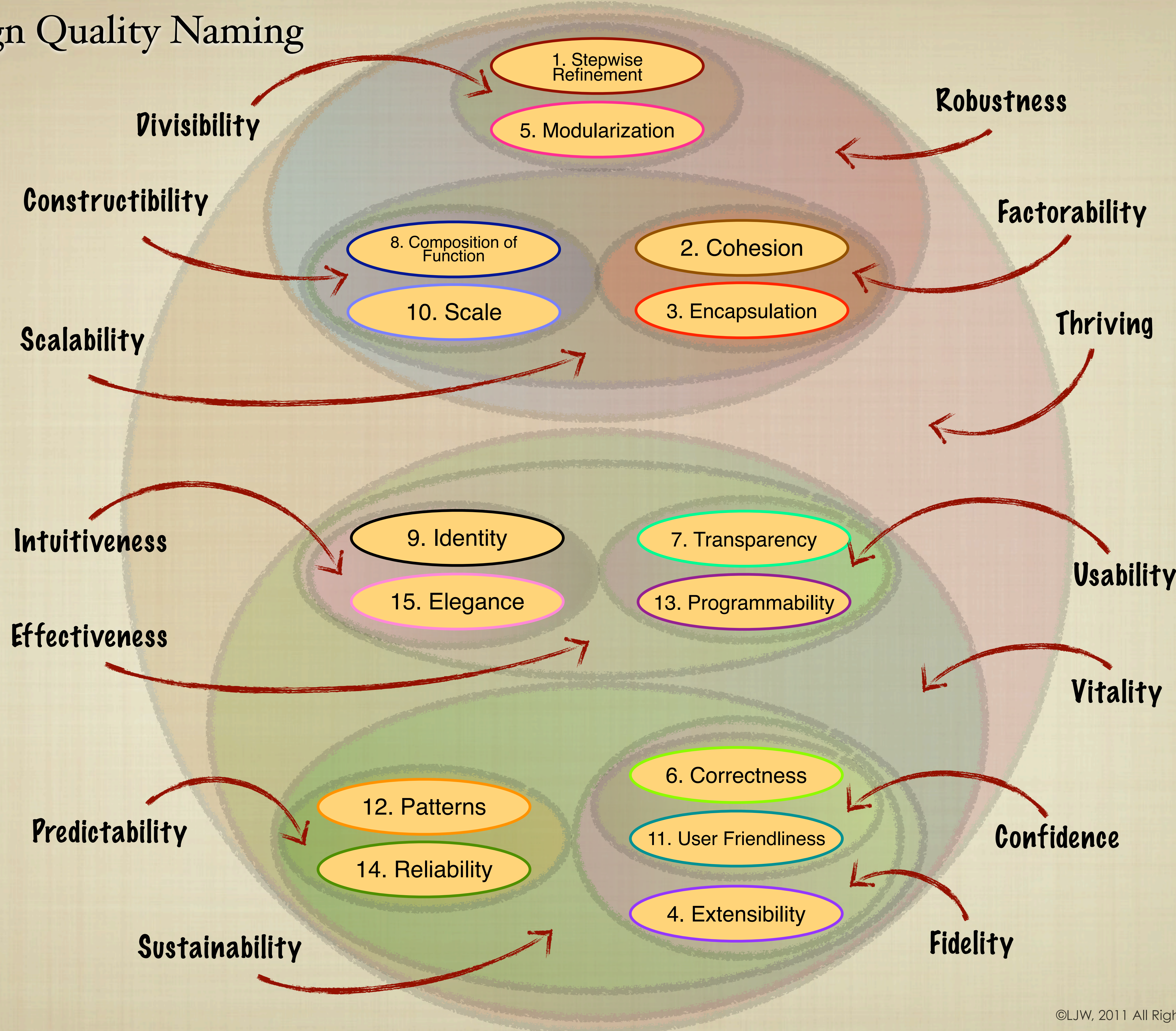

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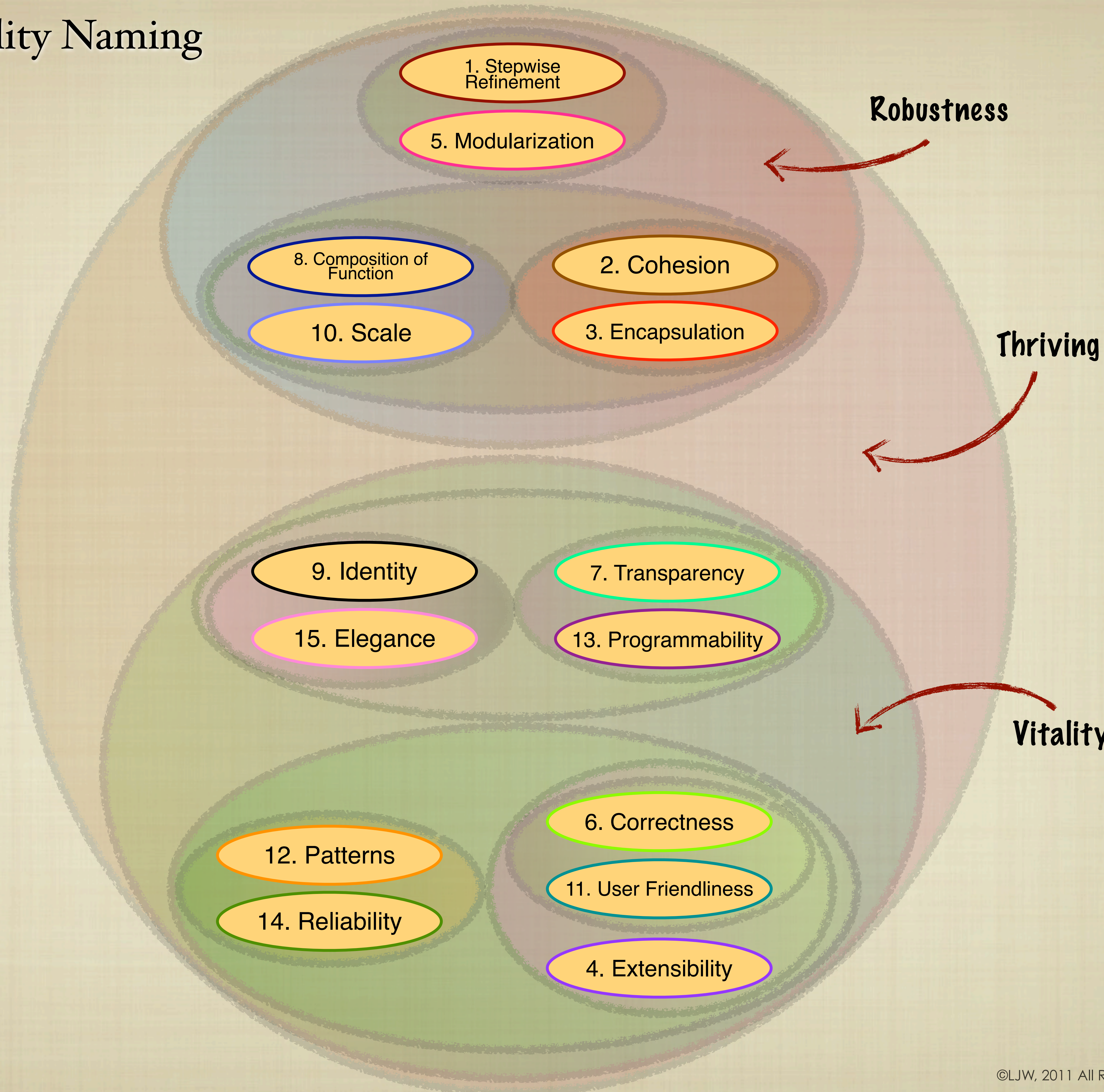
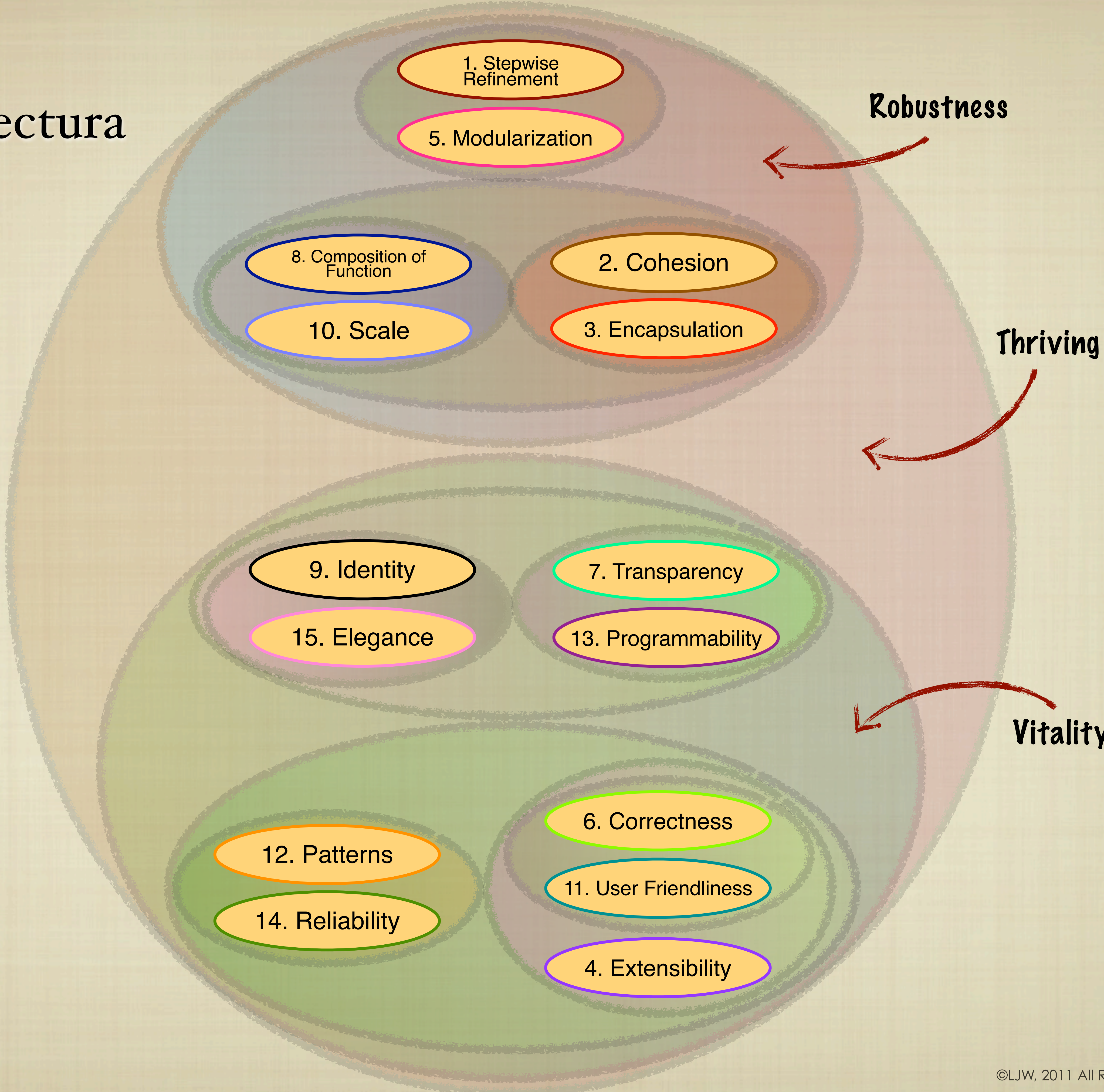


