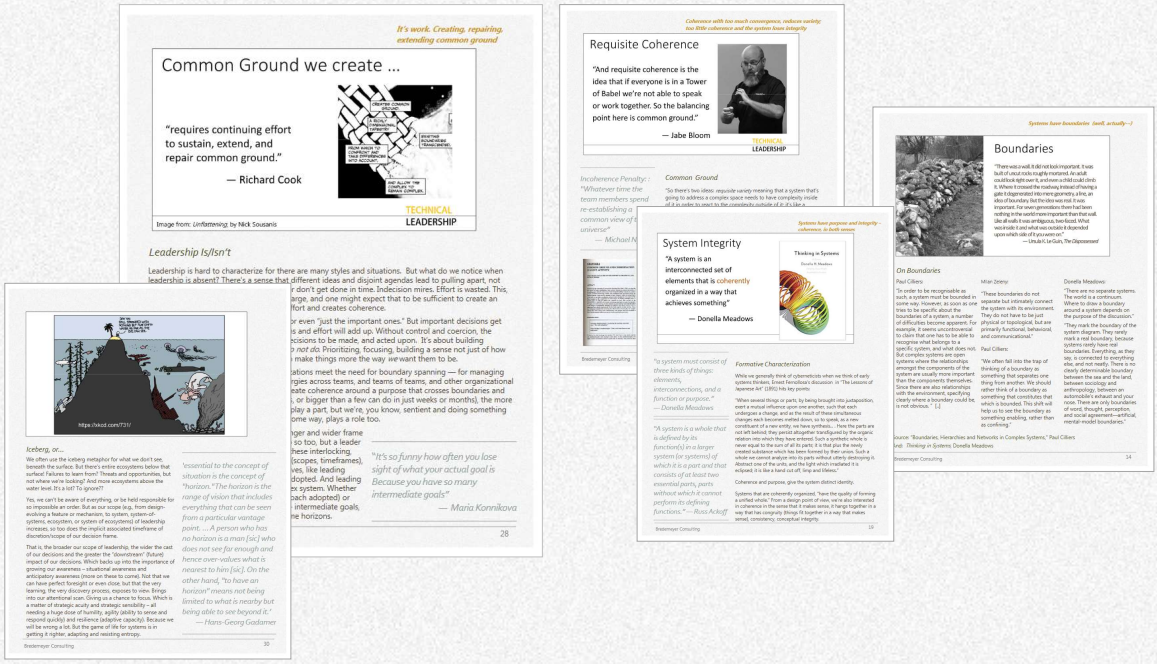
TECHNICAL LEADERSHIP

Ruth Malan



June 2024

Technical Leadership Workshops

Remote:

- July 16 and 23, 2024, 12pm-3pm Eastern Time (US/Canada).

System Design and Software Architecture Workshops

Remote:

- Oct 21-23 and 28-30, 2024, 11am-3:30pm Eastern Time (US/Canada).

See ruthmalan.com for schedule and more information.

discourse (n.): late 14c., "process of understanding, reasoning, thought,"

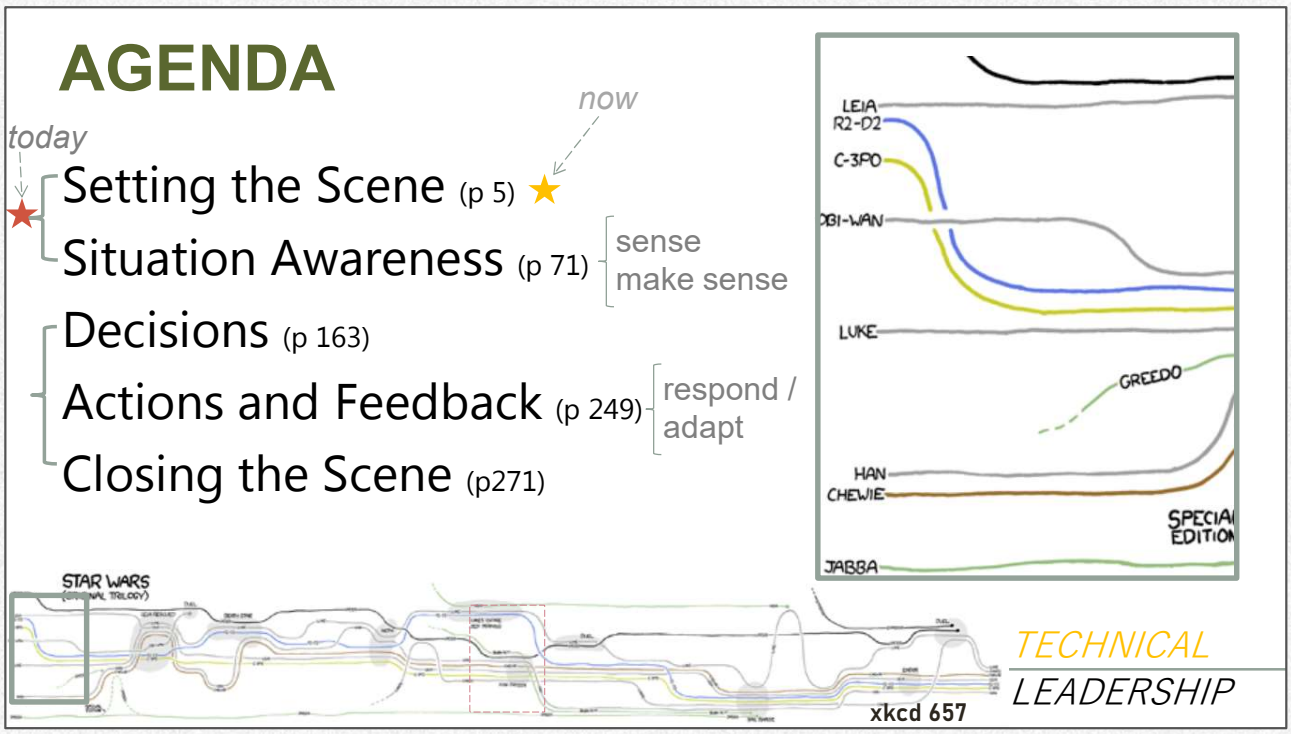


Image: by Randall Monroe, https://xkcd.com/657/

The XKCD 657 narrative map is used to suggest (figuratively) we're all unfolding our own story, and our journeys through this space are unique, and challenging, and this class will have some familiarity and surprises. The slider is just a reminder of where we are. Now, we're at *a* beginning. Setting the scene. But not *the* beginning. We all bring so much to this. We will draw on that throughout.

The territory we span here, is vast. Choices had to be made. This is one path.

