Quickly, Slowly
The Pace-of-Change as Context-of-Designing
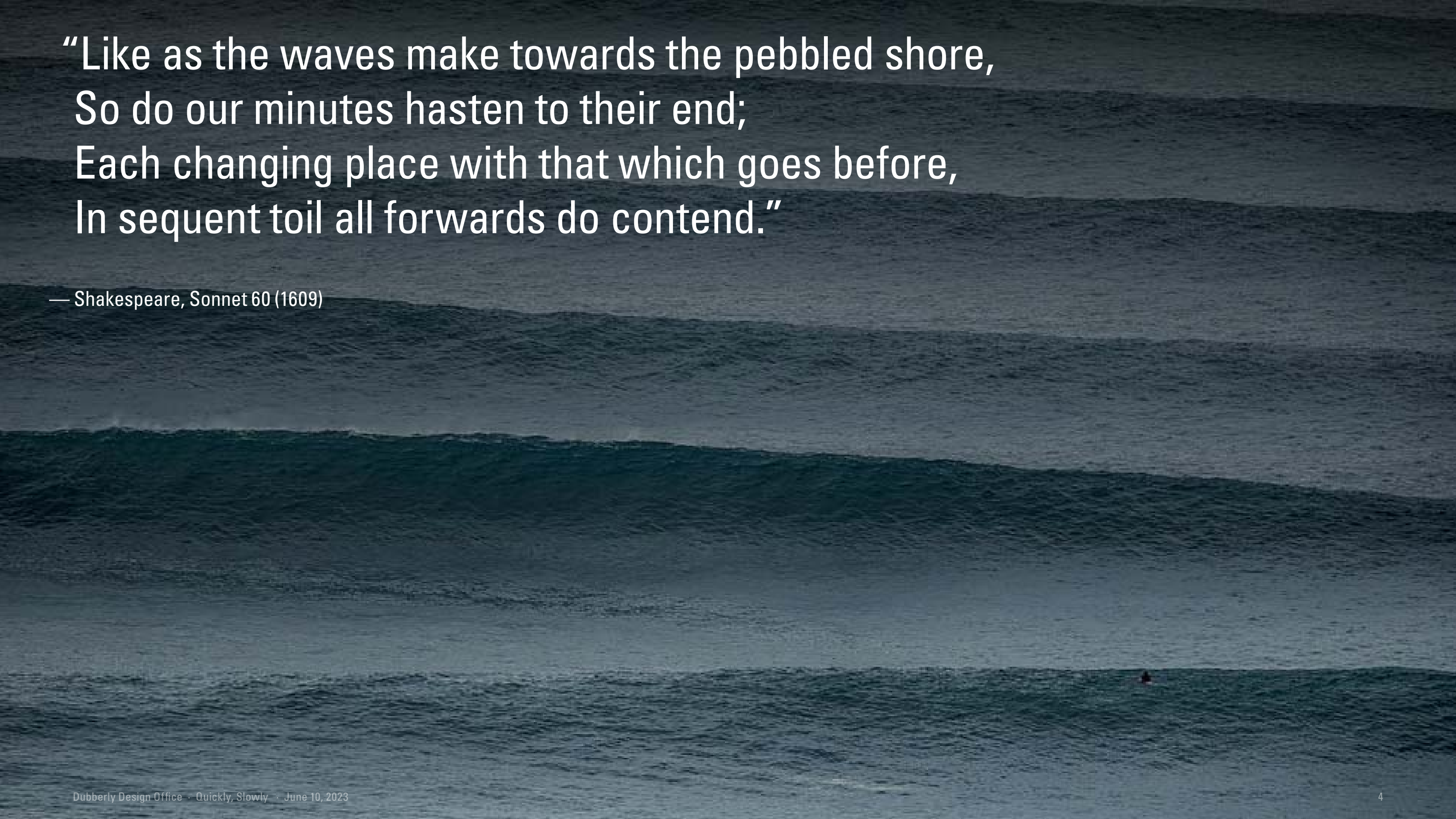
Hugh Dubberly

All is flux.

"Heraclitus, [c. 500 BCE] I believe, says
that **all things pass and nothing stays**,
and comparing existing things to the flow of a river,
he says you could not step twice into the same river."

— reported by Plato, in the Cratylus, 402a = A6 (c. 400 BCE)

"Like as the waves make towards the pebbled shore,
So do our minutes hasten to their end;
Each changing place with that which goes before,
In sequent toil all forwards do contend."

— Shakespeare, Sonnet 60 (1609)

"The law
that **entropy always increases**
holds, I think,
the supreme position
among the laws of Nature."

— Arthur Stanley Eddington, The Nature of the Physical World (1928)

Change and Pace-of-Change have been Elements-of-Designing for as long as there has been story-telling and its partner music.

Beginning   Middle   End

Rhythm

Meter

The length of notes + rests

The progression of movement
through a building, book, or software application

The number + length of cuts
in film-making

The animation of transitions
in a GUI

The sequencing of steps
in service design

But
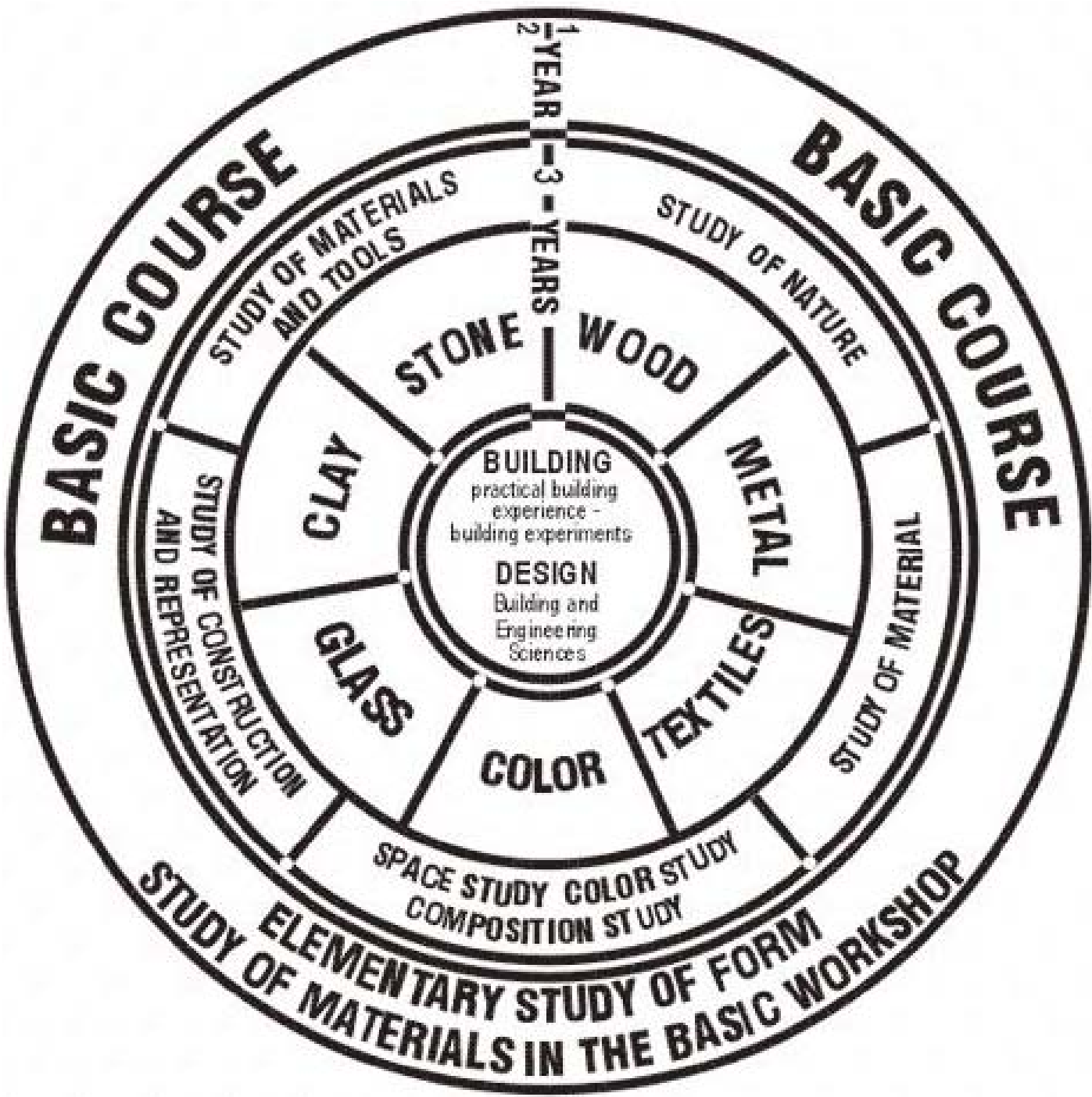Elements-of-Designing
differ from
Context-of-Designing.

And the **Context**-of-Designing —
and **how** we design, **what** we design, and **why** we design —
are changing.

In order to make sense of these changes, we might turn to frameworks or models.
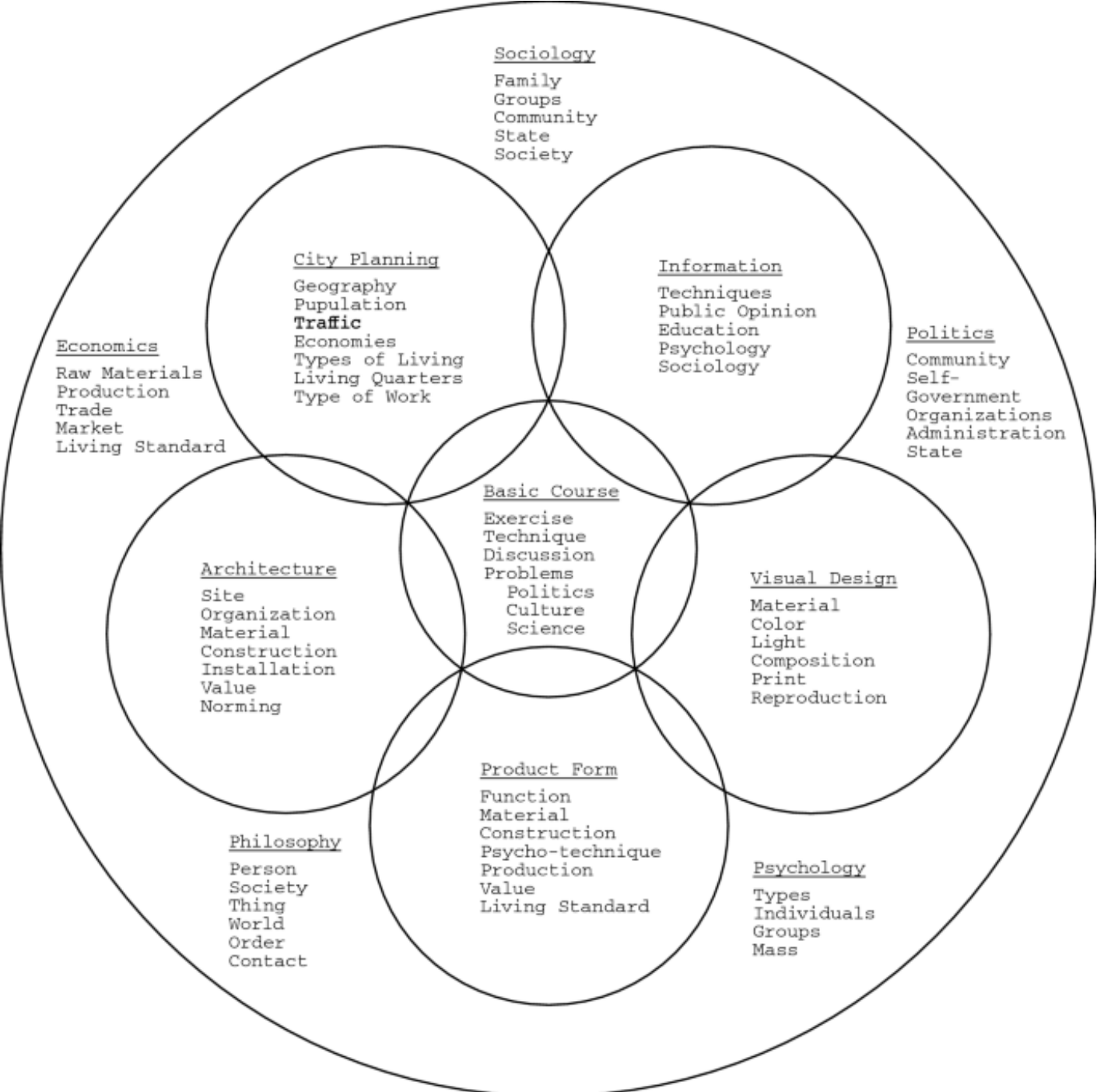
Here are four examples.

The Bauhaus curriculum wheel

— Walter Gropius (1922)

HfG Ulm curriculum wheel

— Inge Scholl and Otto Aicher (1951)

A matrix of design: The six types

The direction of change in design

	Products	Unisystems	Multisystems
Appearance	Christmas ornament Medal Trophy	Restaurant Worlds fair South Street Seaport Disneyland	Market
Performance	Crowbar Paper clip	Infrastructure Government Military project	Market

Why are we making this?
Context/Need
Pragmatic

What are we making?
Meaning/Definition
Semantic

How are we making it?
Form/Grammar
Syntatic

Team
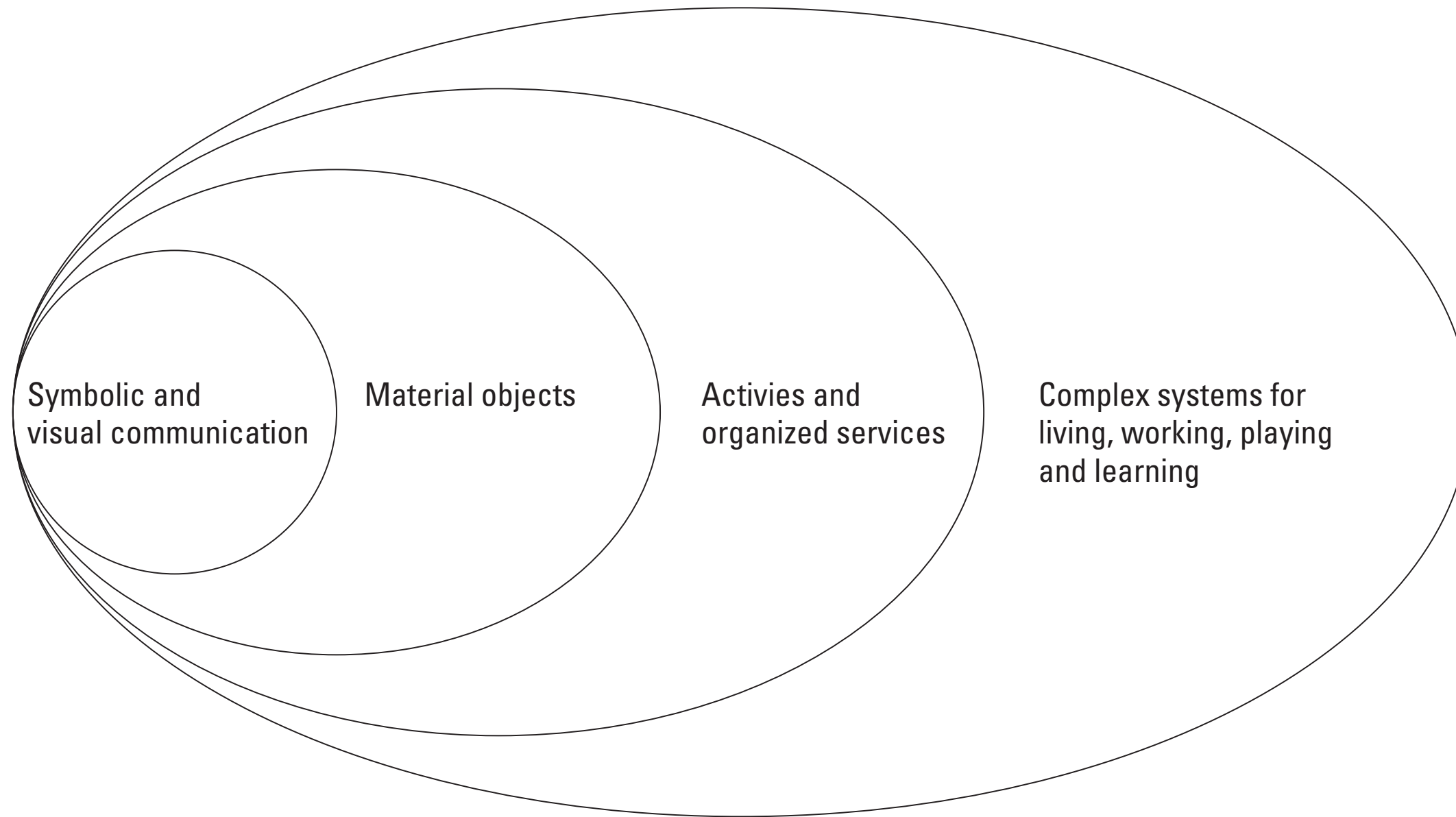Explicit
Shared

Individual
Intuitive
Idiosyncratic

Object
Component

System
Systems of components
Organism

Ecosystem
Systems of systems
Community
Market

The four orders of design

Symbolic and visual communication

Material objects

Activies and organized services

Complex systems for living, working, playing and learning

The four-field framework for design

A

The agenda of
Profit drives the realm of **Commercial Design**
Selling goods and services in a market
"Solving problems" and meeting so-called "human needs"
Ultimate goal of maximizing shareholder value