Vitruvius
De architectura
78 BC



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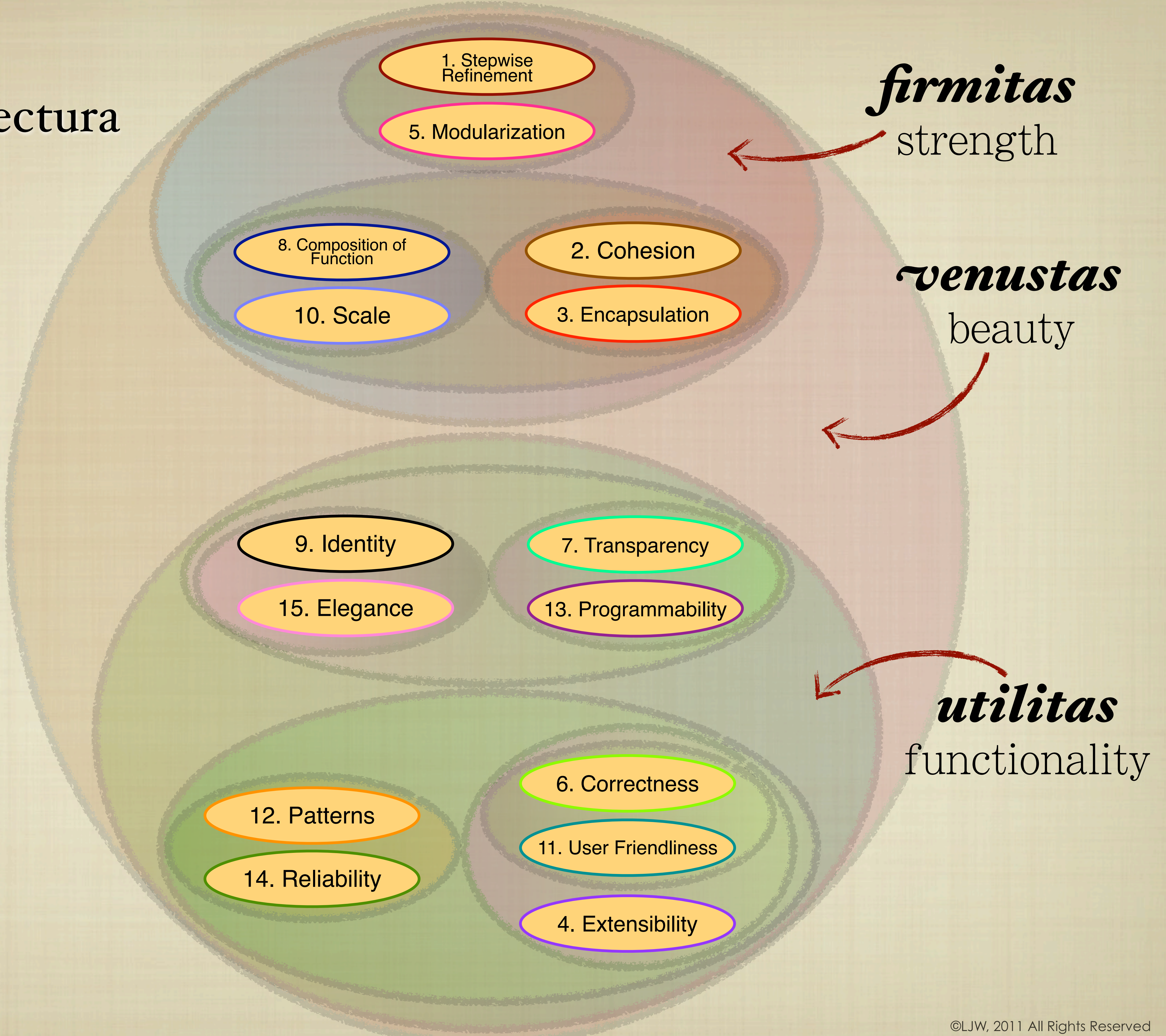
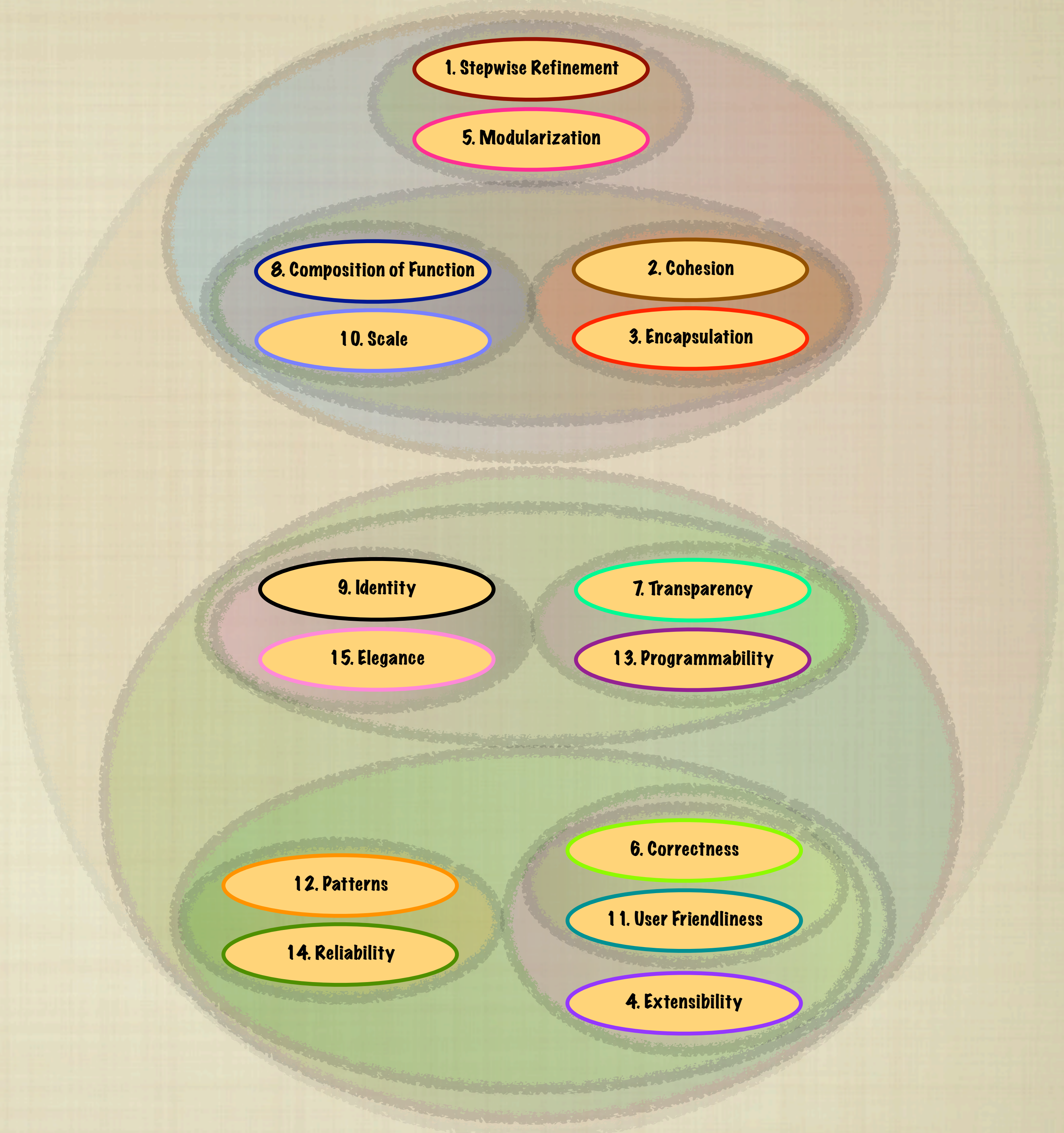
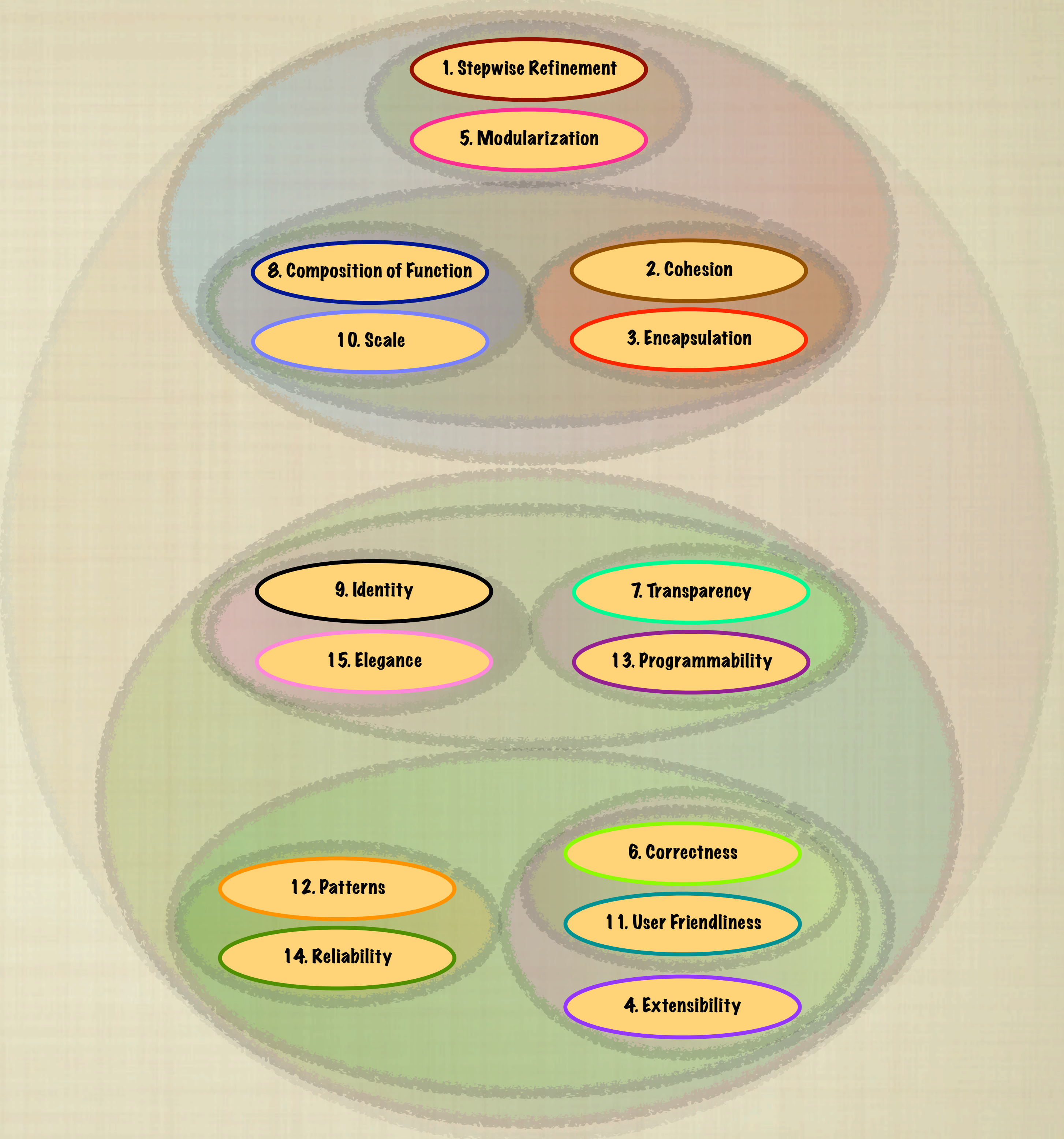


