Thriving Systems Theory & Design Quality

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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 spans 35 years of teaching and research, the last 20+ years teaching object-oriented modeling and systems engineering to undergraduates, graduate students and practicing professionals.
MONOGRAPH IN TWO PARTS
Monograph in Two Parts

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-Driven Modeling
  - metaphorology and its role in both the conception and communication of knowledge
  - metaphor as the implement of design in analysis, representation and realization of information systems
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  - proposing a fundamental and comprehensive taxonomy of system design quality
A Search For Fundamental Principles Of System Design Quality
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Fred Brooks’ Essence and Accidents of Information Systems Development
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Christopher Alexander’s Theory of Life in Architecture

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Fred Brooks Essence and Accidents of Building Information Systems
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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.”

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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).
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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.
Alexander, Great Architect
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OOPSLA 1996 Keynote Speech
Introduction by Jim Coplien
“Once in a great while, a great idea makes it across the boundary of one discipline to take root in another. The adoption of Christopher Alexander’s patterns by the software community is one such event.”
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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.”
Christopher Alexander’s Theory of Life in Architecture
Humans perceive order “... as elements that systematically conform as constituent components of a whole achieving an arrangement of ‘WHOLENESS’.”
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“The concept extends to any space where objects & relationships are observed.”

The Nature of Order
"The arrangement of things is based upon their arrival at relative positions influenced by forces that guide their movement or evolution. Continuously guided by these forces order emerges and is preserved over time, space, or change as elements systematically conform as constituent components of a whole achieving an arrangement of ‘WHOLENESS’.”

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(Alexander)

Wholeness is stable, disorder is not!
Centers in Wholeness
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Center - “a distinct set of points in space, which, because of its organization, because of its internal coherence, and because of its relation to its context, exhibits centeredness, forms a local zone of relative centeredness with respect to other parts of space.”
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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.”

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Center Properties
Center Properties

- Centers and Wholeness are Everywhere
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“Quantum mechanics asserts, via the mathematics, that particles are physically affected in their behavior by the wholeness of the space in which they move. ... [Wholeness] is not restricted to buildings or works of art, but is valid and essential even in those parts of the world that we have historically believed to be mechanical in nature.”
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Alexander’s 15 Center Properties
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- Strong Centers
- Not Separateness
- Boundaries
- Positive Space
- Deep Interlock and Ambiguity
- Good Shape
- Alternating Repetition
- Simplicity and Inner Calm
- The Void
- Levels of Scale
- Gradients
- Roughness
- Echoes
- Local Symmetries
- Contrast
| **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. |
| **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. |
| **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. |
| **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. |
| **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. |
| **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. |
| **Echoes:** The strength of a given center depends on similarities of angle and orientation. Similarities should repeat themselves throughout a design. |
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Center Properties
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A taxonomy / vocabulary of design elements that evoke the experience of quality in architecture, "The Nature of Order" discernible in physicality.

<table>
<thead>
<tr>
<th>Alexander’s 15 Center Properties</th>
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<tbody>
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## Observables / Attainable

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### Observable / Attainable

**observable:** as in assessing the characteristics of an artifact

**attainable:** as in manipulation through design choices

"Order, Wholeness" can be pursued in design!

#### Alexander’s 15 Center Properties

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</table>
“The concept extends to any space where objects & relationships are observed.”

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

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
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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Physical position and distance translate to concepts of consonance in “fields” populated by abstractions rather than shapes.
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In this cognitive space we use the term choice as the counterpart of Alexander’s term center.
Centers in the conceptual World

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In this cognitive space we use the term choice as the counterpart of Alexander’s term center.

Center ==> Choice
Translating the Properties from Centers to Choices
Translating the Properties from Centers to Choices

### Alexander's 15 Center Properties

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### Vocabulary of Choice Properties

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

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Choice Properties
applied Where / how?
Choice Properties
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Choice Properties in Extant Systems
Choice Properties
applied Where / how?