"The map is not the territory," Snicket's chaperon advises him. "That's an expression which means the world does not match the picture in our heads."
— Lemony Snicket, Who Could That Be at This Hour?

This workshop combines concepts (in this book), conversation (among us, and ideas) and practice

(But what's) the Agenda?

We will explore

- Concepts, to think with
- Frames, to think within and across — together
- to inform our conceiving, deciding, doing

as leaders

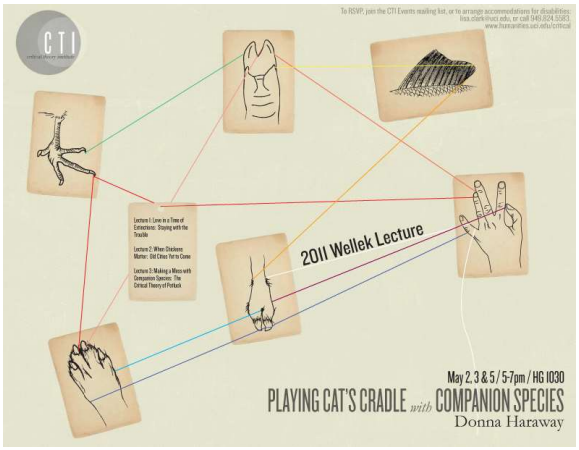


Image: Poster for Donna Haraway's Wellek Lectures, 2011 via https://adanewmedia.org/2013/11/issue3-haraway/

To Think With, To Inform Our Doing

'The British sociologist Marilyn Strathern [..] taught me that "it matters what ideas we use to think other ideas (with)" [..] It matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots; what thoughts think thoughts, what descriptions describe descriptions, what ties tie ties. It matters what stories make worlds, what worlds make stories." — Donna Haraway, *Staying With The Trouble*

The orientation here is that we are all leaders — at different moments. With different styles and different bundles of capabilities, experiences, pasts, present demands and forces, and hopes and threats. In different contexts. And, due to our roles, we have impact on others. It matters how purpose is shaped, and acted on, and that we foster and what we enable and how we learn, and act-to-learn, together.

The intro (Setting the Scene) brings together a "scaffolding" of concepts that informs our practice-oriented sessions. In Situation Awareness (or Observe/Orient) the focus is on seeing and making sense of systems to make and probe Decisions (including technical decisions with organizational consequences and organizational decisions with technical consequences). The last section and work session (Learning and Feedback) explores Acting in learning loops.

" Isabelle Stengers [..] insists we cannot denounce the world in the name of an ideal world. [..] she maintains that decisions must take place somehow in the presence of those who will bear their consequences.

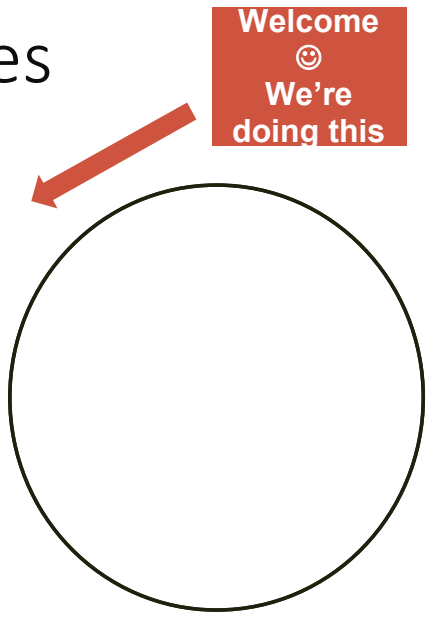
— Donna Haraway

Setting the Scene

Leadership and Systems

Landscape of Leadership

We Are Our Own Stories



Think of yourself in a challenging situation that needed leadership, and you made a difference

- Draw a circle
- Outside the circle: Write some characteristics (esp. what made it demanding) of the situation
- Inside the circle: Write some of your characteristics and actions inside the circle, especially those that reflect you as a leader in that situation

"You are your own stories." —Toni Morrison

TECHNICAL LEADERSHIP

Leadership Stories

We like to begin with a story, and we could begin with a story from history, or our field. But we are our own stories, too, and so let's begin there. Let's spend a few minutes reflecting on some situation we've been in, where we did some architecture work, and we like what we brought to it. Not that we think everything was perfect, but where we brought something to the situation that impacted outcomes and experiences.

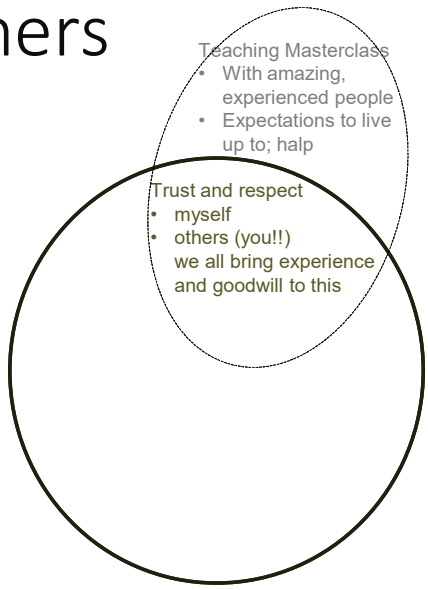
Draw a circle. To one side, describe the situation briefly. Inside the circle, describe what you brought to the situation, to influence and impact "success" (effectiveness or achievement of desired outcomes). Don't shy away from noticing things to learn from, like what didn't go so well. Our stories are messy. Outside the circle, add what others brought to the situation, to impact (or impede) success. We can repeat this, reflecting on our experience, filling out more of the space, with situations and what we brought to them.

Stories are crucibles for learning. Our own stories too. In these stories, it is worth drawing out: what was the problem or challenge and what made it important or of value to solve? What role did we and others play? What did we and others bring to it?

We Are Because of Others

As we do so, what do we notice

- About situations needing leadership?
- About the role of others, when we're leading?
- About ourselves, when we're leading?



Leading and Following

Kurt Lewin proposed the following heuristic equation:

Lewin's Equation: B = f(P, E)
Behavior is a function of a Person interacting with the Environment (or situation)

Our leading in a context has various attributes, including our noticing what in the situation called for leadership, and following in the sense of actively pitching in to co-shape intent and the response to the situation, and get something done, that we couldn't have done alone. And this is ongoing, as we and the situation co-evolve.

Leading is Convening

"The skill of writing is to create a context in which other people can think." — Edwin Schlossberg

"Likewise, the skill of leading an organization, or creating an architecture, or creating a strategy, is structurally analogous: you are creating a context in which other people can succeed" — Eben Hewitt

Leading is distinct from "giving orders" that "must be followed," and is more about fostering conditions and enabling effective co-creation and collaboration.