Thriving Systems Qualities



A Thriving System exhibits the confluence of design qualities described by *robustness* and *vitality* –

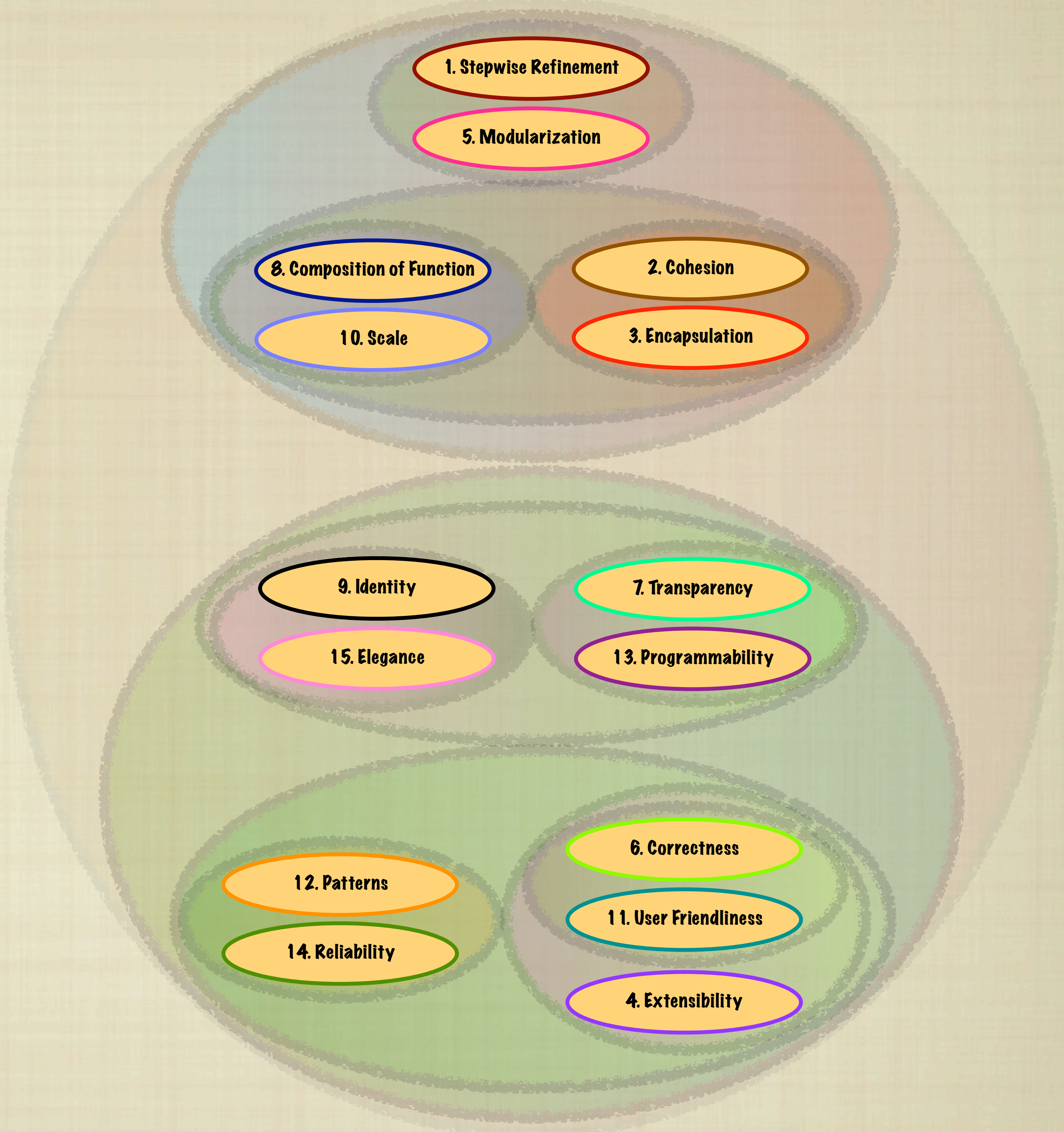
Thriving Systems Qualities



A Thriving System exhibits the confluence of design qualities described by *robustness* and *vitality* –

beyond existing, *beyond functional,*
beyond surviving.