B

The agenda of
Justice drives the realm of (socially) **Responsible Design**
Helping under-served people and the planet's living systems
"Design Justice" and "Sustainable Design"

The four fields (A, B, C, and D) may overlap
suggesting many combinations of priorities

B

C

A AB BC CD D

ABC BCD

ABCD

AC BD

ACD ABD

AD

C

The agenda of
Knowledge ("Truth" and "Beauty") drives the realm of **Experimental Design**
Exploring (new) possibilities with materials, tools, or processes
Inquiring into aesthetic, conceptual, or perceptual issues
on a continuum from play to work

D

The agenda of
Reflection drives the realm of **Discursive Design**
Creating artifacts that question assumptions and tell stories about alternative futures
(other social structures + technologies in order to provoke response and initiate debate)
"Design Fictions" and "Speculative Design"
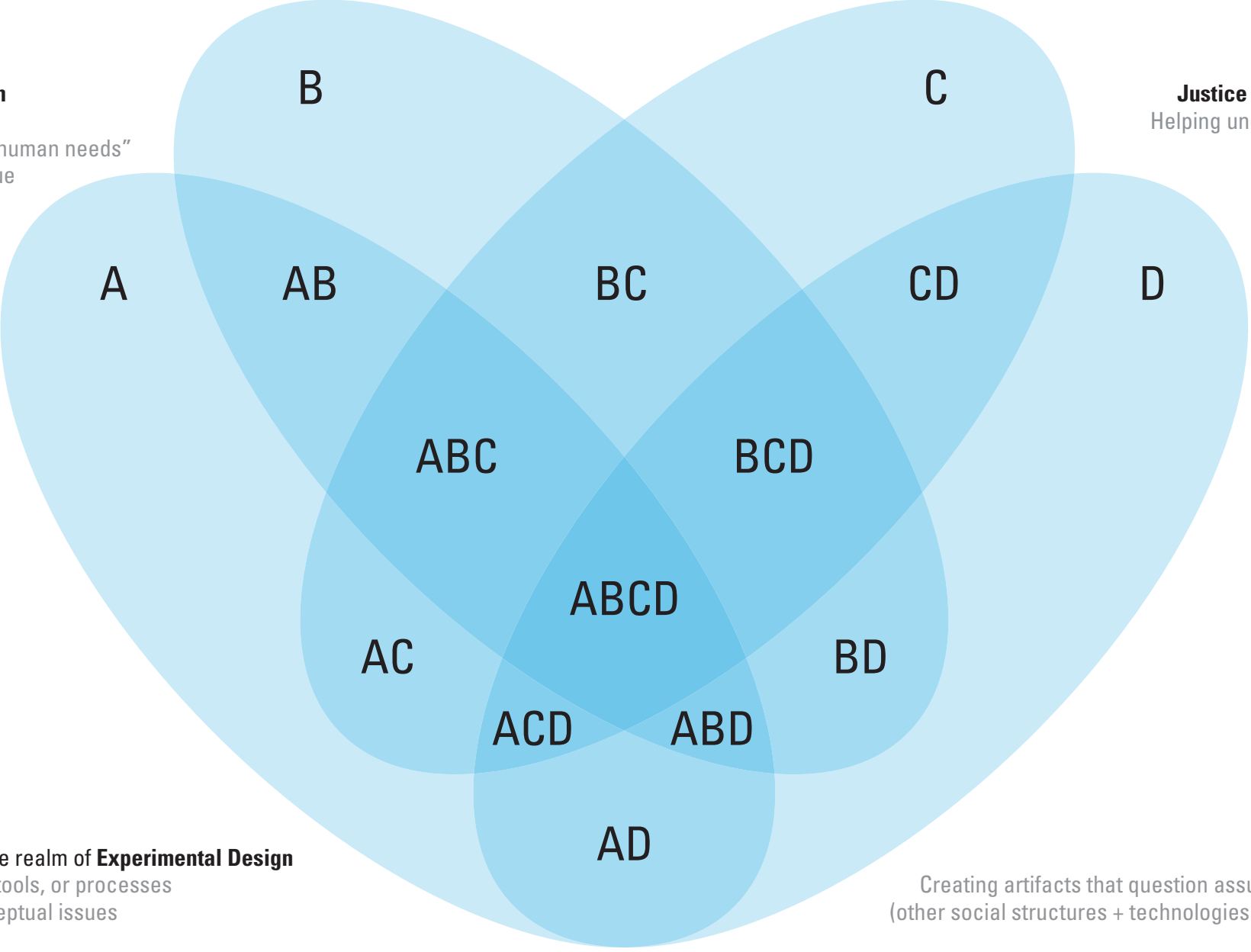
Like most models of designing,
the previous examples aim at an ideal form —
and fit that form to a particular context.

That is:
most models of designing stand outside of time.
They assume a clear path to an ultimate "solution" —
an enduring, unchanging result, free from flux.

In the traditional modernist paradigm,
the designer arrives and analyzes the situation,
draws on innate talent and hard-won experience,
synthesizes "the" right answer to the problem,
and wraps up and **leaves**.

Job done; time to move on.

Rittel, Simon, et al. amended the paradigm,
recognizing the political nature of designing,
the need to negotiate framing,
the reality of "satisficing";

in addition, the value of research
and the necessity of iteration
became common practice.

Yet, the old paradigm of "solutions" has not been overthrown.

Input → Process → Output
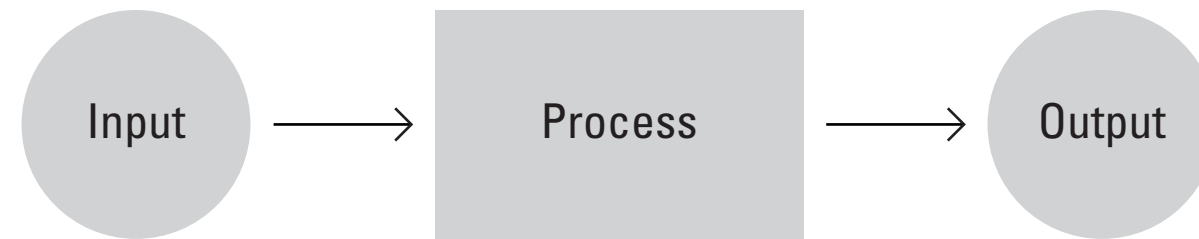
The new paradigm of continuous adjustment —
as ongoing learning and adaptation —
is just beginning to emerge.
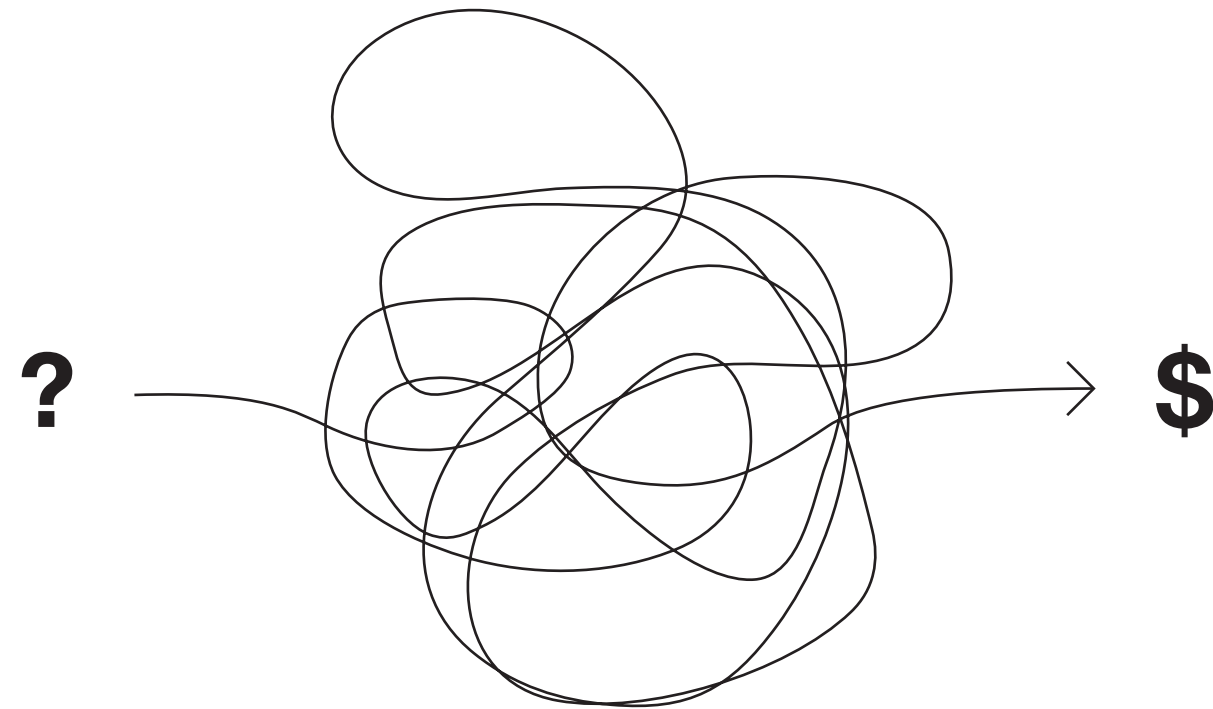
We have not embraced design as "unnatural selection" or "accelerated evolution."

But signs abound.

The very idea of software-as-a-service (SaaS), requires "up-time" and service-level agreements (SLAs), which must be monitored and maintained.

Uptime Operational ✓

60 days ago Today
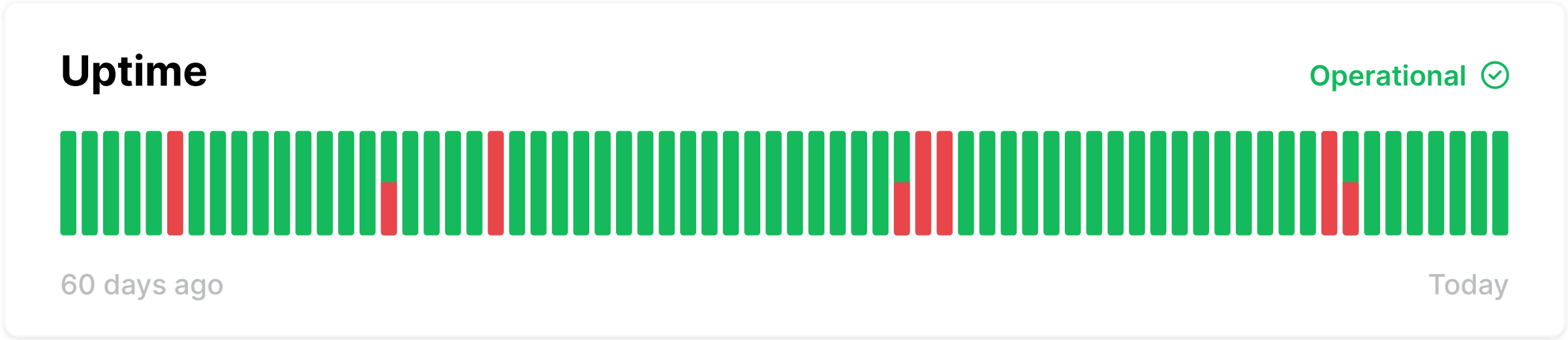
Traditional "waterfall" processes have been overthrown by so-called "agile" methods.

Requirements

Design

Implementation

Testing

Maintenance

Design · Define · Analyze · Deploy · Backlog · Test
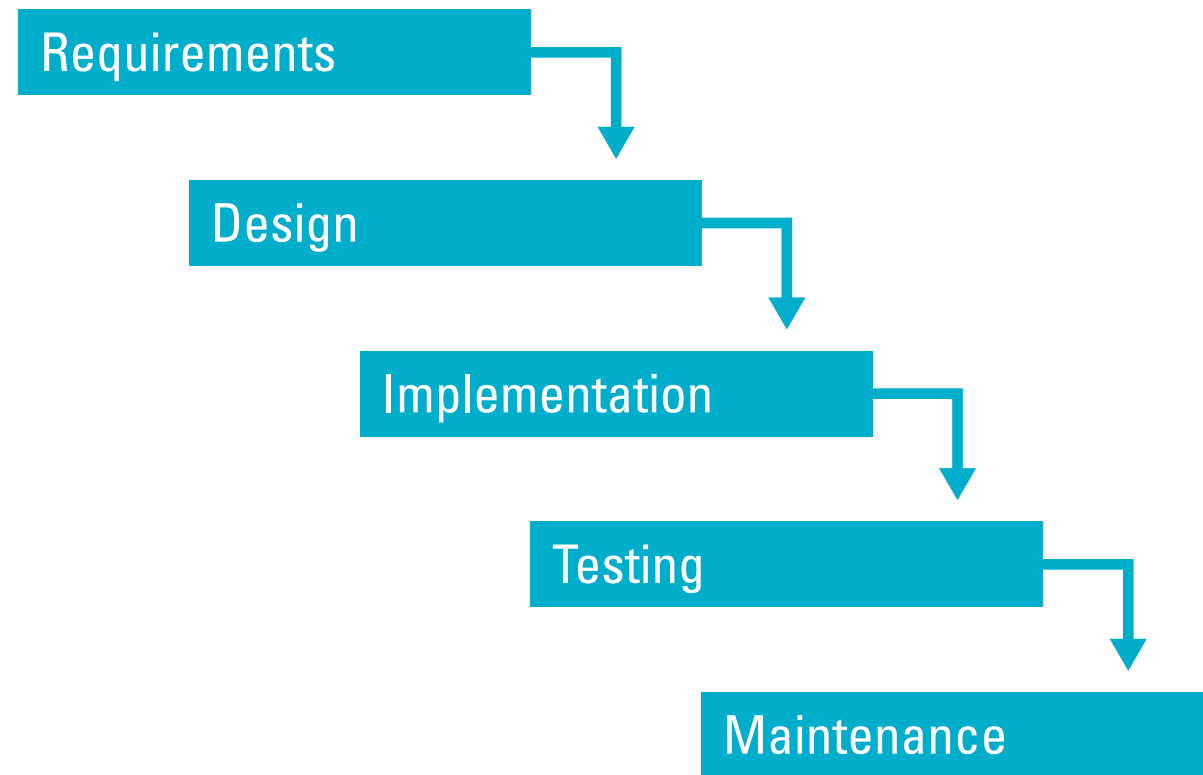
Waterfall
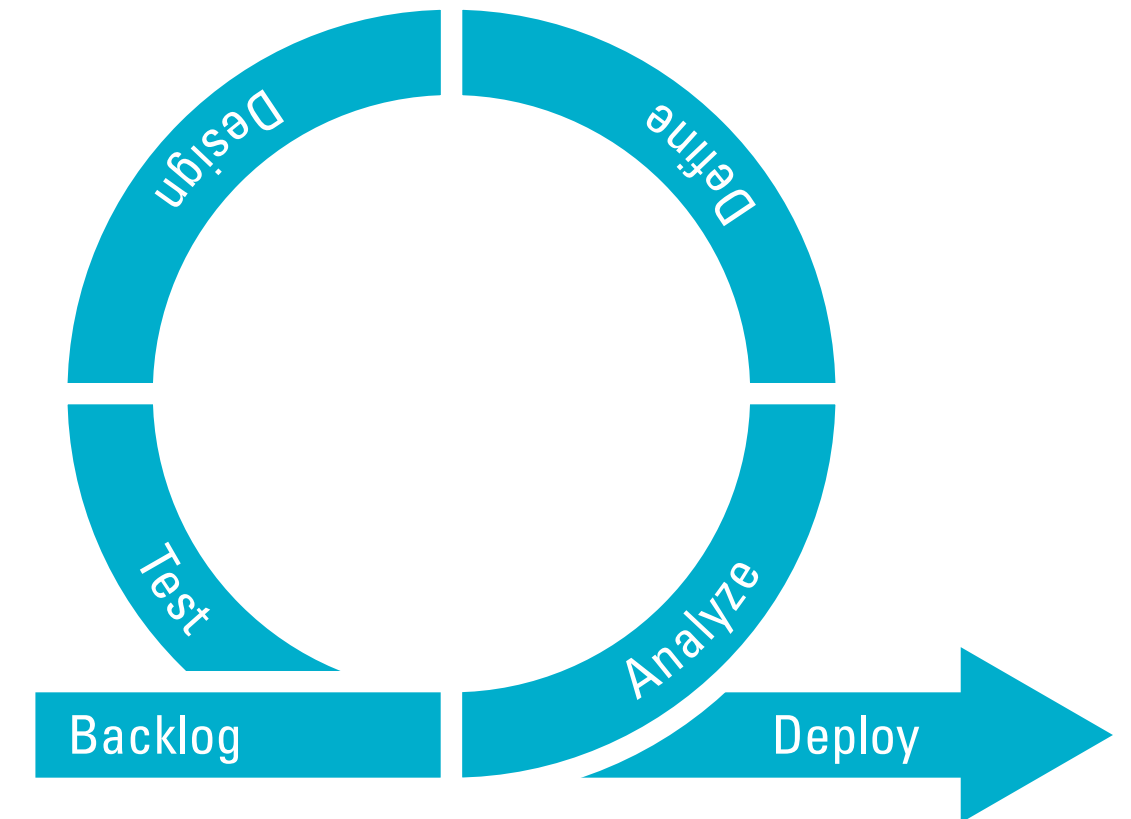
Agile

Google has made continuous beta commonplace.