"[Mary Parker] Follett argues that the primary responsibility of leadership is to discover the sense-making thread that structures understanding of the 'total situation', establish the 'common purpose' that emerges from this, and by leading, 'anticipating', make the next situation."
— Nanette Monin and Ralph Bathurst

Quote Source:
Nanette Monin and Ralph Bathurst, "Mary Follett on the Leadership of 'Everyman'," 2008

Eben Hewitt, *Technology Strategy Patterns*

Leadership and Systems

Leadership and the Organization

Systems Concepts

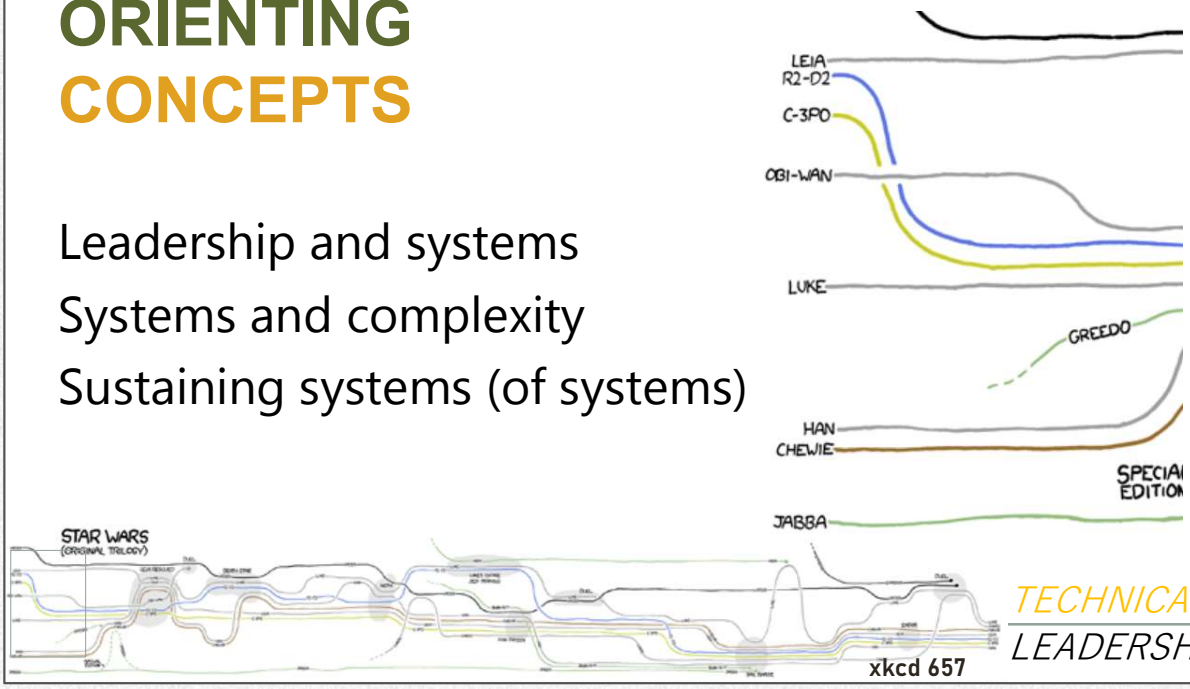
Leadership and Systems

ORIENTING CONCEPTS

Leadership and systems

Systems and complexity

Sustaining systems (of systems)



TECHNICAL
LEADERSHIP

Leadership

Leadership is about doing big, hard, important things – things we need to do, together, because they are bigger than one, or a few, can do. So they take organizational will – willingness to take on, and determination to see it through. This is why we see inspiration to action as a quality of leaders. The articulation of something that urgently needs action of several, or even many, in a way that provokes, invites, inspires, includes, is part of leadership. But it is much – much – more.

Sustained organizational will – willingness and determination and effort – is not to be assumed. We have commitments to follow through, given pay checks and jobs? Well⋯ Choices. Hard – non-obvious – tradeoffs. Short-term wins that undermine longer term initiatives. Agendas. Politics. Much can get in the way of seeing hard things through. "The *right* direction is not simply the morally right thing to do. It has to be what works." (William Duggan) And what works, is a matter of noticing what isn't working, what's risky, what's needed. Leading, in different ways, at different moments, over time.

"The most successful leader of all is the one who sees another picture not yet actualized."

— Mary Parker Follett

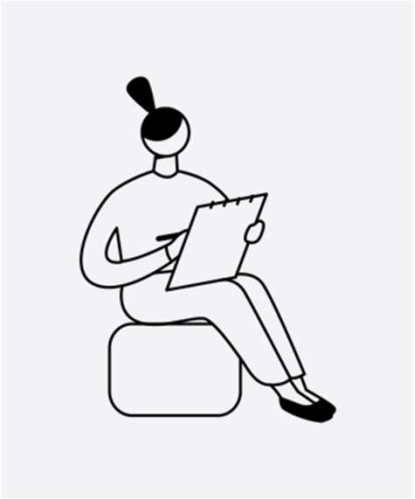
"doing any big thing will take cooperation and alignment from multiple people and teams."

— Erica Stanley

Draw Your Org

Let's get the idea pump going

- draw your org at least two different ways



TECHNICAL
LEADERSHIP

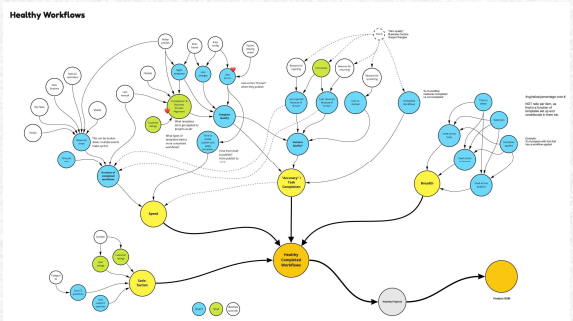
Image source: Sari Braga, thenounproject

Discussion

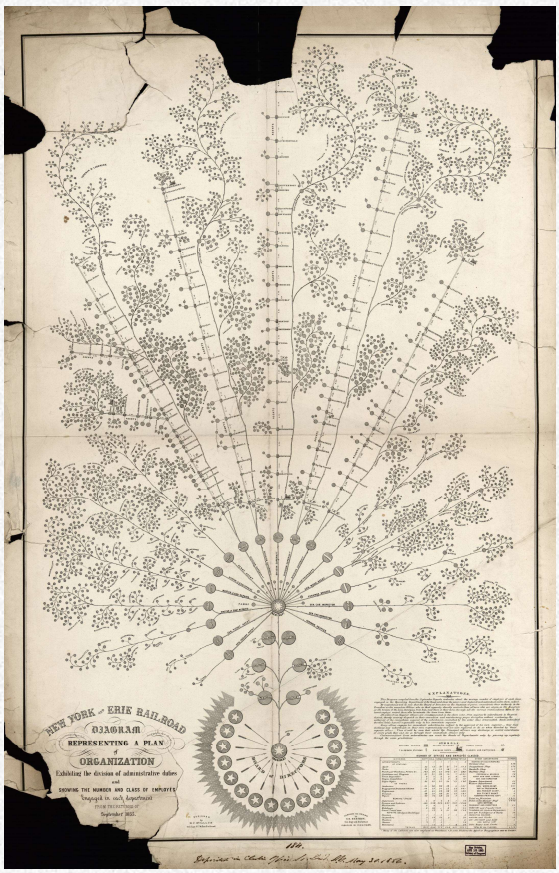
What did you draw? We're not after specifics of your org, but what occurred to you to draw? First? Next?

