

Architecting for Wicked Messes

Towards an affordance language for service systems

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Image CC-BY-SA: Celina Laurette (2017) *Escaping from Plato's Cave*



David Ing, 2018

Agenda

1. Designing for tame problems c.f.
Architecting for wicked messes
2. Analyzing the complicated c.f.
Synthesizing the complex
3. Unfreeze-change-freeze c.f.
Co-responsive movement
4. Planning (teleology) c.f.
Programming (teleonomy)
5. Industrial value chain c.f.
Co-producing offerings

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- a. A tame problem is complicated;
a wicked problem is complex
 - b. Resolving to the prior;
Solving for the optimal;
Dissolving to eliminate;
Absolving (to nature?)
 - c. All architecture is design, but
not all design is architecture
 - d. Problem solving c.f.
Problem seeking
 - e. Issues and argumentation c.f.
Inquiring systems

“Dilemmas in a General Theory of Planning”, (Rittel + Weber, 1973)

The kinds of problems that planners deal with -- societal problems – are inherently different from the problems that scientists and perhaps some classes of engineers deal with.

Planning problems are inherently wicked.

The problems that scientists and engineers have usually focused upon are mostly "**tame**" or "**benign**" ones.

As an example, consider a problem of mathematics, such as solving an equation; or the task of an organic chemist in analyzing the structure of some unknown compound; or that of the chessplayer attempting to accomplish checkmate in five moves.

For each the mission is clear.

It is clear, in turn, whether or not the **problems** have been solved.

Wicked problems, in contrast, have neither of these clarifying traits; and they include nearly all public policy issues – whether the **question** concerns the location of a freeway, the adjustment of a tax rate, the modification of school curricula, or the confrontation of crime.

There are at least **ten distinguishing properties** of planning-type problems, i.e. wicked ones ... We use the term “wicked” in a meaning akin to that of “malignant” (in contrast to “benign”) or “vicious” (like a circle) or “tricky” (like a leprechaun) or “aggressive” (like a lion, in contrast to the docility of a lamb).

Horst WJ Rittel, and Melvin M. Webber. 1973. “Dilemmas in a General Theory of Planning.” *Policy Sciences* 4 (2): 155–169.
<https://doi.org/10.1007/BF01405730>.

Ten distinguishing properties of planning-type (wicked) problems (#1 - #5)

	Tame (benign) problems	Wicked (malignant) problems
1.	An exhaustive formulation can be stated containing all the information needed for understanding and solving the problem	There is no definitive formulation of a wicked problem.
2.	There are criteria that tell when <i>the</i> or a solution has been found .	Wicked problems have no stopping rule .
3.	There are conventionalized criteria for objectively deciding whether the offered solution is correct or false.	Solutions to wicked problems are not true-or-false, but good or bad .
4.	One can determine on the spot how good a solution-attempt has been.	There is no immediate and no ultimate test of a solution to a wicked problem
5.	The problem-solver can try various experimental runs without penalty.	Every solution to a wicked problem is a " one-shot operation "; because there is no opportunity to learn by trial and error, every attempt counts significantly.

Ten distinguishing properties of planning-type (wicked) problems (#6 - #10)

	Tame (benign) problems	Wicked (malignant) problems
6.	There are criteria which enable proof that all solutions have been identified and considered .	Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions , nor is there a well-described.
7.	There might be important classes to know which type of solution to apply.	Every wicked problem is essentially unique .
8.	Small steps lead to overall improvement, through incrementalism .	Every wicked problem can be considered to be a symptom of another problem .
9.	Rules or procedures can determine the “correct” explanation or combination of them.	The existence of a discrepancy representing a wicked problem can be explained in numerous ways . The choice of explanation determines the nature of the problem's resolution.
10.	Science does not blame for postulating hypotheses that are later refuted .	The social planner has no right to be wrong (i.e., planners are liable for the consequences of the actions they generate)

A *mess* (or *problématique*) is a system of problems

The **optimal solution** of a model is not an optimal solution of a problem unless the model is a **perfect representation** of the problem. Therefore, in testing a model and evaluating solutions derived from it, the model itself should not be used to determine the relevant comparative performance measures.

All **models** are **simplifications of reality**. If this were not the case, their **usefulness** would be diminished. Therefore, it is critical to determine how well they represent reality.

... what the French call a ***problématique*** and I call a ***mess*** ... is a **complex** and highly **dynamic system of interacting problems**.

Problems are elements abstracted from messes; therefore, problems are to messes what atoms are to planets. There is an important systems principle, familiar to all of you, that applies to messes and problems: that **the sum of the optimal solutions to each component problem considered separately is not an optimal solution to the mess**. This follows from the fact that the behavior of the mess depends more on how the solutions to its component problems interact than on how they act independently of each other.

The treatment of messes requires **more than problem solving**; it requires planning. Planning should consist of the design of a desirable future and invention or selection of ways of getting there. Therefore, it is **more** a matter of **synthesis**, of **design** and **invention** than it is of analysis, of programming and budgeting.

Ackoff, Russell L. 1977. "Optimization + Objectivity = Optout." *European Journal of Operational Research* 1 (1): 1–7.
[https://doi.org/10.1016/S0377-2217\(77\)81003-5](https://doi.org/10.1016/S0377-2217(77)81003-5).

Dealing with the mess by (i) resolving, (ii) solving; (iii) dissolving; or (iv) absolving?

Resolving to a prior

Resolution is an experientially based (clinical) process based on qualitative judgments and common sense.

It looks for “satisficing” outcomes, ones that are good enough, not necessarily optimal.

Problem resolving has been and still is the principal method used by managers to deal with problems.

Solving for the optimal

Problem solution involves analysis, research employing quantitative methods seeking optimal outcomes.

Unfortunately, as conditions change, problems frequently do not remain solved or resolved but reappear, and usually in more complex forms.

Furthermore, every solution and resolution generates new problems, ones that tend to be more complex than the ones solved or resolved.

Dissolving to eliminate

Problem dissolution consists of redesign of the system that has the problem or its environment in such a way as to eliminate the problem, precluding the possibility of its reappearance.

Design is to synthetic thinking what scientific research is to analytic thinking.

Absolving (to nature?)

Absolution occurs when a problem is ignored with the hope that it will solve itself or fade away.

Problem resolution always absolves itself from some aspects of problems in order to “cut it down to size”, to simplify it.

Problem solution always involves resolving and absolving some aspects of the problem that do not lend themselves to quantification.

Supply-side sustainability manages systems from their context

We will achieve **sustainability** when it becomes a **transparent outcome** of managing the contexts of production and consumption rather than the consumption itself. If we shift our management emphases to **managing from the context for whole ecosystem functions, rather than for resources**, the cost of problem solving will diminish and the effectiveness of management greatly increase. When a manager **gets the context right, the ecosystem does the rest**. Because the material ecosystem supplies renewal resources and makes them renewable, we call our approach supply-side sustainability. [p. 14]

1	Manage for productive systems rather than for their outputs	..., understand the productive system as fully as possible and management for that. Sustainable outputs follow automatically, potentially at reduced management costs. [...] In criminology it would consist of alleviating the factors thought to generate crime rather than trying to fortify every house and business and incarcerate every offender. [p. 15]
2	Manage systems by managing their contexts	Any system is controlled one level up: by its context Management efforts are most effectively focused on on the system of interest ... but on the contexts that regulate such systems [p. 16]
3	Identify what dysfunctional systems lack and supply only that	To know precisely what ecosystems lack and provide only that takes research and monitoring on a variety of processes. It also takes managers who can ... understand a broad array of ecological phenomena, and who can comprehend both social and biophysical processes. [p. 19]
4	Deploy ecological processes to subsidize management efforts, rather than conversely	In this strategy, the management objective is subsidized by processes that are free and available whether we use them or not: ... [pp. 385-386] ... on the ecosystem criterion, managers should concentrate on energy flows rather than structures. [pp. 386-387]
5	Understand the problem of diminishing returns to problem solving	Human creativity in problem solving is often is constrained by the factors of complexity and costliness. The Roman Empire did not lack creativity or flexibility; it could not deploy them given its circumstances. [pp. 386-387]

Allen, Timothy F. H., Joseph A Tainter, and Thomas W. Hoekstra. 2003. *Supply-Side Sustainability*. New York: Columbia Univ Press.

Confusion as complex systems → networking thinking?

There is no generally accepted formal definition of “complex system”.

Informally, a complex system is a large network of relatively simple components with no central control, in which emergent complex behavior is exhibited.

Of course, the terms in this definition are not rigorously defined. “Relatively simple components” means that the individual components, or at least their functional roles in the system’s collective behavior, are simple with respect to that collective behavior. For example, a single neuron or a single ant are complicated entities in their own right. However, the functional role of these single entities in the context of an entire brain or an entire colony is relatively simple as compared with the behavior of the entire system.

“Emergent complex behavior” is tougher to define.

Roughly, the notion of emergence refers to the fact that the system’s global behavior is not only complex but arises from the collective actions of the simple components, and that the mapping from individual actions to collective behavior is non-trivial.

The notion of nonlinearity is important here: the whole is more than the sum of the parts. The complexity of the system’s global behavior is typically characterized in terms of the patterns it forms, the information processing that it accomplishes, and the degree to which this pattern formation and information processing are adaptive for the system—that is, increase its success in some evolutionary or competitive context. In characterizing behavior, complex-systems scientists use tools from a variety of disciplines, including nonlinear dynamics, information theory, computation theory, behavioral psychology, and evolutionary biology, among others.

The field of complex systems seeks to explain and uncover common laws for the emergent, self-organizing behavior seen in complex systems across disciplines. Many scientists also believe that the discovery of such general principles will be essential for creating artificial life and artificial intelligence.

Complex systems, as their name implies, are typically hard to understand.

Traditionally the more mathematically oriented sciences such as physics, chemistry, and mathematical biology have **concentrated on simpler model systems that are more tractable via mathematics.**

The rise of interest in understanding general properties of complex systems has paralleled the rise of the computer, because the computer has made it possible for the first time in history to make more accurate models of complex systems in nature.

Source: Melanie Mitchell. 2006. “Complex Systems: Network Thinking.” *Artificial Intelligence* 170 (18): 1194–1212. doi:10.1016/j.artint.2006.10.002. Also as Working Paper. Santa Fe Institute. <http://www.santafe.edu/research/working-papers/abstract/986548948d2c660564b407678933664d/>

Complicated systems are rare; complex systems are the norm

The following is possibly the golden rule for distinguishing 'complex' from 'complicated' problems and systems.

Complicated problems

originate from **causes** that can be **individually distinguished**; they can be **addressed piece-by-piece**; for **each input** to the system there is a **proportionate output**; the relevant systems can be **controlled** and the problems they present admit **permanent solutions**.

... complex problems and systems

result from networks of **multiple interacting causes** that cannot be individually distinguished; must be **addressed as entire systems**, that is they cannot be addressed in a piecemeal way; they are such that **small inputs** may result in **disproportionate effects**; the problems they present **cannot be solved once and for ever**, but require to be systematically managed and typically **any intervention merges into new problems** as a result of the interventions dealing with them; and the **relevant systems cannot be controlled** ...

... decision-makers ask their consultants ... to **treat complex problems as if they were complicated** ones. Complexity and the nature of contemporary science show that the claim to 'solve' (complex) problems is often ungrounded. **'Learning to dance'** with a complex system is definitely **different from 'solving' the problems** arising from it.

Architecting and designing? Landscape and taskscape?

As a **noun**, **design** is the named (although sometimes unnamable) **structure or behavior** of an system whose presence resolves or contributes to the **resolution** of a force or **forces** on that system. [...]

As a **verb**, **design** is the activity of **making such decisions**. Given a large set of **forces**, a relatively malleable set of **materials**, and a large **landscape** upon which to play, the resulting **decision space** may be large and complex. [...]

All architecture is design but not all design is architecture.

Booch, Grady. 2006. "On Design." *Software Architecture, Software Engineering, and Renaissance Jazz* (blog). March 2, 2006. https://web.archive.org/web/20160213001803/https://www.ibm.com/developerworks/community/blogs/gradybooch/entry/on_design.

Architectural thinking as shaping the structure of the environment ...

The landscape is **not 'space'**.

... the **landscape** is the **world** as it is known to those who **dwell therein**, who **inhabit** its places and **journey** along the paths connecting them.

[**Temporality**] is **not chronology** ... and it is **not history** I shall adopt the term '**task**', defined as **any practical operation**, carried out by a **skilled agent in an environment**, as part of his or her **normal business of life**.

It is to the entire **ensemble of tasks**, in their **mutual interlocking**, that I refer by the concept of **taskscape**.

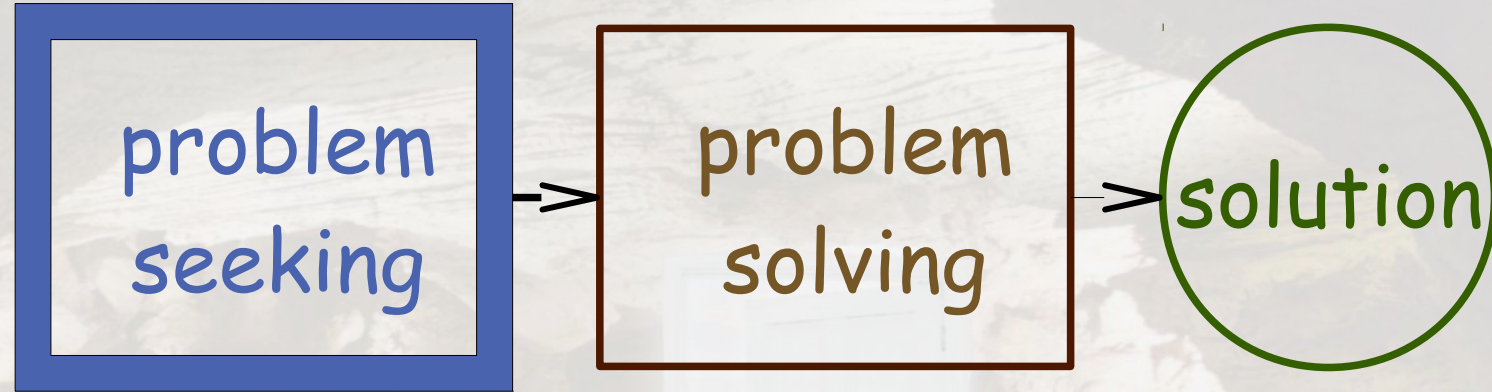
Design thinking as divergent steps (i.e. creating choices) and convergent steps (i.e. making choices)

Ingold, Tim. 2000. "The Temporality of the Landscape." In *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*, 189–208. Routledge.

In 1969, problem seeking was *architectural programming*, and problem solving was *design*

Programming is a specialized and often misunderstood term. It is “a *statement of an architectural problem* and the requirements to be met in offering a solution. While the term is used with other descriptive adjectives such as *computer programming*, *educational programming*, *functional programming*, etc., in this report, programming is used to refer only to architectural programming.

Why programming? The client has a project with many unidentified sub-problems. The architect must define the client's total problem.



Design is problem solving; programming is problem seeking.

The end of the programming process is a statement of the total problem; such a statement is the element that joins programming and design. The “total problem” then serves to point up constituent problems, in terms of four considerations, those of form, function, economy and time.

The aim of the programming is to provide a sound basis for effective design. The State of the Problem represents the essence and the uniqueness of the project. Furthermore, it suggests the solution to the problem by defining the main issues and giving direction to the designer (Pena and Focke 1969, 3).

Rittel's approach was IBIS: Issues-Based Information Systems

Issue-Based Information Systems (IBIS) are meant to support coordination and planning of political decision processes.

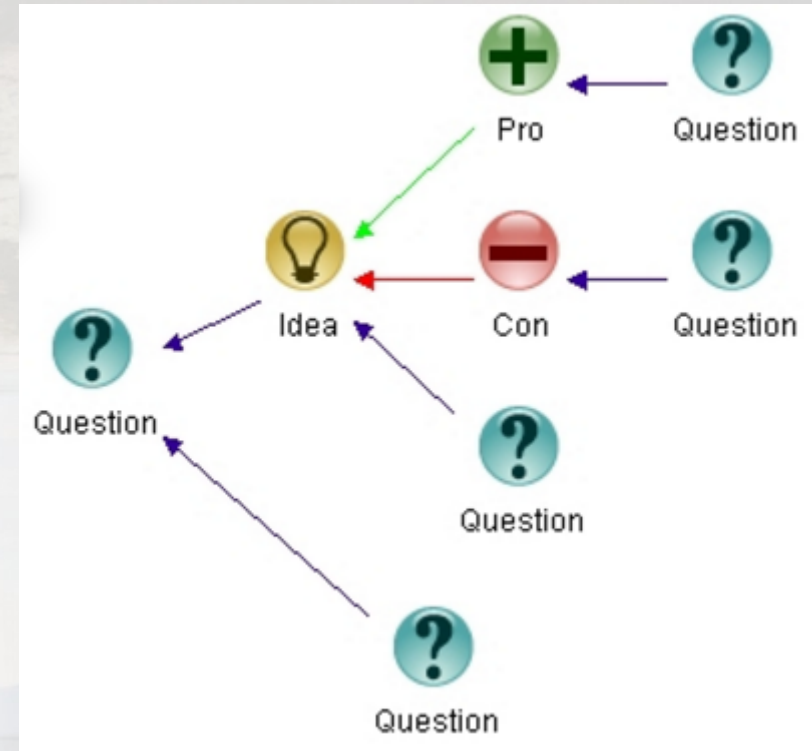
• IBIS guides the ...

- **identification**,
- **structuring** and
- **settling** of issues

raised by problem-solving groups, and provides information pertinent to the discourse.

Elements of the system are

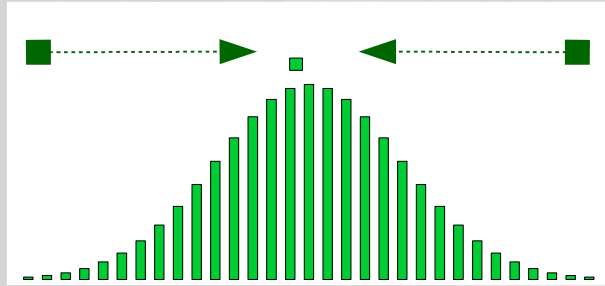
- **topics**,
- **issues**,
- **questions of fact**,
- **positions**,
- **arguments**, and
- **model problems**.



Werner Kunz and Horst WJ Rittel. 1970. *Issues as Elements of Information Systems*. Vol. 131. Institute of Urban and Regional Development, University of California, Berkeley.