Tools for managing change have become standard, such as:

GitHub for version control

Jira for tracking issues

Figma for branching design options

One model of the pace-of-change in design has emerged from architecture.

"Our basic argument is that there isn't such a thing as a building. A building properly conceived is several layers of longevity of built components."

— Frank Duffy (1990)

Set

Scenery

Services

Shell

Shell is the structure + skin, which lasts 35 to 50 years.

Set
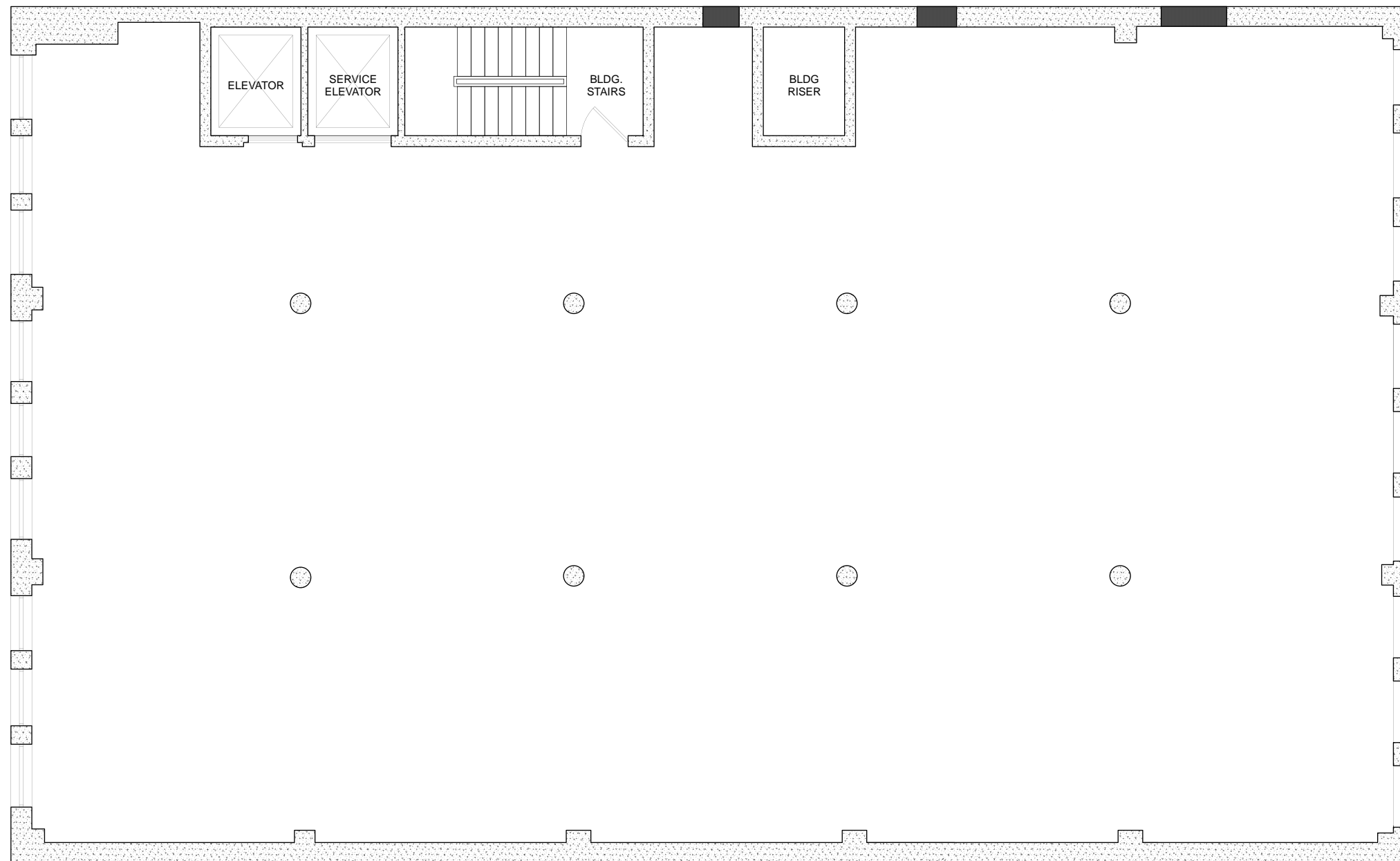
Scenery

Services

Shell

Services are the cabling, plumbing, HVAC, elevators, etc., which last 15 to 20 years.

Set
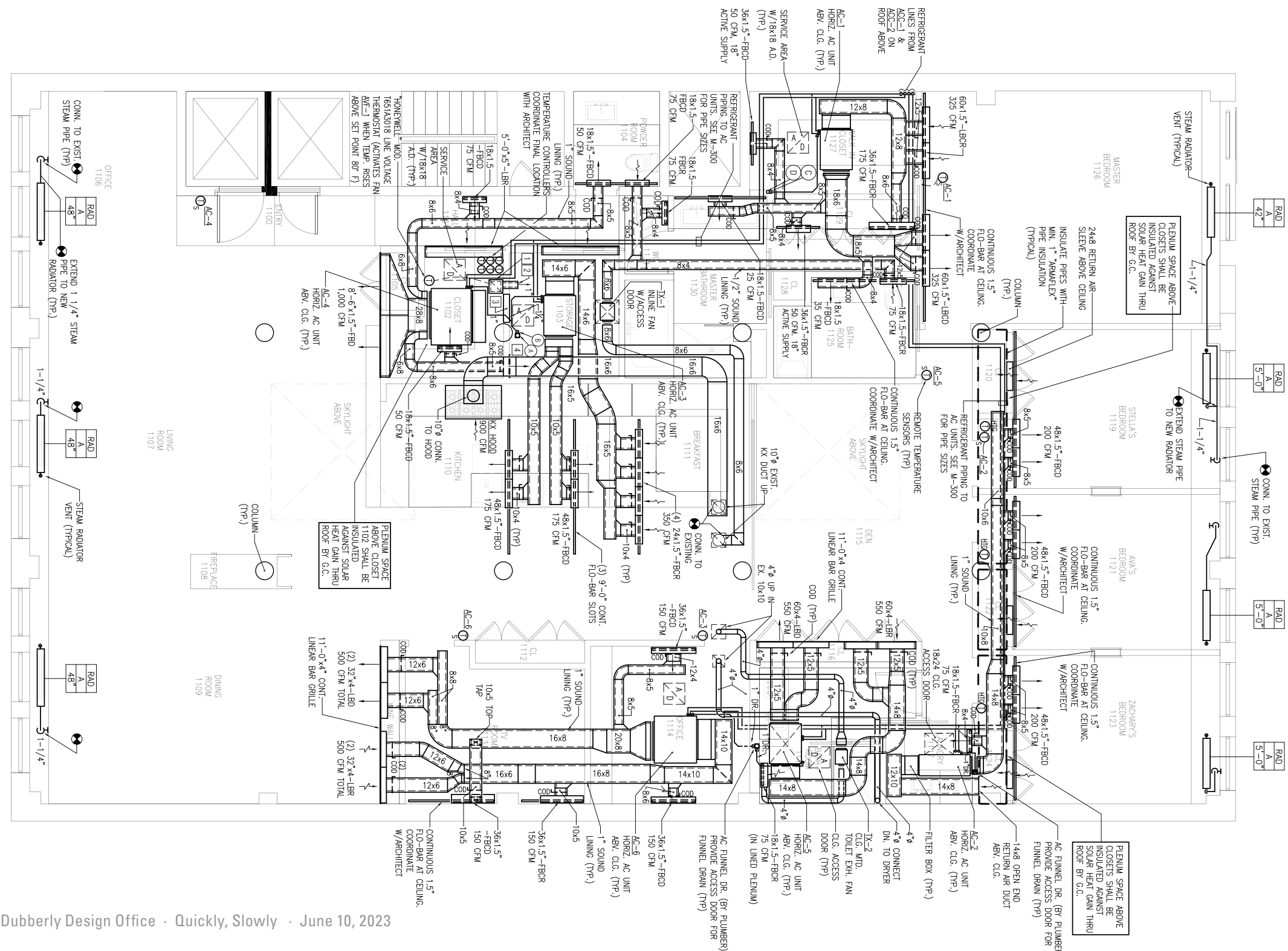
Scenery

Services

Shell

Scenery is the layout of partitions, signage, surfaces, etc., which last 5 to 7 years.

Set
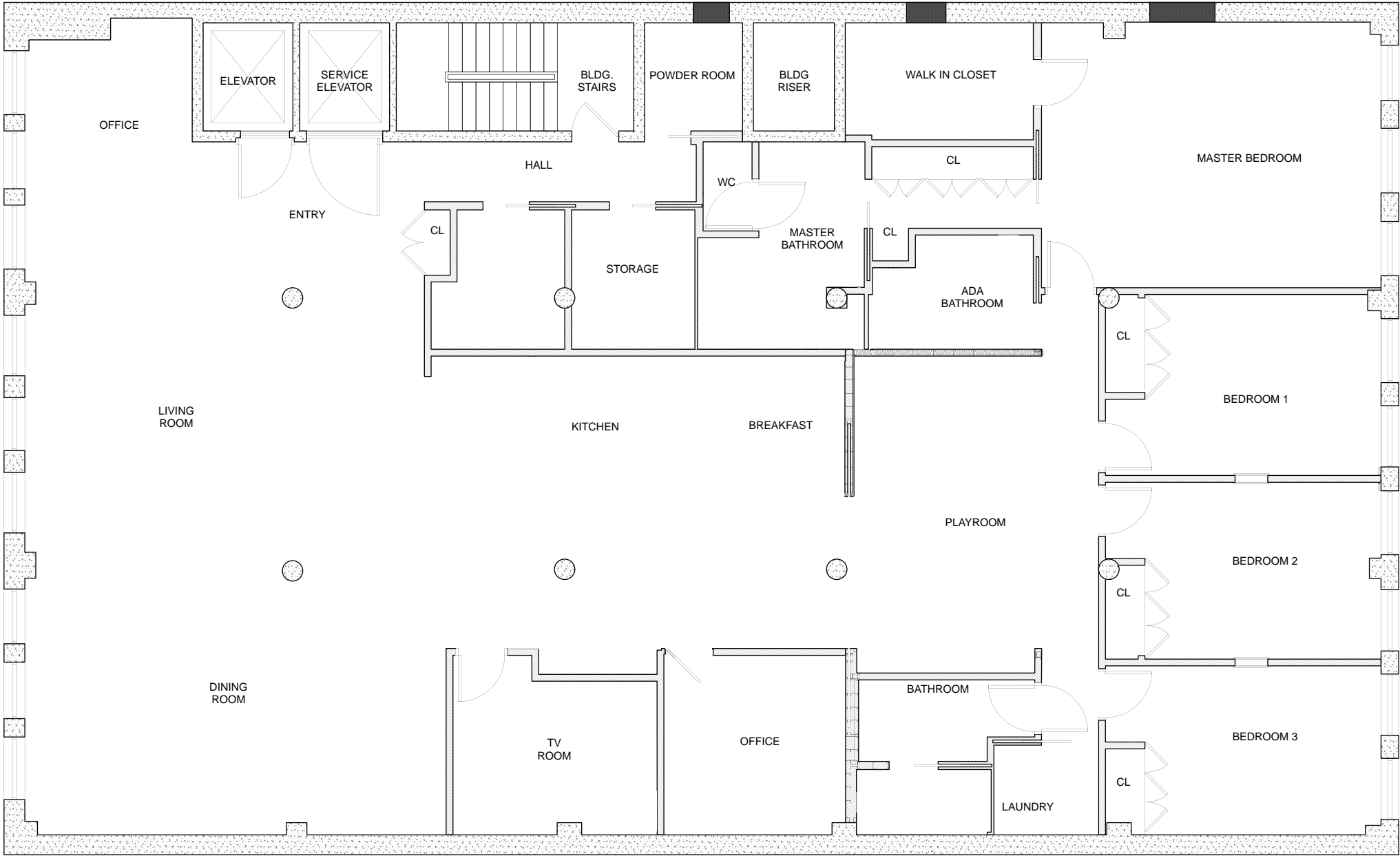
Scenery

Services

Shell

Set is the shifting of furniture by the occupants, which changes in months or weeks.

Set

Scenery

Services

Shell

"The unit of analysis for us isn't the building,
it's the use of the building through time."

— Frank Duffy (1990)

From left to right: barn, back house, little house, big house, in a typical "L" arrangement.
Construction likely began with the little house, expanding to the back house, barn, and big house.

Over the 50-year life of the structure, services will change 3 times, and scenery will change 8 to 10 times — many times the original costs.

Capital Costs

7 yrs

5 yrs

7 yrs

5 yrs

7 yrs

5 yrs

Set — 7 yrs · 15 yrs

Scenery — 5 yrs · 20 yrs

Services — 15 yrs

Shell — 50 yrs
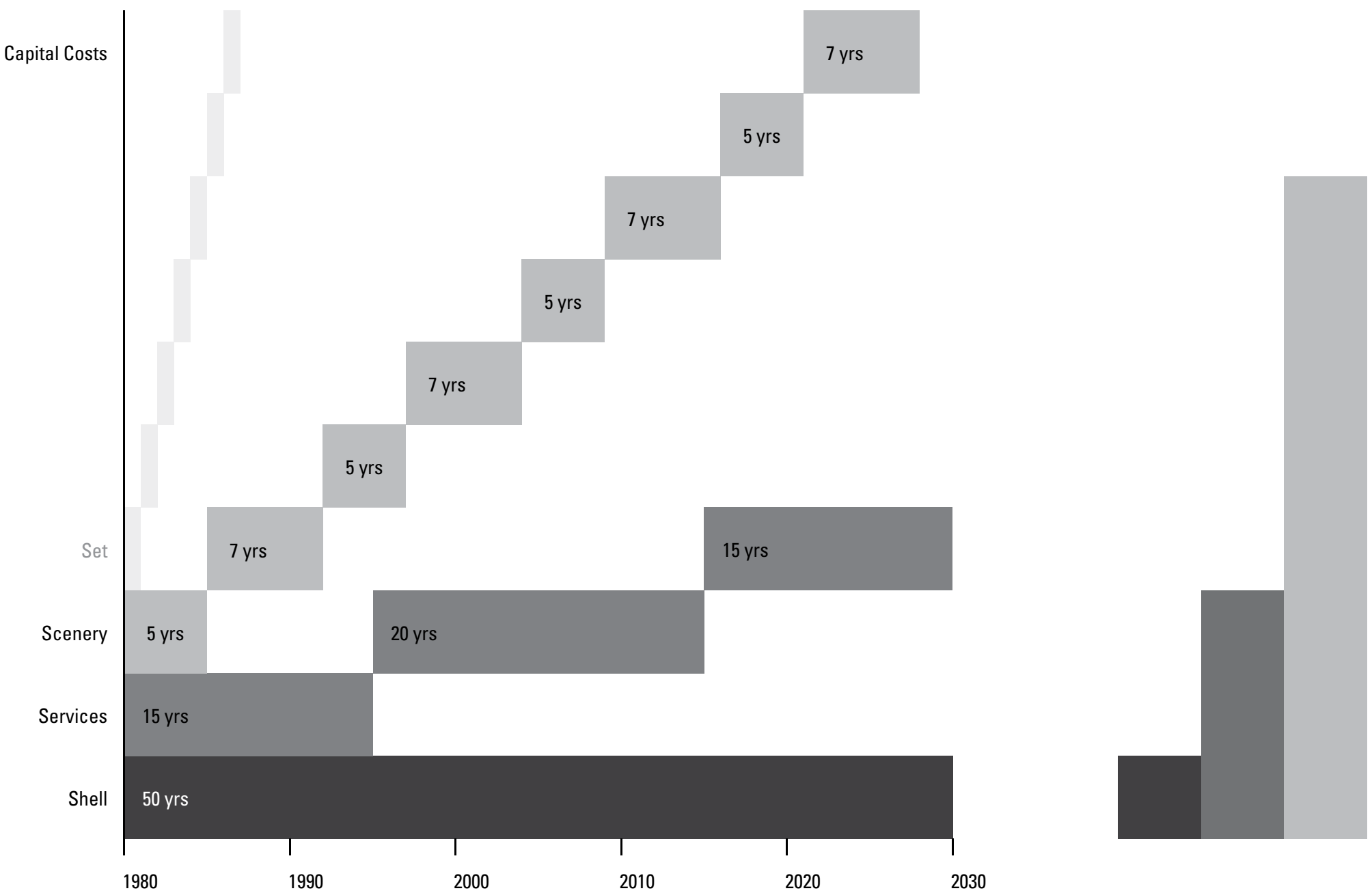
1980 · 1990 · 2000 · 2010 · 2020 · 2030

"A design imperative emerges:

An adaptive building has to allow slippage between the differently-paced systems...