Thriving Systems Qualities



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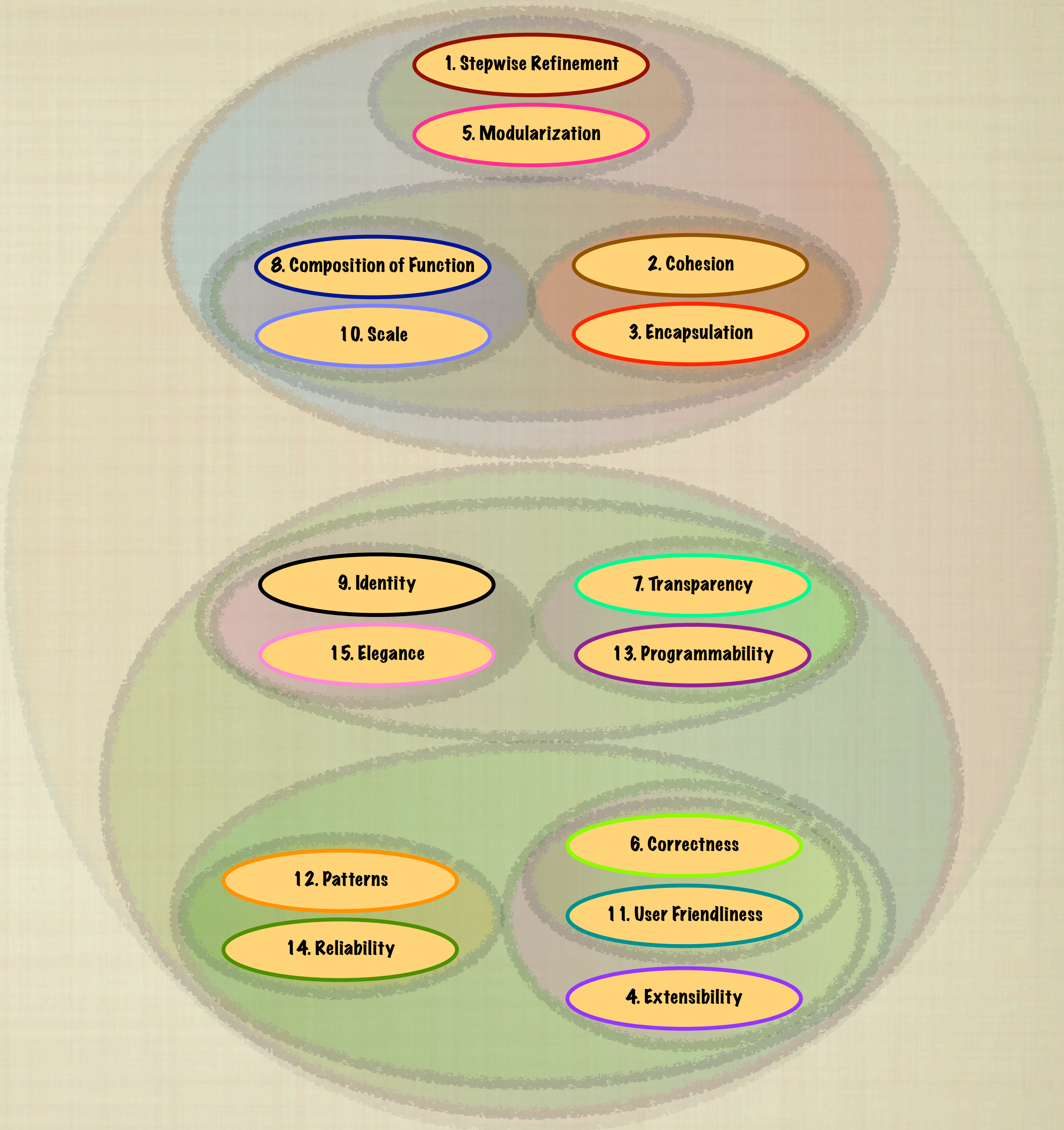
It thrives not only because it supports and aligns with the stakeholders' intentions in the "now," but –

Thriving Systems Qualities



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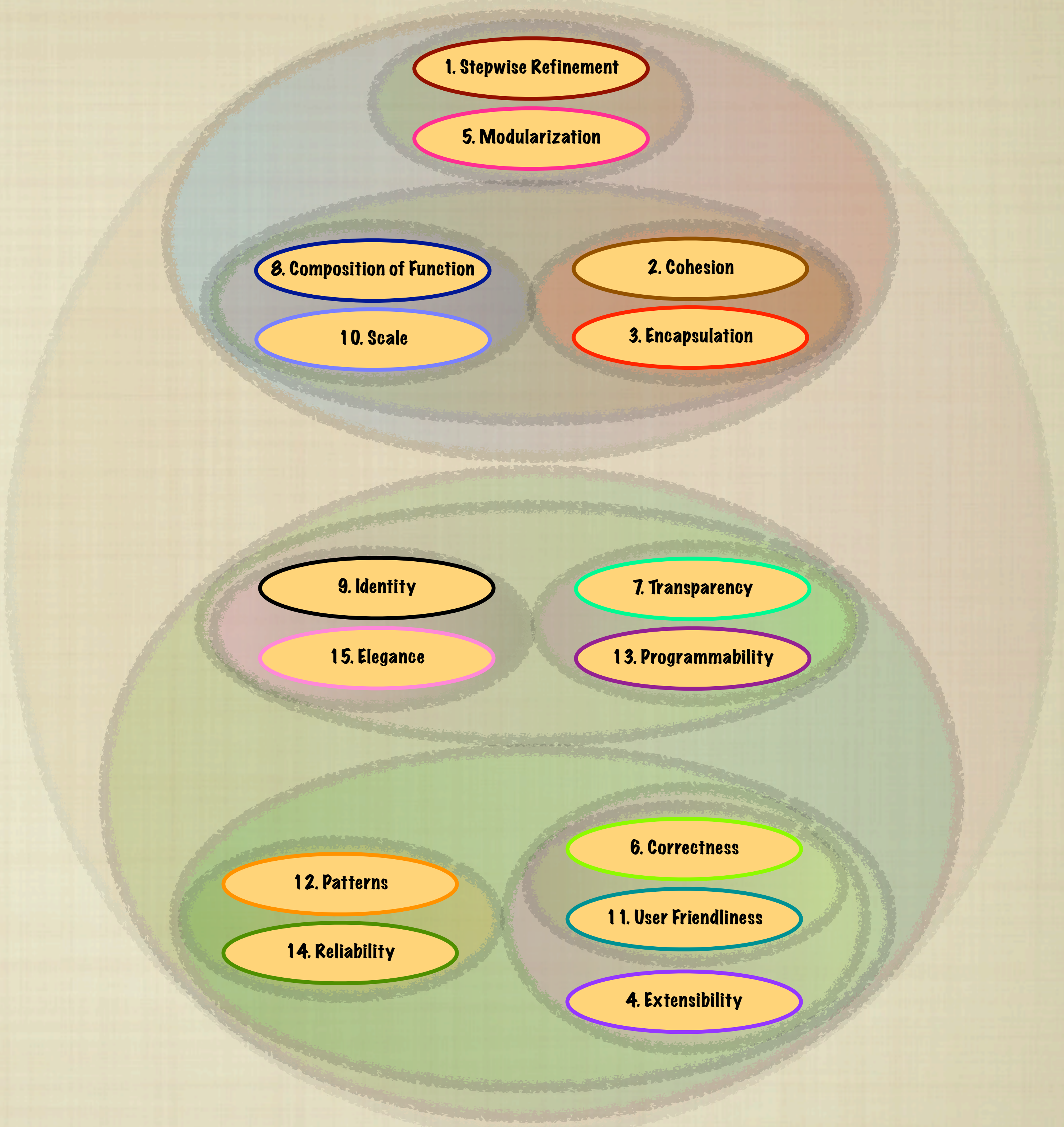
It actually promotes the unfolding of those intentions through the conceptual clarity and efficiency with which it represents them – the symbiosis that great design has with an authentic requirement.

Thriving Systems Qualities



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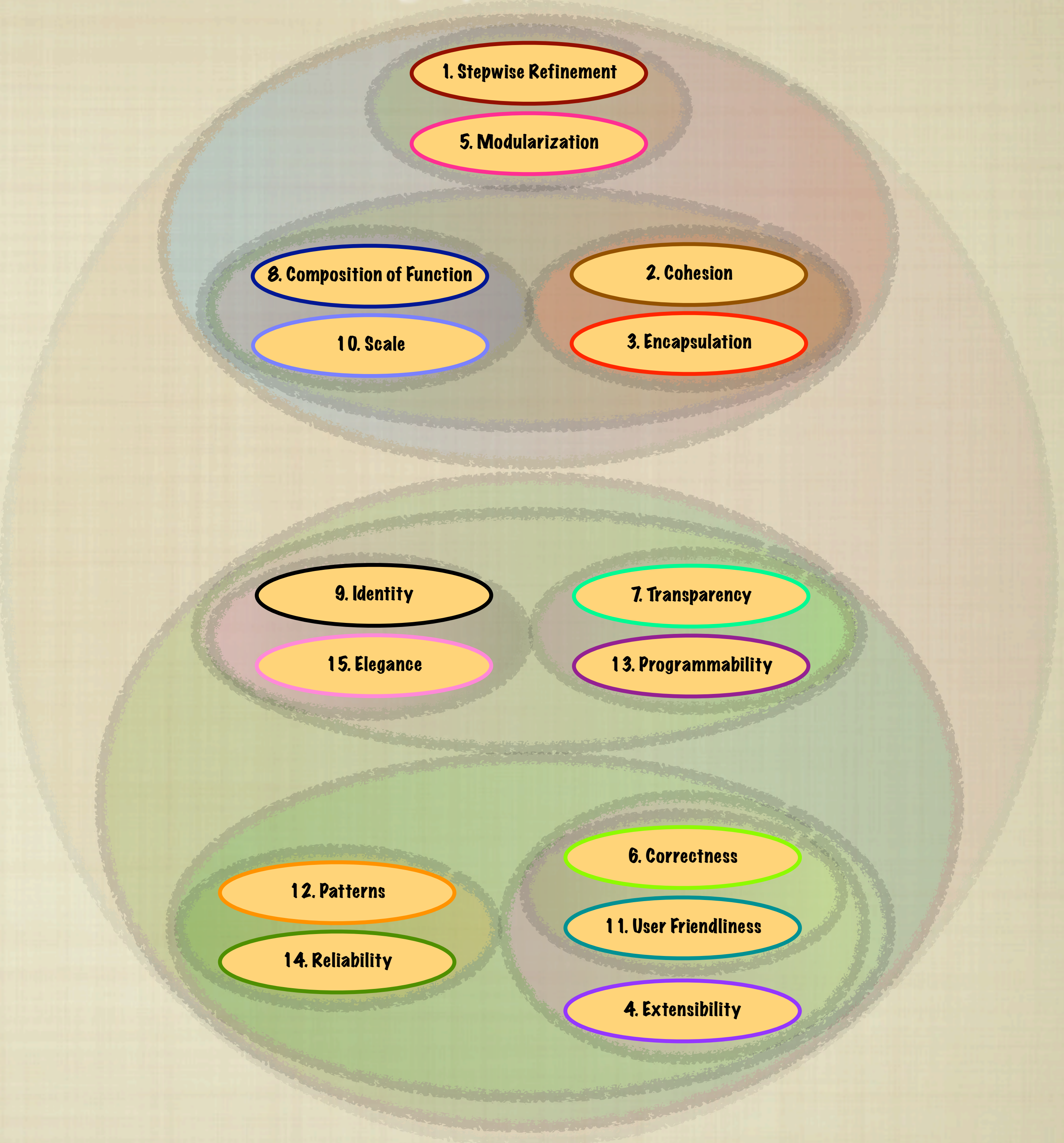
Great design meets both "fields" of challenge: a model with strength in all the Thriving Systems qualities enumerated above, but inexorably grounded on an authentic representation of stakeholder intentions.