An inquiring system is a way of knowing for human beings

Inductive-Consensual IS: The first way (on *objective* views)



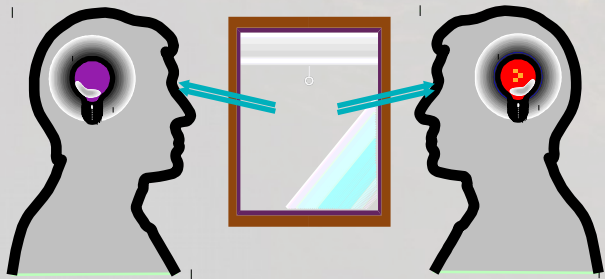
guarantor =
agreement
(consensus)
e.g. Delphi
approach

Analytic-Deductive IS: The second way (on *objective* views)

guarantor =
**logical
consistency**
(fact nets)
e.g. the “best
man” for the job

Objective	Rank	9
Agreed Criteria	Scorecard	
a. attribute	a. attribute	9
b. attribute	b. attribute	7
c. attribute	c. attribute	6

Multiple Realities IS: The third way (on *subjective* views)



model + data as inseparable whole

guarantor =
**ability to see
range of views**
(representations)
e.g. disciplinary
views of drug
problem

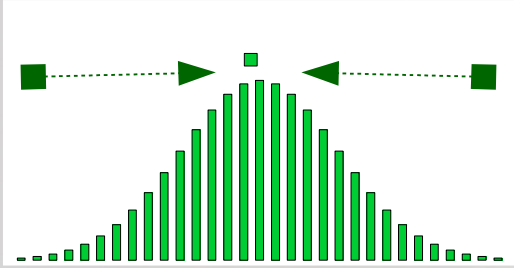
Dialectic IS: The fourth way (on *subjective* views)

guarantor =
conflict
e.g. challenging
assumptions of what
skid row housing
should be



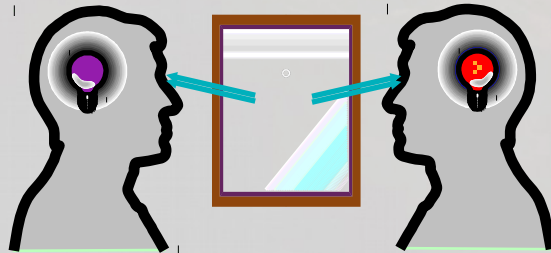
A systems approach sweeps in across 4 modes of knowing

John Locke (1632-1704)



Gottfried Wilhelm Leibniz (1646-1712)

Objective	Rank	9
Agreed Criteria	Scorecard	
a. attribute	a. attribute	9
b. attribute	b. attribute	7
c. attribute	c. attribute	6



Immanuel Kant (1725-1804)



Georg Wilhelm Friedrich Hegel (1770-1831)

The fifth way of knowing
Systems Approach
(with multiple perspectives)
guarantor = **progress**
(sweeping-in process)

Edgar Arthur Singer (1973-1954)

C. West Churchman (1913-2004)

Mitroff, Ian I., and Harold A. Linstone. 1993. *The Unbounded Mind: Breaking the chains of traditional business thinking*. Oxford University Press.

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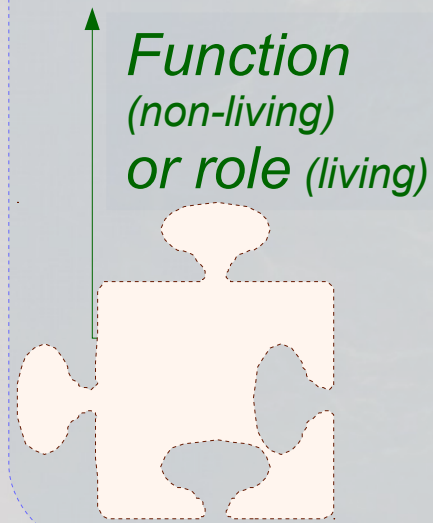
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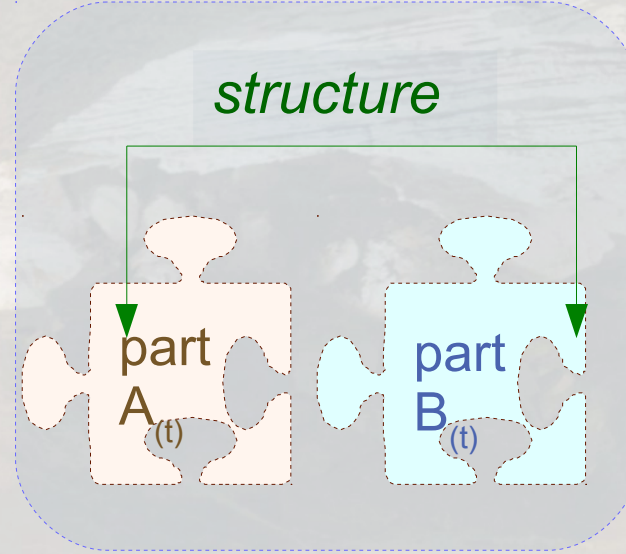
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- a. Parts, wholes and their relations
 - b. Synthesis before analysis
 - c. Facilitating (first order) c.f. Participating (second order)
 - d. High gain ~ efficiency / collapse c.f. Low gain ~ sustainability
 - e. (De-)complicating c.f. (De-)complexifying

Systems thinking is a perspective on wholes, parts and their relations

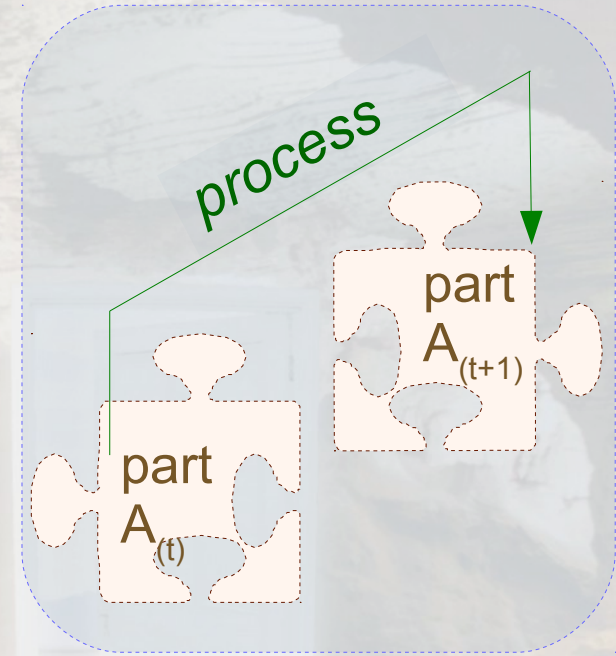
containing
whole



Function
“contribution of the
part to the whole”



Structure
“arrangement in
space”

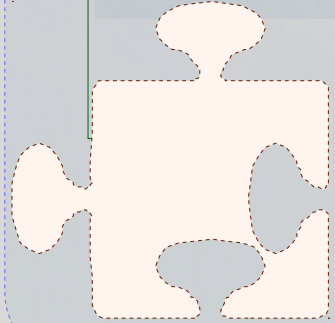


Process
“arrangement in
time”

In authentic systems thinking, synthesis precedes analysis and the containing whole is appreciated

containing
whole

Function
(non-living)
or *role* (living)








Synthesis precedes analysis

1. Identify a **containing whole** (system) of which the **thing to be explained** is a part.
2. Explain the **behavior or properties** of the **containing whole**
3. Then explain the **behavior or properties** of the **thing to the explained** in terms of its **role(s) or function(s)** within its containing whole.

Source: Ackoff, Russell L. 1981. *Creating the Corporate Future: Plan or Be Planned For*. New York: John Wiley and Sons. <http://books.google.com/books?id=8EEO2L4cApsC>.

Types of systems can be categorized by purposefulness

<i>Systems and models</i>	<i>Parts</i>	<i>Wholes</i>
Deterministic	Not purposeful	Not purposeful
Animated	Not purposeful	Purposeful
Social	Purposeful 	Purposeful 
Ecological	Purposeful  	Not purposeful 
Purposive == goal-seeking	<i>Goals:</i> those ends that we can expect to attain within the period covered by planning.	
	<i>Objectives:</i> those ends that we do not expect to attain within the period planned for but which we hope to attain later, and toward which we believe progress is possible within the period planned for.	
Purposeful == ideal-seeking	<i>Ideals:</i> those ends that are believed to be unattainable but towards which we believe progress is possible during and after the period planned for.	

Ackoff, Russell L., and Jamshid Gharajedaghi. 1996. "Reflections on Systems and Their Models." *Systems Research* 13 (1): 13–23. [https://doi.org/10.1002/\(SICI\)1099-1735\(199603\)13:1<13::AID-SRES66>3.0.CO;2-O](https://doi.org/10.1002/(SICI)1099-1735(199603)13:1<13::AID-SRES66>3.0.CO;2-O).

Definitions of First and Second Order Cybernetics

<i>Author</i>	<i>First Order Cybernetics</i>	<i>Second Order Cybernetics</i>
Von Foerster	The cybernetics of observed systems	The cybernetics of observing systems
Pask	The purpose of a model	The purpose of a modeler
Varela	Controlled systems	Autonomous systems
Umpleby	Interaction among the variables in a system	Interaction between observer and observed
Umpleby	Theories of social systems	Theories of interaction between ideas and society

Stuart Umpleby | Second Order Cybernetics Then and Now | 2013 at <https://www2.gwu.edu/~umpleby/recent.html>

Collapse, resilience, sustainability, regeneration

Collapse

A society has **collapsed** when it displays a **rapid, significant loss** of an established level of **sociopolitical complexity**. [....]

Losses that are less severe, or take longer to occur, are to be considered cases of weakness and decline.

[Tainter 1990]

Resilience

[**Engineering resilience** means] stability near an equilibrium steady state, ... resistance to disturbance and **speed of return to the equilibrium** are used to measure the property. [...]

[**Ecological resilience** means] conditions far from any equilibrium steady state, ... **instabilities can flip a system into another regime of behavior** ... to another stability domain

[Holling 1996]

Sustainability

"Of what, for whom, for how long, and at what cost?" ... sustainability as maintaining, or fostering the development of **systemic contexts** that produce the goods, services and amenities that people need or value, at an acceptable cost, for as long as they are needed or valued.

[Allen, Tainter and Hoekstra 2003]

Regeneration

... regenerative systems tend to follow a **strategy of dispersal, or spreading out over the landscape**, combined with some degree of augmentation. [....]

Whatever the means used, sustainability requires that the basic processes not be exploited beyond their **capacity for renewal**.

[Lyle 1996]

Complexity in social systems refers to *differentiation and organization* or to *increasing organization*



[Contrast] between a social unit that was simple, in an anthropological sense, and one that is much more complex.

[... The] Dominguez Ruin, a small pueblo ruin of the twelfth century A.D. in what is now southwestern Colorado. The structure is **small, simple, and undifferentiated**, reflecting the group that produced it.



[... The] Anasazi Heritage Center, where the remains of the prehistoric people are stored and studied. It is many times the the size of the small pueblo, and requires a permanent staff and a fleet of vehicles. The staff is **hierarchically organized and differentiated by specialization**. The center's existence is authorized by the federal government, which provides the funds it needs. The energy needed to heat and cool the building may well exceed what the entire prehistoric community consumed when the Dominguez Ruin was occupied.

Source: Timothy F. H. Allen, Joseph A Tainter, and Thomas W. Hoekstra. 2003. *Supply-Side Sustainability*. Columbia Univ Press.

The two structures reflect societies that are vastly **differentiated** not only in **scale**, but also in **complexity**. [p. 62]

Images: James Q. Jacob, Southwest Anthropology and Archaeology Pages (2013), <http://www.jqjacobs.net/southwest/anasazi.html>

High gain \leftrightarrow greater efficiency; low gain \leftrightarrow greater sustainability

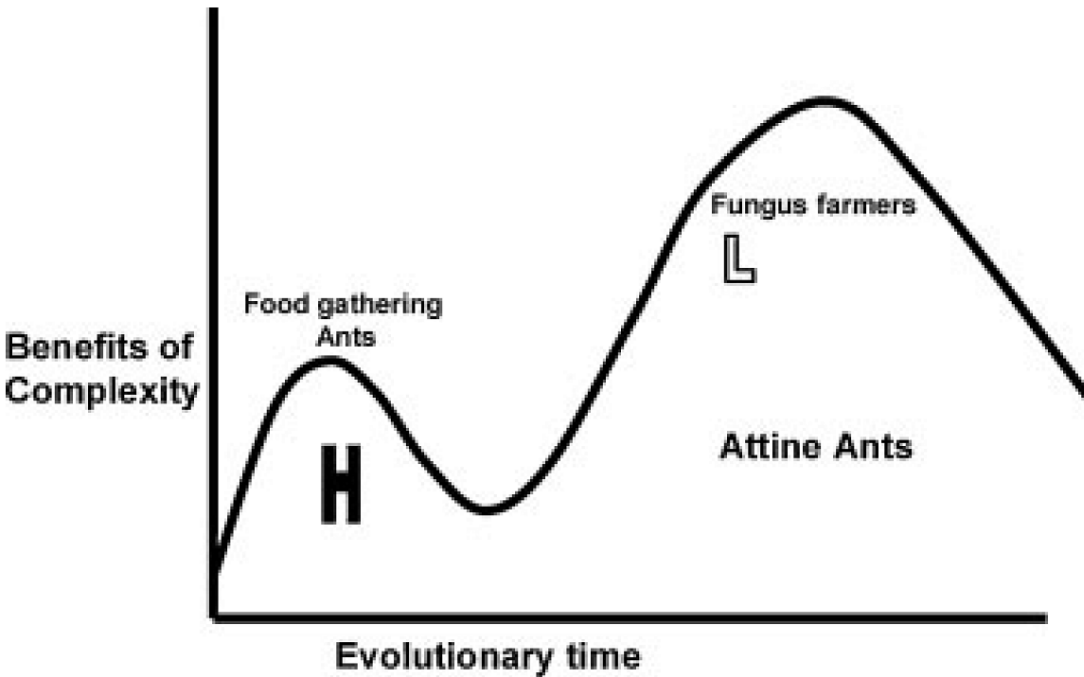


Figure 3. Most ants simply gather food directly and this might be characterized as high gain. The material that is used as fuel is simply gathered ... But then there are the Attine ants, a complex of 12 related genera that gather some non-food resource, and then grow fungus upon it. Attine ants then eat the fungus in a low gain system of nutrition. [...]
The transition to fungus farming will have started as eating fungus in the environment, but as farming fungi emerged there was an abandonment of high gain harvesting of wild fungus, as a new cycle of low gain emerged as fungus farming.

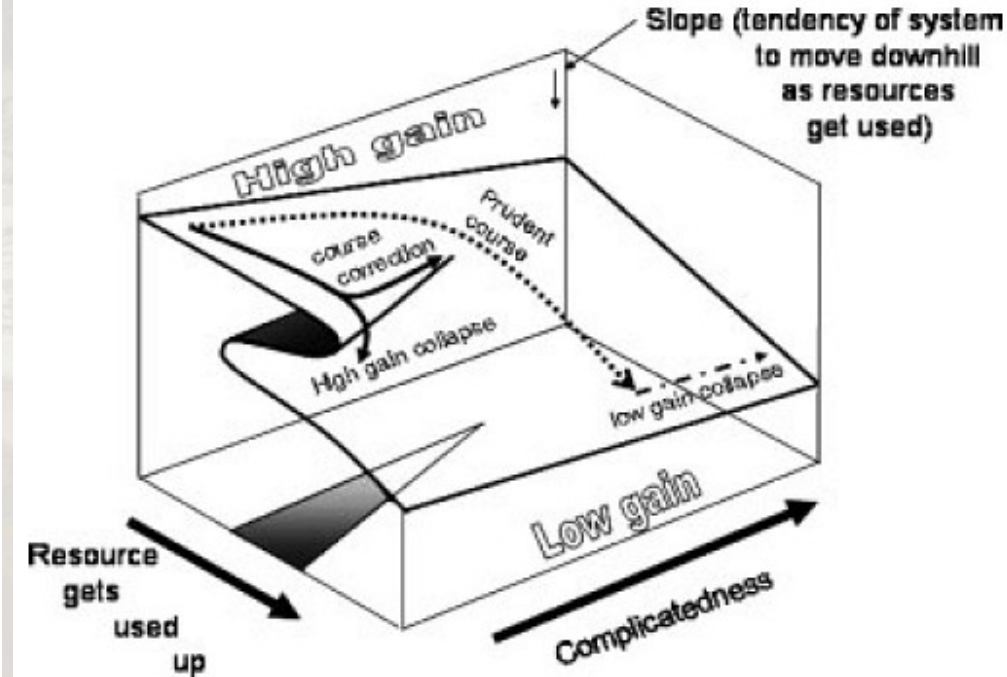


Figure 7. A representation of the tracks that lead from high to low to super low gain patterns. There are three points on the track where there is either a move to the next type of gain or collapse. The prudent course is never taken, since high gain keeps on using resources until it is under pressure to change course. Resistance to join the prudent track is the phenomenon of Jevon's paradox ... where increases in efficiency are simply rolled into the high gain degradation of the resource gradient. If it does not change course the high gain system falls over the catastrophe cusp.

Allen, Timothy F. H., Peter C. Allen, Amy Malek, John Flynn, and Michael Flynn. 2009. "Confronting Economic Profit with Hierarchy Theory: The Concept of Gain in Ecology." *Systems Research and Behavioral Science* 26 (5): 583–99. <https://doi.org/10.1002/sres.998>.

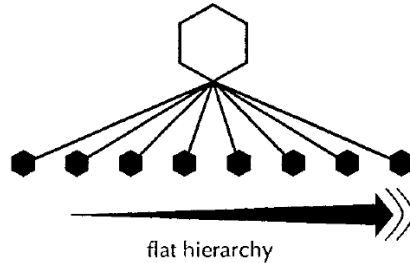
Complexity ← elaboration of organization, complicatedness ← elaboration of structure

Allen, Timothy F. H., Joseph A. Tainter, and Thomas W. Hoekstra. 1999. "Supply-Side Sustainability." *Systems Research and Behavioral Science* 16 (5): 403–27.
[https://doi.org/10.1002/\(SICI\)1099-1743\(1999/10\)16:5<403::AID-SRES335>3.0.CO;2-R](https://doi.org/10.1002/(SICI)1099-1743(1999/10)16:5<403::AID-SRES335>3.0.CO;2-R)

Horizontal Differentiation

Elaboration of structure

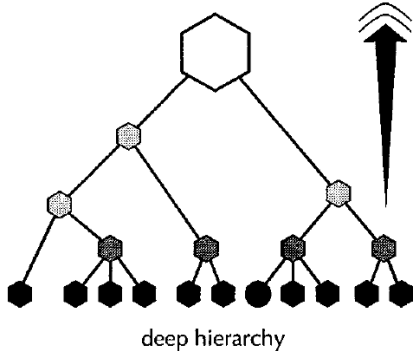
solves problems and moves on to the next problem, leaving structure behind. Evolution makes COMPLICATED structure that is difficult to control, predict, or mend. It causes horizontal differentiation.