Otherwise, the slow systems block the flow ... and the quick ones tear up the slow..."

— Stewart Brand, *How Buildings Learn* (1994)
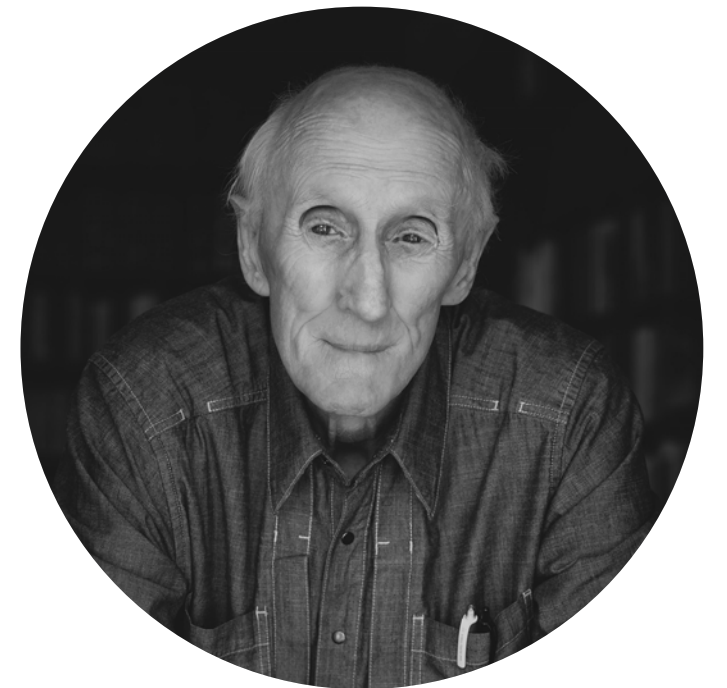
"*Things that are good have a certain kind of structure
You can't get that structure except dynamically.*

Period.

*In nature, you've got continuous
very-small-feedback-loop adaptation going on,
which is why things get to be harmonious.*

*That's why they have the qualities we value.
If it wasn't for the time dimension, it would happen.*

Yet here we are playing a major role in creating the world,
and we haven't figured this out."

— Christopher Alexander (1994)

Stewart Brand added to Frank Duffy's layers and "translated" some terms.

Duffy	Brand	
	Souls	Staff or occupants
Set	**Stuff**	Furniture, appliances, decorations
Scenery	**Space Plan**	Internal walls, halls, and doorways
Services	**Services**	Electrical, plumbing, HVAC
	Skin	Exterior surfaces, windows, and doors
Shell	**Structure**	Foundation, load-bearing elements
	Site	The lot and its contours

Brand notes, "**the construction sequence** is strictly in order:

Site preparation,
      then foundation and framing the **Structure**,
            followed by **Skin** to keep out the weather,
                installation of **Services**,
                    and finally **Space Plan**.
                            Then the tenants truck in their **Stuff.**"

Time
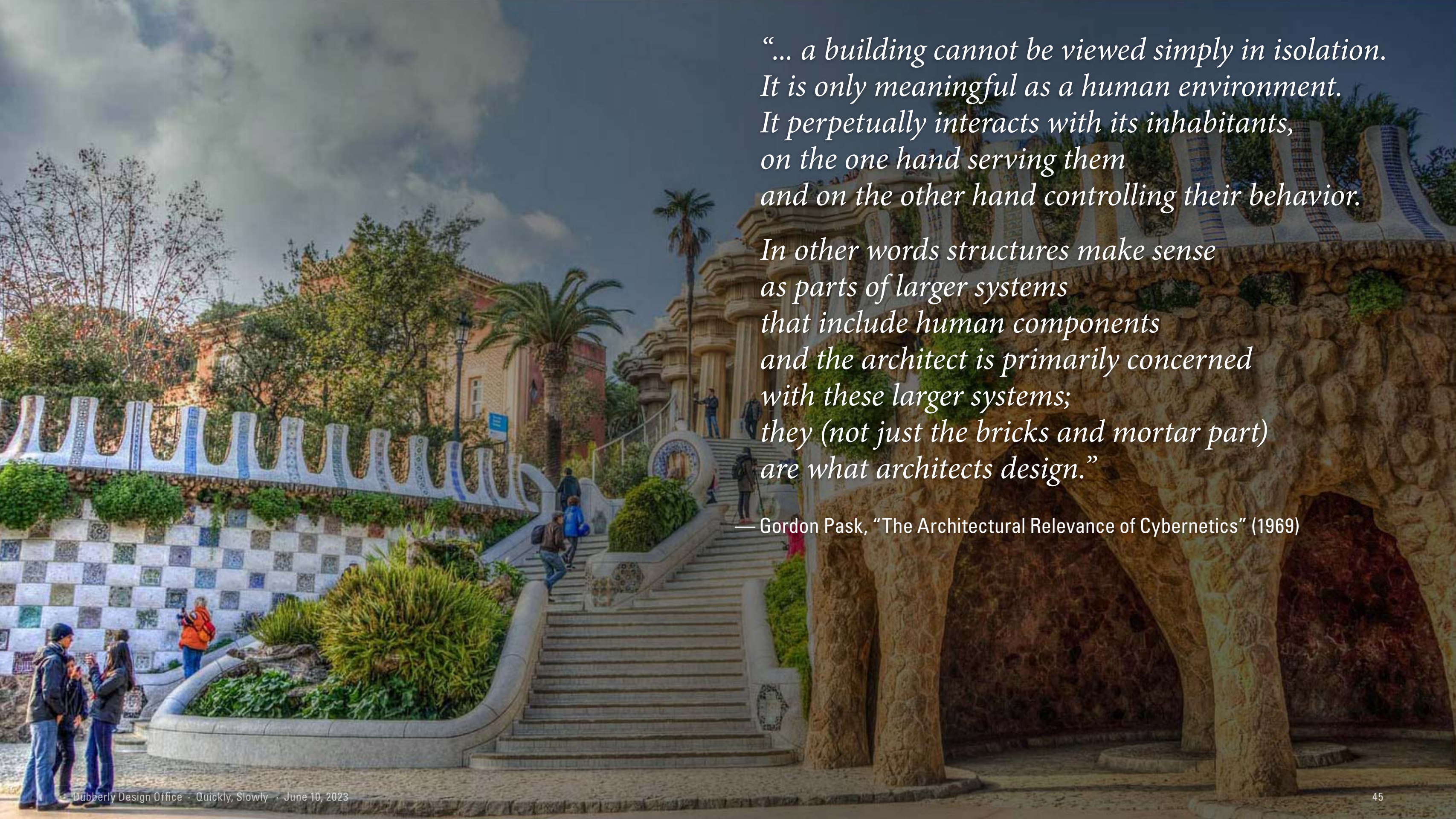
Brand also turned the list into a looping house icon, with thin lines **for fast layers and thick lines for slow.**
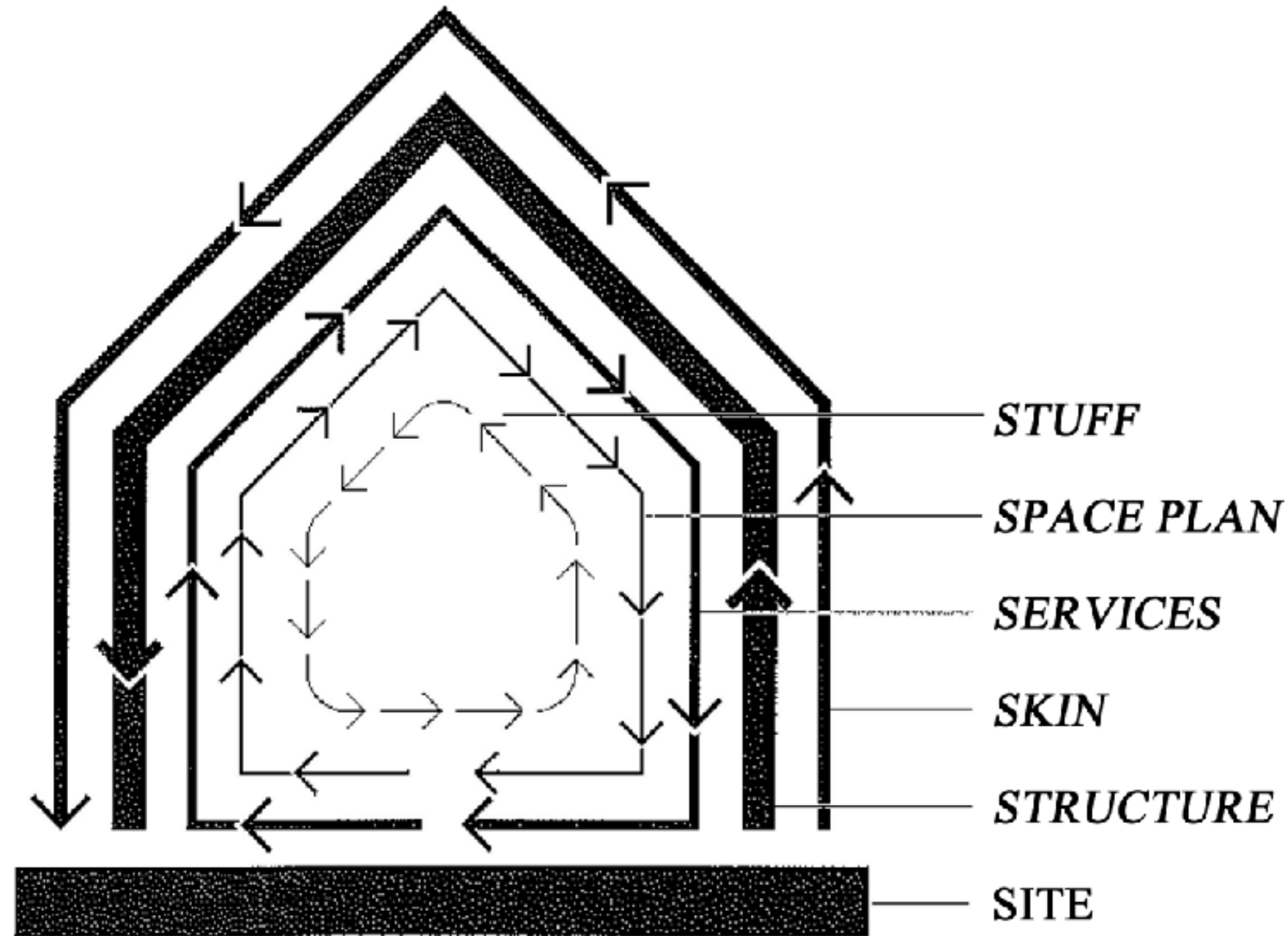
STUFF

SPACE PLAN

SERVICES

SKIN

STRUCTURE

SITE

"We make our buildings,
and afterwards they make us.
They regulate the course of our lives."

— Winston Churchill (1943)

*"... a building cannot be viewed simply in isolation.
It is only meaningful as a human environment.
It perpetually interacts with its inhabitants,
on the one hand serving them
and on the other hand controlling their behavior.*

*In other words structures make sense
as parts of larger systems
that include human components
and the architect is primarily concerned
with these larger systems;
they (not just the bricks and mortar part)
are what architects design."*

— Gordon Pask, "The Architectural Relevance of Cybernetics" (1969)

**Both quotes describe a reciprocal relationship —
an on-going conversation, which is ontological in nature.**

shape

People   **Buildings**

shape
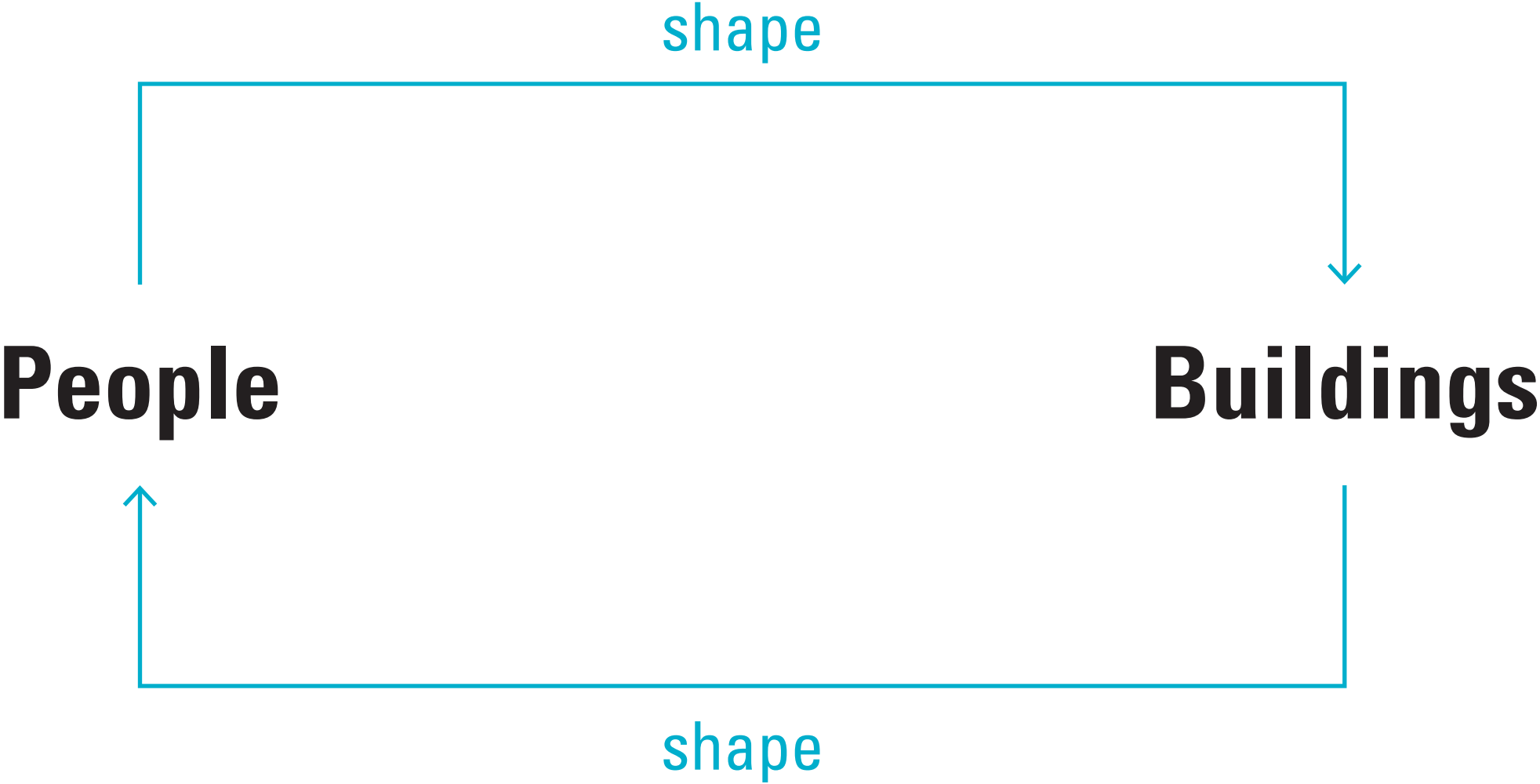
"... ontological designing is a way
of characterising the relation
between human beings and lifeworlds....

we design,...— in turn we are designed by our
designing and by that which we have designed...

this adds up to a double movement —
we design our world,
while our world acts back on us and designs us."

— Anne Marie Willis, "Ontological Designing" (2006)

Pace layers (and ontological designing) are not confined to architecture.

Duffy's and Brand's layers form a "stack" — a development platform — common in many domains.