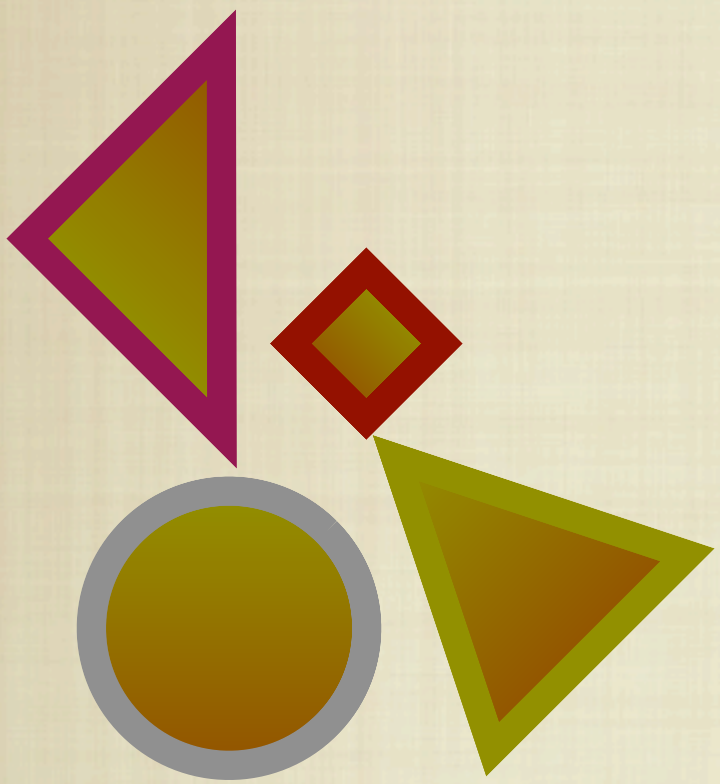
Thriving Systems Qualities



- Design: The application of quality Principles in the process of creating artifacts

The Design Process

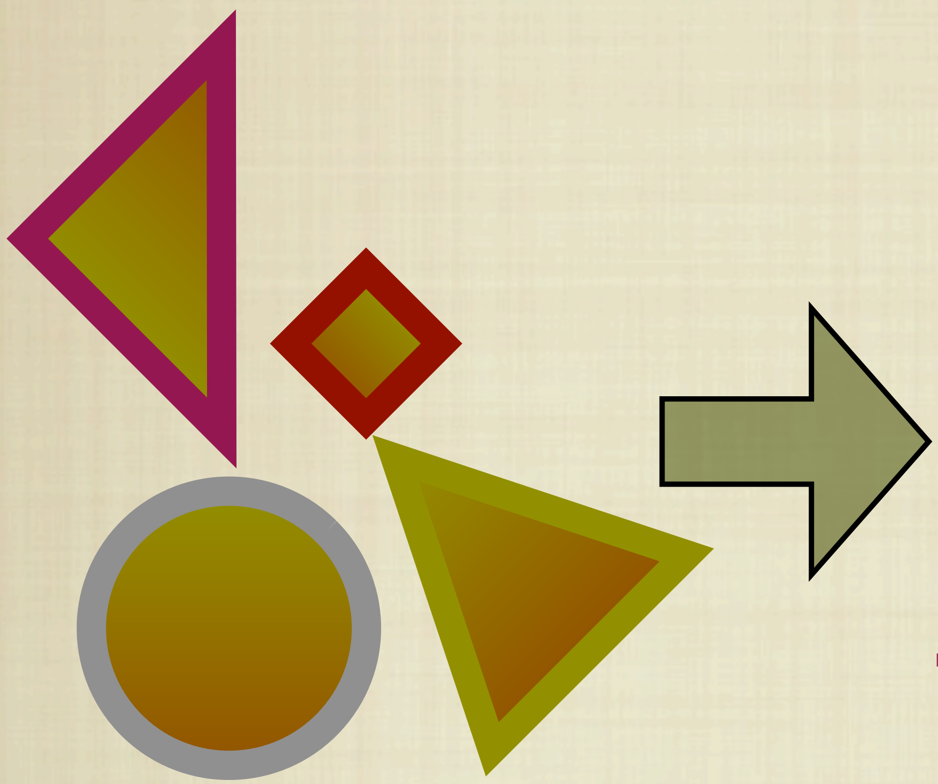
The Design Process



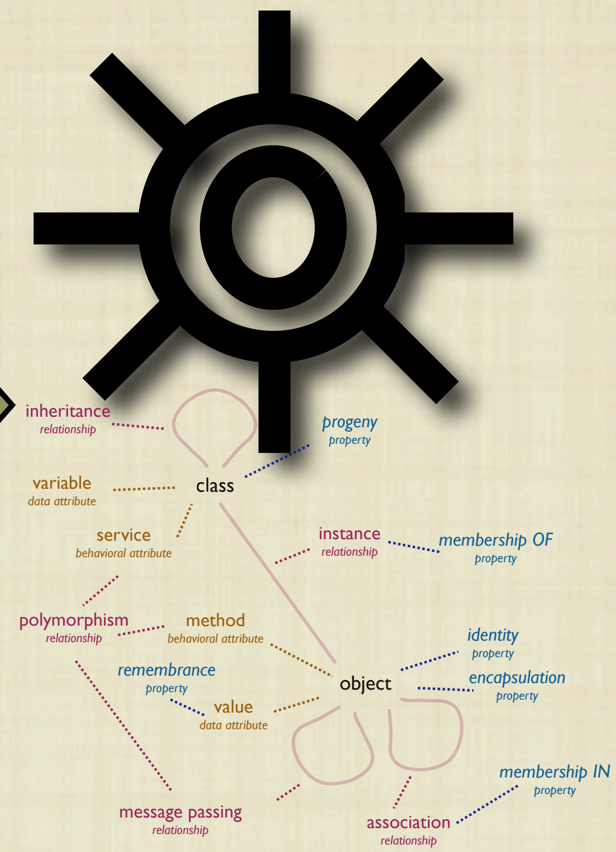
Stakeholder intensions
requirement elements
model elements
design elements

The Design Process

"rules of thumb"
Traditional patterns



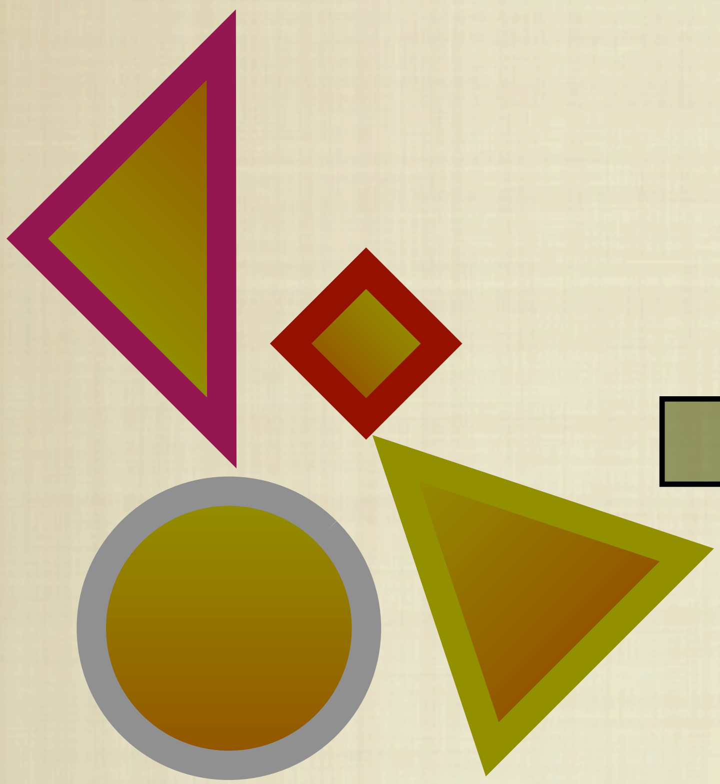
Stakeholder intensions
requirement elements
model elements
design elements