Vertical Differentiation

Elaboration of organization

creates energy dissipative far from equilibrium structures. It causes COMPLEX structure with many levels. Behavior becomes simple but energetic cost is high. Emergence causes vertical differentiation.



Complexity

Elaboration of organization

Behavior gets simpler

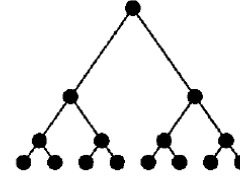
Hierarchy gets deeper

- Hierarchical complexity

- Spectral complexity

- Elaboration across scales

- Increased certainty from samples



Complicatedness

Elaboration of structure

Behavior gets more complicated

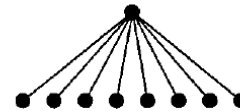
Hierarchy gets flatter

More degrees of freedom

- Diversity

- Graph theoretic connectedness

- Information theory–Uncertainty



Behavior

Becomes more elaborate

e.g. Chaotic or Random

- Algorithmic complexity

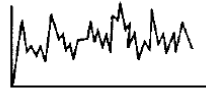


Figure 3. The top hierarchy shows increases in complicatedness by increasing the structural elaboration. Structural elaboration is portrayed as widening the span in horizontal differentiation. The bottom hierarchy shows increasing complexity, by an elaboration of organization. New levels appear as new constraints emerge as limits to the positive feedbacks of the emergent process. Elaboration or organization increases hierarchical depth

Figure 5. The measures of structurally, organizationally or behavioral elaboration are next to bullets beneath the system in question, while the characteristics of the system are listed above the bulleted measures.

On the lower left of the figure is diagrammed a simple system that is only complicated. Complicatedness arises from elaborations of system structure, shown here as a wider span.

At the upper left is diagrammed a complex system with elaboration of constraints and organization shown by new levels in a hierarchy of greater depth.

At the middle right of the figure, the opposing effects of complexity and complicatedness are integrated in behavioral complexity

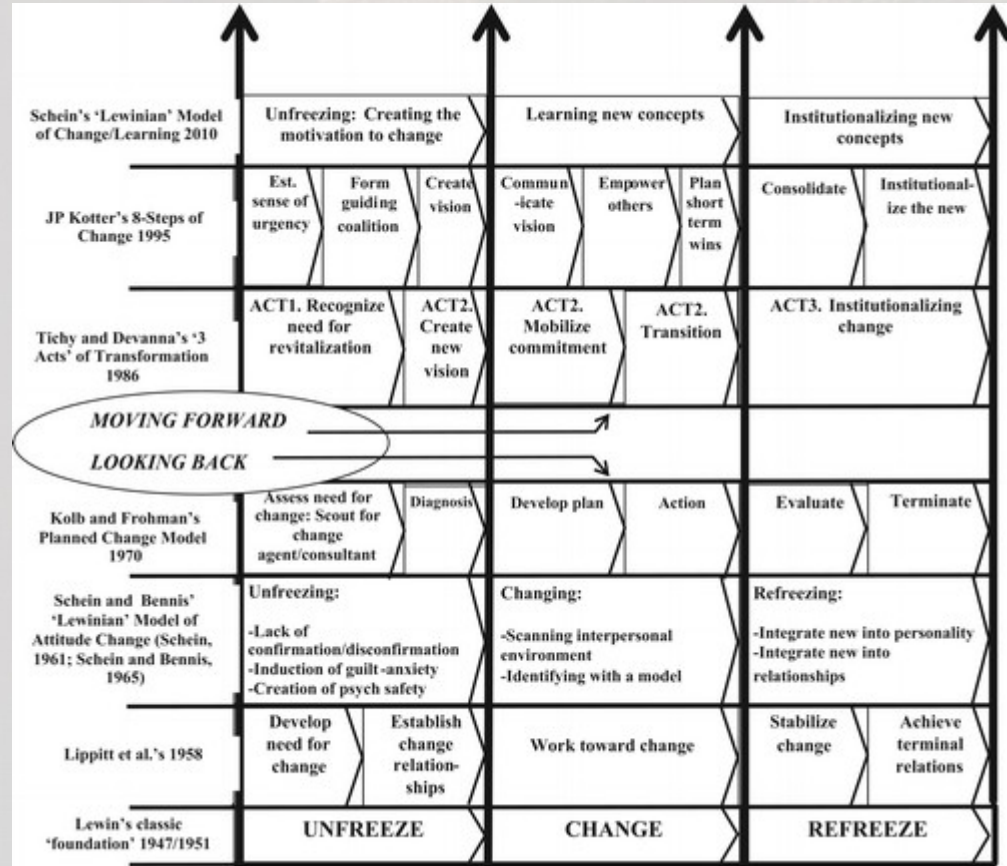
Agenda

1. Designing for tame problems c.f.
Architecting for wicked messes
 2. Analyzing the complicated c.f.
Synthesizing the complex
 3. Unfreeze-change-freeze c.f.
Co-responsive movement
 4. Planning (teleology) c.f.
Programming (teleonomy)
 5. Industrial value chain c.f.
Co-producing offerings
- a. Parts, wholes
and their relations
 - b. Synthesis before analysis
 - c. Facilitating (first order) c.f.
Participating (second order)
 - d. High gain ~ efficiency / collapse
c.f. Low gain ~ sustainability
 - e. (De-)complicating c.f.
(De-)complexifying

Agenda

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Co-producing offerings
 - a. Disruptive innovation theory c.f.
Innovation learning theory
(normative: learning-for,
learning-by, learning alongside)
 - b. Socio-Psychological Systems,
Socio-Technical Systems,
Socio-Ecological Systems
 - c. Causal texture theory
 - d. Pacing layers of change
 - e. Product-process change matrix
(dynamic stability)

In human systems, change as three steps started with Lewin (1947)



By going back and looking at what Lewin wrote (particularly the most commonly cited reference for CATS [Change As Three Steps], 'Lewin, 1947': the first article ever published in Human Relations published just weeks after Lewin's death), we see that **what we know** of CATS **today** is largely a **post hoc reconstruction**. [...]

Prior to the early 1980s, Lewin's CATS was largely unseen; by the end of the 1980s, despite the fact that its form was anomalous to what Lewin actually wrote or likely intended for the idea, it was the basis of our understanding of a fast growing field: change management. The **early seeds** of this formation may be discerned in the reception afforded CATS in the work of two key interpreters in the small but growing field of management studies: **Ronald Lippitt** and **Edgar Schein** in the 1950s and 1960s.

Cummings, Stephen, Todd Bridgman, and Kenneth G. Brown. 2016. "Unfreezing Change as Three Steps: Rethinking Kurt Lewin's Legacy for Change Management." *Human Relations* 69 (1): 33–60. <https://doi.org/10.1177/0018726715577707>.

Sustaining technologies improve the performance of established products; *disruptive technologies* are worse in the near term

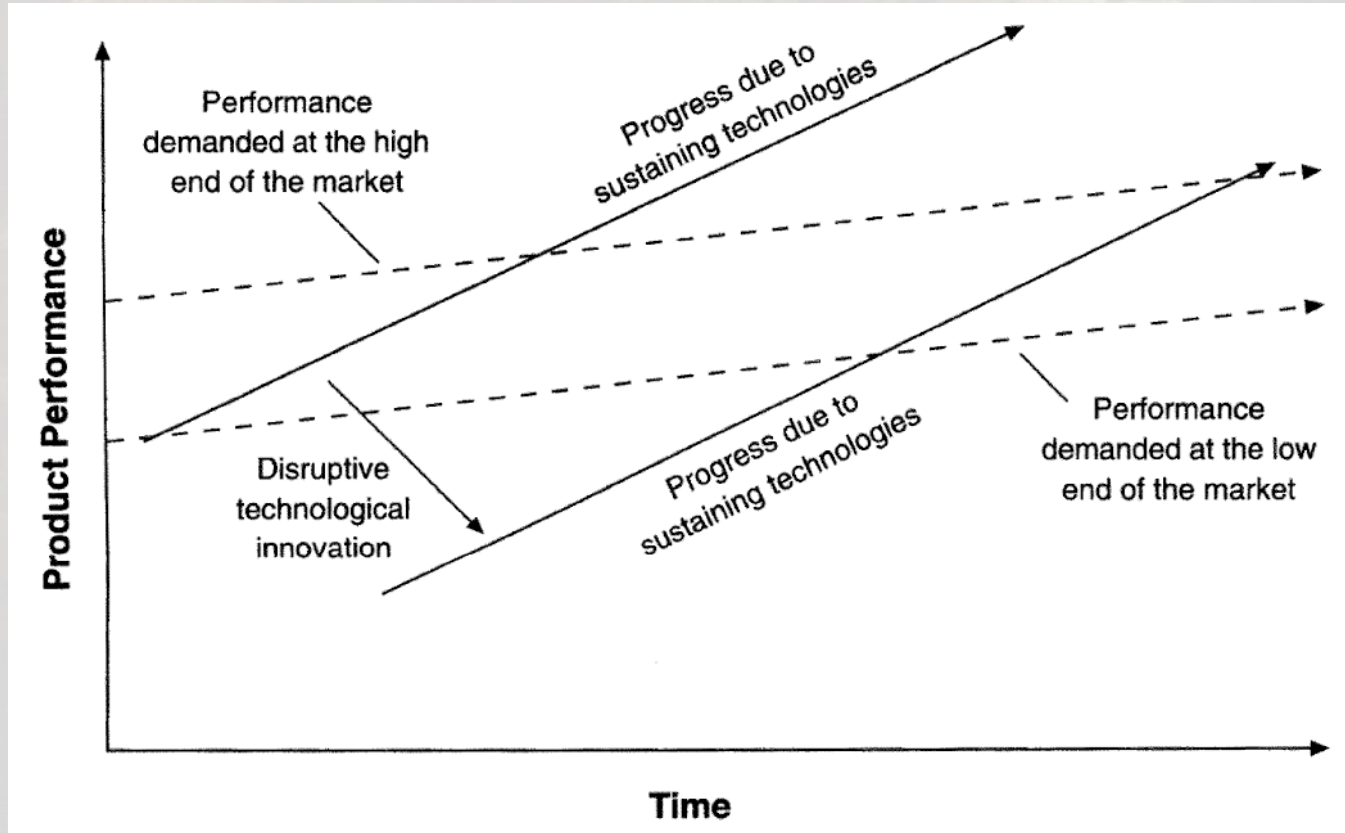


Figure 11: The Impact of Sustaining and Disruptive Technological Change

Christensen, Clayton M. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Press.

In the 21st century, the *nature of innovation* is increasingly...

Open

Collaborative

Multidisciplinary

Global

“Innovation as open, collaborative, multidisciplinary, global” | June 13, 2008 at
<http://coevolving.com/blogs/index.php/archive/innovation-as-open-collaborative-multidisciplinary-global/>

An inferred shift from *Industrial Age innovation* educates

Industrial Age

Private

methods and development
enabling autonomous control
over designs

Transactional

production chains linked by
inter-organizational contracting

Analytical
problem-solving

Colonial
trade

strategy

relationship

method

economics

21st Century

Open

standards and interfaces leveraging
expedient platforms for advancing
design

Collaborative

alliances coproducing accelerated
learning

Multidisciplinary
conversations

Global
talent

"Innovation as open, collaborative, multidisciplinary, global" | June 13, 2008 at
<http://coevolving.com/blogs/index.php/archive/innovation-as-open-collaborative-multidisciplinary-global/>

Human lifelines co-respond in a theory of (i) habit, (ii) agencing, and (iii) attentionality



Habit, rather than volition:

I become my walking, and that my walking walks me. I am there, inside of it, animated by its rhythm. And with every step I am not so much changed as modified, in the sense not of transition from one state to another but of perpetual renewal. [p. 16]

Agencing, rather than agency:

Interaction goes back and forth as agents, facing each other on opposite banks of the river, trade messages, missiles, and merchandise. But to *correspond*, in my terms, is to join with the swimmer in the midstream. It is a matter not of taking sides but of going along. [p. 18]

Attentionality, rather than intentionality:

Walking calls for the pedestrian's continual responsiveness to the terrain, the path, and the elements. To respond, he must attend to these things as he goes along, joining or participating with them in his own movements. [p. 19]

Ingold, Tim. 2017. "On Human Correspondence." *Journal of the Royal Anthropological Institute* 23 (1):9–27. <https://doi.org/10.1111/1467-9655.12541>.

"Holding Hands" CC BY RichardBH at <https://www.flickr.com/photos/rbh/9580659326/>

Tavistock Institute: Socio-Psychological Systems, Socio-Technical Systems, Socio-Ecological Systems Perspectives

[... the] **socio-psychological, the socio-technical and the socio-ecological perspectives** ... emerged from each other in relation to changes taking place in the wider social environment. One could not have been forecast from the others. Though **interdependent**, each has its own focus. Many of the more complex projects require all three perspectives. [Trist & Murray 1997, p. 30]

Socio-Psychological

... in Institute projects, the **psychological forces** are are directed **towards the social field**, whereas in the the Clinic, it is the other way around [with social forces directed toward the psychological field].

[Trist & Murray 1997, p. 31]

Socio-Technical

... the best **match** between the **social and technical systems** of an organization, since called the principle of joint optimization
... the second design principle, the **redundancy of functions**, as contrasted with the **redundancy of parts**.

[Trist & Murray 1997, p. 32]

Socio-Ecological

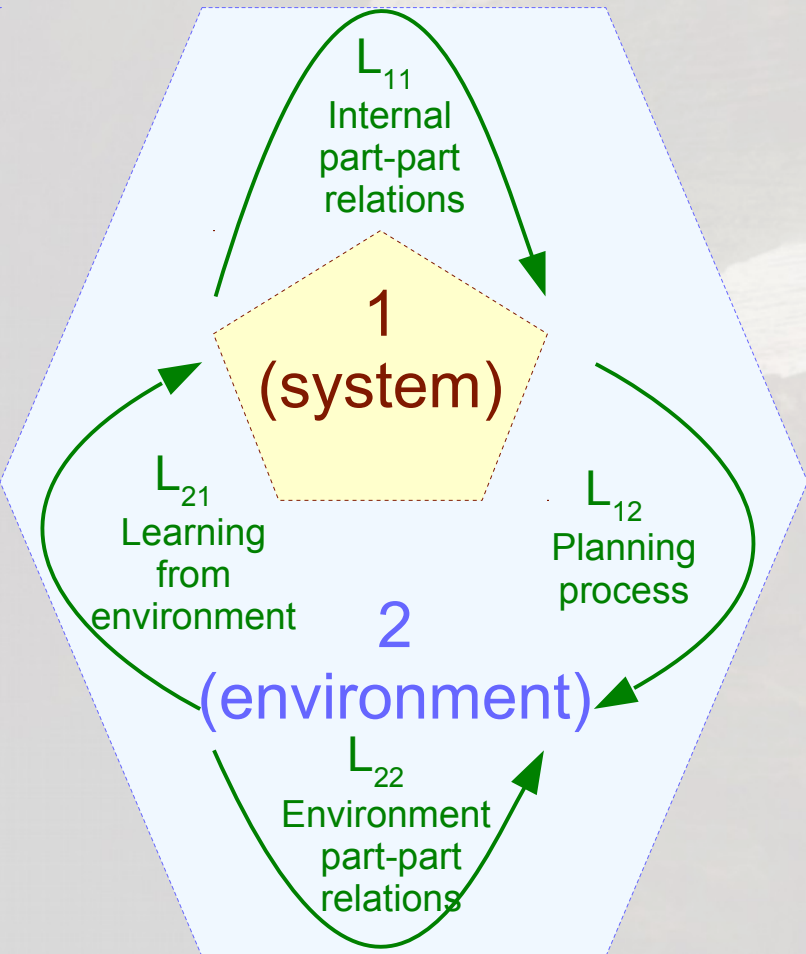
... ... the context of the **increasing levels of interdependence, complexity and uncertainty** that characterize societies a the present time.




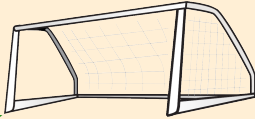



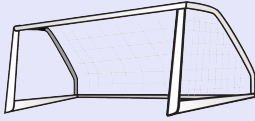
... new problems related to emergent values such as cooperation and nurturance.

[Trist & Murray 1997, p. 33]

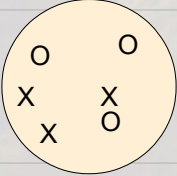
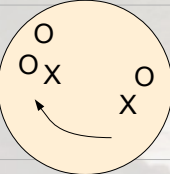
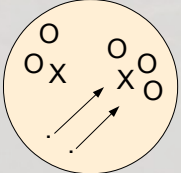
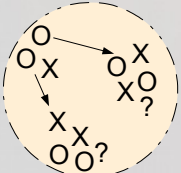
Trist, Eric L., and Hugh Murray. 1997. "Historical Overview: The Foundation and Development of the Tavistock Institute to 1989." In *The Social Engagement of Social Science: The Socio-Ecological Perspective*, edited by Eric L. Trist, Frederick Edmund Emery, and Hugh Murray, 3:1–35. Philadelphia: University of Pennsylvania Press.