Layer 2: App A	App B

New services added by outside developers

Rules or APIs define how layers interact, enabling the platform to support app development

Layer 1: Platform

Core services from original developers
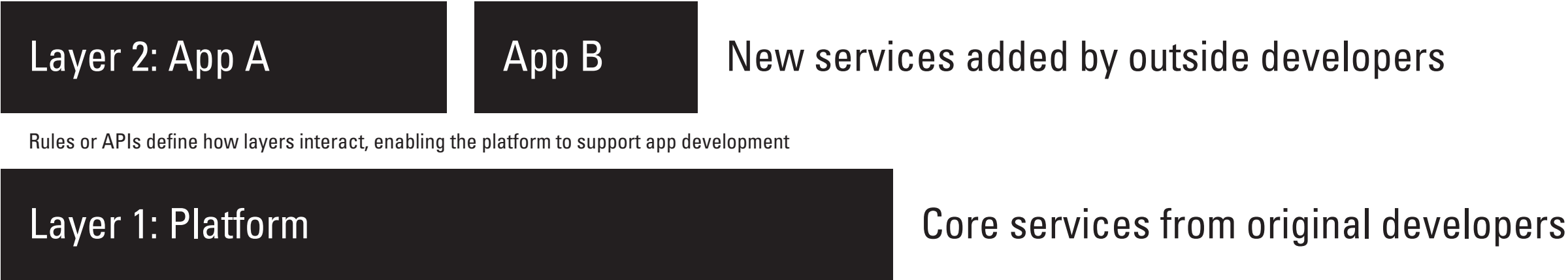
In software development, layers of the stack connect via "APIs", rules for exchanging information, which enable swapping versions at different rates.

| Data or Documents | .doc, .xls, .html, etc. |

APIs

| Applications | Word, Excel, Chrome |

APIs

| Operating System (OS) | DOS, Windows, Linux |

APIs

| Micro-processor | 8086, 80286, 80386, etc. |
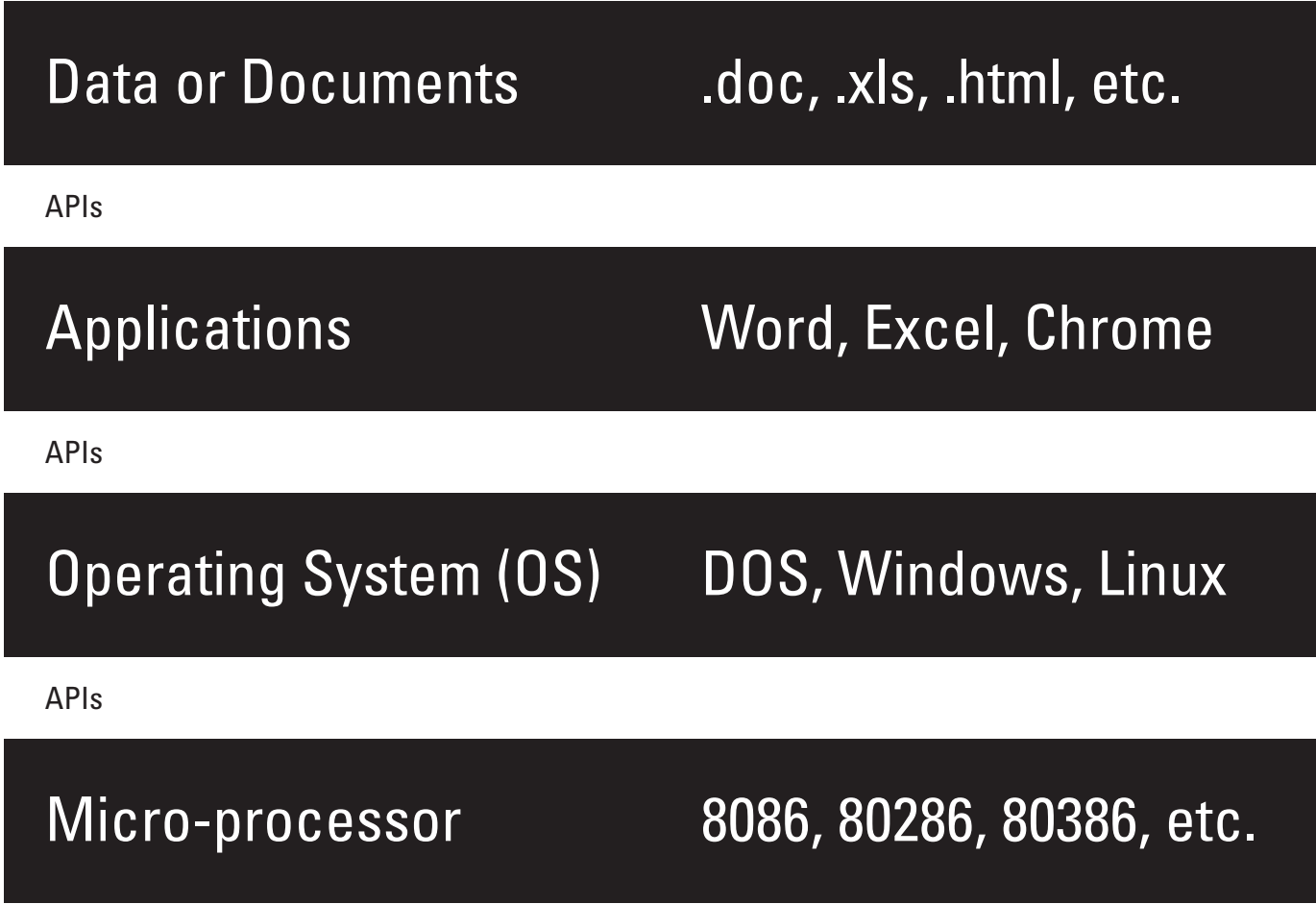
In design, too, layers play a role;
by definition strategies should last longer than tactics.

Concrete

Surface brings everything together visually: What will the finished product look like?

Skeleton makes structure concrete: What components will enable people to use the site?

Structure gives shape to scope: How will the pieces of the site fit together and behave?

Scope transforms strategy into requirements: What features will the site need to include?

Strategy is where it all begins: What do we want to get out of the site? What do our users want?

Abstract

Source: Jesse James Garrett, *The Elements of User Experience* (2002)

Similarly, design systems have layers of use which change at different rates.

- **Acting outside** the system.
- **Accepting** and **applying** the system.
- **Extending** the system.
- **Managing** the system.
- **Creating** the system. (Or later **transforming** it.)
- **Automating** the system.

Dan Hill explicitly compared Brand's building layers model to a tech stack for iPod. (2003)
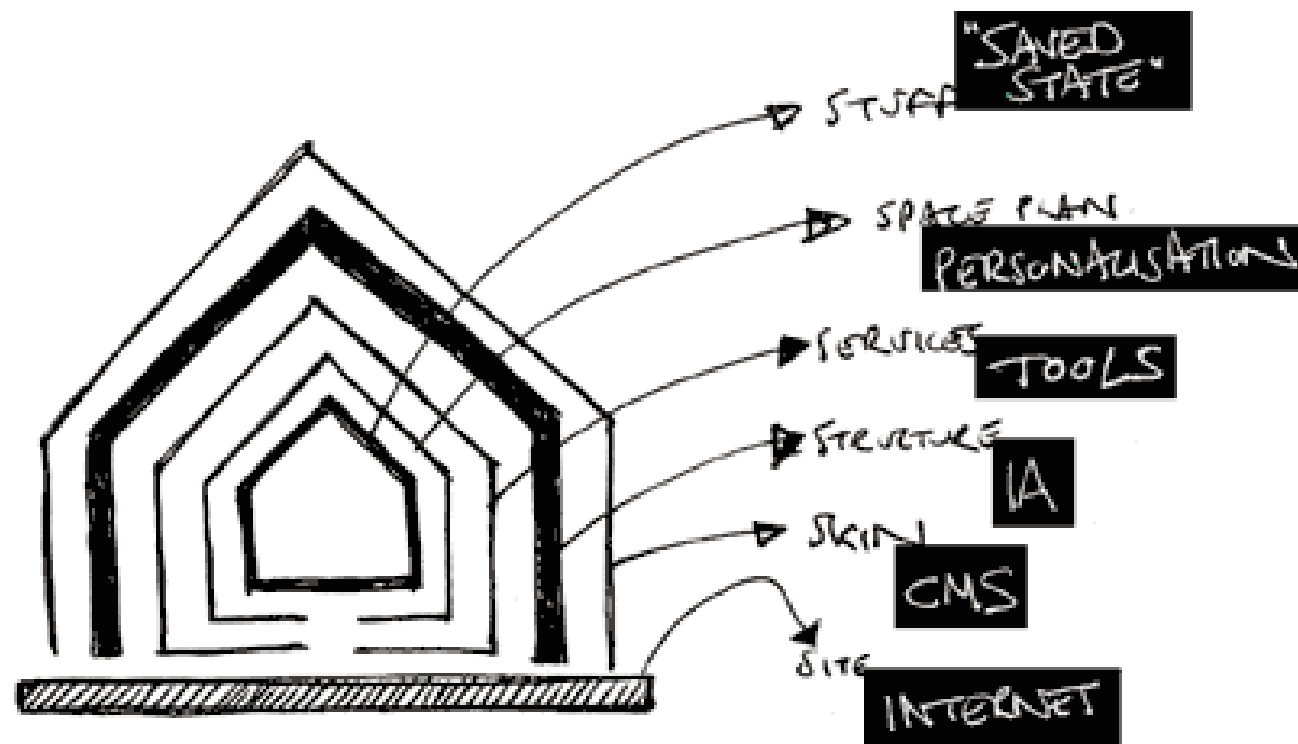
- Saved State
- Personalization
- Tools
- IA
- CMS
- Internet

In 2020, the NY Times asked, "How long will a vaccine really take?" The typical process was estimated to take about 14 years.

Source: https://www.nytimes.com/interactive/2020/04/30/opinion/coronavirus-covid-vaccine.html
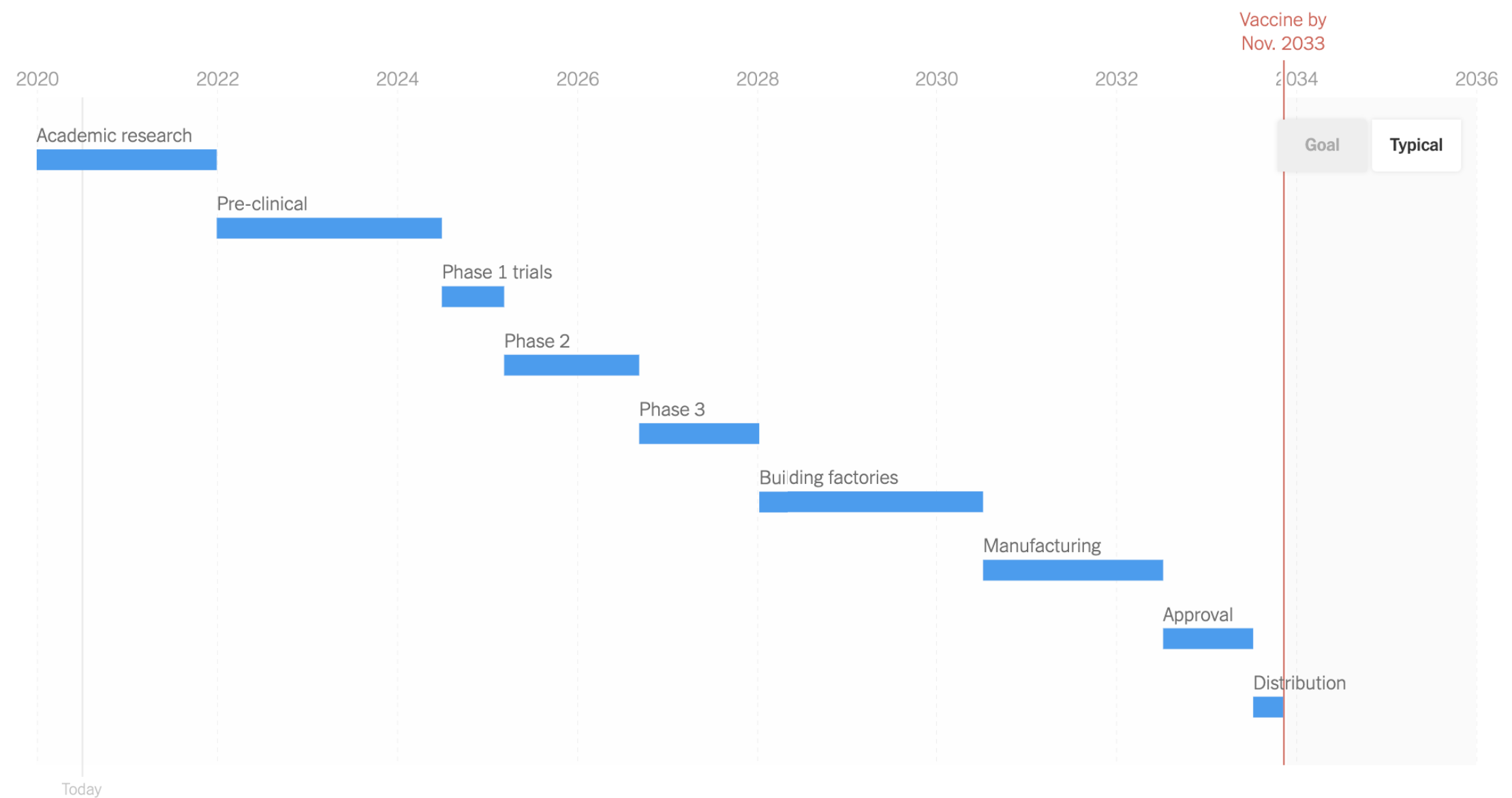
New mRNA technologies and a clear-and-present danger accelerated the process to under a year.
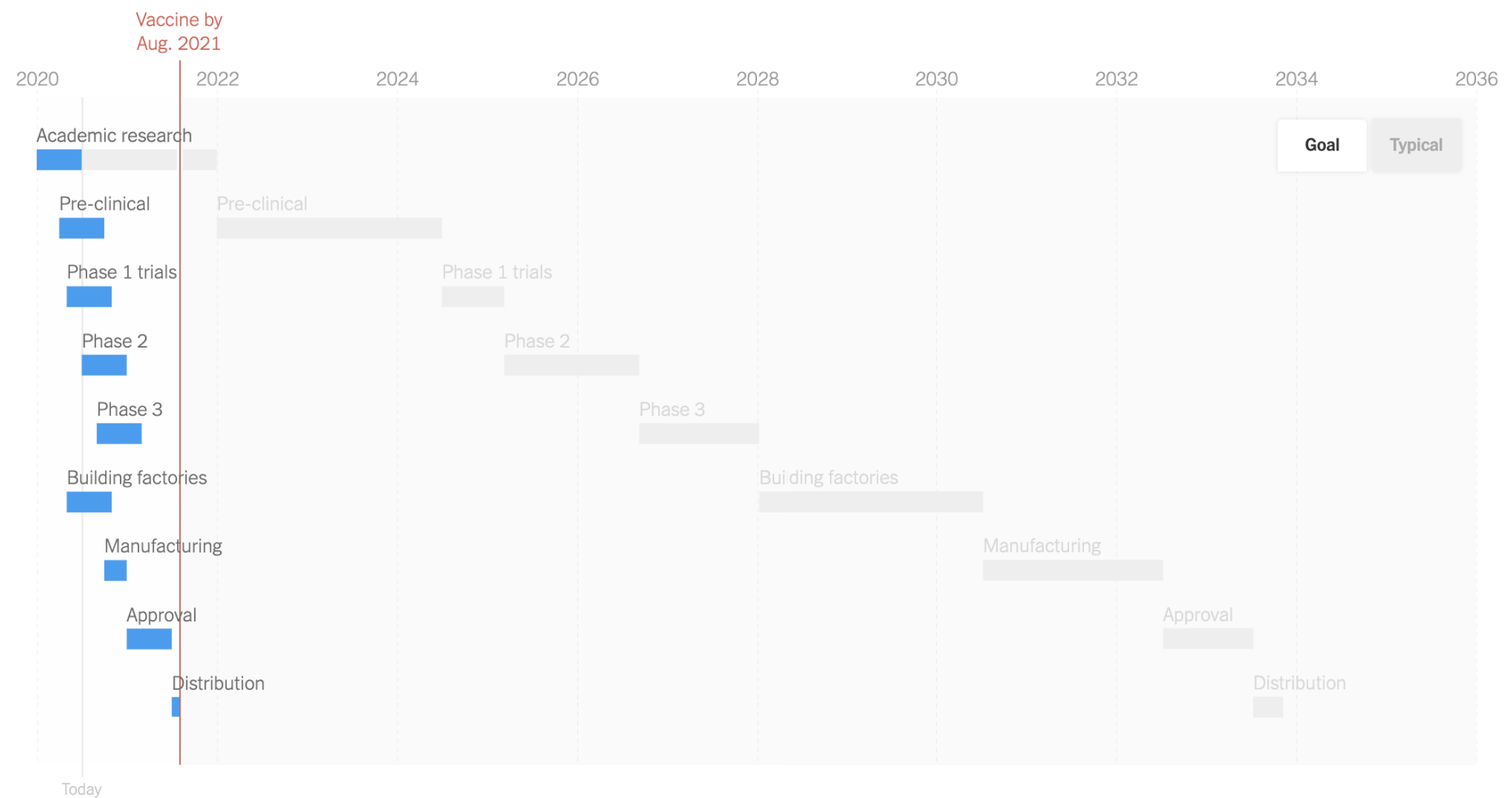
The Pace-layer Model has broader implications.

Brand claims, "All durable dynamic systems have this sort of structure..."

"The destiny of our species is shaped by the imperatives of survival on six distinct time scales."