This is a quick exercise, but that plays a role here: it's interesting to see what our histories present to us as "natural" views of our organizations, and what we find useful and have perhaps put into practice.

The New York and Erie Railroad organization diagram (Library of Congress) is interesting in how organic it looks, and the placement of the President and Board at the "root" presents an interesting interpretive opportunity.



Healthy Work Flows, John Cutler, https://cutlefish.substack.com/p/tbm-652-inputs-first-bets-next

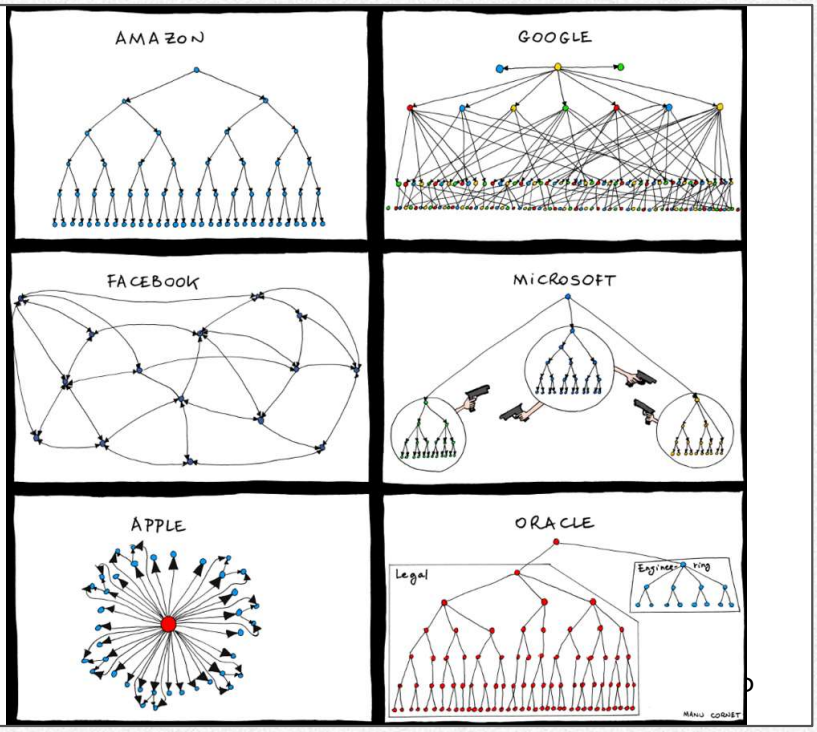


New York and Erie Railroad diagram representing a plan of organization : exhibiting the division of academic duties and showing the number and class of employees engaged in each department : from the returns of September 1855 https://www.loc.gov/item/2017586274/

Lol ⋯ yup. Org culture bleeds through at the relationships⋯

Org Charts

If you drew a cartoon (exaggerated form) of your org, what would we learn?



"Org charts" comic by Manu Cornet
Source: wikimedia commons

"One of the hardest and most valuable things you can do as a company is the following:

1. Have a fully up to date org chart
2. Have a diagram that is not the org chart that accurately reflects how work flows through the company
3. Have an up to date and accurate diagram and explanation of what the company does and how it does it (architecture, revenue funnels, business value streams, code-bases)

*Scaling decision making is *impossible* without a shared context to build alignment off of.*

— Hazel Weakly

Who Drew That Org Chart Comic?

Manu Corbet, but I mean in our exercise. There is a range of possibility in this area, from drawing the formal structures and structural relationships (like hierarchy or reporting relationships), to cultural aspects that draw out power dynamics and "dragons be there" and "elephants here," to dynamic views like how work flows.

Why are these views useful? One answer comes from Hazel Weakly:

> "Scaling decision making is *impossible* without a shared context to build alignment off of. [..]
>
> Alignment and direction is so hard to get; clarity of what you're doing and how you fit into and contribute to a system is so hard to maintain. But it's so important that it should never be neglected."

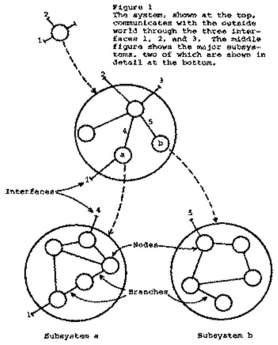
With the exception perhaps of quite small organizations, they will form, or be formed into, some structure — it might be relatively stable or quite dynamic; it might centralize or distribute power; and so forth. That structure introduces co-ordination and alignment needs.

Quote source: Hazel Weakly
https://hachyderm.io/@hazelweakly/110979361948302539

Culture is shaped and renewed in formal and informal conversations: what gets attention? Not?

Org Charts and Conversations

The formal org indicates where conversations are fostered or (more or less) impeded by org distance and incentives



conclusion

The basic thesis of this article is that organizations which design systems (in the broad sense used here) are constrained to produce designs which are copies of the communication structures of these organizations. We have seen that this fact has important implications for the management of system design. Primarily, we have found a criterion for the structuring of design organizations: a design effort should be organized according to the need for communication.

This criterion creates problems because the need to communicate at any time depends on the system concept in effect at that time. Because the design which occurs first is almost never the best possible, the prevailing system concept may need to change. Therefore, flexibility of organization is important to effective design.

Ways must be found to reward design managers for keeping their organizations lean and flexible. There is need

HOW DO COMMITTEES INVENT?

by MELVIN E. CONWAY

Org Charts … and Org Culture?

Organization (org) charts reflect the formal organization, and structure enables and constrains, facilitating some and impeding other organizational relationships and communication flows, impacting in(ter)dependence and co-ordination of work towards outcomes (intended or otherwise). That is, org structure impacts and is impacted by organizational culture (in good part shaped and transmitted in conversations, and what is attended to and emphasized, and not). The interaction between org design and culture, and culture and org design, is (hilariously and keenly) illustrated in Emmanuel "Manu" Cornet's well-known comic (created in 2011).