Open systems (Emery and Trist), directive correlation (Sommerhoff)



t_0 player sees ball	t_k player kicks ball	end
Case (a): Action adapted to ball		
 Ball ₀	 Action _k  Ball _k	 Goal
Case (b): Ball is adapted to action		
 Action ₀	 Action _k  Ball _k	 Goal

The Causal Texture of Social Environments – Extended fields of directive correlations (Emery and Trist)

	Where O = goals (goodies), X = noxiants (baddes)		Elements to know	Ideals	Forms of learning	Forms of planning
Type 1. Random Placid		Goals and noxiants randomly distributed. Strategy is tactic. "Grab it if it's there". Largely theoretical of micro, design, e.g. concentration camps, conditioning experiments. Nature is not random.	system	Homonymy – sense of belonging	conditioning	tactics
Type 2. Clustered Placid		Goals and noxiants are lawfully distributed – meaningful learning. Simple strategy – maximize goals, e.g. use fire to produce new grass. Most of human span spent in this form. Hunting, gathering, small village. What people mean by the "good old days".	system, action	Nurturance – caring for	meaningful	tactics / strategies
Type 3. Disturbed Reactive		Type 2 with two or more systems of one kind <i>competing</i> for the same resources. Operational planning emerges to out-maneuvre the competition. Requires extra knowledge of both Ss and E. E is stable so start with a set of givens and concentrate on problem solving for win-lose games. Need to create instruments that are variety-reducing (foolproof) – elements must be standardized and interchangeable. Birth of bureaucratic structures where people are redundant parts. Concentrate power at the top – strategy becomes a power game.	system, action, learning	Humanity – in broadest sense	problem solving	tactics / operational strategies
Type 4. Turbulent		Dynamic, not placid/stable. Planned change in type 3 triggers off unexpected social processes. Dynamism arises from the field itself, creating unpredictability and increasing <i>relevant uncertainty</i> and <i>its continuities</i> . Linear planning impossible, e.g. whaling disrupted reproduction, people react to being treated as parts of machine. Birth of open systems thinking, ecology, and catastrophe theory.	system, action, learning, environment	Beauty – includes fitting together naturally	puzzle- solving	active adaptive planning

Normative theory defines “what causes the outcome of interest”

J PROD INNOV MANAG 2006;23:39–55
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THE JOURNAL OF
PRODUCT
INNOVATION
MANAGEMENT

The Ongoing Process of Building a Theory of Disruption

Clayton M. Christensen

The easiest way to respond to the critiques and complements the other authors in this issue have written about the model of disruption would simply be to address them head on—to accept some as useful additions or corrections and to suggest that others are ill-founded. Because this special issue of *JPIM* represents a unique opportunity to examine the process of theory-building as it unfolds, however, this article is structured in a way that addresses the other scholars' suggestions in the context of a model of the process by which theory is built and improved. My hope in doing so is that this issue might not just be an examination of this particular theory of disruptive innovation but that it might also constitute a case study about theory-building itself—a study that can help scholars of management in different fields to conceptualize how the theory-building process is or is not at work in their domain—and how they might help the process work better.

A Model of the Theory-Building Process

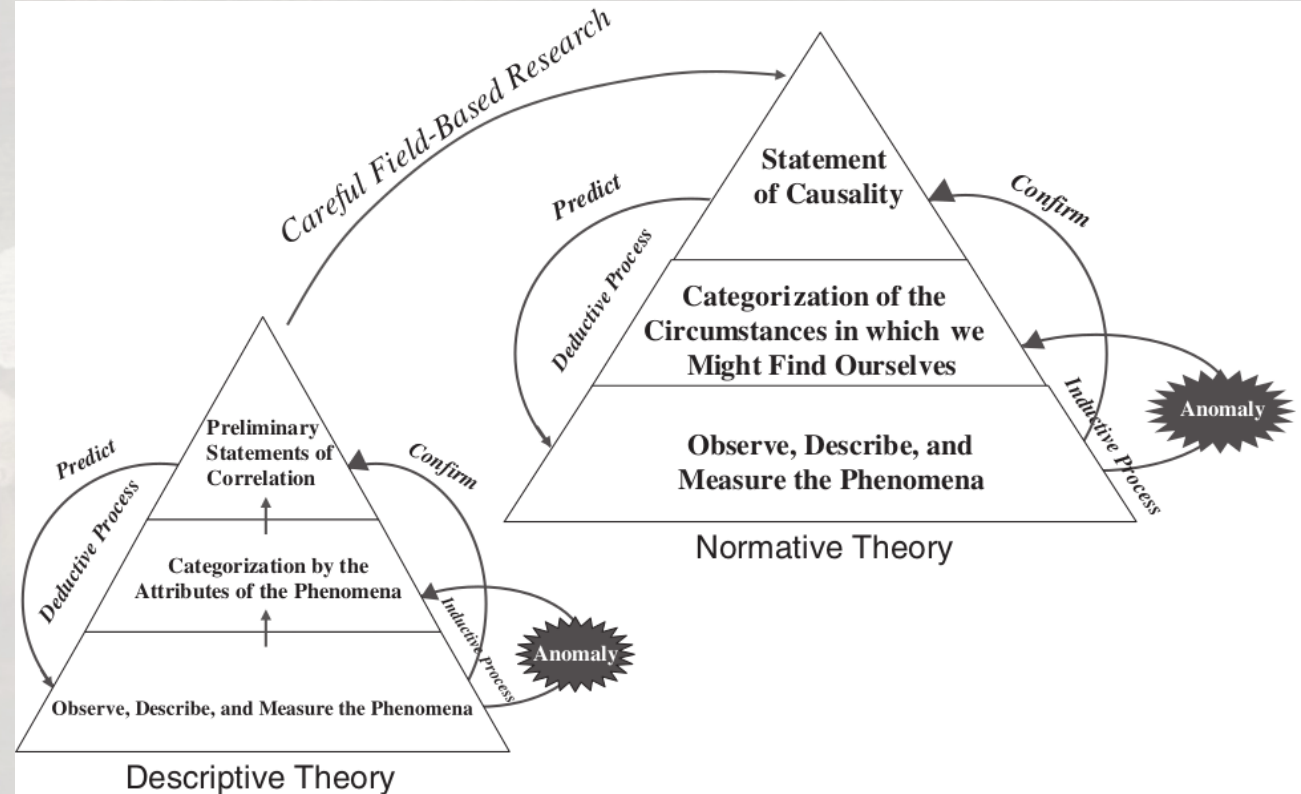
Some years ago in a doctoral seminar my students and I examined how communities of researchers in a variety of disciplines had cumulatively built bodies of understanding. Seeing some stunning commonalities in the processes these scholars had followed, we synthesized a model of the process of theory building (for a summary, see Carlile and Christensen, 2005). My students and I found this model extremely useful as we designed our own research, positioned our work within streams of prior researchers' efforts, and evaluated the reliability and validity of various papers. The present article recounts the development of the theory of disruption within the context of this model

of what theory is and how it is built. It also suggests how the comments of the other authors in the current issue of *JPIM* might contribute to the improvement of this body of theory. In this way, I hope that both the content of this theory and the process by which it is being built might become clearer.

Our model asserts that theory is built in two major stages: the descriptive stage and the normative stage. Within each of these stages, theory builders proceed through three steps. The theory-building process iterates through these three steps again and again. In the past, management researchers have quite carelessly applied the term *theory* to research activities pertaining to only one of these steps. Terms such as *utility theory* in economics and *contingency theory* in organization design, for example, actually refer only to an individual step in the theory-building process in their respective fields. It is more useful to think of the term *theory* as a body of understanding researchers build cumulatively as they iterate through each of the three steps in the descriptive and normative stages. This should be abundantly clear as we examine the theory of disruption. It already has evolved considerably as a growing group of scholars, including those whose work is published herein, have worked to refine it. Among the most notable improvements to date have been Adner and Zemsky (2003), Adner (2002), Gilbert (2001), Christensen and Raynor (2003), and Christensen, Anthony, and Roth (2004).

Building Descriptive Theory

The descriptive stage of theory building is a preliminary stage because researchers generally must pass through it before developing normative theory. The three steps researchers use to build descriptive theory are observation, categorization, and association.



- Descriptive theory produces “statements of correlation”.
- An “understanding of causality enables researchers to assert what actions managers ought to take to get the results they need”.

Address correspondence to: Clayton M. Christensen, Harvard Business School, Boston, MA 02163. E-mail: cchristensen@hbs.edu.

Normative theory on Innovation Learning may guide emerging cases

Innovation Learning with the rise of:

Polycentric Governance

- Deglobalization, Brexit, Trump presidency
- International innovation as:
 - i) complete concentration; or
 - ii) core-periphery concentration; or
 - iii) sequential dispersal; or
 - iv) modularized dispersal; or
 - v) inclusive dispersal.

Innovation Learning with the rise of:

The Internet of Things (IoT)

- Physical world interweaved with actuators, sensors + computational elements through network connectivity
- Smart cities
- Smart homes
- Smart grid
- Smart buildings
- Smart transportation
- Smart health
- Smart industry

Innovation Learning with the rise of:

Cognitive Computing (Intelligence Augmentation)

- An evolution from
 - mechanical tabulating era (1900s-1940s); to
 - digital programming era (1950s to present); to
 - cognitive era (2011, IBM Watson winning Jeopardy).
- Man-machine symbiosis in cooperative interaction
- Open AI
- Partnership on AI

Three *normative theory building* streams are alongside one *paradigm*

Paradigm:

Co-responsive movement

- Ecological anthropology: getting a grip on the larger world
- Material culture studies: artifacts with physicality + history with associated human beings

Theory building:
**Innovation
learning
for**

- Enskilling attentionality
- Episteme
(know why)

Theory building:
**Innovation
learning
by**

- Weaving flows in form-giving
- Techné
(know how)

Theory building:
**Innovation
learning
alongside**

- Agencing strands
- Phronesis
(know whom, when, where)

Innovation learning **for**: *enskilling attentionality* as 3 types

Paradigm:

Co-responsive movement

Theory building:

**Innovation
learning**

for

- Enskilling attentionality
- Episteme (know why)

Type: **Proto-learning**

- Selecting an alternative in context

Type: **Deutero-learning**

- Changing the set or sequence of alternatives in contextual change

Type: **Trito-learning**

- Changing systems of alternatives in meta-contextual change

Innovation learning **by**: *weaving flows in form-giving* as 3 types

Paradigm:

Co-responsive movement

Theory building:

**Innovation
learning**

by

- Weaving flows in form-giving
- **Techne**
(know how)

Type: **Learning-by-doing**

- Accumulating experience, in both organizational + personal senses

Type: **Learning-by-making**

- Constructing with sociomaterial creativity, in critical making

Type: **Learning-by-trying**

- Co-configuring architecturally + dialogically, social interaction + technology

Innovation learning alongside: agencing strands as 3 types

Paradigm:

Co-responsive movement

Theory building:

Innovation learning alongside

- Agencing strands
- Phronesis
(know whom, when, where)

Type: Polyrhythmia entangling
eurhythmia

- Experience in living beings

Type: Regenerating entangling
preserving

- Continuity in living nature vs. form

Type: Less-leading-to-more entangling
more-leading-to-more

- Increasing complicatedness or complexity

Lacking history to study organizational learning circa 1995, videos and a book explored *How Buildings Learn*



1. How Buildings Learn - Stewart Brand - 1 of 6 -...
26,610 views • 2 years ago



6. How Buildings Learn - Stewart Brand - 6 of 6 -...
10,888 views • 2 years ago



2. How Buildings Learn - Stewart Brand - 2 of 6 - 'T...
8,386 views • 2 years ago



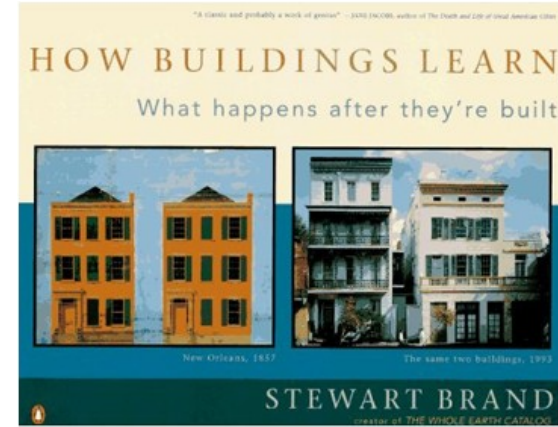
3. How Buildings Learn - Stewart Brand - 3 of 6 -...
7,432 views • 2 years ago



5. How Buildings Learn - Stewart Brand - 5 of 6 - 'T...
4,345 views • 2 years ago



The Oak Beams of New College, Oxford
1,967 views • 2 years ago



Pacing layers emphasize coevolution and learning

SITE

This is the geographical setting, the urban location, and the legally defined lot, whose boundaries outlast generations of ephemeral buildings. "Site is eternal", Duffy agrees.

STRUCTURE

The foundation and load-bearing elements are perilous and expensive to change, so people don't. These are the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

SKIN

Exterior surfaces now change every 20 years or so, to keep up with fashion or technology, or for wholesale repair. Recent focus on energy costs has led to re-engineered skins that are air-tight and better-insulated.

SERVICES

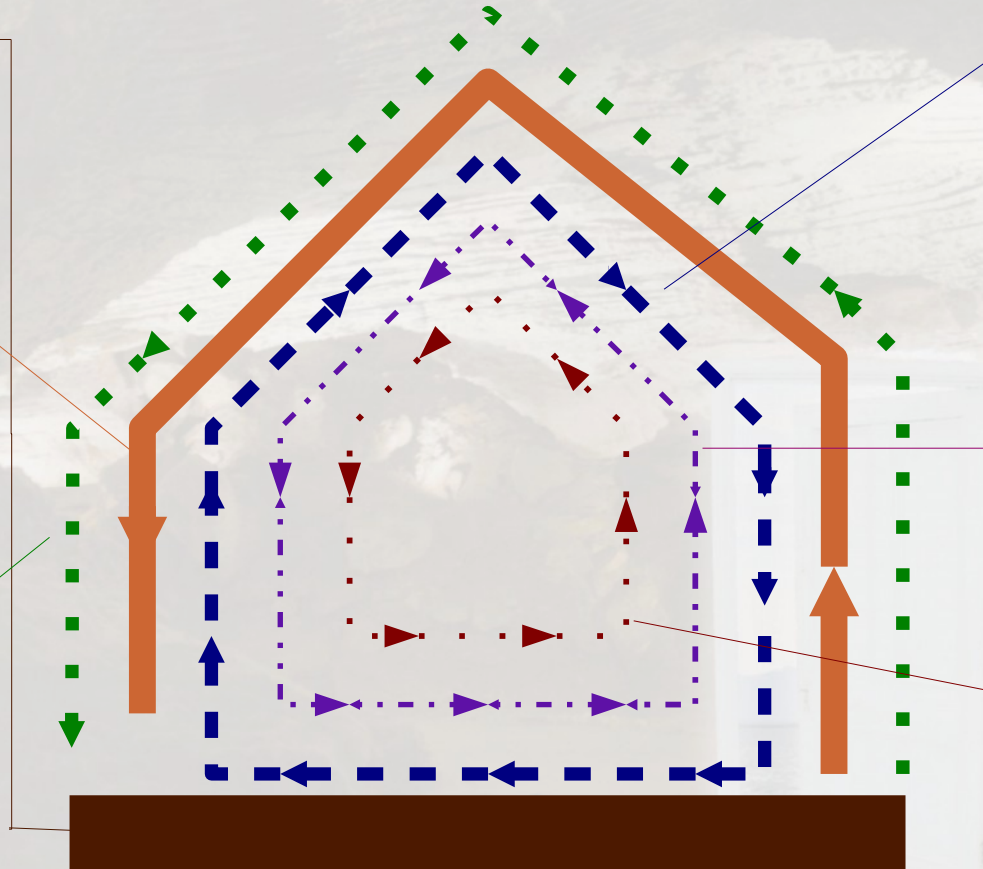
These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilation, and air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.

SPACE PLAN

The interior layout, where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years; exceptionally quiet homes might wait 30 years.

STUFF

Chairs, desks, phones, pictures; kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called mobilia in Italian for good reason.



Source: Stewart Brand. 1994. *How Buildings Learn: What Happens after They're Built*. New York: Viking.

Categories of change include product and process, static and dynamic

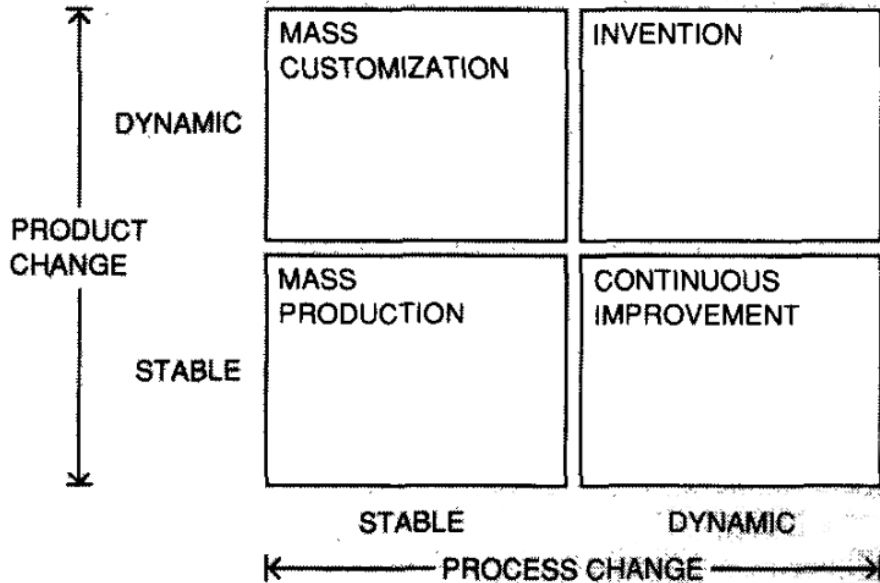


Figure 1: Product-process change matrix

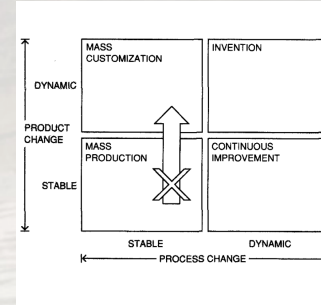


Figure 9
Making the transformation:
The wrong path

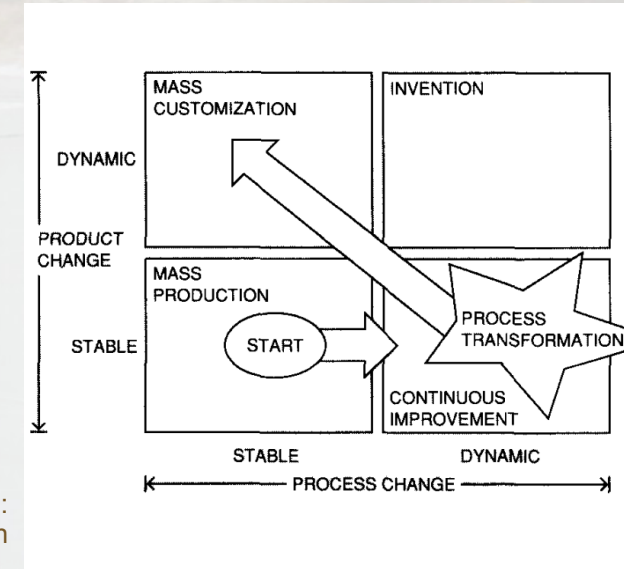


Figure 10
Making the transformation:
The right path

Boynton, Andrew C., Bart Victor, and B. Joseph Pine. 1993. "New Competitive Strategies: Challenges to Organizations and Information Technology." IBM Systems Journal 32 (1): 40–64. <https://doi.org/10.1147/sj.321.0040>.