Individual	years
Family	decades
Tribe or nation	centuries
Culture	millennia
Species	tens of millenia
The web of life	eons

Source: Freeman Dyson, From Eros to Gaia (1992)

Stewart Brand popularized Frank Duffy's model in 1994.
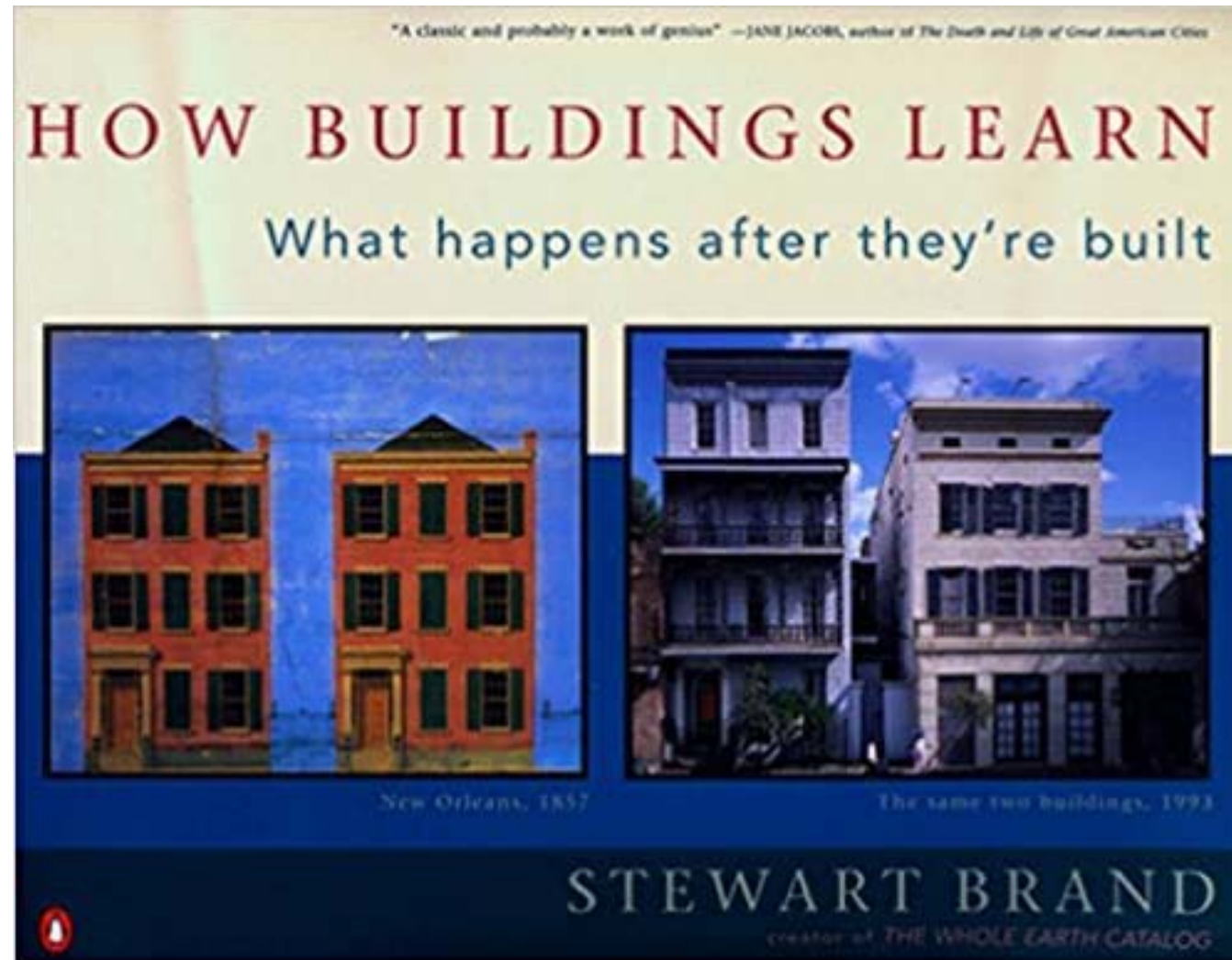
Brand broadened the idea with a new model in 1999.
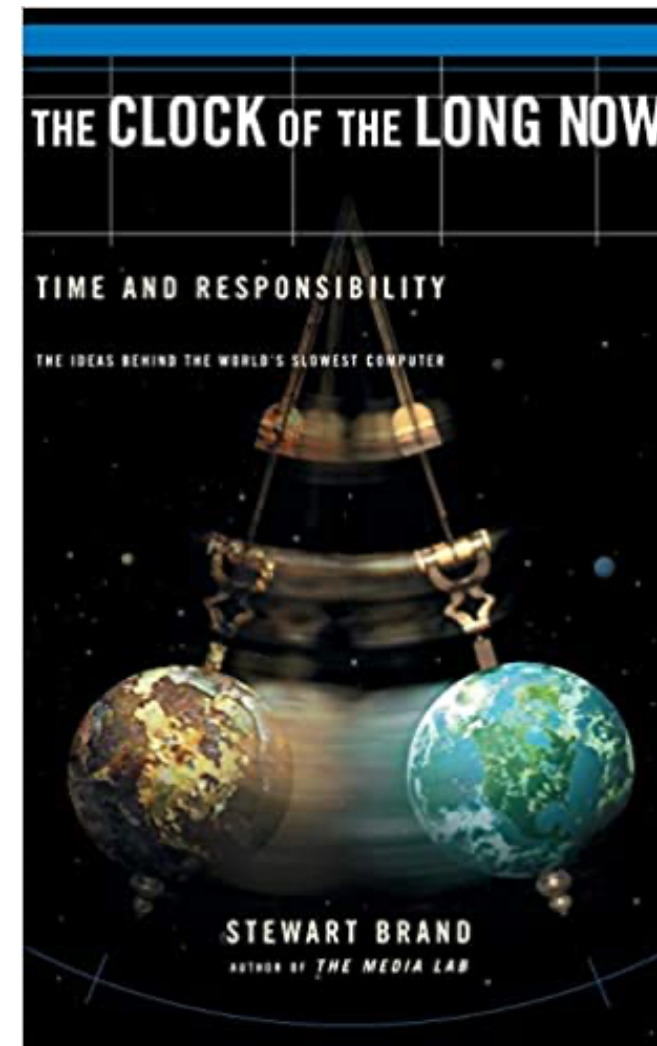
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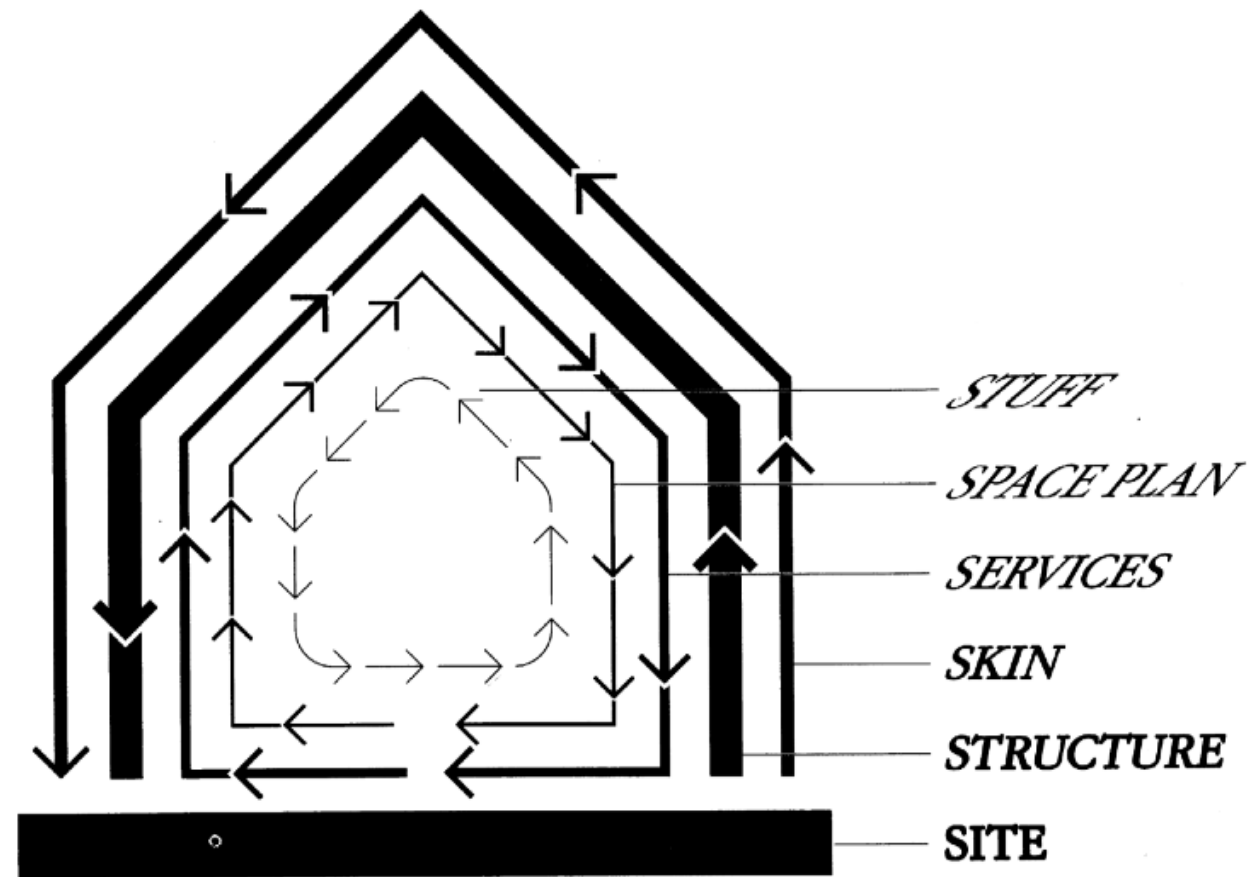
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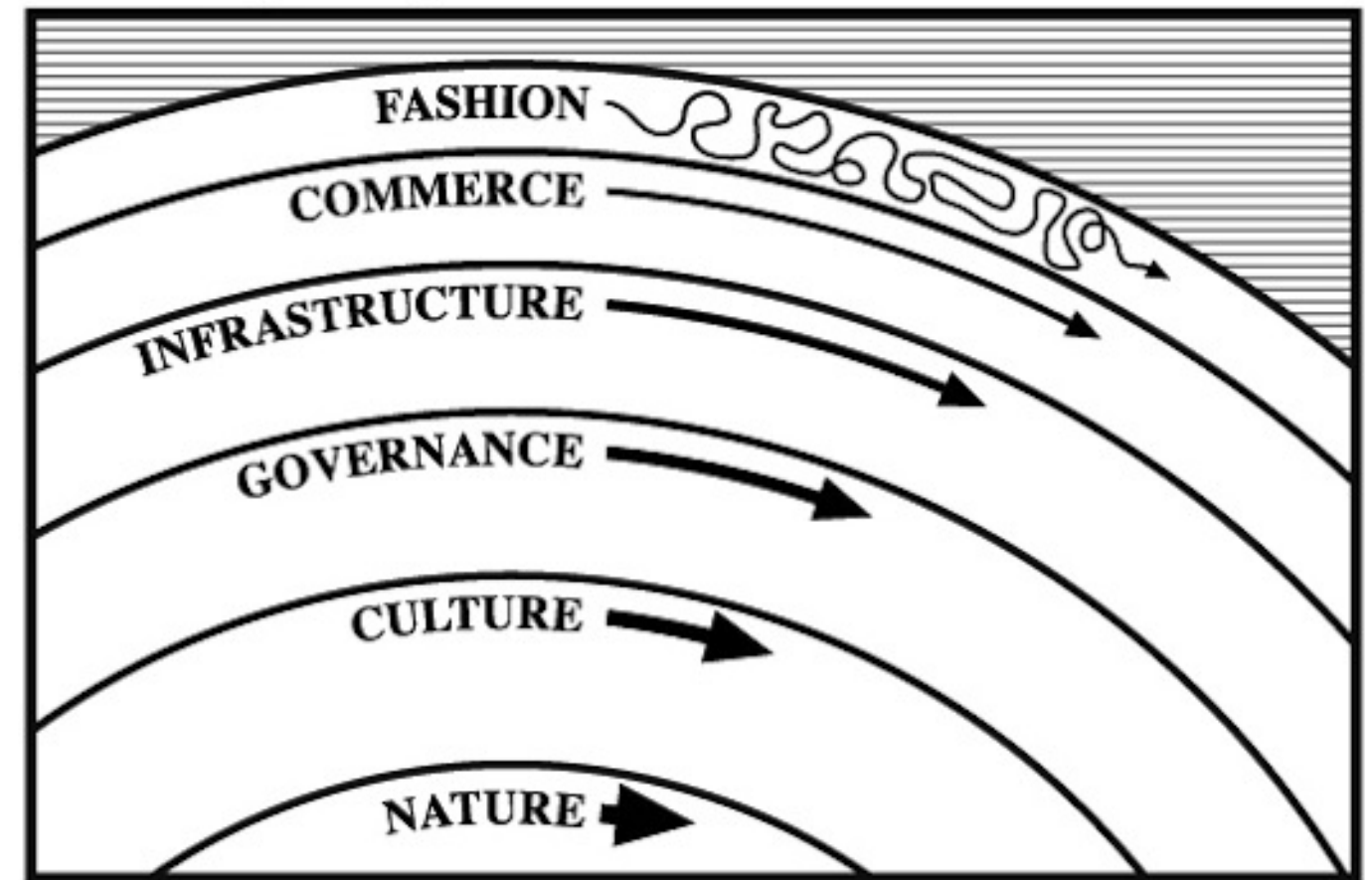
Brand provides only sparse definitions of the layers.

Fashion and Art ... froth: quick, irrelevant, engaging, self-preoccupied, and cruel, the driving energy for...

Commerce ... is short sighted; the private sector exploits and absorbs change, and creates wealth that enables...

Infrastructure ... such as transportation, sanitation, and communications systems, which cannot be justified in strictly commercial terms.

Governance ... manages Infrastructure and keeps Commerce from becoming crime; the social sector also acts on the level of...

Culture ... moves at the pace of language and religion; it's where the Long Now operates — our 10,000 year future.

Nature ... is vast power, inexorable and implacable — the longest now.

The combination of fast and slow components makes the system resilient, along with the way the differently paced parts affect each other.

Fast learns, ... slow remembers.

Fast proposes, ... slow disposes.

Fast is discontinuous, ... slow is continuous.

Fast and small instructs
by accrued innovation
and occasional revolution, ...

Slow and big controls
by constraint
and constancy.

Fast gets all our attention, ... slow has all the power.