- Choice Properties in Extant Systems
- APACHE web server (Design Principles & Practices)
<table>
<thead>
<tr>
<th>Choice Property</th>
<th>Modeling Action</th>
<th>Action Definition</th>
<th>Apache Exemplars of Choice Property Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stepwise Refinement</td>
<td>elaborate</td>
<td>develop or present (a theory, policy, or system) in detail</td>
<td>Filter chains (2.0)</td>
</tr>
<tr>
<td>Cohesion</td>
<td>factor</td>
<td>express as a product of factors</td>
<td>Resources pools</td>
</tr>
<tr>
<td>Encapsulation</td>
<td>encapsulate</td>
<td>cause the essential features of something to be multiplied by another</td>
<td>Platform independence (2.0)</td>
</tr>
<tr>
<td>Extensibility</td>
<td>extend</td>
<td>something capable of expansion in size, extent, or scope</td>
<td>Apache server API’s (public)</td>
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<td>Modularization</td>
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<td>Enable configuration &amp; management (2.0)</td>
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<td>Module design patterns</td>
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  - ☐ network architecture

- Choice Properties Mapped to Modeling
  - ✓ object-oriented modeling (monograph Ch12)
Object-Oriented Ontology

- inheritance
  - relationship
- variable
  - data attribute
- service
  - behavioral attribute
- polymorphism
  - relationship
- method
  - behavioral attribute
- remembrance
  - property
- value
  - data attribute
- message passing
  - relationship
- object
  - property
- progeny
  - property
- instance
  - relationship
- membership OF
  - property
- identity
  - property
- encapsulation
  - property
- membership IN
  - property
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- business process modeling
- Other System Domains
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- Other System Domains
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- Other System Domains
  - music
  - english composition
Toward a Vision of Thriving Systems
“The Nature of Order” is evident in choice properties observable in information systems!
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The translated properties denote design features that may appear to be discrete.
“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?
“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

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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
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Alexander’s Inter-Property Support Network

- Levels of Scale
- Positive Space
- Not Separateness
- Strong Centers
- Local Symmetries
- Boundaries
- Simplicity and Inner Calm
- Deep Interlock and Ambiguity
- Echoes
- Gradients
- Good Shape
- Alternating Repetition
- Roughness
Alexander's Inter-Property Support Network

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- Echoes
- Simplicity and Inner Calm
- Local Symmetries
- The Void
- Contrast

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Choice Properties Substituted for Center Properties
# Coherence Analysis

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Coherence is the sum of the fraction of supporting properties that mutually overlap between two properties ($0 \leq \varsigma \leq 2$). The distance is $(2 - \varsigma)$. 

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## Coherence Analysis

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Coherence is the sum of the fraction of supporting properties that mutually overlap between two properties ($0 \leq \zeta \leq 2$). The distance is $(2 - \zeta)$. 

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**Choice Clusters**

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
### Clusters with Supporting Properties

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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

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

1. Stepwise Refinement

5. Modularization
Design Quality Naming

Divisibility

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
4. Modularity

- Cohesion reflects choice self-sufficiency: well-formed with cogency
- Encapsulation bounds but also interfaces the choice to the surrounding collection
Design Quality Naming

- Divisibility
  - 1. Stepwise Refinement
  - 5. Modularization

- Factorability
  - 2. Cohesion
  - 3. Encapsulation
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

Divisibility

1. Stepwise Refinement
5. Modularization

Constructibility

8. Composition of Function
10. Scale

2. Cohesion
3. Encapsulation

Factorability
soundness of individuals, internal stability and structural independence

opportunity of combining to build larger/more capable arrangements
Design Quality Naming

- Divisibility
  - 1. Stepwise Refinement
  - 5. Modularization
  - 8. Composition of Function
  - 10. Scale
- Constructibility
  - 2. Cohesion
  - 3. Encapsulation
- Scalability
- Factorability
Divisibility

Constructibility

Scalability

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
8. Composition of Function
5. Modularization
10. Scale

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

**Divisibility**

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
4. Composition of Function
5. Modularization
6. Scale
7. Scalability
8. Constructibility
9. Robustness
10. Factorability
Design Quality Naming