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(dynamic stability)

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Synthesizing the complex
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Co-responsive movement
4. Planning (teleology) c.f.
Programming (teleonomy)
5. Industrial value chain c.f.
Co-producing offerings
 - a. Rittel (issues + argumentation);
Alexander (pattern language);
Churchman (systems approach)
 - b. Structured methods c.f.
Agile Methods
 - c. Appreciative systems:
Reality judgements, value judgements,
instrumental judgements
 - d. Anticipatory systems:
The map is not the territory
 - e. Error types: E1, E2, E3, E4

Coevolving Innovations

... in Business Organizations and Information Technologies

Christopher Alexander, Horst Rittel, C. West Churchman

At U.C. Berkeley in the 1960s, [Christopher Alexander](#), [Horst Rittel](#) and [C. West Churchman](#) could have had lunch together. While disciplinary thinking might lead novices to focus only on each of [pattern language](#), [wicked problems](#) and [the systems approach](#), there are ties (as well as domain-specific distinctions) between the schools.



Circa 1968-1970: Christopher Alexander, Horst Rittel, West Churchman

Recent Posts

- [Christopher Alexander, Horst Rittel, C. West Churchman](#)
- [Open Innovation Learning and Open Data](#)
- [Learning data science, hands-on](#)
- [Innovation Learning and Open Sourcing: IoT + Cloud + Cognitive](#)
- [Acts of representation with systems thinking \(OCADU 2017/03\)](#)
- [Service Systems Thinking, with Generative Pattern Language \(Metropolia 2016/12\)](#)

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David Ing
@daviding

Anshansicun: Whimsically residential area,... [bit.ly/2jU](#)



At Berkeley: Churchman, Rittel and Alexander taught in 1960-1970s

C. West Churchman (1913-2004)

- 1957 joined Berkeley, graduate programs in OR at School of Business Administration
- 1964-1970 Associate Director and Research Philosopher, Space Sciences Laboratory
- 1981-1994 retired, taught Peace & Conflict Studies

Horst Rittel (1930-1990)

- 1963 Berkeley College of Environmental Design
- 1974 both Berkeley and University of Stuttgart

Christopher Alexander (1936 -)

- 1963 Berkeley College of Environmental Design
- 1967 cofounder Center for Environmental Structure
- 1998 retired from university

Both Alexander and Rittel were part of what at the time was called the 'design methods' movement in architecture, worked and taught in the same building, and did talk and were seen walking off to have lunch together. Churchman was teaching in the Business School a few minutes down on the way to the center of campus.

- *Thor Mann*
(posted April 17, 2017)

Structured methods assume progressing with succeeding or preceding steps, now described as *waterfall*

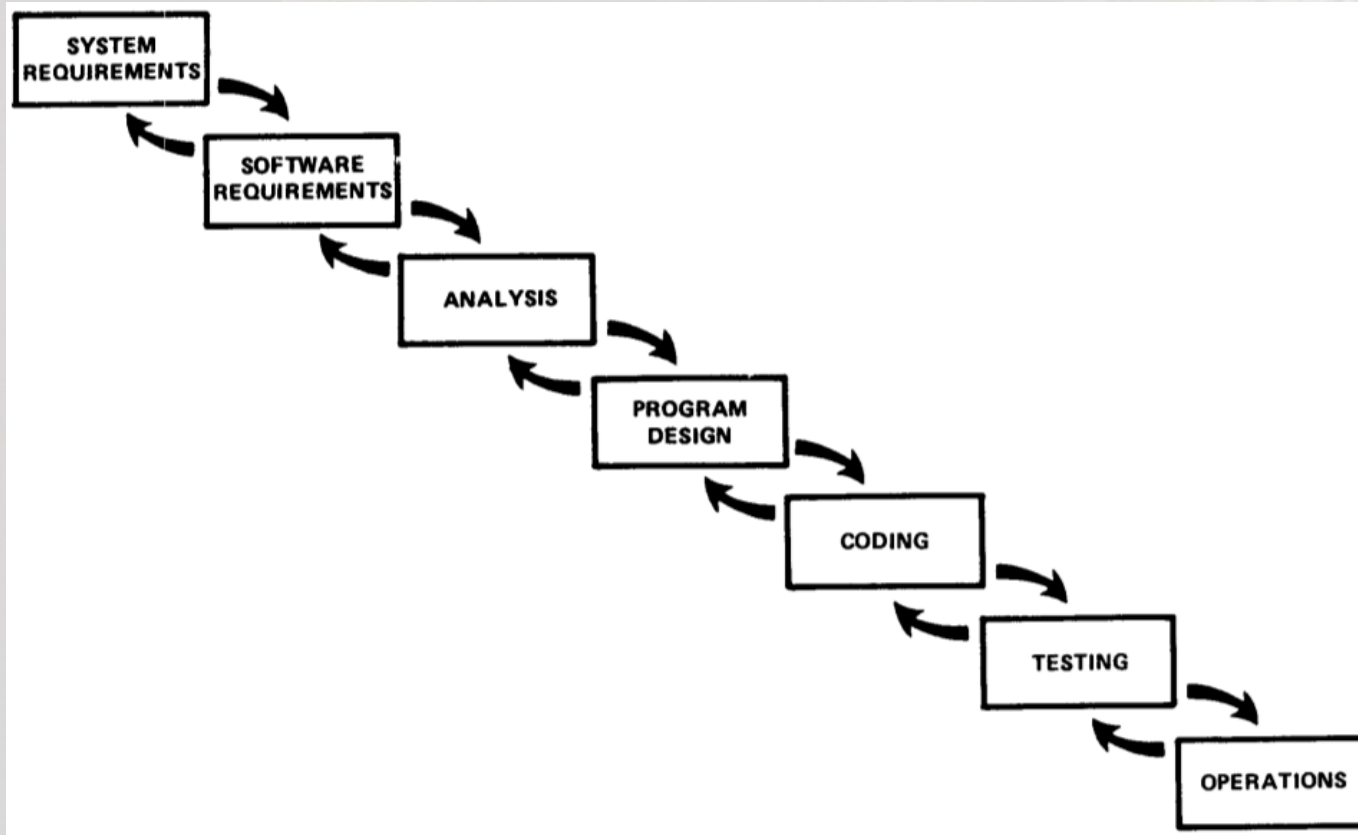
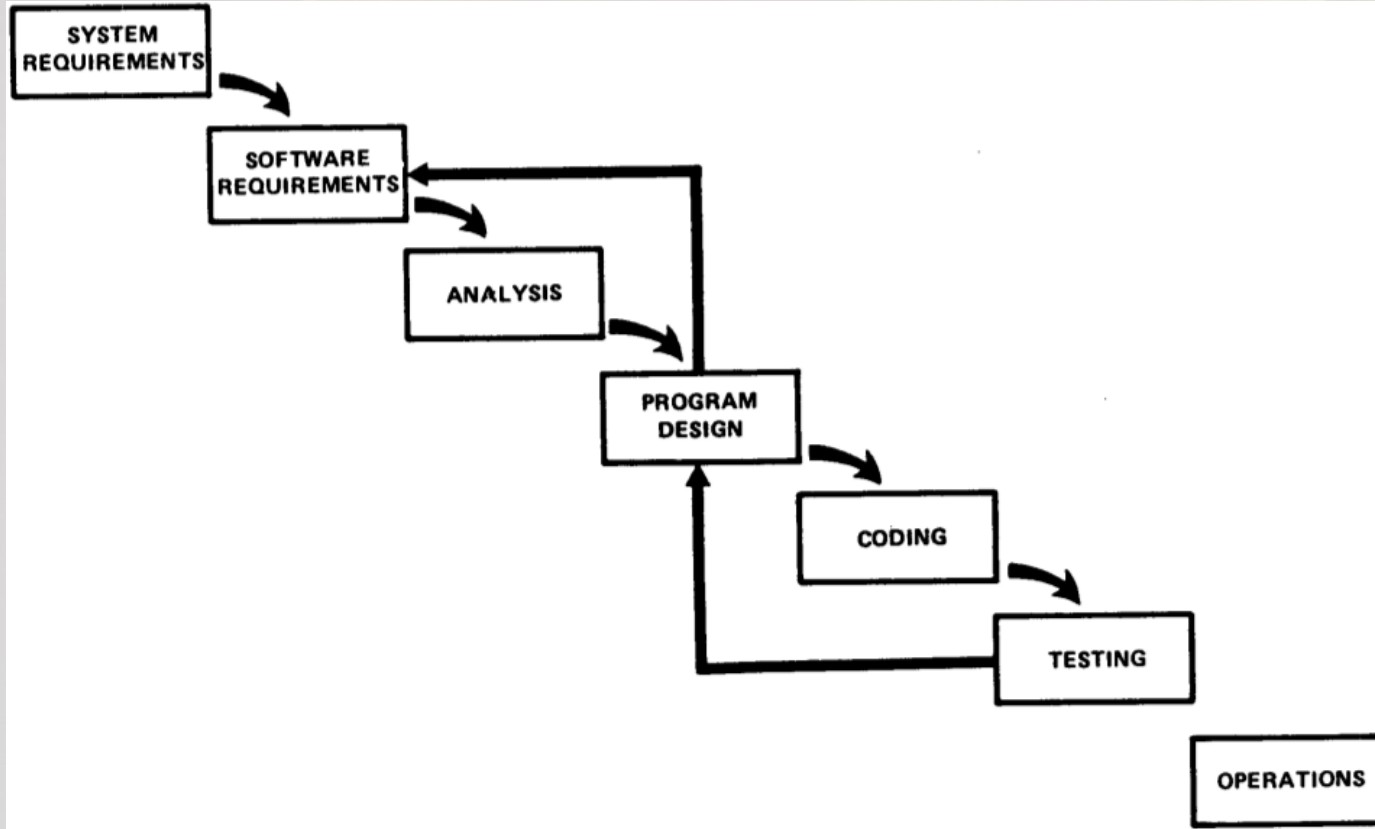


Figure 3 portrays the iterative relationship between successive development phases for this scheme. The ordering of the steps is based on the following concept: that as each step progresses and the design is furthered detailed, there is an iteration with the preceding and succeeding steps but rarely with the more remote steps in the sequence. The virtual of all of this is that as the design proceeds the change process is scoped down to manageable limits. At any point in the design process after the requirement analysis is completed there exists a firm and closeup, moving baseline to which to return in the event of unforeseen design difficulties. What we have is an effective fallback position that tends to maximize the extent of early work that is salvageable and preserved.

Source: Winston W. Royce, "Managing the Development of Large Software Projects", IEEE Wescon 1970 (Figure 3)

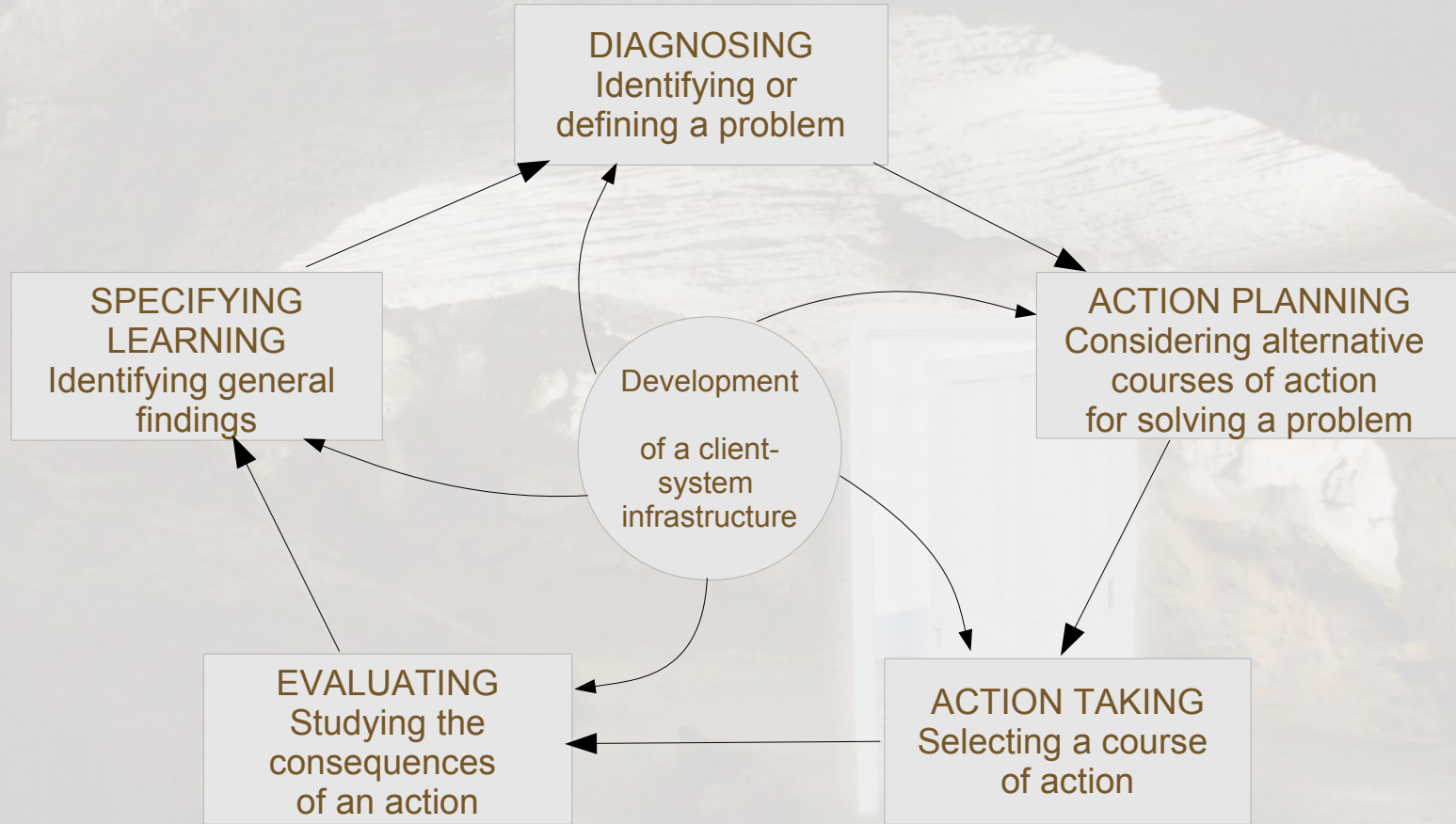
If testing fails, a major design is required, which could lead to necessary modifications in requirements



I believe in this concept, but the implementation described above is risky and invites failure. The problem is illustrated in figure 4. The testing phase at the end of the development cycle is first even for which timing, storage, input/output transfers, etc., are experience as distinguished from analyzed. These phenomena are not precisely analyzable. if the phenomena fail to satisfy the various external constraints, then invariably a major design is required. ... The requirements changes are likely to be so disruptive that the software requirements upon which the design is based on which provides the rationale for everything is violated. Either the requirement must be modified, or a substantial change in the design is required. In effect, the development process has returned to the origin and one can expect up a 100-percent overrun in schedule and costs.

Source: Winston W. Royce, "Managing the Development of Large Software Projects", IEEE Wescon 1970 (Figure 4)

The action research cycle has been refined into five phases encouraging both single-loop and double-loop learning



Source: Gerald I. Susman and Roger D. Evered. 1978. "An Assessment of the Scientific Merits of Action Research." *Administrative Science Quarterly* 23 (4): 582–603. <http://www.jstor.org/stable/10.2307/2392581>.

Architecting for Wicked Messes: Towards an affordance language for service systems

March 2018



David Ing, 2018

“The Systems Approach and Its Enemies”, (Churchman, 1979)

Common to all these enemies is that none of them accepts the reality of the "whole system": we do not exist in such a system. Furthermore, in the case of **morality, religion, and aesthetics**, at least a part of our reality as human is not "in" any system, and yet it plays a central role in our lives.

To me these enemies provide a powerful way of learning about the systems approach, precisely because they enable the rational mind to step outside itself and to observe itself (from the vantage point of the enemies). [....]

We must face the reality that the enemies offer: what's really happening in the human world is **politics, or morality, or religion, or aesthetics**. This confrontation with reality is totally different from the rational approach, because the reality of the enemies cannot be conceptualized, approximated, or measured (Churchman, 1979, pp. 24–53).