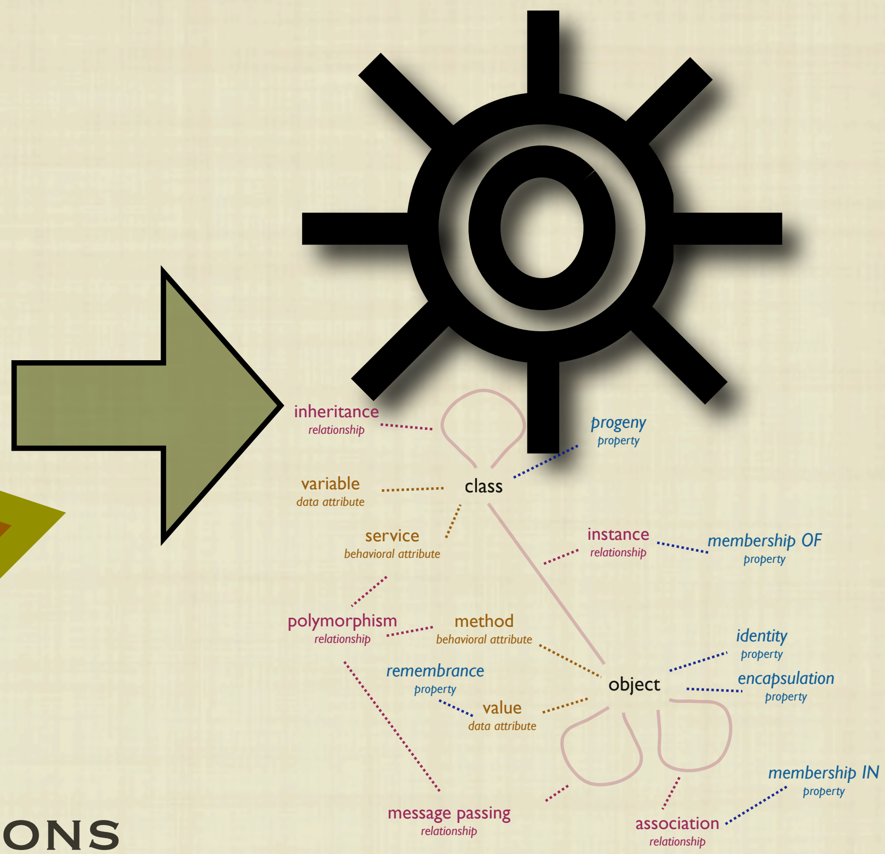


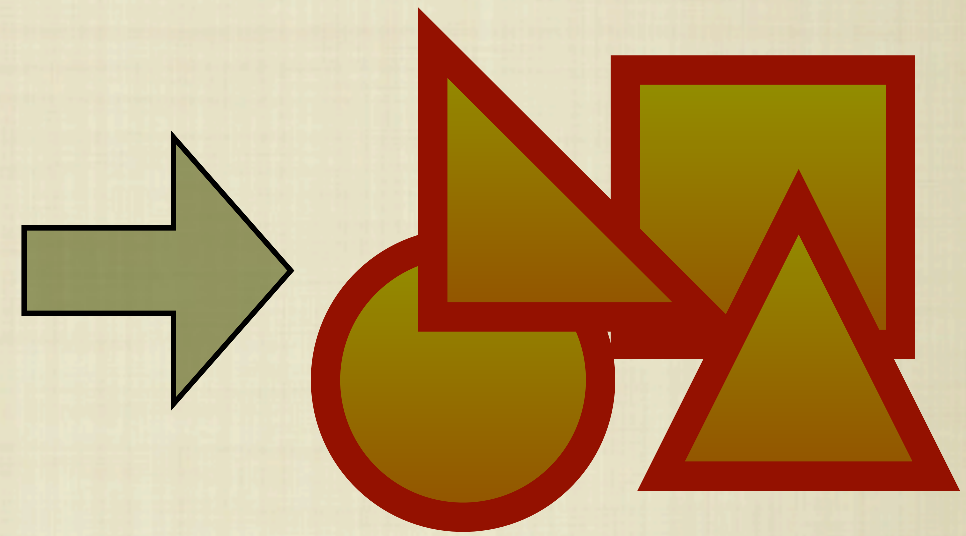
Representational
paradigm or Ontology

The Design Process

"rules of thumb"
Traditional patterns





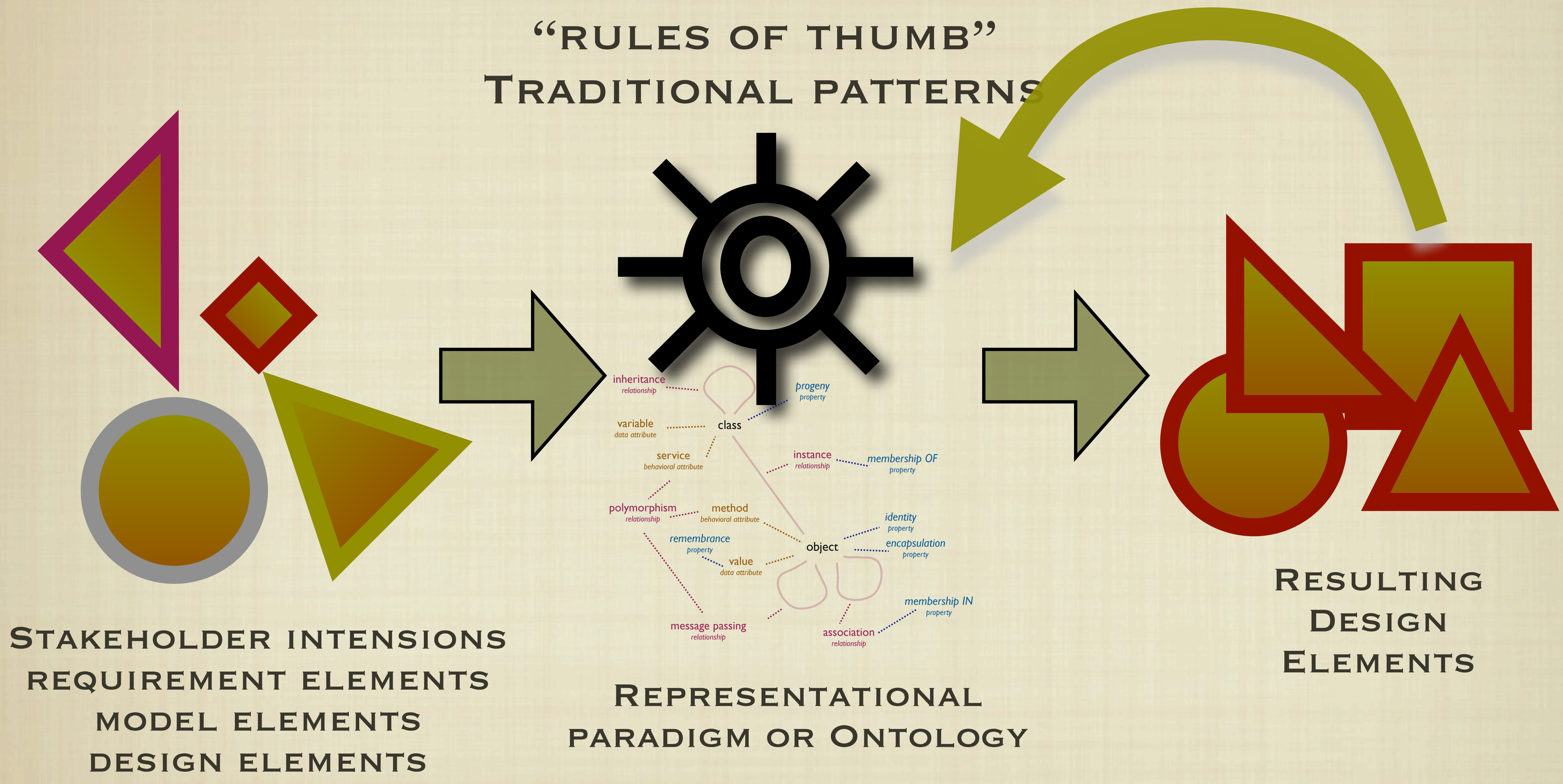


Stakeholder intensions
requirement elements
model elements
design elements

Representational
paradigm or Ontology

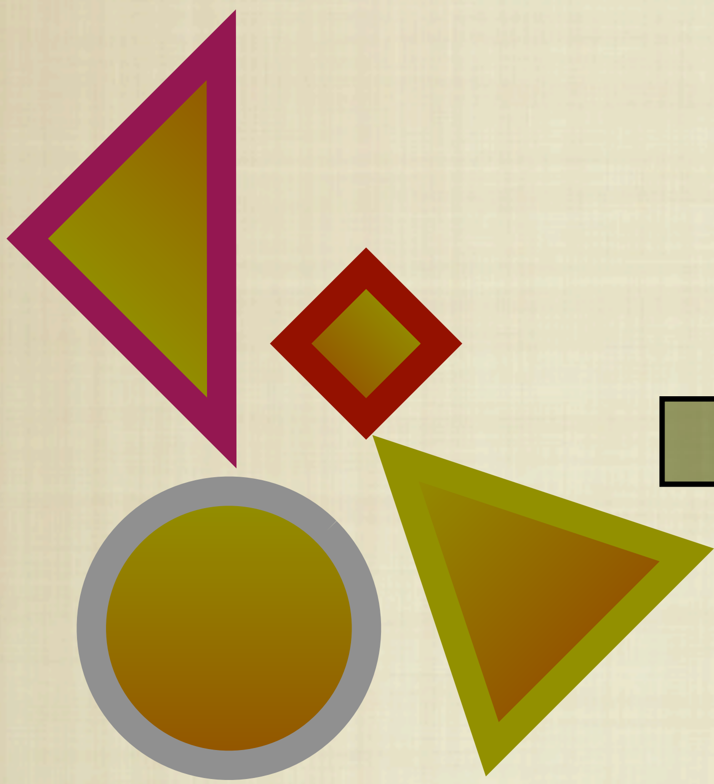
Resulting
Design
Elements

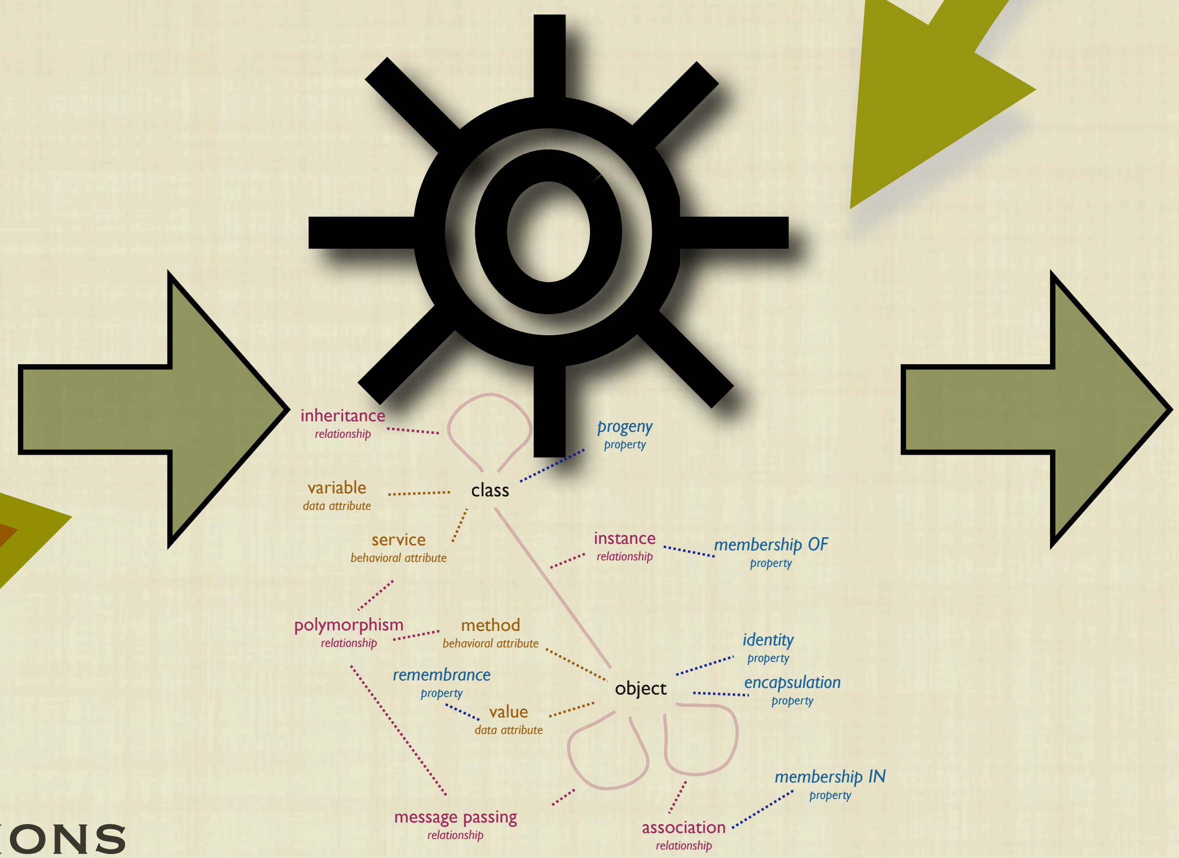
The Design Process

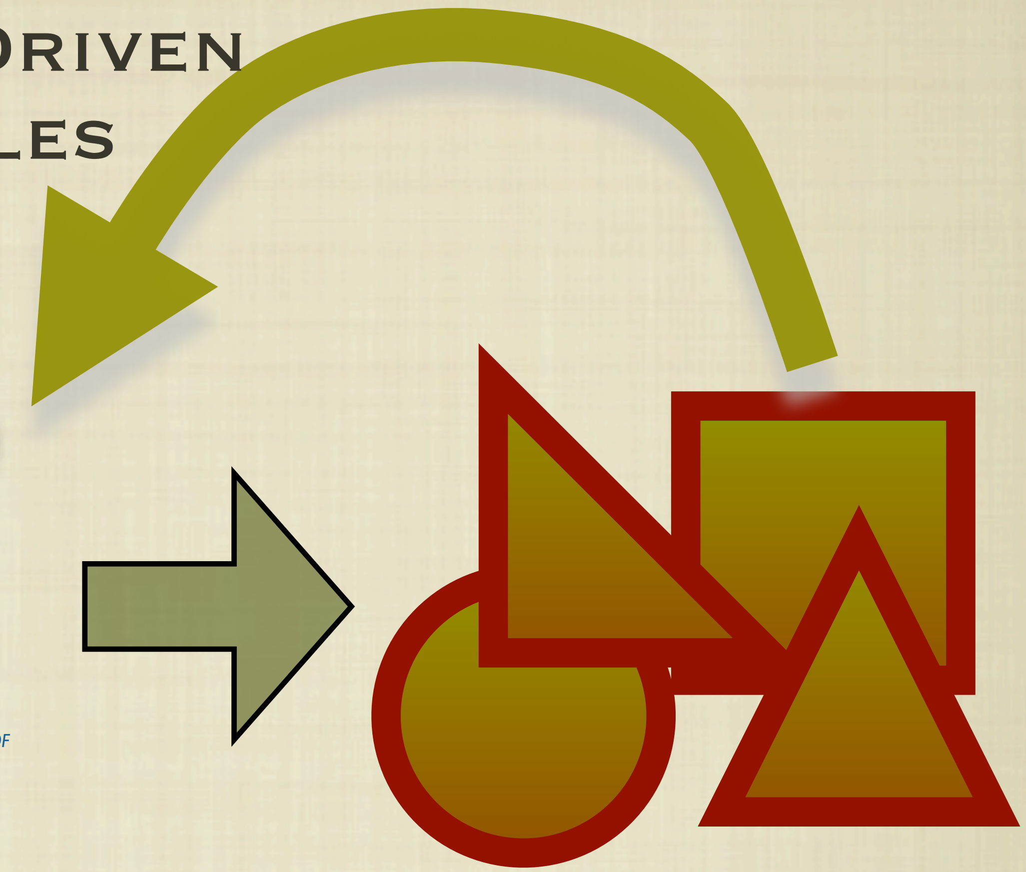


The Design Process

Choice Property-Driven Design Principles







Stakeholder intensions
requirement elements
model elements
design elements

Representational paradigm or Ontology

Resulting Design Elements

A Mindset For Great Design

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- *Perceive the wholeness and the impact of individual design choices on the system as a whole – not only in the static present, but in the dynamic unfolding of the stakeholders' perspectives of life; in the system they will live in.*

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- *Focus on why you use the modeling tools – not on the tools themselves. Redirect decision-making energy to the questions: "What does life mean to these stakeholders?" and "How does each choice increase the life in the system by fulfilling the stakeholders' evolving concerns?"*

Les Waguespack

Monograph in Two Parts

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- Thriving Systems Theory
  - a vocabulary of elemental properties describing system elements appropriate to a particular domain
  - a taxonomy of system quality resulting from the interplay of those elemental properties

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  - metaphor as the implement of design in analysis, representation and realization of information systems

