Translating Architectural Design Quality from the Physical Domain to Information Systems

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Agenda

- Introduction
- Properties Expressing Quality in Design
- The Nature of Order in the Mind
- 15 Properties, Information Systems and Apache
- Beauty in Choice Properties
- IS Architecture Informing the Physical
In 25 B.C., Vitruvius writes *De architectura*, delineating three properties all architecture should fulfill: *firmitas* strength, *utilitas* functionality and *venustas* beauty.

In 2005, Christopher Alexander, already known in IT as the father of pattern languages, completes his four-book study on the nature of order. He distills great architecture to 15 properties.
Alexander’s 15 Properties of Centers
Expressing Architectural Quality

Positive Space
Levels of Scale
Gradients
Roughness
Echoes
Local Symmetries

Not Separateness
Strong Centers
Boundaries

Positive Space
Deep Interlock and Ambiguity
Good Shape
Alternating Repetition
Simplicity and Inner Calm

The Void
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.

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.

Alexander’s 15 Properties of Centers
Expressing Architectural Quality

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.
The Nature of Order in the Mind

- Lakoff and Johnson: conceptual metaphors
- sensorimotor experience (touch, taste, smell, sight, sound) to primary metaphors
- event categorization: survival/satisfaction
- Abstractions/Conceptual Metaphors map to layers/extensions of primary metaphors
- Brain physiology: store, retrieve, correlate aided by categorization (subconscious)
- Language exposes this conceptual matrix
Properties in the Nature of Order
Properties in the Nature of Order
Expressed in Physical Architecture

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

- Properties of order in nature
- Architectural domains
- Chosen design characteristics of a discipline
- Vocabulary of design properties
Properties in the Nature of Order
Expressed in Modeling & Information Systems

Properties of order in nature
architectural domains
chosen design characteristics of a discipline
vocabulary of design properties

modeling & information systems
architecture in physical structures

Stepwise Refinement
Modularization
Cohesion
Encapsulation
Composition of Function
Scale
Correctness
User Friendliness
Extensibility
Patterns
Reliability
Transparency
Programmability
Identity
Elegance

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

Tuesday, February 9, 2010
## Alexander’s Inter-Property Support Matrix

<table>
<thead>
<tr>
<th>Center Property Support Intersection Row item supported by column</th>
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</tbody>
</table>
Choice Properties Substituted for Center Properties
Choice Property Cluster
Analysis Results
In Search of Cluster Names
Vitruvius’s Driving Principles of Design

strength “firmitas”

beauty “venustas”

functionality “utilitas”
A Choice Property Language Expressing Design Quality

- **Properties of order in nature**
  - Deep Interlock and Ambiguity
  - Gradients
  - Roughness
  - Alternating Repetition
  - Echoes
  - Simplicity and Inner Calm
  - Local Symmetries
  - The Void
  - Contrast
  - Not Separateness

- **Architectural domains**
  - Positive Space
  - Levels of Scale
  - Strong Centers
  - Boundaries
  - Good Shape
  - Roughness
  - Alternating Repetition
  - Echoes
  - Simplicity and Inner Calm
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- **Properties of architecture in physical structures**
  - Levels of Scale
  - Positive Space
  - Strong Centers
  - Boundaries
  - Good Shape
  - Roughness
  - Alternating Repetition
  - Echoes
  - Simplicity and Inner Calm
  - Local Symmetries
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  - Contrast
  - Not Separateness

- **Properties of modeling & information systems**
  - Deep Interlock and Ambiguity
  - Gradients
  - Roughness
  - Alternating Repetition
  - Echoes
  - Simplicity and Inner Calm
  - Local Symmetries
  - The Void
  - Contrast
  - Not Separateness

- **Properties of chosen design characteristics of a discipline**
  - Modularity
  - Constructibility
  - Confidence
  - Predictability
  - Usability
  - Intuitiveness
  - Scalability
  - Fidelity
  - Effectiveness
  - Sustainability
  - Vitality
  - Factorability
  - Robustness
  - Thriving