Appreciative system: reality judgements, value judgements, instrumental judgements

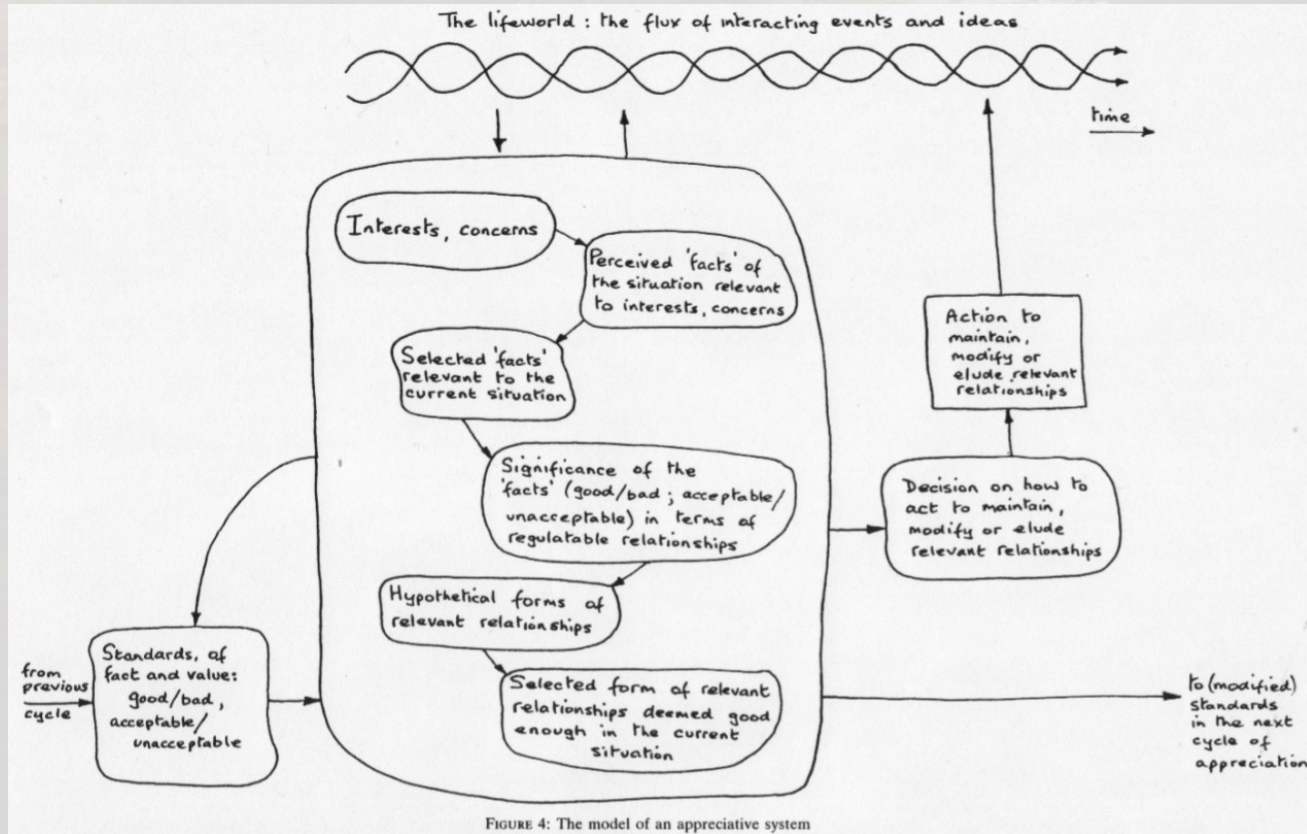
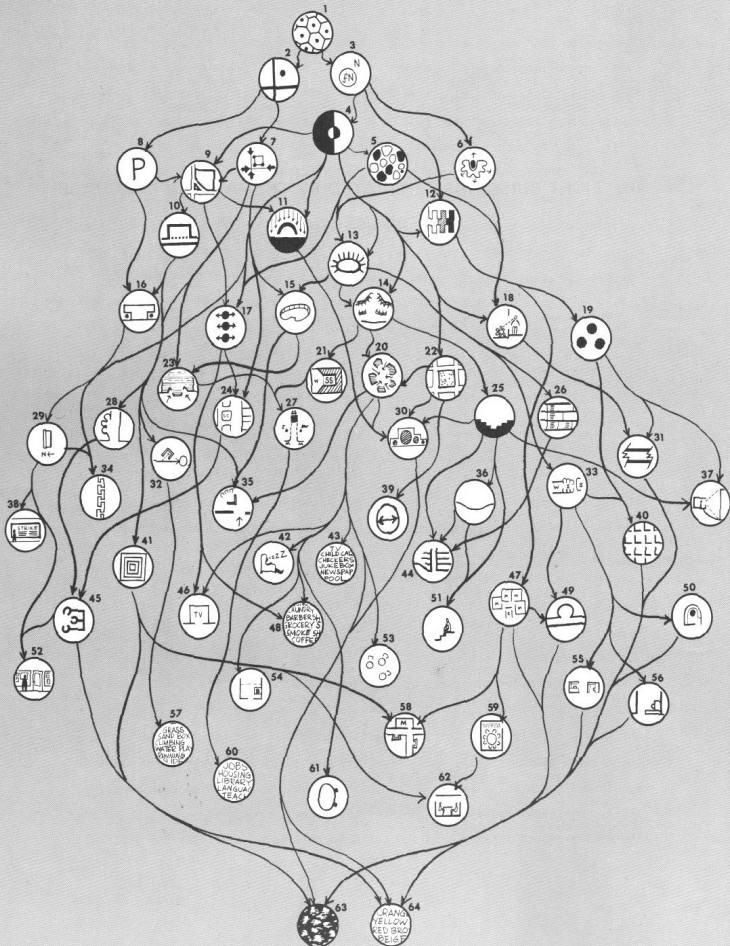


FIGURE 4: The model of an appreciative system

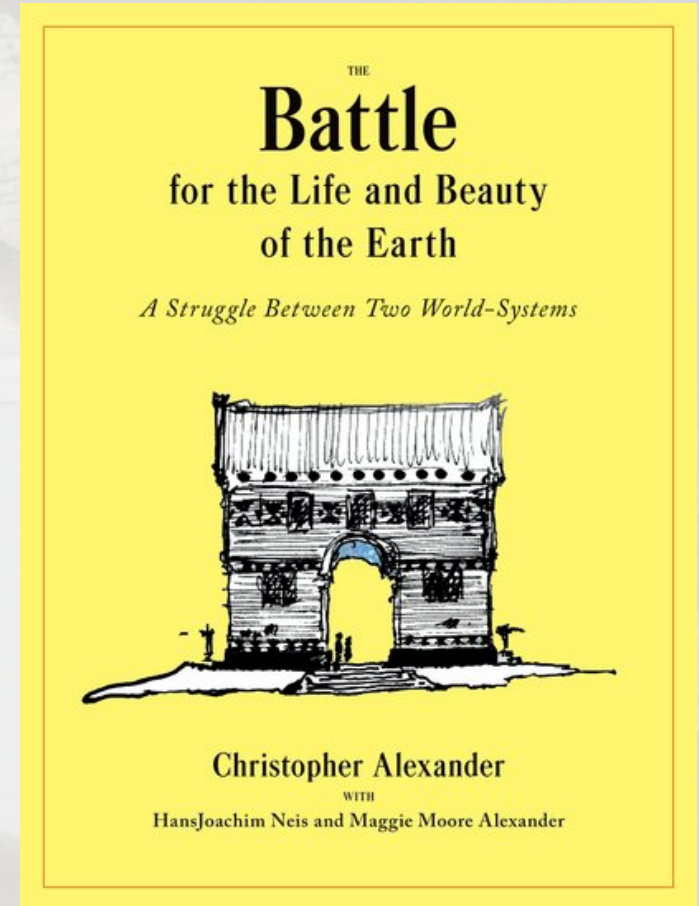
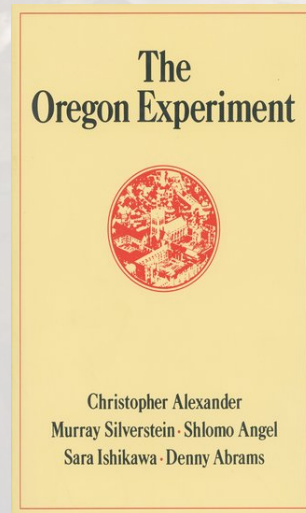
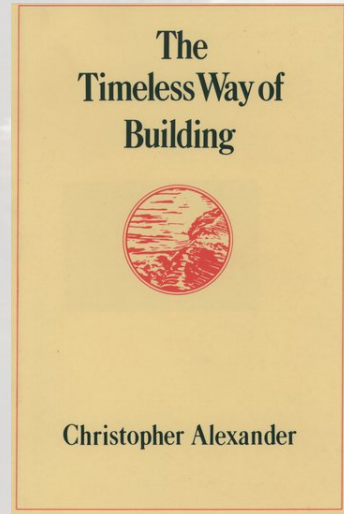
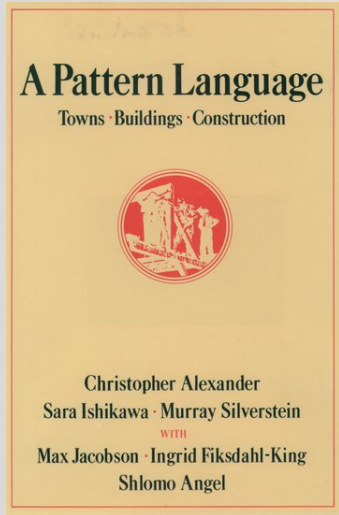
Checkland, Peter B., and Alejandro Casar. 1986. "Vickers' Concept of an Appreciative System: A Systemic Account." *Journal of Applied Systems Analysis* 13 (3): 3–17.

Pattern language intends to give 3 types of help



1. It gives him the opportunity to use the patterns in the way which pays full respect to the **unique features** of each special building: the local peculiarities of the community, its special needs ...
2. It tells him which patterns to consider **first**, and which ones to consider **later**. Obviously he wants to consider the **biggest ones** ... before he considers the **details**.
3. It tells him which patterns "**go together**" ... so that he knows which ones to think about at the same time, and which ones separately (Alexander et al., 1968, pp. 17–19).

The writing of 1975-1979 by Alexander was prescriptive;
the 2012 is reflections on practice



Here is a short and necessarily incomplete definition of a pattern:

A recurring structural configuration that solves a problem in a context, contributing to the wholeness of some whole, or system, that reflects some aesthetic or cultural value.[1]

Pattern Name: A name by which this problem/solution pairing can be referenced

Problem: The specific problem that needs to be solved.

Context

The circumstances in which the problem is being solved imposes constraints on the solution. The context is often described via a "situation" rather than stated explicitly.

Forces

The often contradictory considerations that must be taken into account when choosing a solution to a problem.

Solution: The most appropriate solution to a problem is the one that best resolves the highest priority forces as determined by the particular context.

Resulting Context

The context that we find ourselves in after the pattern has been applied. It can include one or more new problems to solve

Rationale

An explanation of why this solution is most appropriate for the stated problem within this context.

Related Patterns

The kinds of patterns include:

- Other solutions to the same problem,
- More general or (possibly domain) specific variations of the pattern,
- Patterns that solve some of the problems in the resulting context (set by this pattern)

Source: [1] Coplien, James O., and Neil B. Harrison. 2004. *Organizational Patterns of Agile Software Development*. Prentice-Hall, Inc.

<http://books.google.ca/books?id=6K5QAAAAMAAJ> . [2] Gerard Meszaros and Jim Doble, "A Pattern Language for Pattern Writing", *Pattern Languages of Program Design* (1997), <http://hillside.net/index.php/a-pattern-language-for-pattern-writing>

The essential idea of a pattern language is: *a solution to a problem in context*

Every time a designer creates a pattern (or, for that matter, entertains any idea about the physical environment), he essentially goes through a three-step process.

He considers a PROBLEM, invents a PATTERN to solve the problem, and makes mental note of the range of CONTEXTS where the pattern will solve the problem. [...]

The format says that whenever a certain **CONTEXT** exists, a certain **PROBLEM** will arise; the stated **PATTERN** will solve the **PROBLEM** and there should be provided in the **CONTEXT**.

While it is not claimed that the PATTERN specified is the only solution to the PROBLEM, it is implied that unless the PATTERN or an equivalent is provided, the PROBLEM will go unsolved (Alexander, Ishikawa, & Silverstein, 1967, pp. 1–4).

Alexander, Christopher, Sara Ishikawa, and Murray Silverstein. 1967. *Pattern Manual*. Berkeley, California: Center for Environmental Structure

Try who+what, how+why, where+when, containing, contained

(i) Pattern label	Tapping into the grapevine	Signing in for services	Minding children
	◇ ◇ ◇	◇ ◇ ◇	◇ ◇ ◇
(ii) Voices on issues (who and what)	(a) For a client, what jobs and training are available? (b) For a neighbour, in what ways can we share and update community news?	(a) For a client, what services are available to me, now and on appointment? (b) For a parent, what do I do with my kids while I'm busy? (c) For a child, what can I do while my parent is at the MSC?	
(iii) Affording value(s) (how and why)	Displaying up-to-date news and local information, so that individuals can know ways to independently act. Adding, revising and moderating community contributions so that individual and authoritative viewpoints are balanced.	Matching client needs with MSC resources, so that holistic treatments are received. Triaging and scheduling so that urgent cases are prioritized, and wait times are tolerable	Leaving a child at a supervised play area so that whereabouts are known. Availing distractions for toddlers through teens, so that coming with parents is less of a chore
(iv) Spatio-temporal frames (where and when)	Access to information onsite MSC for clients who don't have devices, and on the open Internet for the public	On demand lookups of trending and prior MSC busy and slow periods transparently visible onsite and on the Internet, enabling clients to adjust and/or rebook	Facilities and programs are known both to children and parents in advance of appointments
	◇ ◇ ◇	◇ ◇ ◇	◇ ◇ ◇
(v) Containing systems (slower and larger)	For municipal, regional and national agencies, are community health and social services in their jurisdictions well provide?		For extended family, schools and community workers, what personal responsibilities inhibit service engagement?
vi) Contained systems (faster and smaller)	For neighbours in mutual support, friends and family ties, who should know about news?	For friends or assistants speaking on behalf or interpreting for a client, is the situation understood?	For other parents at the MSC at the same time, would you look after my kids like I look after yours?

Minding children: who+what, how+why, where+when, containing, contained

(i) Pattern label	Minding children ◇ ◇ ◇
(ii) Voices on issues (who and what)	(a) For a client, what services are available to me, now and on appointment? (b) For a parent, what do I do with my kids while I'm busy? (c) For a child, what can I do while my parent is at the MSC?
(iii) Affording value(s) (how and why)	Leaving a child at a supervised play area so that whereabouts are known. Availing distractions for toddlers through teens, so that coming with parents is less of a chore
(iv) Spatio-temporal frames (where and when)	Facilities and programs are known both to children and parents in advance of appointments ◇ ◇ ◇
(v) Containing systems (slower and larger)	For extended family, schools and community workers, what personal responsibilities inhibit service engagement?
(vi) Contained systems (faster and smaller)	For other parents at the MSC at the same time, would you look after my kids like I look after yours?

Alexandrian format mapped to proposed service systems thinking

Format for service systems thinking

(i) Pattern label	An interaction phrased as a present participle
(ii) Voices on issues (who and what)	Archetypal roles of stakeholders, with concerns and interests posed as questions
(iii) Affording value(s) (how and why)	Objects and/or events that enable modes of practised capacities for independent or mutual action
(iv) Spatio-temporal frames (where and when)	Occasions at which dwelling in issues and affordances are salient and at hand
(v) Containing systems (slower and larger)	Constraining conditions in which the pattern operates, potentially where multi-issue messes are dissolved
(vi) Contained systems (faster and smaller)	Opportunistic conditions which the pattern contains, potentially allowing ad hoc resolving of a specific issue at hand

From System-B to System-A, c.f. from waterfall to agile

From System-B to System-A		From waterfall methods to agile	
(i) Pattern language for the community	From preprogrammed assembly to local adaptation with feedback and correction	(i) Writing user stories	From detailing specifications to conversing on narratives
(ii) Construction budget	From overemphasizing tangible aspects to negotiating collective feelings	(ii) Scoping; estimating value, costs and dates	From projecting and committing to converging on estimates
(iii) Reality of the land	From drawing abstract layout plans to adjusting the wholeness on the real site	(iii) Reviewing iteratively; tracking work item backlogs	From dividing-and-conquering to collaborating for learning

Amplifications from Alexandrian to service systems thinking

1.	Shared meaning on the situated	<p>The pattern is merely a mental image, which can help to predict those situations where forces will be in harmony, and those in which they won't. But the actual forces which will occur in a real situation, although objectively present there, are, in the end unpredictable, because each situation is so complex, and forces may grow, or die, according to subtle variations of circumstance (Alexander, 1979, pp. 285–286).</p>
2.	Systems thinking and complexity	<p>Systems generating systems</p> <ol style="list-style-type: none">1. There are two ideas hidden in the word system: the idea of a system as a whole and the idea of a generating system.2. A system as a whole is not an object but a way of looking at an object. It focuses on some holistic property which can only be understood as a product of interaction among parts.3. A generating system is not a view of a single thing. It is a kit of parts, with rules about the way these parts may be combined.4. Almost every 'system as a whole' is generated by a 'generating system'. If we wish to make things which function as 'wholes' we shall have to invent generating systems to create them. <p>In a properly functioning building, the building and the people in it together form a whole: a social, human whole. The building systems which have so far been created do not in this sense generate wholes at all (Alexander, 1968, p. 605).</p>
3.	Method content + development process	<p>Volume 1, The Timeless Way of Building [TWB], and Volume 2, A Pattern Language [APL], are two halves of a single work. This book [APL] provides a language, for building and planning; the other book [TWB] provides the theory and instructions for the sue of the language. This book [APL] describes the detailed patterns for towns and neighbourhoods, houses, gardens and rooms. The other book [TWB] explains the discipline which makes it possible to use these patterns to create a building or a town. This book [APL] is the sourcebook of the timeless way; the other [TWB] is its practice and its origin (Alexander et al., 1977, p. ix).</p>

Rephilosophizations from Alexandrian to service systems thinking

1.	From structuralism to alternative stable states	<ul style="list-style-type: none">• Criticism of teleology• Three types of change in biological evolution: (i) environmental change; (ii) somatic (cellular) change; and (iii) genotypic change (Bateson 1963)• Teleonomic processes through closed programs or open programs• Regime shifts (ecosystem ecology, community ecology)
2.	From dwelling to journeying	<ul style="list-style-type: none">• Being served over a period of time (a journey) rather than in a moment of time (dwelling)?• Heidegger world-time and time-as-ordinarily-conceived• Places existing not in space, but as nodes in a matrix of movement (Ingold 2000)
3.	From semi-lattice to meshwork	<ul style="list-style-type: none">• "A City is Not a Tree" focuses on physical invariants• Social relations with movement and time (e.g. gaining and losing friends)• Each person not as a point, but as a line (Ingold 2011)• Meshworks as trails of movements or growth

Reinterpretations from Alexandrian to service systems thinking

1.	From problem-solving to issue-seeking	<ul style="list-style-type: none">• Design is problem-solving; [architectural] programming is problem-seeking (Peña & Focke, 1969, p. 4).• Issues-based approach appreciating how values influence and impact defining problems (Rittel & Webber, 1973, p. 159).• Problem Structuring Methods (e.g. Soft Systems Methodology, Strategic Choice Approach, Strategic Optoins Development and Analysis)
2.	From quality-wholeness to interactive value	<ul style="list-style-type: none">• "Quality without a name" – “an objective quality that things ... can possess that makes them good places or beautiful places. (Gabriel 1996)• 15 geometric invariants, mutually-reinforcing centers• Services separating value from the outcome• Interactive value: enjoyment takes place over time• Outcomes of service systems: use-value, exchange value
3.	From anti-patterns to wayfaring	<ul style="list-style-type: none">• Dead patterns leak out, infect other patterns (Alexander 1979)• Anti-patterns as non-solutions; to be coupled with patterns in pairs (towards problem-solving)• Wayfaring more equivalent to piecemail growth (than transport from origin to destination)

Mainstream architecture and urban design are rationalistic and teleological; generative pattern language is ateleological

<i>Attributes of the design process</i>	<i>Development philosophies</i>	
	Teleological development	Ateleological development
Ultimate purpose	Goal / purpose	Wholeness / harmony
Intermediate goals	Effectiveness / efficiency	Equilibrium / homeostasis
Design focus	Ends / result	Means / process
Designers	Explicit designer	Member / part
Design scope	Part	Whole
Design process	Creative problem solving	Local adaptation, reflection and learning
Design problems	Complexity and conflict	Time
Design management	Centralized	Decentralized
Design control	Direct intervention with a master plan	Indirect via rules and regulations

Lucas D. Intraña 1996. "Notes on Ateleological Information Systems Development." *Information Technology & People* 9 (4): 20–39.
doi:10.1108/09593849610153412.