Changing the speed of a layer can have drastic effects, e.g., Government slowing Commerce or Commerce accelerating Nature.
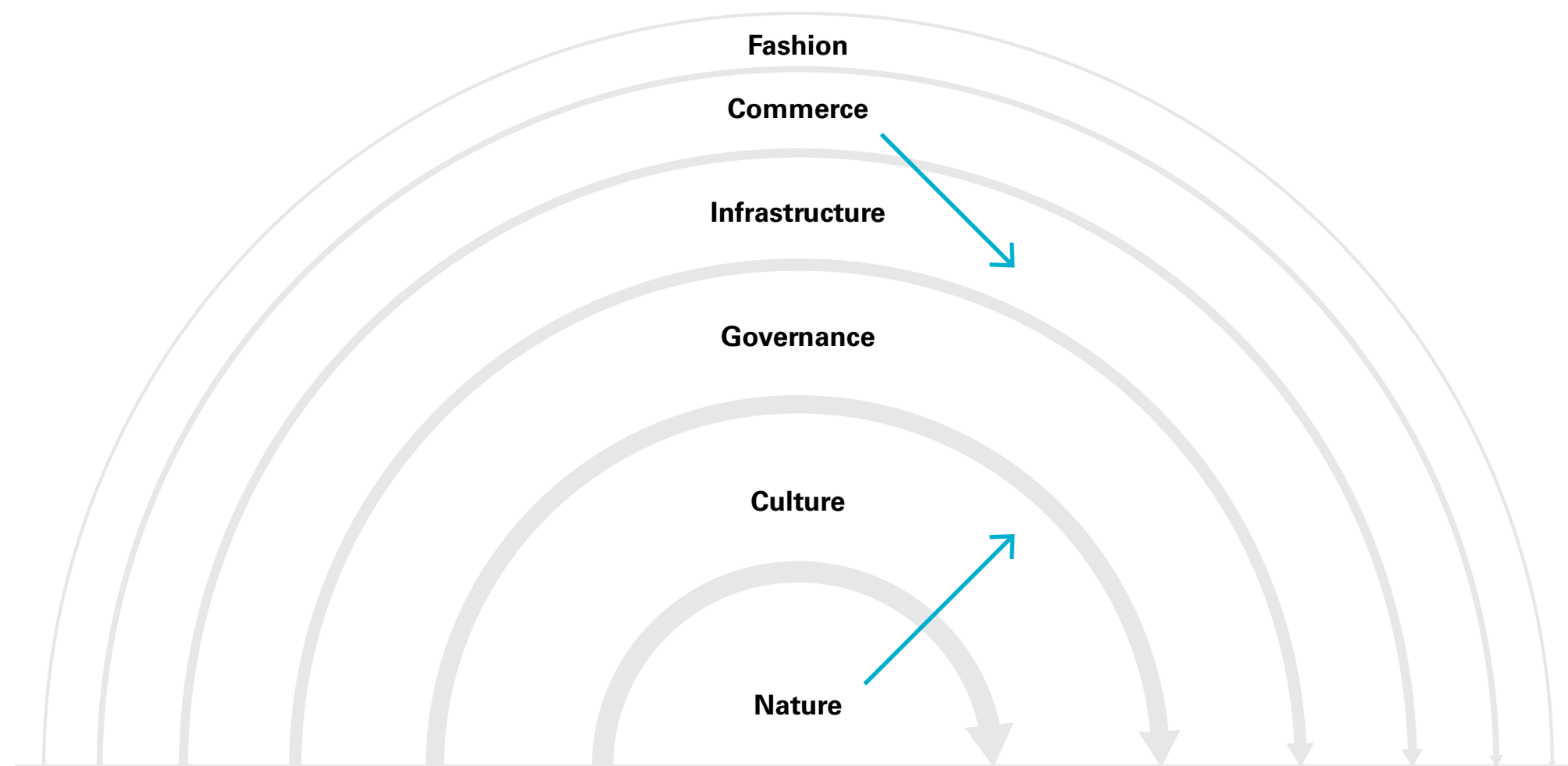
Another way to look at Pace Layers is as a trade-off between coherence (slower) and responsiveness (faster).
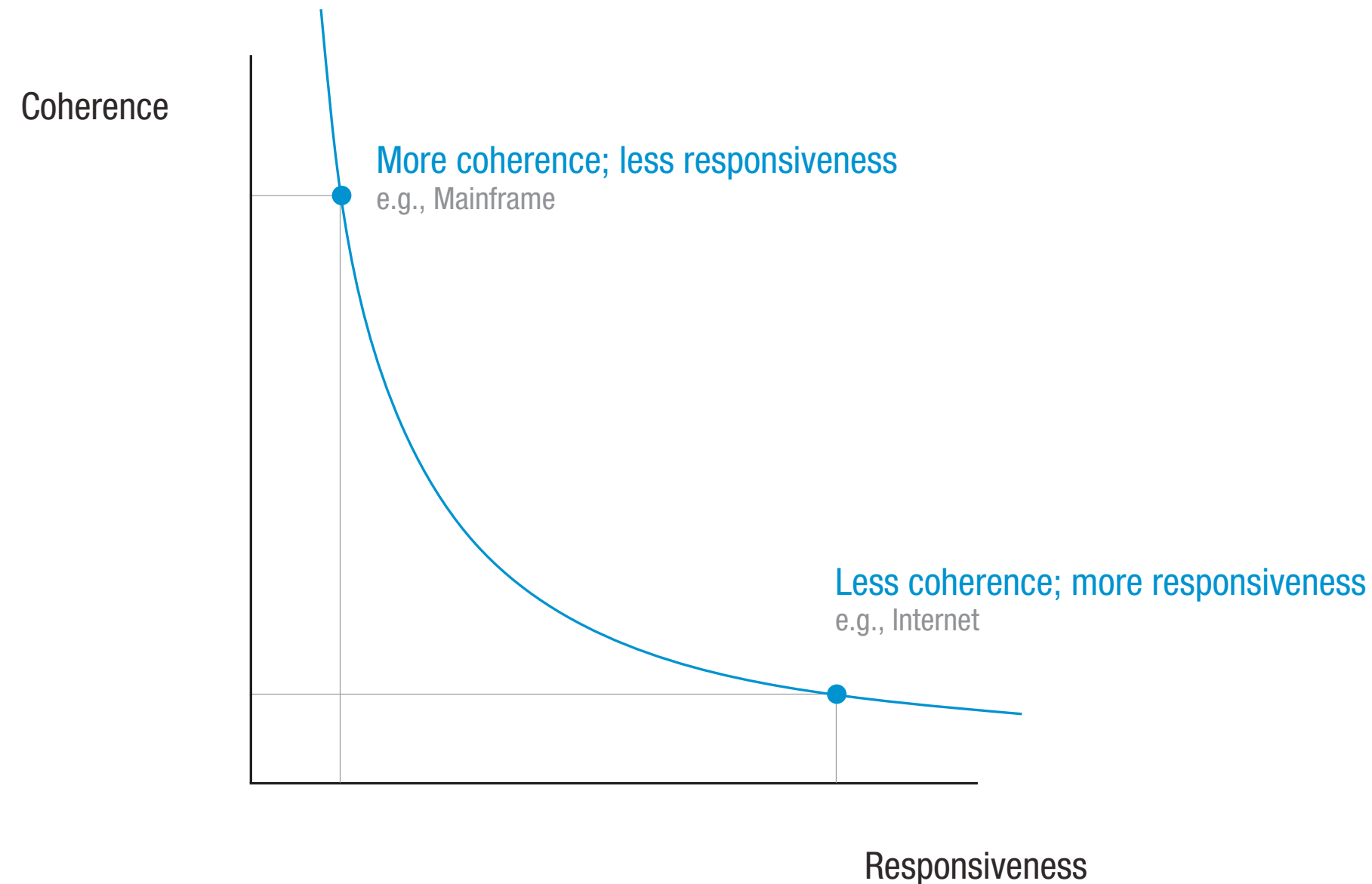
Coherence

More coherence; less responsiveness
e.g., Mainframe

Less coherence; more responsiveness
e.g., Internet

Responsiveness

The pace-layer framework can help explain the success of many systems.

It is also curiously "fractal".

Nature

"... a forest may appear
- as a dynamic entity in its own right
- as a constant background within which an organism operates
- as inconsequential noise in a major geomorphological process"

Source: Robert V. O'Neill, et al., "A Hierarchical Concept of Ecosystems" (1986).
Referenced by Brand in How Buildings Learn; also referenced by Mayo Nissen

Government
The US federal government includes layers designed to operate at different speeds.

Faster
More volatile

Slower
More stable

	Members	Terms of office
House of Representatives	435	2 years
President	1	4 years
Senate	100	6 years
Current Authorized Federal Judges	874	Lifetime
Supreme Court Judges	9	Lifetime
Courts of Appeals Judges	179	Lifetime
Court of International Trade Judges	9	Lifetime
District Courts Judges	677	Lifetime

Commerce

Pace layers	Company size	Department	Agile hierarchy
Fashion / art	Young start-up	Marketing	Subtask
Commerce		Engineering	Story
Infrastructure		Logistics	Sprint
Governance	Average company	IT	Epic
Culture		HR	Initiative
Nature	Huge conglomerate	Legal	Product

Faster ↑

Slower ↓
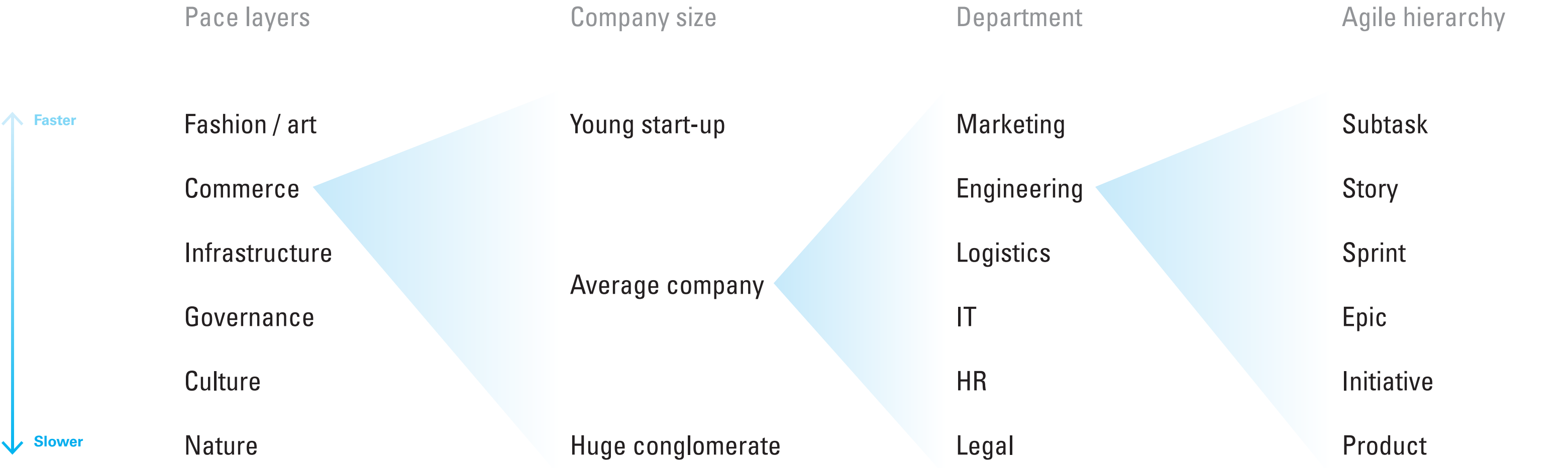
Daily Living

	Self-care	Medical	Home	Entertainment	Social	Financial	Legal
Daily	Sleep Eat Toilet Bathe / brush teeth Dress Exercise	Measure weight Log food Take medications Track symptoms	Cook meals Wash dishes Make bed	Watch TV Surf the Web	Send email	Go to work	. . .
Weekly	Interact with support group Trim nails	Set out pills for the week	Change bed linens Clean house Clean clothes	Make time for favorite shows	Attend religious service Go out to eat Touch base with family	Buy groceries Buy gas	. . .
Monthly	Cut hair	Visit primary physician Visit specialist Fill prescription Get lab test	. . .	Go to game or movie	Touch base with weak ties	Pay bills	. . .
Yearly	Take vacation	Visit dentist Get annual physical	Clean carpets Touch up paint Wash windows	. . .	Celebrate holidays Celebrate birthdays	Pay taxes Amend insurance Buy clothes + shoes Maintain car	. . .
Rarely in decade	. . .	Rarely Get special tests Enter hospital Under go rehab Change physiciansdecade	Move to a new location	. . .	Attend wedding Watch kids graduate	Buy a new car Long-term planningin decade	. . .
Rarely in life	. . .	Enter hospice program	. . .	. . .	Get married Have a child	Pay estate taxes	Draw up a will

Faster
More volatile

Slower
More stable

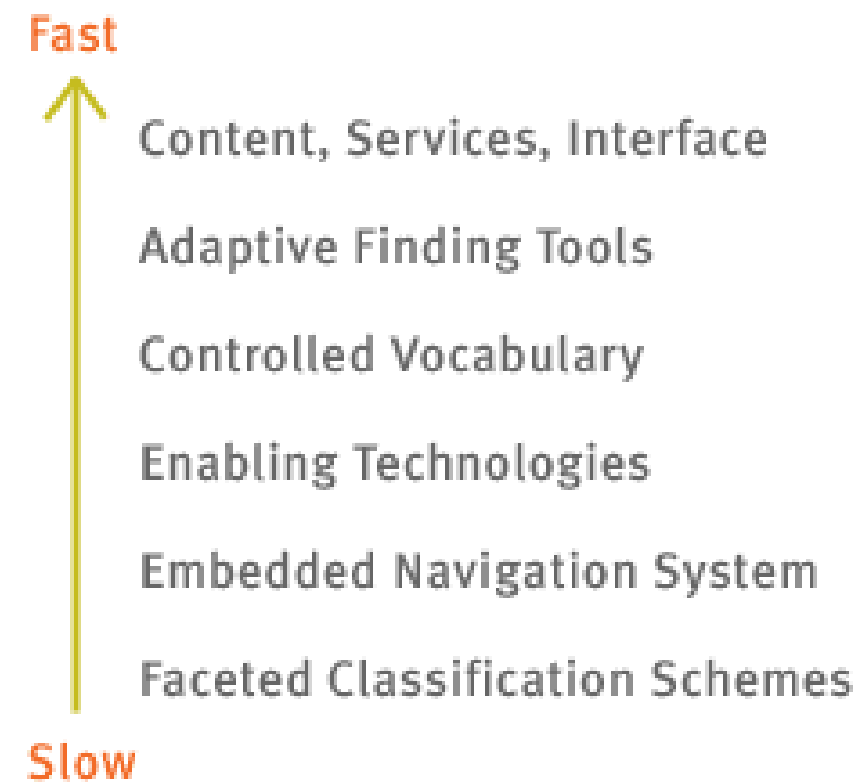Source: adapted from a diagram by Rajiv Mehta (2015)

IT
Enterprise information systems have three layers, which change at different rates.

	Paces of change	Life cycle	Planning horizon	Governance model
Systems of innovation new applications built adhoc to address new business requirements or opportunities, with a short life-cycle using departmental or outside resources and consumer-grade technologies.	Rapid Very frequent Ad hoc Customization Weekly or daily	Short life cycle 0 – 12 months	Up pt 6 months	Flexible Ad hoc
Systems of differentiation applications utilising unique company processes or industry specific capabilities, with medium-cycle change requiring frequent reconfiguration to accommodate changing business practices or customer requirements.	Moderate More frequent Reconfigurability Every 3 – 6 months	Medium life cycle 1 – 3 years	1 – 3 years	Responsive Business-led
Systems of record support the core of business transactions and manage critical master data with a slow rate of change, common functions between organisations and often subject to regulatory changes.	Slow Infrequent Incremental Every 6 – 12 months	Long life cycle 10 + years	7+ years	Formal Global

IA

"By isolating enduring IA from adaptive IA, we can invest sensibly in long-term infrastructure while creating flexibility where it's needed."

Fast

↑

Fashion & Art

Commerce

Infrastructure

Governance

Culture

Nature

Slow

Fast

↑

Content, Services, Interface

Adaptive Finding Tools

Controlled Vocabulary

Enabling Technologies

Embedded Navigation System

Faceted Classification Schemes

Slow

Source: Peter Morville, "The Speed of Information Architecture" (2001)
http://semanticstudios.com/the_speed_of_information_architecture/