- **Vocabulary of design properties**
  - Cohesion
  - Encapsulation
  - Composition of Function
  - Scale
  - Correctness
  - User Friendliness
  - Extensibility
  - Patterns
  - Reliability
  - Transparency
  - Programmability
  - Identity
  - Elegance
  - Stepwise Refinement
  - Risk
  - Confidence
  - Predictability
  - Usability
  - Intuitiveness
  - Scalability
  - Fidelity
  - Effectiveness
  - Sustainability
  - Vitality

- **Properties of order in nature**
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  - Local Symmetries
  - The Void
  - Not Separateness

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  - Usability
  - Intuitiveness
  - Scalability
  - Fidelity
  - Effectiveness
  - Sustainability
  - Vitality
<table>
<thead>
<tr>
<th>Alexander’s Property</th>
<th>Choice Property</th>
<th>Modeling Action</th>
<th>Action Definition</th>
<th>Apache Exemplar of Choice Property Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levels of Scale</td>
<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>Strong Centers</td>
<td>Cohesion</td>
<td>factor</td>
<td>express as a product of factors</td>
<td>Resources pools</td>
</tr>
<tr>
<td>Boundaries</td>
<td>Encapsulation</td>
<td>encapsulate</td>
<td>enclose the essential features of something succinctly by a protective coating or membrane</td>
<td>Platform independence (2.0)</td>
</tr>
<tr>
<td>Alternating Repetition</td>
<td>Extensibility</td>
<td>extend</td>
<td>render something capable of expansion in scope, effect, or meaning</td>
<td>Apache server API’s (public)</td>
</tr>
<tr>
<td>Positive Space</td>
<td>Modularization</td>
<td>modularize</td>
<td>employing or involving a module or modules as the basis of design or construction</td>
<td>Apache server API’s (private)</td>
</tr>
<tr>
<td>Good Shape</td>
<td>Correctness</td>
<td>align</td>
<td>put (things) into correct or appropriate relative positions</td>
<td>HTTP implementation</td>
</tr>
<tr>
<td>Local Symmetries</td>
<td>Transparency</td>
<td>expose</td>
<td>reveal the presence of (a quality or feeling)</td>
<td>Apache portable runtime (2.0)</td>
</tr>
<tr>
<td>Deep Interlock and Ambiguity</td>
<td>Composition of Function</td>
<td>assemble</td>
<td>fit together the separate component parts of (a machine or other object)</td>
<td>Filter chains (2.0)</td>
</tr>
<tr>
<td>Contrast</td>
<td>Identity</td>
<td>identify</td>
<td>establish or indicate who or what (someone or something) is</td>
<td>Management interfaces (2.0)</td>
</tr>
<tr>
<td>Gradients</td>
<td>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>
<td>Core elements of server</td>
</tr>
<tr>
<td>Roughness</td>
<td>User Friendliness</td>
<td>accommodate</td>
<td>fit in with the wishes or needs of</td>
<td>Flexible configuration &amp; management (2.0)</td>
</tr>
<tr>
<td>Echoes</td>
<td>Patterns</td>
<td>pattern</td>
<td>give a regular or intelligible form to</td>
<td>Module design patterns</td>
</tr>
<tr>
<td>The Void</td>
<td>Programmability</td>
<td>generalize</td>
<td>make or become more widely or generally applicable</td>
<td>Hierarchical &amp; layered configuration</td>
</tr>
<tr>
<td>Simplicity and Inner Calm</td>
<td>Reliability</td>
<td>normalize</td>
<td>make something more normal, which typically means conforming to some regularity or rule</td>
<td>Process lifecycle &amp; resource management</td>
</tr>
<tr>
<td>Not Separateness</td>
<td>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>
<td>Configuration change management</td>
</tr>
</tbody>
</table>
IS Architecture Informing the Physical

• Fred Brook’s *(No Silver Bullet!)*

• **Essence:** *requirement that defines the system expressly aligned with stakeholders’ satisfaction*

• **Accident:** *ancillary aspect (tools, methodology, platform, etc.), an artifact of implementation*

• Balancing property strengths should be guided by discerning essential vs. accidental design choices to pursue beautiful systems
Translating Architectural Design Quality From The Physical Domain To Information Systems

- Fred Brooks’ Essence and Accidents of Building Information Systems
- Christopher Alexander’s Theory of Life in Architecture
- George Lakoff’s Theories of Metaphor in Cognition