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OCTOBER 10, 2010
Boston Sunday Globe
NEW ENGLAND'S LARGEST NEWSPAPER
DILBERT®/ by Scott Adams
WALLY, HAVE YOU MADE ANY PROGRESS CODING YOUR MODULE?
PROGRESS IS DIFFICULT TO MEASURE IN THE SOFTWARE REALM.
YOU COULD MEASURE THE LINES OF CODE I PRODUCE, BUT THAT WOULD REWARD INEFFICIENCY.
THE ART OF THIS JOB IS BINDING THE RARE MOMENTS OF INSPIRATION TO KNOWLEDGE AND MACHINES.
IN FACT, JUST A MINUTE AGO I COULD FEEL THE INSPIRATION WELLING UP INSIDE ME.
BUT THEN YOU INTERRUPTED ME WITH YOUR NAIVE QUESTION AND THE MOMENT WAS LOST.
MAYBE YOU SHOULD GO BACK TO YOUR OFFICE AND REFLECT ON THE DAMAGE YOU'VE DONE HERE TODAY.
THERE GOES THE ONE PERSON WHO HAS LESS OF A REAL JOB THAN I DO.
DilbertCartoonist@gmail.com
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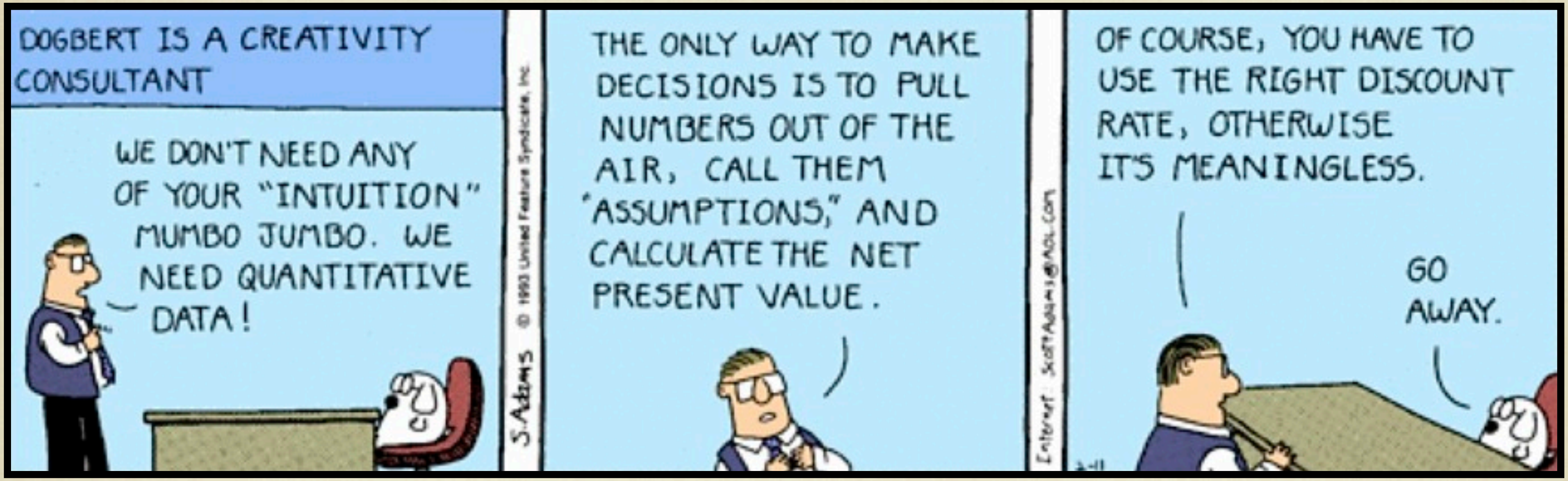
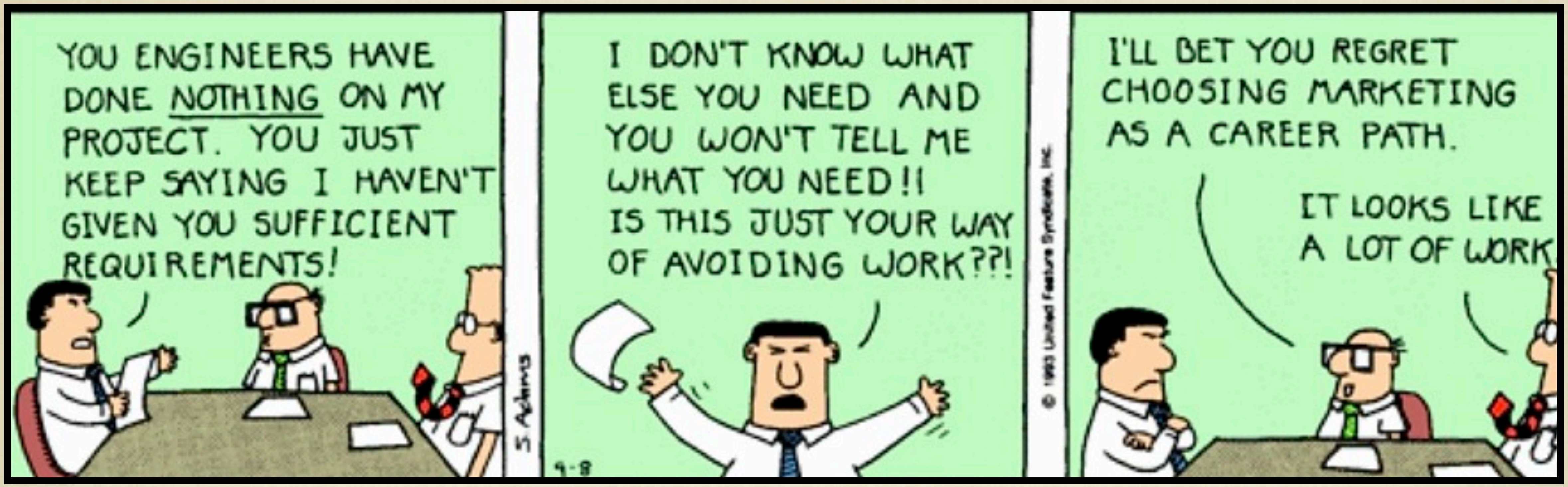
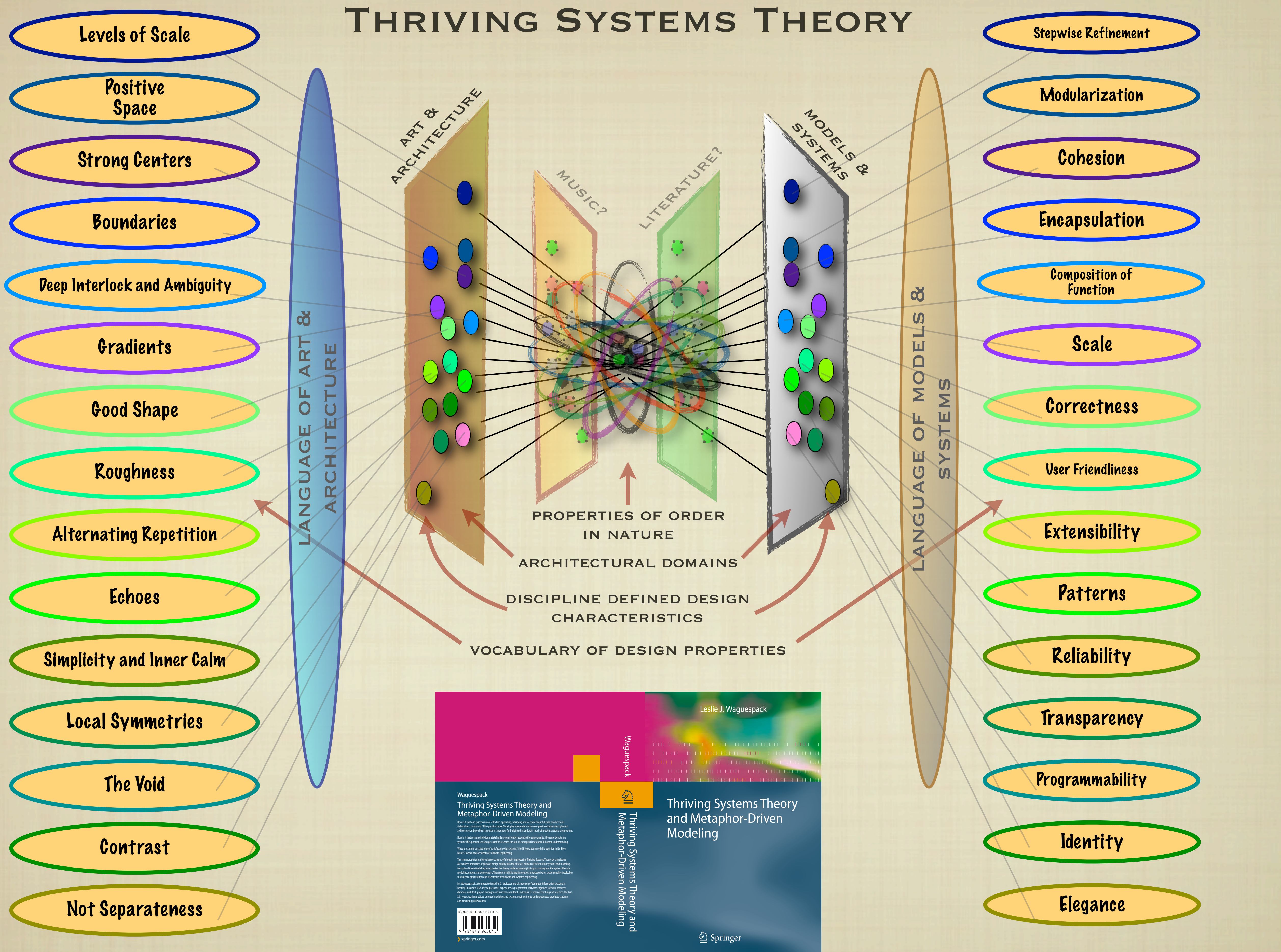
10-10-10



DOGBERT IS A CREATIVITY CONSULTANT
WE DON'T NEED ANY OF YOUR "INTUITION" MUMBO JUMBO. WE NEED QUANTITATIVE DATA!
S. Adams
THE ONLY WAY TO MAKE DECISIONS IS TO PULL NUMBERS OUT OF THE AIR, CALL THEM "ASSUMPTIONS," AND CALCULATE THE NET PRESENT VALUE.
OF COURSE, YOU HAVE TO USE THE RIGHT DISCOUNT RATE, OTHERWISE IT'S MEANINGLESS.
GO AWAY.


YOU ENGINEERS HAVE DONE NOTHING ON MY PROJECT. YOU JUST KEEP SAYING I HAVEN'T GIVEN YOU SUFFICIENT REQUIREMENTS!
I DON'T KNOW WHAT ELSE YOU NEED AND YOU WON'T TELL ME WHAT YOU NEED!! IS THIS JUST YOUR WAY OF AVOIDING WORK??!
I'LL BET YOU REGRET CHOOSING MARKETING AS A CAREER PATH.
IT LOOKS LIKE A LOT OF WORK.


THRIVING SYSTEMS THEORY
Levels of Scale
Positive Space
Strong Centers
Boundaries
Deep Interlock and Ambiguity
Gradients
Good Shape
Roughness
Alternating Repetition
Echoes
Simplicity and Inner Calm
Local Symmetries
The Void
Contrast
Not Separateness
LANGUAGE OF ART & ARCHITECTURE
ART & ARCHITECTURE
MUSIC?
LITERATURE?
MODELS & SYSTEMS
LANGUAGE OF MODELS & SYSTEMS
PROPERTIES OF ORDER IN NATURE
ARCHITECTURAL DOMAINS
DISCIPLINE DEFINED DESIGN CHARACTERISTICS
VOCABULARY OF DESIGN PROPERTIES
Stepwise Refinement
Modularization
Cohesion
Encapsulation
Composition of Function
Scale
Correctness
User Friendliness
Extensibility
Patterns
Reliability
Transparency
Programmability
Identity
Elegance
Leslie J. Waguespack
Waguespack
Thriving Systems Theory and Metaphor-Driven Modeling
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