Teleonomy learns from teleology in a philosophy with alternative stable states

Teleology: Goals, objectives, ideals

- Emphasis on *final cause*, of Aristotle's four causes:
 - (i) material cause (that out of which);
 - (ii) formal cause (the account of what it-is-to-be);
 - (iii) efficient cause (the primary source of change or rest);
 - (iv) **final cause** (the end, that for the sake of which a thing is done).

Teleonomy: Environmental change, somatic (cellular) change, genotypic change

- A process or behaviour which owes its goal-directedness to the operation of a program
- Coded or prearranged information that controls a process (or behaviour) leading it toward a given end.

Alternative stable states: Panarchy, resilience, regime shifts

- From community ecology, changes in state variables (e.g. population densities).
- From ecosystem ecology, changes to the parameters governing interactions within an ecosystem.

If they can get you asking the wrong questions, they don't have to worry about answers (Thomas Pynchon)

Type **1** error **False positive:**
finding a (statistical) relation that isn't real

Type **2** error **False negative:**
missing a (statistical) relation that is real

Type **3** error **Tricking ourselves:**
Unintentional error of solving wrong problems precisely
(through ignorance, faulty education or unreflective practice)

Type **4** error **Tricking others:**
Intentional error of solving wrong problems
(through malice, ideology, overzealousness, self-righteousness,
wrongdoing)

Ian I. Mitroff and Abraham Silvers. 2010. *Dirty Rotten Strategies: How We Trick Ourselves and Others into Solving the Wrong Problems Precisely*. Stanford University Press.

Agenda

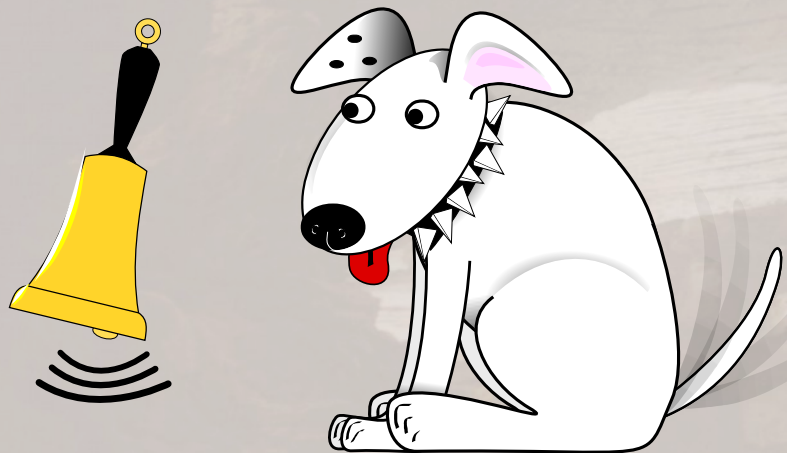
1. Designing for tame problems c.f. Architecting for wicked messes
2. Analyzing the complicated c.f. Synthesizing the complex
3. Unfreeze-change-freeze c.f. Co-responsive movement
4. Planning (teleology) c.f. Programming (teleonomy)
5. Industrial value chain c.f. Co-producing offerings
 - a. Rittel (issues + argumentation); Alexander (pattern language); Churchman (systems approach)
 - b. Structured methods c.f. Agile Methods
 - c. Appreciative systems: Reality judgements, value judgements, instrumental judgements
 - d. Anticipatory systems: The map is not the territory
 - e. Error types: E1, E2, E3, E4

Agenda

1. Designing for tame problems c.f.
Architecting for wicked messes
2. Analyzing the complicated c.f.
Synthesizing the complex
3. Unfreeze-change-freeze c.f.
Co-responsive movement
4. Planning (teleology) c.f.
Programming (teleonomy)
5. Industrial value chain c.f.
Co-producing offerings
 - a. Quality in the thing c.f.
Quality in the interaction
 - b. Theory of the offering
 - c. Production systems c.f.
Service systems
 - d. Production language c.f.
Affordance language
 - e. Adaptive
(cellular change, allopoietic) c.f.
Generative
(genetic change, autopoietic)

Ask Not What's Inside Your Head, but What Your Head's Inside of

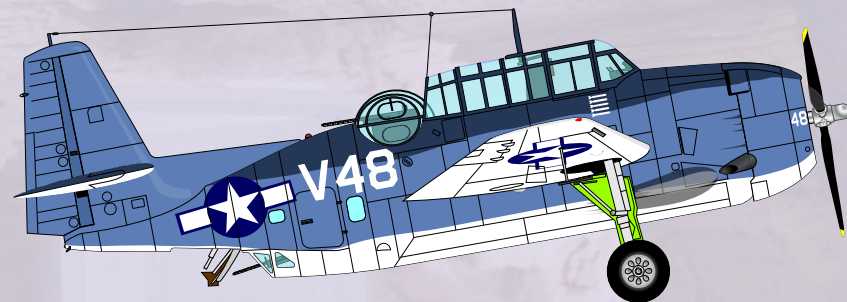
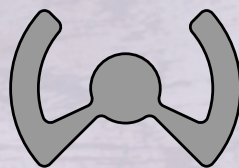
Stimulus – Response (Behavioral Psychology)



[In the 1950] psychophysics of perception ... "givens" in the light to the eye could not support perceptual phenomena, but only elementary experiences such as sensations. [...] Succinctly put, the psycho-physical program was ... traditional in considering perception to be a set of responses to presented stimuli (albeit "higher order" stimuli).

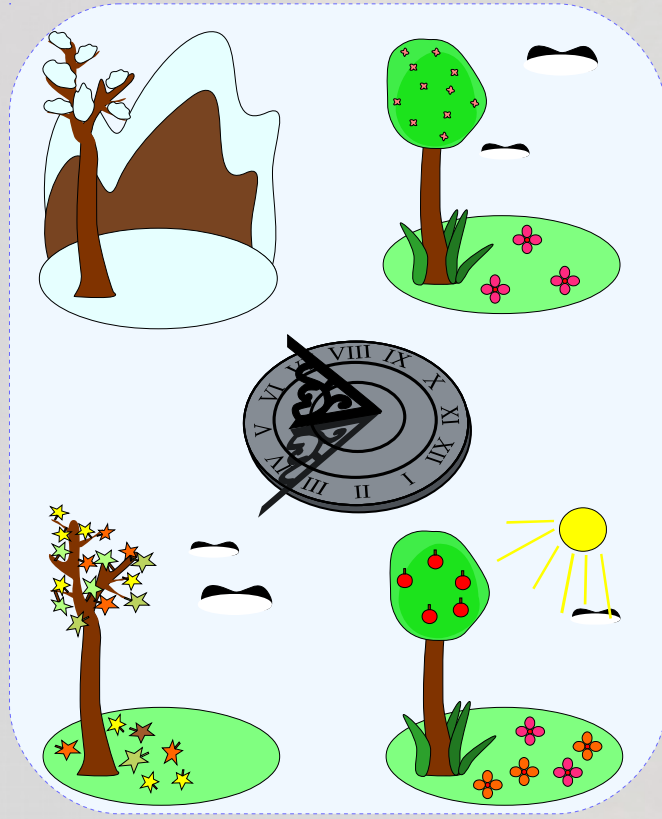
William M. Mace 1977. "James J. Gibson's Strategy for Perceiving: Ask Not What's inside Your Head, but What Your Head's inside of." In *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, edited by Robert Shaw and John Bransford, 43–65.

Ecological Approach to Perception

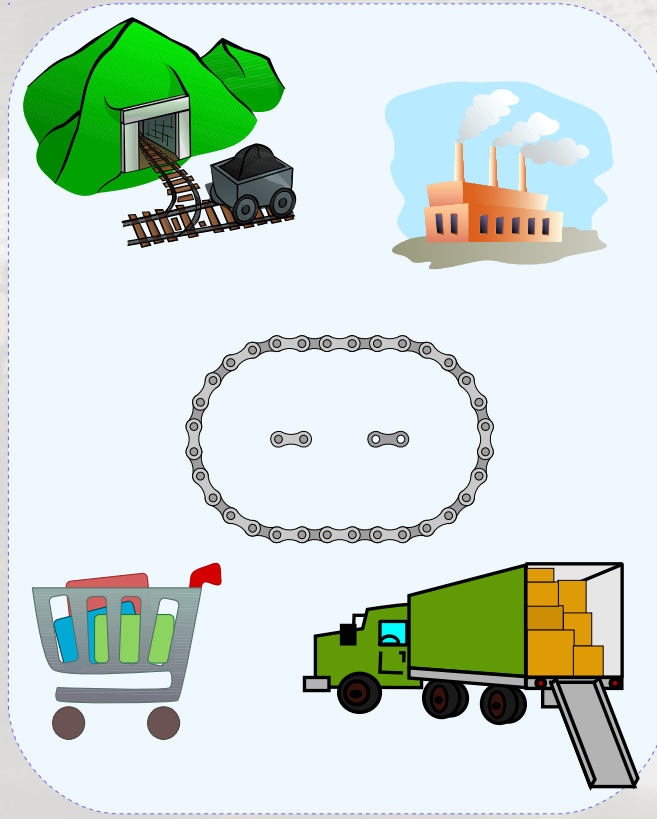


Over the last 10-15 years [James J. Gibson] has tried to develop enough theory ... to demonstrate that direct perception is indeed plausible even if hordes of difficult details remain to be worked out. The ... analysis of the optic array, stimulus organization, and the functional organization of perceptual systems are what Gibson often points to as radical features

Is thinking different across agricultural systems, industrial systems, and service systems?



Agricultural Systems



Industrial Systems



Service Systems(?)

Service systems in our society can be ranked from concrete to abstract, as subjects for schoolchildren

Systems that
move, store,
harvest,
process

• Transportation	K
• Water and waste management	1
• Food and global supply chain	2
• Energy and energy grid	3

Systems that
enable healthy,
wealthy and
wise people

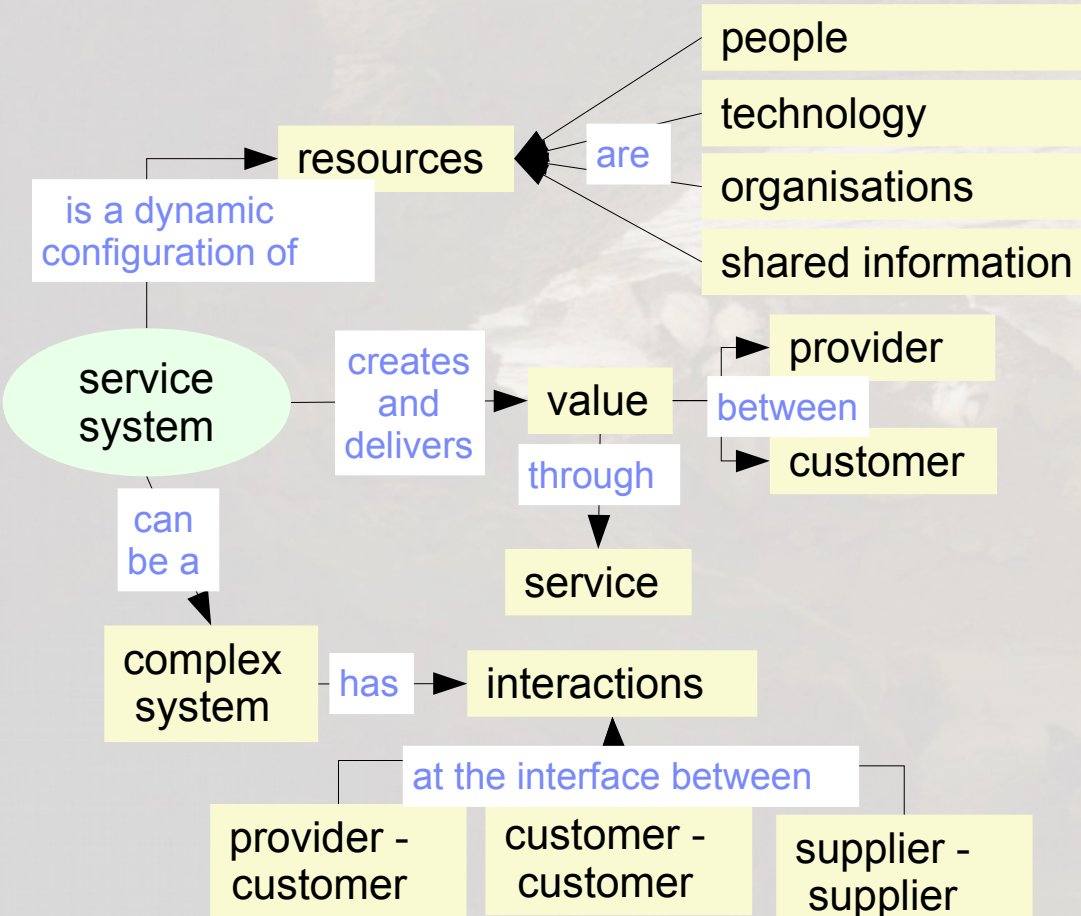
• Information + communications (ICT) infrastructure	4
• Building and construction	5
• Banking and finance	6
• Retail and hospitality	7
• Healthcare	8

Systems that
govern

• Education (including universities)	9
• Government (cities)	10
• Government (regions / states)	11
• Government (nations)	12

Source: Spohrer, James C., and Paul P. Maglio. 2010. "Toward a Science of Service Systems: Value and Symbols." In *Service Science: Research and Innovations in the Service Economy*, edited by Paul P. Maglio, Cheryl A. Kieliszewski, and James C. Spohrer, 157–94. 10.1007/978-1-4419-1628-0_9

After 2007, service systems have been recognized as the largest part of developed economies globally



A **service system** can be defined as a **dynamic configuration** of **resources** (people, technology, organisations and shared information) that **creates and delivers value** between the provider and the customer through service.

In many cases, a service system is a **complex system** in that configurations of resources interact in a non-linear way.

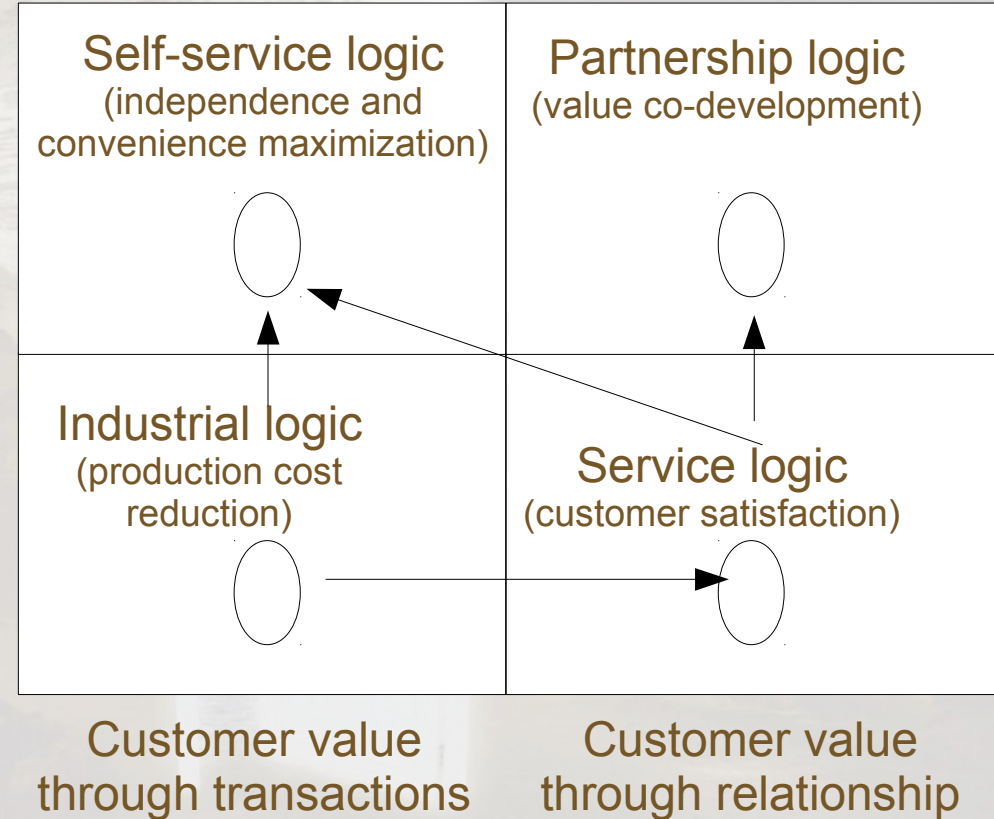
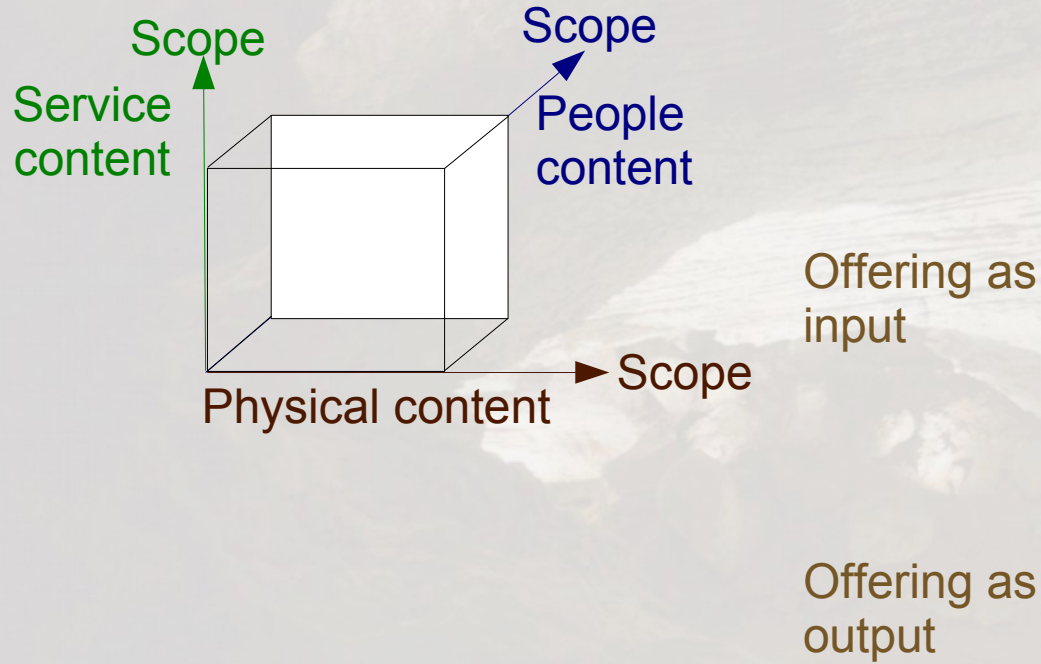
Primary interactions take place at the interface between the provider and the customer.