Whether the organization is more hierarchical and leans more into power-over, or flatter, supporting a co-active, participatory power-with culture, or some hybrid of power and participation, it is worth reiterating: leadership factors in any and all of them. What distinguishes leaders is noticing a big thing that needs to be done, and setting about inspiring and gathering the organizational will and wherewithal to do that – over time, too, as the difficulty becomes clear and commitment otherwise flags. And other leaders step up to those challenges. It is about hard choices (decisions) and priorities. But first it is about noticing. It is also about working together to build shared intent, and enough concert and coherence and focus to do the big thing – together. As things change and new obstacles emerge.

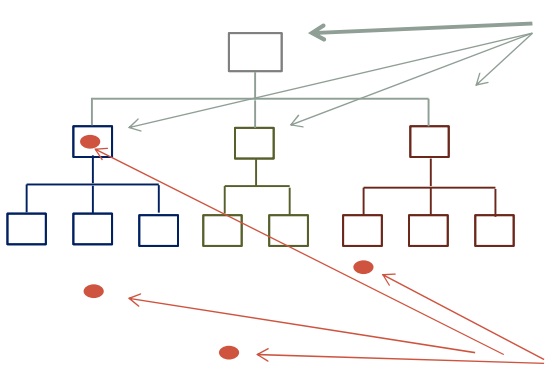
'Ed Schein defines culture as "the accumulated shared learning of that group as it solves its problems of external adaptation and internal integration; which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, feel, and behave in relation to those problems" [..] That is, how people interact with each other while pursuing organizational objectives leads to organizational culture.'

*— Eb Ikonne**

** Becoming a Leader in Product Development*, Ebenezer Ikonne, 2021

Leadership isn't inherently about hierarchy. Though hierarchy is not irrelevant.

Hierarchies, Leadership, Relationship?



It's useful to ask: when is leadership needed?

TECHNICAL
LEADERSHIP

Leadership and Hierarchy

Leadership plays a role in various organizational forms. Even in hierarchical organizations, people throughout the organization step into and out of leadership moments, to foster doing something that isn't being done, needs to be, but takes more than just a few people collaborating closely.

Still, senior management are often referred to as "The Leadership," and it's worth taking a moment to consider. Formal power over hiring/retention and budgets/priorities, as well as the social capital of esteem and prestige of senior managers, can mean that even their "whispers are heard as roars." We attend, and interpret and try to line up with their intent. This is worth saying, so that senior managers understand that dynamic, and responsibility, for it has implications. For example, it can make it harder for leading to happen elsewhere in the organization.

If managers are getting things done through control and threat and negative force, if that's a style of leadership, it's not one we're exploring here. (We do have the option to, for example, explore the uses and abuses of power in office hours.)

"it is possible to develop the conception of power-with, a jointly developed power, a co-active, not a coercive power."

— Mary Parker Follett

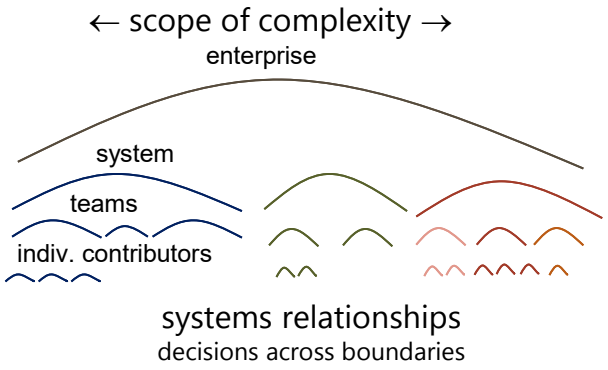
"The leader-leader structure is fundamentally different from the leader-follower structure. At its core is the belief that we can all be leaders and, in fact, it's best when we are all leaders."

— David Marquet, Turn the Ship Around!

Leadership Across

Scope of complexity is about the span of responsibility (taken on, or inherent to) and focus of attention of a role

Scope within a team evolving a (part of a) system is less than scope at the business unit level, for example.



TECHNICAL LEADERSHIP

Leadership Across (Scopes of Complexity)

The management hierarchy is an accountability hierarchy in the contractual, fiduciary and financial sense. It manages people but also resources, like getting funding early on, and allocating budgets across priorities, including new business creation, later on. Obvious, and yet we can overlook both the importance, work and attention required, and the stresses involved, in being responsible for keeping salaries paid, investors and boards satisfied, and making choices where outcomes may only be fully visible years ahead.

It is also a part of the (broader) communication and co-ordination network. Influence networks, or informal relationships, facilitate communication, creating alternate pathways in the organization, and can help to get cross-boundary things done with less bureaucracy. They may be largely invisible (the kind of thing where it would take many interviews to map the influence network out, and still miss much) until they kick into higher gear to effect or impede change.

There's also the network of relationships in place to get work done. We're going to focus on complex systems built, evolved and operated by several, or even many, teams. Some of the system spanning work is reflected in the management hierarchy; some in technical roles that span, like architect roles; some is (ad hoc) "glue" work. As the span of responsibility increases in scope, from responsibility for some local part of a system, to responsibility across subsystems and systems, the compass (span) of complexity in technical and organizational terms increases, and the demands on mastery shifts.

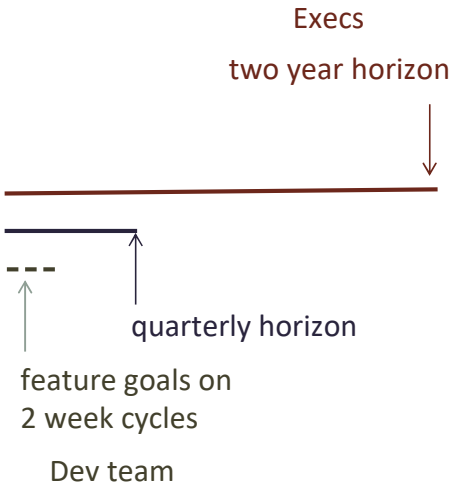
Back to hierarchy for a moment, and a couple of points from the Jo Freeman classic ("The Tyranny of Structurelessness"): "Contrary to what we would like to believe, there is no such thing as a 'structureless' group." and "The structure may be flexible, it may vary over time. It may evenly or unevenly distribute tasks, power and resources over the members of the group." An explicit hierarchy is visible, and hence can be worked on, to make it more inclusive and more about leadership (power-with rather than dominance and power-over).