Divisibility

Constructibility

Scalability

Robustness

Factorability

1. Stepwise Refinement
2. Cohesion
3. Encapsulation

5. Modularization
8. Composition of Function
10. Scale
11. User Friendliness

6. Correctness

choice alignment with intentions (dynamically)
a perception of “what is natural,” “seeing” what
you expect reinforces reliance and trust
Design Quality Naming

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
5. Modularization
8. Composition of Function
10. Scale

Divisibility
Constructibility
Scalability

6. Correctness
11. User Friendliness

Robustness
Factorability
Confidence

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Design Quality Naming

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
4. Correctness
5. Modularization
6. Composition of Function
7. Scale
8. User Friendliness
9. Patterns
10. Reliability
11. Robustness
12. Constructibility
13. Scalability
14. Factorability

Proven formulae or techniques enable repeatable success consistently safe practice continues success with compatible challenges
Design Quality Naming

- Divisibility
  - 8. Composition of Function
  - 5. Modularization
- Constructibility
  - 1. Stepwise Refinement
- Scalability
  - 2. Cohesion
  - 3. Encapsulation
- Predictability
  - 6. Correctness
  - 10. Scale
  - 4. Encapsulation
- Factorability
  - 12. Patterns
- Robustness
  - 11. User Friendliness
- Confidence
  - 14. Reliability
Design Quality Naming

Divisibility

Constructibility

Scalability

Robustness

Factorability

1. Stepwise Refinement
   5. Modularization

2. Cohesion
   10. Scale

3. Encapsulation

8. Composition of Function

6. Correctness

7. Transparency

13. Programmability

12. Patterns

14. Reliability

11. User Friendliness

keeping “technology” out of the way of intentions
enabling users to recognize then apply choices to their needs
Design Quality Naming

- **Divisibility**
  - 1. Stepwise Refinement
  - 5. Modularization
  - 8. Composition of Function
  - 10. Scale

- **Constructibility**
  - 2. Cohesion
  - 3. Encapsulation
  - 6. Correctness
  - 7. Transparency

- **Scalability**
  - 11. User Friendliness

- **Divisibility**
  - 12. Patterns

- **Predictability**
  - 13. Programmability

- **Usability**
  - 14. Reliability

- **Robustness**
  - 12. Patterns

- **Factorability**
  - 13. Programmability

- **Usability**
  - 14. Reliability

- **Confidence**
  - 6. Correctness

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Design Quality Naming

- **Divisibility**
  - 5. Modularization
  - 8. Composition of Function
  - 10. Scale

- **Constructibility**
  - 1. Stepwise Refinement
  - 2. Cohesion
  - 3. Encapsulation

- **Scalability**
  - 6. Correctness
  - 7. Transparency
  - 9. Identity

- **Robustness**
  - 11. User Friendliness
  - 12. Patterns
  - 13. Programmability
  - 15. Elegance

- **Factorability**
  - 14. Reliability

- **Usability**
  - 6. Correctness

- **Predictability**
  - 12. Patterns

- **Confidence**
  - 14. Reliability

**Fusing**

- Using the conceptual with the linguistic (concise, precise, clear, distinct)

- Realizing resonance between choice and intentions like the "ring" in a chord
Design Quality Naming

- Modularization
  - Stepwise Refinement
  - Cohesion
  - Encapsulation
- Correctness
  - Composition of Function
  - Scale
- Transparency
  - Identity
- Usability
  - Patterns
  - Reliability
- Predictability
  - Correctness
  - User Friendliness
- Constructibility
  - Robustness
- Scalability
  - Factorability
- Intuitiveness
  - Usability
- Predictability
  - Confidence
Design Quality Naming

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
4. Extensibility
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8. Composition of Function
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11. User Friendliness
12. Patterns
13. Programmability
14. Reliability
15. Elegance

Divisibility
Constructibility
Scalability
Intuitiveness
Predictability

Robustness
Factorability
Usability

achieving confidence in the “now”
enabling alignment into the future to embrace change
usability is the ease with which the user can grasp and apply a choice

intuitiveness expresses the “naturalness” of the choice’s expression of the intention it is supposed to represent (or implement)
fidelity anchors choices in intentions
predictability fosters choice evolution with anticipated intentions, enabling long-term viability
Design Quality Naming