Web App Stack
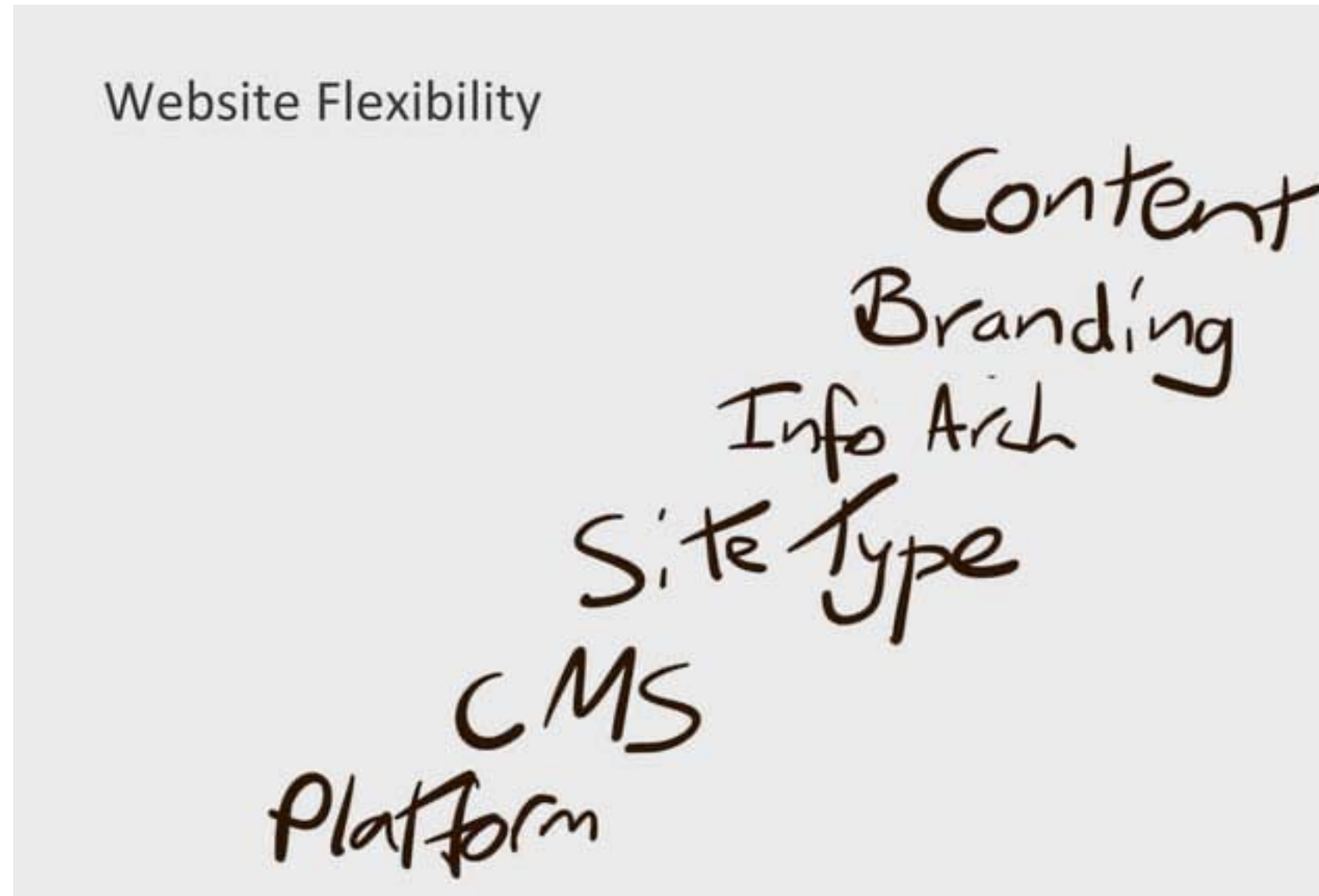
Website Flexibility

Content
Branding
Info Arch
Site Type
CMS
Platform

Design Practice

"... understanding which layer we're acting on at any given time is key to being effective as change agents..."
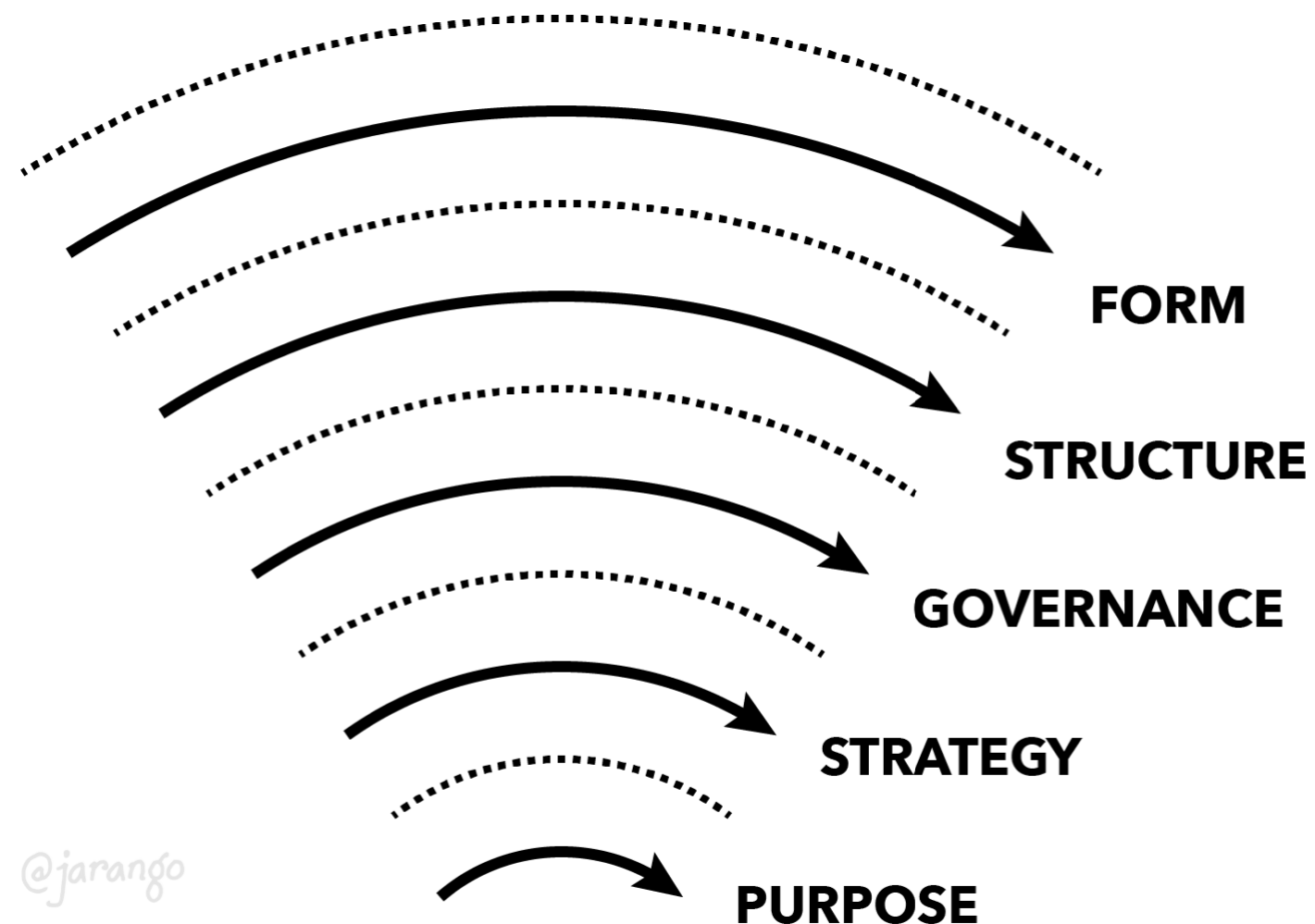

FORM

STRUCTURE

GOVERNANCE

STRATEGY

PURPOSE

@jarango

Form: The user interfaces that people use to interact with the organization's products and services. This layer is where the structure is articulated as artifacts that humans can experience.

Structure: The relationships between particular semantic elements that will inform end products and services.

Governance: How the organization shapes itself to implement its strategy. The rules and means of engagement, including the organization's internal hierarchy.

Strategy: How the organization aspires to do things differently to strive towardsits purpose; how it's going to compete.

Purpose: Why the organization, team, or product exists. This is not a goal since it can never be achieved; it's an aspiration that the system is always working towards.

Source: Jorge Arango, Living in Information (2018)

Most designing focuses on Form and Structure — but designers can and should go deeper.

FORM

STRUCTURE

GOVERNANCE

STRATEGY

PURPOSE

@jarango

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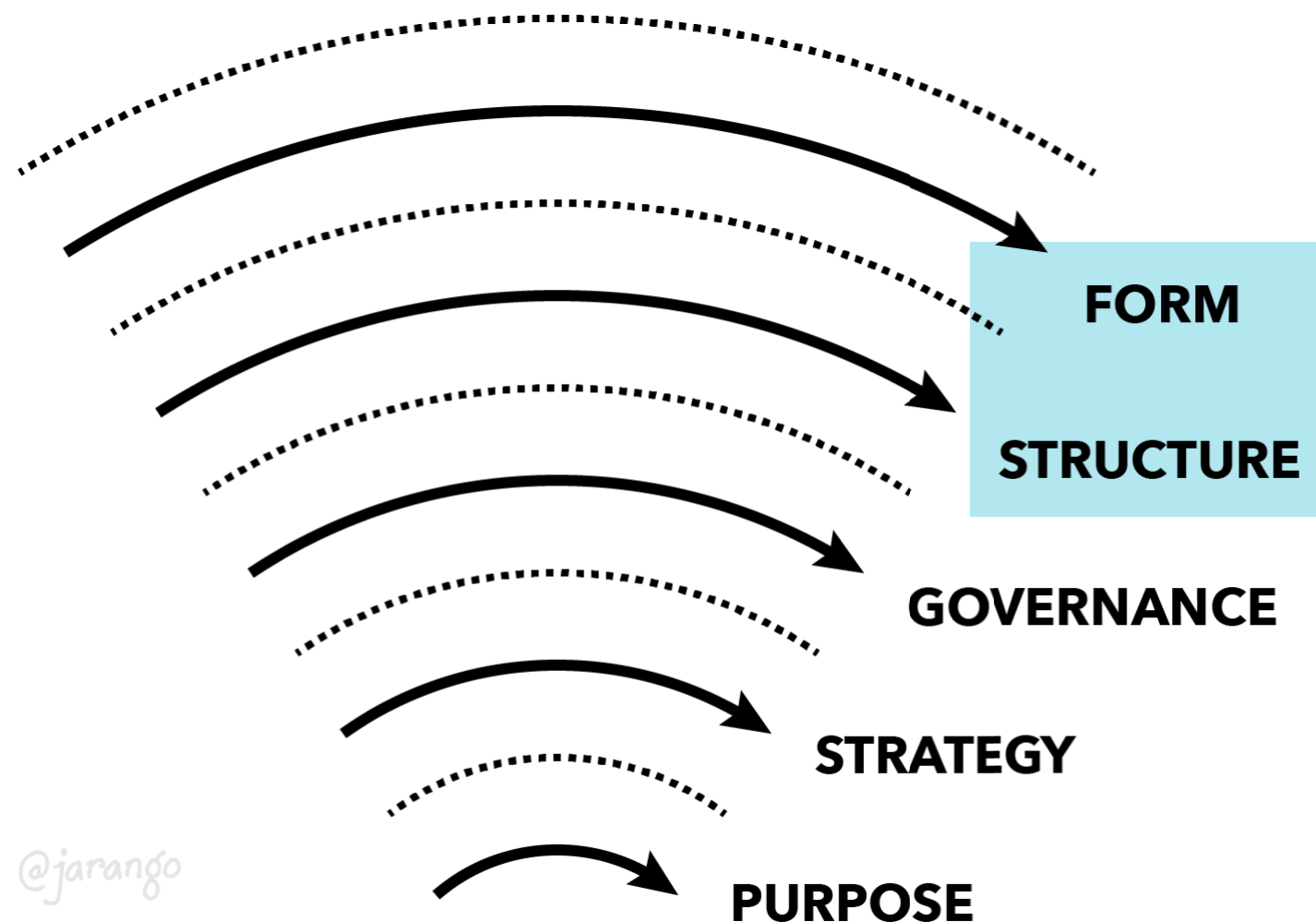
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Source: Jorge Arango, Living in Information (2018)

For example, managing a modern design system requires a sophisticated governance system.

Brand et al. used line weight to indicate speed; physics uses wavelength to indicate frequency.

Faster
More Volatile

Form
User interfaces through which people interact with products and services—where structure is articulated...

Designers tend to operate in these layers

Structure
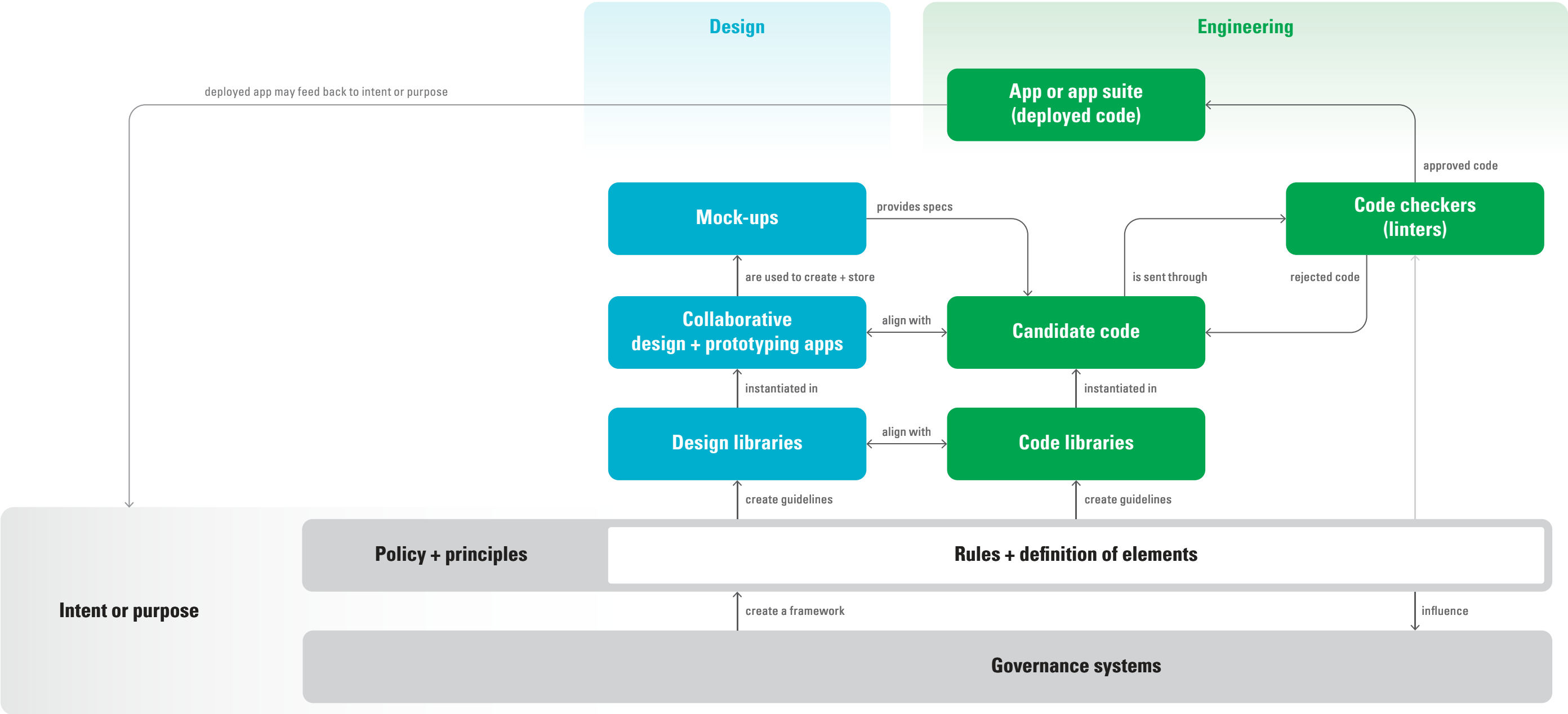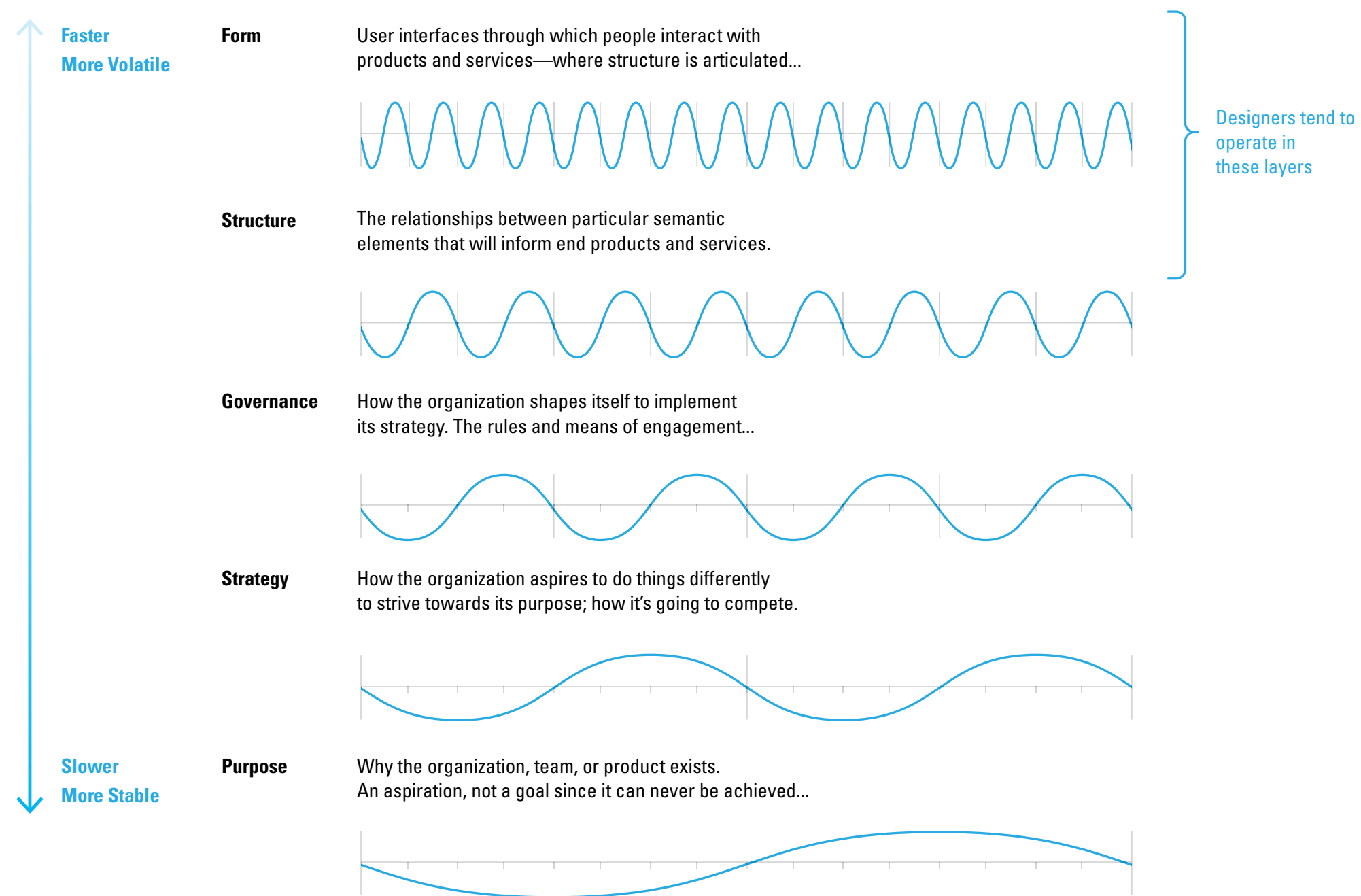The relationships between particular semantic elements that will inform end products and services.

Governance
How the organization shapes itself to implement its strategy. The rules and means of engagement...

Strategy
How the organization aspires to do things differently to strive towards its purpose; how it's going to compete.

Slower
More Stable

Purpose
Why the organization, team, or product exists.
An aspiration, not a goal since it can never be achieved...

Three points to remember:

1 Change and pace-of-change are elements-of-designing.

2 The context-of-designing is changing.

3 Designers may work at different pace layers.

One last thought about time:
We tend to "mistake a clear view for a short distance."

— attributed to Roy Amara and Paul Saffo

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Presentation posted at
presentations.dubberly.com/pace_layers.pdf