> *"the scales of information, people, time horizons and information all changes. As a result so does the impact." — Nivia Henry*

Seniority relates to scope and time span of work, with increasing complexity and uncertainty associated with more seniority

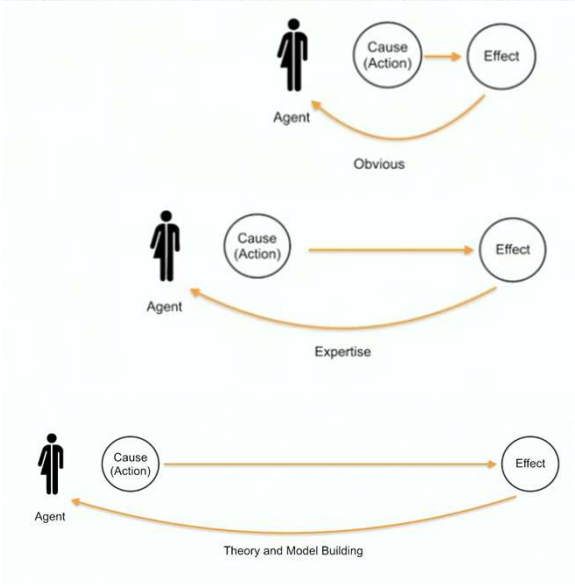
Time Span of Discretion

A person's time span of discretion is about the (time and complexity related) span of the work they have discretion (decision power) over.



Reference: *Requisite Organization*, by Elliot Jaques

TECHNICAL LEADERSHIP



Source: Jabe Bloom, Whole Work: Sociotechnicity & DevOps

Leadership and Time/Scope

Seniority generally comes with increasing scope of concern (across systems, of systems, and, with more seniority, more impact on ecosystems). Increases in scope mean we're with dealing with greater complexity, and need expertise and experience that is rooted in the technical but is increasingly strategic and organizational. And we're dealing with longer time horizons, so more uncertainty.

Elliott Jaques' concept of time span of discretion/span of complexity provides a way to talk about roles and decision span. Those with shorter time span of discretion (and more narrowly scoped decision frames) are making decisions with more immediate impact and conscribed decision autonomy (e.g., the time horizon for completion of work made visible to others on the team or management, may be days or weeks). More senior roles are paying attention to longer term outcomes, across more of the organization. More hinges on what decisions are made, and not. All of these different scopes of concern take attention and cognitive bandwidth, and demand experience and expertise, but the focus shifts from more immediate observable effects, to making judgment calls under greater uncertainty and complexity. (That said, the essentialism aspect of Jaques work is⋯ hard pass.)

While "time span of discretion" flavors the concept with what decisions we have discretion over or power to effect, Yvonne Lam draws attention to what timespan infuses our work and so draws/shapes our focus: "different entities (orgs, roles, etc.) have a span of time in which they can effect change, so that's the span of time to which they tend to pay attention." What I'm attending to, shapes what I perceive and attend to.

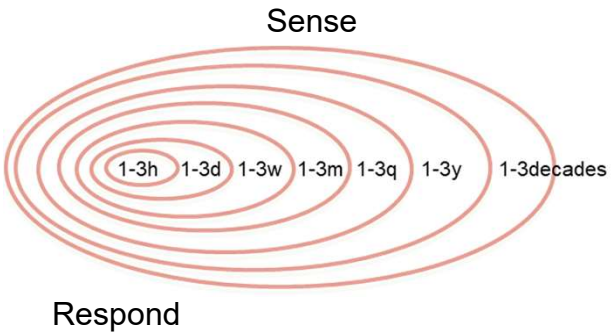
"thought about it as time travel: the higher up you go, the more you live in the future. As a senior eng you live 1-2 sprints out. A manager, 1-3 months. A director 3-9 months and so on. " — Danielle Leong

While, in general, we're seeking to shorten feedback loops, some decisions unfold impact over longer horizons

Anticipatory Response-ability

"One (of many) ways to think of product [and systems] work is to imagine a series of interlocking and related sense and respond orbits....it is all happening NOW, but the orbits range in terms of length..."

— John Cutler



TECHNICAL LEADERSHIP

Image and quote source: https://twitter.com/johncutlefish/status/1571582435598675970

Implications for Horizons of Concern

One way to think about strategic significance, has to do with what shapes the ecosystem and system possibility space. What decisions lay down more or less binding "tracks" – create constraints, and relationships and value flows. What decisions are long horizon "bets," that set us up for years of value creation and transformation, and enable viability and establish identity, but also bind us into expectations and ecosystem (legacy) relationships that are harder to vacate without damaging market relationships. And what are local decisions we can adjust to and away from quite readily.

A decision with broad impact across the organization, that underpins a myriad subsequent decisions and hence shapes the outcome possibility space over time, has many social and technical implications.

We introduce these concepts of scope and timespan, to offer some language and distinctions around scopes of influence and impact. A leader in a small group setting is working with qualitatively different challenges (in terms of complexity, uncertainty, feedback loops) than a leader working across groups within an organization, or across organizations.

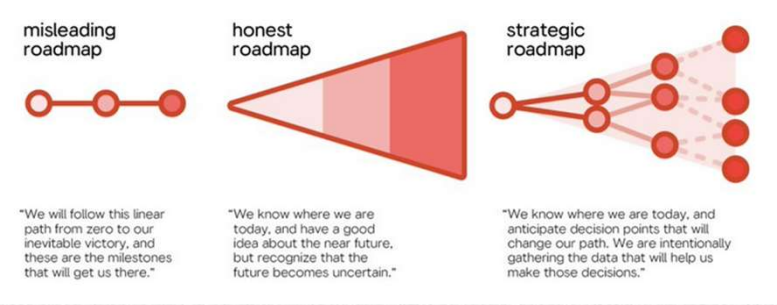


Image Source: Pavel A Samsonov, https://twitter.com/PavelASamsonov/status/1296818042928861184

"the cost of change from an executive, is completely different from the cost of change from a development team"

— Jabe Bloom

Systems? And Leadership?

What makes what we do challenging?

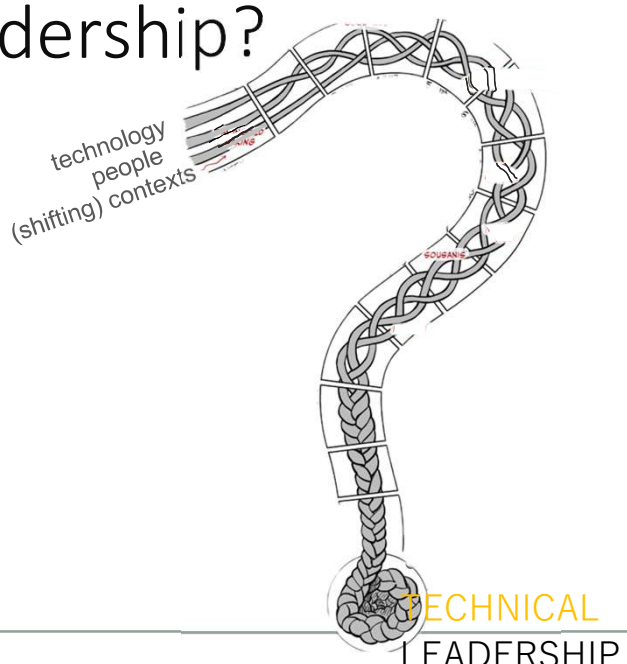


Image (adapted) from: Nick Sousanis, https://twitter.com/Nsousanis/status/1354209403172319234

We're Starting with Systems. Why?