However, with the advent of ICT, customer-to-customer and supplier-to-supplier **interactions** have also become prevalent.

These complex interactions create a system whose behaviour is difficult to explain and predict.

(IfM and IBM, 2008, p. 6)

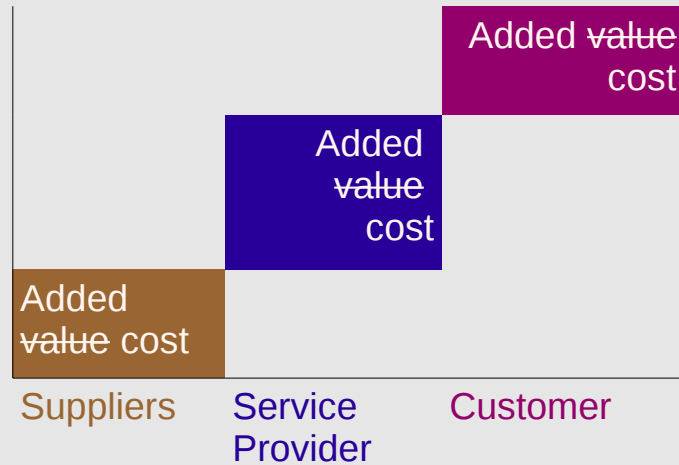
Theory of the offering sees coproduction with *input*, or *output*



Rafael Ramirez and Johan Wallin. *Prime Movers: Define Your Business or Have Someone Define It Against You*, 2000, p. 141.

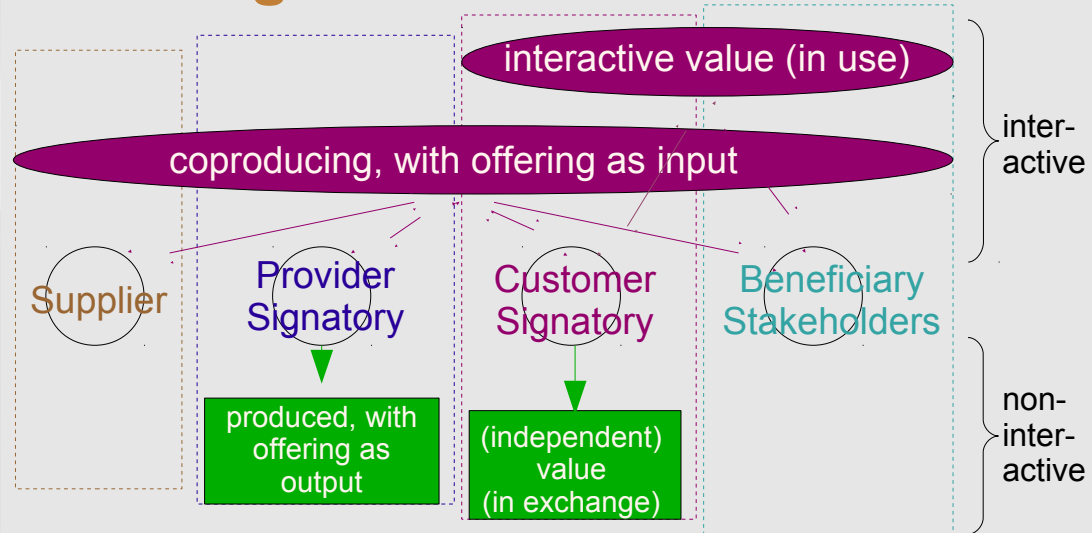
The theory of firms adding value cost has given way to mobilizing customers towards creating their own value

Adding value cost



Our traditional about value ... [says] every company occupies a position on the value chain. Upstream, suppliers provide inputs. The company then adds values to these inputs, before passing them downstream to then next actor in the chain [whether another business or the final consumer].

Enabling interactive value creation



... IKEA's strategic intent [is] to understand how customers can create their own value and create a business system that allows them to do it better. IKEA's goal is not to *relieve* customers of doing certain things but to *mobilize* them to do easily certain things they have never done before. Put another way, IKEA invents value by enabling customers' own value-creating activities. ... Wealth is [the ability] to realize your own ideas.

Source: Richard Normann and Rafael Ramirez, 1993, "From Value Chain to Value Constellation: Designing Interactive Strategy," Harvard Business Review 71: 65-65. <http://hbr.org/1993/07/designing-interactive-strategy>

Service systems are dynamic, with parties interacting and providers and/or clients

A service system can be defined as "**a dynamic value-cocreation configuration of resources**, including people, organizations, shared information (language, laws, measures, methods), and technology, all connected internally and externally to other service systems by **value propositions**"

(Maglio, Vargo, Caswell, & Spohrer, 2009, p. 399).

The smallest service system centers on an individual as he or she **interacts** with others, and the largest service system comprises the global economy. Cities, city departments, businesses, business departments, nations, and government agencies are all service systems.

Every service system is **both a provider and client of service** that is connected by **value propositions** in value chains, value networks, or value-creating system

(Maglio & Spohrer, 2008, p. 18)

Basic Concepts (#1-5). If we are to understand human history as the evolution and design of value-cocreation mechanisms between entities, then where should we begin?

Let's start by understanding the following ten basic concepts:

1.	Resources	Businesses may own physical resources or contract for physical resources, but as a type of resource they are themselves not physical, but instead a conceptual-legal construct. So in the end, all resources fall into one of four types: <i>physical-with-rights</i> , <i>not-physical-with-rights</i> , <i>physical-with-no-rights</i> , and <i>not-physical-with-rights</i> .
2.	Service system entities	The most common types of service system entities are people and organizations. New types of service system entities are constantly emerging and disappearing. Recently, open-source and on-line communities have emerged as service systems entities.
3.	Access rights	"By what authority, do you use that resource?" Service system entities have four main types of access rights to the resources within their configuration: <i>owned outright</i> , <i>leased/contracted</i> , <i>shared access</i> , and <i>privileged access</i> . Shared access resources include resources such as air, roads, natural language, and internet web sites. Privileged access resources include resources such as thoughts, individual histories, and family relationships.
4.	Value-proposition-based interactions	"I'll do this, if you'll do that." [...] Interactions via value propositions are intended to cocreate-value for both interacting entities. Both interacting entities must agree, explicitly or tacitly, to the value proposition.
5.	Governance mechanisms	"Here's what will happen if things go wrong." [...] If value is not realized as expected, this may result in a dispute between the entities. Governance mechanisms reduce the uncertainty in these situations by prescribing a mutually agreed to process for resolving the dispute.

Source: Jim Spohrer and Stephen K. Kwan. 2009. "Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline & References." *International Journal of Information Systems in the Service Sector* 1 (3): 1–31.

Basic Concepts (#6-10). If we are to understand human history as the evolution and design of value-cocreation mechanisms between entities, then where should we begin?

Let's start by understanding the following ten basic concepts:

6.	Service system networks	"Here's how we can all link up." [...] Over time, for a population of entities, the patterns of interaction can be viewed as networks with direct and indirect connectivity strengths. A service system network is an abstraction that only emerges when one assumes a particular analysis overlay on the history of interactions amongst service system entities.
7.	Service system ecology	"Populations of entities, changing the ways they interact." Different types of service systems entities exist in populations, and the universe of all service system entities forms the service system ecology or service world
8.	Stakeholders	"When it comes to value, perspective really matters." The four primary types of stakeholders are <i>customer</i> , <i>provider</i> , <i>authority</i> , and <i>competitor</i> . In addition ... other stakeholder perspectives include employee, partner, entrepreneur, criminal, victim, underserved, citizen, manager, children, aged, and many others.
9.	Measures	"Without standardized measures, it is hard to agree and harder to trust." The four primary types of measures are <i>quality</i> , <i>productivity</i> , <i>compliance</i> , and <i>sustainable innovation</i> .
10.	Outcomes	"How did we do? Can this become a new routine or long-term relationship?" [...] Beyond a standard two player game, with a customer player and a provider player, ISPAR assumes there exists both an authority player as well as a competitor-criminal player.

Source: Jim Spohrer and Stephen K. Kwan. 2009. "Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline & References." *International Journal of Information Systems in the Service Sector* 1 (3): 1–31.

These ten basic concepts underlie the service systems worldview

1. **Resources**
2. **Service system entities**
3. **Access rights**
4. **Value-proposition-based interactions**
5. **Governance mechanisms**
6. **Service system networks**
7. **Service system ecology**
8. **Stakeholders**
9. **Measures**
10. **Outcomes**

..... the world is made up of populations of **service system entities** that **interact (normatively)** via value propositions to **cocreate-value**, but often disputes arise and so **governance mechanisms** are invoked to resolve disputes.

Formal service system entities are types of legal entities with rights and responsibilities, that can own property, and with named identities that can create contracts with other legal entities. [...] Formal service systems exist within a legal and economic framework of contracts and expectations.

Informal service system entities include families ..., open source communities ..., and many other societal or social systems that are governed typically by unwritten cultural and behavioral norms (social systems with rudimentary political systems).

Natural history of service system entities. Service science seeks to create an understanding of the formal and informal nature of service in terms of entities, interactions, and outcomes, and how these evolve (or are designed) over time. An initial premise is that the entities, which are sophisticated enough to engage in rationally designed service interactions that can consistently lead to win-win value cocreation outcomes, must be able to build models of the past (reputation, trust), present, and future (options, risk-reward, opportunities, hopes and aspirations) possible worlds, including models of themselves and others, and reason about knowledge value

Source: Jim Spohrer and Stephen K. Kwan. 2009. "Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline & References." *International Journal of Information Systems in the Service Sector* 1 (3): 1–31.

Basic questions. A general theory of service system entities and networks formed through value-proposition-based interactions has four parts

... which directly lead to the four basic types of questions that SSMED seeks to answer.

Science (improve understanding, map natural history, validate mechanisms, make predictions).

What are service system entities, how have they naturally evolved to present, and how might they evolve in the future? What can we know about their interactions, how the interactions are shaped (value propositions, governance mechanisms), and the possible outcomes of those interactions both short-term and long-term?

Management (improve capabilities, define progress measures, optimize investment strategy).

How should one invest to create, improve, and scale service system networks? How do the four measures of quality, productivity, compliance, and sustainable innovation relate to numerous key performance indicators (KPIs) of business and societal systems? Is there a “Moore’s Law” of service system investment? Can doubling information lead to a doubling of capabilities (performance) on a predictable basis?

Engineering (improve control, optimize resources).

How can the performance of service system entities and scaling of service system networks be improved by the invention of new technologies (and environmental infrastructures) or the reconfiguration of existing ones? What is required to develop a CAD (Computer-Aided Design) tool for service system entity and service system network design?

Design (improve experience, explore possibilities).

How can one best improve the experience of people in service system entities and networks? How can the experience of service system creation, improvement, and scaling be enhanced by better design? Can the space of possible value propositions and governance mechanisms be explored systematically?

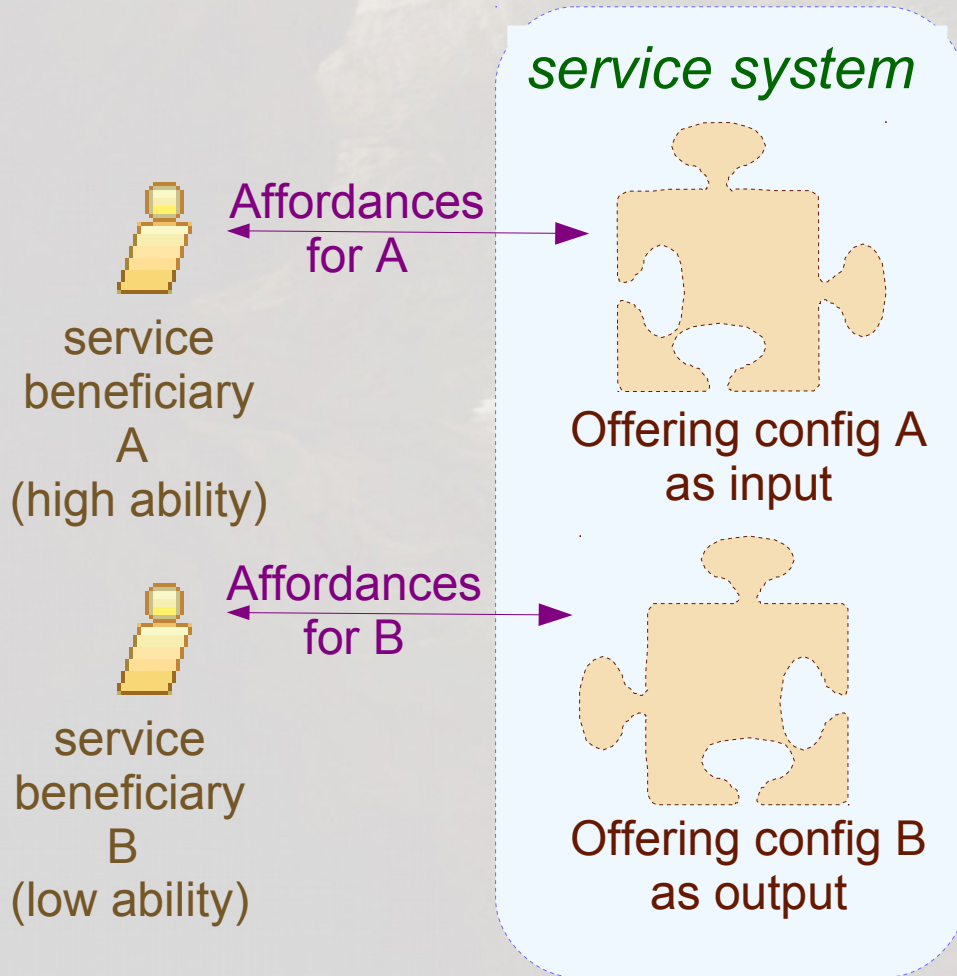
Sciences of the artificial.

Sciences of the artificial are different from natural sciences, and so it becomes especially important to consider these four parts – science, management, engineering, and design – as important knowledge components. In “The Sciences of the Artificial” (Simon 1996), Simon reflects “The world we live in today is much more man-made, or artificial, world than it is a natural world....

Service Science, Management, Engineering, and Design (SSMED) is emerging as one of the sciences of the artificial. Service science is knowledge about service system entities, value-proposition-based interactions (or value-cocreation mechanisms), governance mechanisms, and the other seven basic concepts. Following Simon even further, one could argue that service system entities are physical symbol systems, dealing with symbols that are named resources, and grounded in physical routines for carrying out the symbolic manipulations related to named resources.

Source: Jim Spohrer and Stephen K. Kwan. 2009. “Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline & References.” *International Journal of Information Systems in the Service Sector* 1 (3): 1–31.

Affordances are relational in an ecological perception



The term **affordance** refers to whatever it is about **the environment** that **contributes** to the kind of **interaction** that occurs. [...]

An affordance relates attributes of something in the environment to an interactive activity by an agent who has some ability, and an ability relates attributes of an agent to an interactive activity with something in the environment that has some affordance.

The relativity of affordances and abilities is fundamental. Neither an affordance nor an ability is specifiable in the absence of specifying the other.

James G. Greeno 1994. "Gibson's Affordances."
Psychological Review 101 (2): 336–342.

“Stable equilibrium is death”. Is *innovation learning* a living system?

A LETTER
TO
AMERICAN TEACHERS
OF
HISTORY

BY
HENRY ADAMS

WASHINGTON
1910

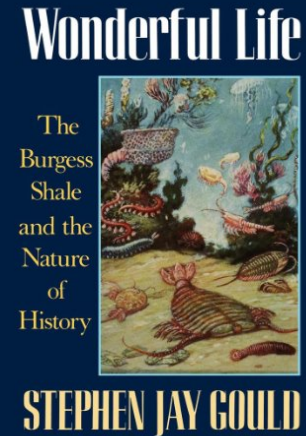
... if one physical law exists more absolute than another, it is the law that **stable equilibrium is death**.

A society in stable equilibrium is — by definition, — one that has history, and wants not historians. [Adams, p. 186]

... Gould has shown that evolution has been by **catastrophes**, like the one that caused the demise of the dinosaurs and more serious ones that extinguished up to percent of all species nearly six hundred million.

Gould has concluded that such catastrophes have been more instrumental in shaping the course of evolution than competition and natural selection.

If so, then no necessary direction can be imputed to evolution, and **the current state of nature may not be inevitable and predictable**. [Burich p. 645]



Adams, Henry. 1910. A Letter to American Teachers of History. Washington [Press of J.H. Furst]. <http://archive.org/details/alettertoamerica00adamuoft>.

Burich, Keith R. 1992. “‘Stable Equilibrium Is Death’: Henry Adams, Sir Charles Lyell, and the Paradox of Progress.” *The New England Quarterly* 65 (4): 631–47. doi:10.2307/365825.

“Stable equilibrium is death” at <https://stream.syscoi.com/2017/09/24/stable-equilibrium-is-death/>

Is your (theory building) system generative?

Systematic

Somatic

(adaptive, cellular)
change

Non-living,
effect-producing
(allopoietic)

Reactive

Systemic

Genotypic

(generational)
change

Living,
systems-generating
(autopoietic)

Co-responsive

Agenda

1. Designing for tame problems c.f.
Architecting for wicked messes
2. Analyzing the complicated c.f.
Synthesizing the complex
3. Unfreeze-change-freeze c.f.
Co-responsive movement
4. Planning (teleology) c.f.
Programming (teleonomy)
5. Industrial value chain c.f.
Co-producing offerings
 - a. Quality in the thing c.f.
Quality in the interaction
 - b. Theory of the offering
 - c. Production systems c.f.
Service systems
 - d. Production language c.f.
Affordance language
 - e. Adaptive
(cellular change, allopoietic) c.f.
Generative
(genetic change, autopoietic)