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

Divisibility
Constructibility
Scalability
Intuitiveness
Effectiveness
Predictability
Sustainability

Robustness
Factorability
Usability
Confidence
Fidelity

Predictability Confidence
Sustainability

Ef fecti veness
Fidelity

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Design Quality Naming

- **Divisibility**
  - 5. Modularization
  - 8. Composition of Function
- **Constructibility**
  - 10. Scale
  - 12. Patterns
  - 15. Elegance
- **Scalability**
  - 3. Encapsulation
  - 7. Transparency
  - 13. Programmability
- **Intuitiveness**
  - 9. Identity
  - 6. Correctness
  - 11. User Friendliness
- **Effectiveness**
  - 2. Cohesion
  - 1. Stepwise Refinement
  - 4. Extensibility
  - 14. Reliability
  - 14. Reliability
- **Predictability**
  - 5. Modularization
  - 8. Composition of Function
  - 12. Patterns
  - 15. Elegance
- **Sustainability**
  - 3. Encapsulation
  - 7. Transparency
  - 13. Programmability
- **Robustness**
  - 10. Scale
  - 1. Stepwise Refinement
  - 4. Extensibility
  - 11. User Friendliness
  - 14. Reliability
- **Factorability**
  - 2. Cohesion
  - 3. Encapsulation
  - 6. Correctness
  - 9. Identity
- **Fidelity**
  - 8. Composition of Function
  - 12. Patterns
  - 14. Reliability
  - 15. Elegance

**effectively representing intentions:**
choices that are understandable and applicable

**choices aligned in the current reality; poised to respond to change; to grow predictably and evolve**
Design Quality Naming

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

Robustness
Factorability
Usability
Vitality
Confidence
Fidelity
Predictability
Sustainability
Constructibility
Divisibility

robustness: soundness of structure, integrity of form, capacity for stability
vitality: alignment with stakeholder intentions, capacity for useful growth and unfolding over time

Living Structure
Design Quality Naming

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

Robustness

Thriving

Vitality
Vitruvius
De architectura
78 BC

1. Stepwise Refinement
2. Cohesion
3. Encapsulation
4. Extensibility
5. Modularization
6. Correctness
7. Transparency
8. Composition of Function
9. Identity
10. Scale
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Robustness
Thriving
Vitality
Vitruvius
De architectura
78 BC
Thriving Systems Qualities

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
A Thriving System exhibits the confluence of design qualities described by *robustness* and *vitality* –
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* beyond existing, beyond functional, beyond surviving.*
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*beyond existing, beyond functional, beyond surviving.*

It thrives not only because it supports and aligns with the stakeholders’ intentions in the “now,” but –
A Thriving System exhibits the confluence of design qualities described by *robustness* and *vitality* –

*beyond existing, beyond functional, beyond surviving.*

It thrives not only because it supports and aligns with the stakeholders’ intentions in the “now,” but –

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

beyond existing, beyond functional, beyond surviving.

It thrives not only because it supports and aligns with the stakeholders‘ intentions in the “now,” but –

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.

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.
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 INTENTIONS
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

“Rules of Thumb”
Traditional patterns

Stakeholder intentions
requirement elements
model elements
design elements

Representational paradigm or Ontology

Resulting Design Elements

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The Design Process

Choice Property-Driven Design Principles

Stakeholder intensions
requirement elements
model elements
design elements

Representational paradigm or Ontology

Resulting Design Elements

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A Mindset For Great Design
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.
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.

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
Monograph in Two Parts

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
Monograph in Two Parts

- 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

- Metaphor-Driven Modeling
  - metaphorology and its role in both the conception and communication of knowledge
  - metaphor as the implement of design in analysis, representation and realization of information systems
Monograph in Two Parts

- Thriving Systems Theory
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  - metaphor as the implement of design in analysis, representation and realization of information systems
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 INEFFECTIVENESS.

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.
Dogbert is a Creativity Consultant

We don't need any of your "intuition" mumbo jumbo. We need quantitative data!

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.
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.