The grounding assumption is that we are leaders in technology-intensive system development settings. If we ask what makes what we do challenging, the answer is often something along the lines of "people. The software part is easy." And is it, though? Or is it that what we want to do with technology draws us into systems. Social systems to get the work done. Software intensive systems that have all manner of economic, social, technical, and ecological implications — that people disagree on. And suddenly we're tumbling into challenges that are not readily partitioned into a technology part and a people part, where the latter is the hard part. And yet! The latter is hard, and not the same kind of hard as addressing a bounded technical challenge. Even if we limit ourselves to talking about programming, complex systems reach beyond our individual cognitive carrying capacity. And we're right back into people things. And people things happen slowly then fast. Fast then not at all. People things are as simple as a conversation. And the kind of messy that is full of conflicting ideas and inertial sinks. We needs must involve people; several and then many. And organize our systems, and teams that design-evolve them. Which gets us into matters of scopes of relative focus and independence, and integration. Matters of systems, and the concepts that we can use to think other matters with. That help us frame, and shape, our practice as leaders.

"Often in systems thinking, we make sure we understand technical integration — the work needed at technical boundaries. But we also do ourselves & our teams a huge service in understanding, building, & maintaining pathways needed to navigate organizational boundaries."

— Erica Stanley

Systems have structural elements, but they are other than sums of parts

System

"The defining properties of any system, are properties of the whole, which none of the parts have. If you take the system apart, it loses its essential properties"

— Russell Ackoff

If Russ Ackoff had given a TED Talk...

TECHNICAL LEADERSHIP

"The only thing added to the parts to make the whole greater than the sum of its parts is the interrelationships among them." — Eb Rechtin

"You think that because you understand "one" that you must therefore understand "two" because one and one make two. But you forget that you must also understand "and."

— Donella Meadows

What Characterizes Systems

In this roughly 10 minute (starting at 1:12) talk, Russ Ackoff covers and illustrates the key characteristics of systems. Notably, a system has properties that none of its parts have, on their own. When we take a system, decompose it into its parts, optimize the parts, and put them back together, we don't even necessarily get a working system. To see this, imagine you have the best automotive engineers in the world pick the best carburetor, the best fuel pump, distributor, and so on. Now ask them to assemble those best parts into a car. They can't because the parts don't fit. [But even if we could make them fit, we can't say anything about the properties, since they are emergent from interactions among the parts, and with the context (stopping on gravel versus pavement, etc.).]

Without interrelationships, we have, as Wim Roelandts put it: "parts flying in formation, trying to be an airplane."

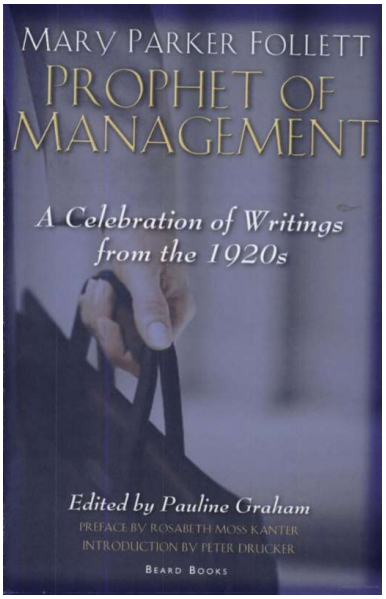
Obvious? Surely. Yet we need to act on this understanding. It is not enough to decompose a system into components or microservices or whatever the chunking du jour, minimizing interdependence, and proceed as if coherent systems will gracefully emerge from independent "two pizza" teams.

Synergy: from Greek sunergos 'working together'

Not Aggregation, but Integration

"It has often been thought in the past [..] that I need be concerned only with doing my part well. It has been taken as self-evident, as a mere matter of arithmetic like 2 and 2 making 4, that if everyone does his best, then all will go well. But one of the most interesting things in the world is that this is not true, although on the face of it it may seem indisputable. Collective responsibility is not something you get by adding up one by one all the different responsibilities. Collective responsibility is not a matter of adding but of interweaving, a matter of the reciprocal modification brought about by the interweaving. It is not a matter of aggregation but of integration."

— Mary Parker Follett



Observations on Ackoff and Systems

From Rubén Mezas' notes on the Russ Ackoff talk:

> "The System is a Whole that consists of parts, each of which can affect it's behavior or properties."
>
> "The Parts of the System are interdependent"
>
> "The System has properties that none of the parts has."
>
> "The System is a product of its parts interactions."
>
> "Improvement of the parts taken separately won't improve the whole"
>
> "The form of the System depends on how the parts fits"
>
> "Improvement must be directed at what you want. Not what you don't want."

This from Trond Hjorteland:

> "We still haven't taken onboard the interconnectedness of the parts in a system. We still believe we can break things down and treat it in isolation. See it all the time, everywhere, both in design, but also team structure, projects, etc."

is underscored in Joonas Koivunen's point too:

> "I guess my main question which comes out of the understandable/intuitive examples is, why is system thinking still such a niche/unpopular idea."

No easy answers, but grist for important discussion.

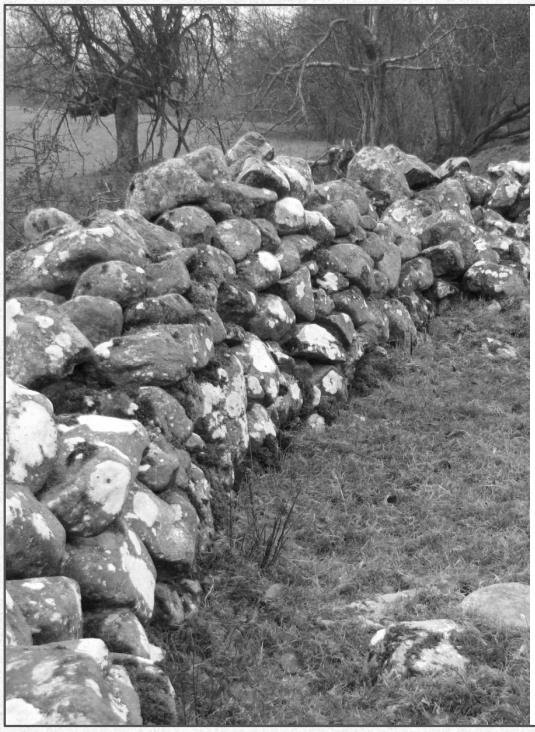
"Finding and removing defects is not a way to improve the overall quality or performance of a system."

"An improvement program must be directed at what you want, not at what you don't want."

— Russell Ackoff

"When there is a weak link, a chain is not made stronger by strengthening the other links"

— Richard Rumelt



Boundaries

"There was a wall. It did not look important. It was built of uncut rocks roughly mortared. An adult could look right over it, and even a child could climb it. Where it crossed the roadway, instead of having a gate it degenerated into mere geometry, a line, an idea of boundary. But the idea was real. It was important. For seven generations there had been nothing in the world more important than that wall. Like all walls it was ambiguous, two-faced. What was inside it and what was outside it depended upon which side of it you were on."

— Ursula K. Le Guin, *The Dispossessed*

On Boundaries

Paul Cilliers:

"In order to be recognisable as such, a system must be bounded in some way. However, as soon as one tries to be specific about the boundaries of a system, a number of difficulties become apparent. For example, it seems uncontroversial to claim that one has to be able to recognise what belongs to a specific system, and what does not. But complex systems are open systems where the relationships amongst the components of the system are usually more important than the components themselves. Since there are also relationships with the environment, specifying clearly where a boundary could be, is not obvious. " [..]

Milan Zeleny:

"These boundaries do not separate but intimately connect the system with its environment. They do not have to be just physical or topological, but are primarily functional, behavioral, and communicational."

Paul Cilliers:

"We often fall into the trap of thinking of a boundary as something that separates one thing from another. We should rather think of a boundary as something that constitutes that which is bounded. This shift will help us to see the boundary as something enabling, rather than as confining."

Donella Meadows:

"There are no separate systems. The world is a continuum. Where to draw a boundary around a system depends on the purpose of the discussion."

"They mark the boundary of the system diagram. They rarely mark a real boundary, because systems rarely have real boundaries. Everything, as they say, is connected to everything else, and not neatly. There is no clearly determinable boundary between the sea and the land, between sociology and anthropology, between an automobile's exhaust and your nose. There are only boundaries of word, thought, perception, and social agreement—artificial, mental-model boundaries."

Source: "Boundaries, Hierarchies and Networks in Complex Systems," Paul Cilliers

And: *Thinking in Systems*, Donella Meadows

Architecture Of Complexity

"Empirically, a large proportion of the complex systems we observe in nature exhibit hierarchic structure. On theoretical grounds we could expect complex systems to be hierarchies in a world in which complexity had to evolve from simplicity."

— Herbert Simon

THE ARCHITECTURE OF COMPLEXITY

HERBERT A. SIMON*

Professor of Administration, Carnegie Institute of Technology

(*Read April 26, 1962*)

A NUMBER of proposals have been advanced in recent years for the development of "general systems theory" which, abstracting from properties peculiar to physical, biological, or social systems, would be applicable to all of them.[1] We might well feel that, while the goal is laudable, systems of such diverse kinds could hardly be expected to have any nontrivial properties in common. Metaphor and analogy can be helpful, or they can be misleading. All depends on whether the similarities the metaphor captures are significant or superficial.

It may not be entirely vain, however, to search for common properties among diverse kinds of complex systems. The ideas that go by the name of cybernetics constitute, if not a theory, at least a point of view that has been proving fruitful over a wide range of applications.[2] It has been useful to look at the behavior of adaptive systems in terms of the concepts of feedback and homeostasis, and to analyze adaptiveness in terms of the theory of selective information.[3] The ideas of feedback and information provide a frame of reference for viewing a wide range of situations, just as do the ideas of evolution, of relativism, of axiomatic method, and of operationalism.

In this paper I should like to report on some things we have been learning about particular kinds of complex systems encountered in the behavioral sciences. The developments I shall discuss arose in the context of specific phenomena, but the theoretical formulations themselves make little reference to details of structure. Instead they refer primarily to the complexity of the systems under view without specifying the exact content of that complexity. Because of their abstractness, the theories may have relevance—application would be too strong a term—to other kinds of complex systems that are observed in the social, biological, and physical sciences.

In recounting these developments, I shall avoid technical detail, which can generally be found elsewhere. I shall describe each theory in the particular context in which it arose. Then, I shall cite some examples of complex systems, from areas of science other than the initial application, to which the theoretical framework appears relevant. In doing so, I shall make reference to areas of knowledge where I am not expert—perhaps not even literate. I feel quite comfortable in doing so before the members of this society, representing as it does the whole span of the scientific and scholarly endeavor. Collectively you will have little difficulty, I am sure, in distinguishing instances based on idle fancy or sheer ignorance from instances that cast some light on the ways in which complexity exhibits itself wherever it is found in nature. I shall leave to you the final judgment of relevance in your respective fields.

I shall not undertake a formal definition of

* The ideas in this paper have been the topic of many conversations with my colleague, Allen Newell. George W. Corner suggested important improvements in biological content as well as editorial form. I am also indebted, for valuable comments on the manuscript, to Richard H. Meier, John R. Platt, and Warren Weaver. Some of the conjectures about the nearly decomposable structure of the nucleus-atom-molecule hierarchy were checked against the available quantitative data by Andrew Schoene and William Wise. My work in this area has been supported by a Ford Foundation grant for research in organization and a Carnegie Corporation grant for research on cognitive processes. To all of the above, my warm thanks, and the usual absolution.

[1] See especially the yearbooks of the Society for General Systems Research. Prominent among the exponents of general systems theory are L. von Bertalanffy, K. Boulding, R. W. Gerard, and J. G. Miller. For a more skeptical view—perhaps too skeptical in the light of the present discussion—see H. A. Simon and A. Newell, Models: their uses and limitations, in L. D. White, ed., *The state of the social sciences*, 66-83, Chicago, Univ. of Chicago Press, 1956.

[2] N. Wiener, *Cybernetics*, New York, John Wiley & Sons, 1948. For an imaginative forerunner, see A. J. Lotka, *Elements of mathematical biology*, New York, Dover Publications, 1951, first published in 1924 as *Elements of physical biology*.

[3] C. Shannon and W. Weaver, *The mathematical theory of communication*, Urbana, Univ. of Illinois Press, 1949; W. R. Ashby, *Design for a brain*, New York, John Wiley & Sons, 1952.

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, VOL. 106, NO. 6, DECEMBER, 1962

467

Source: "The Architecture of Complexity" by Herbert Simon

"We find structure on all scales. In order to see how difficult it is to grasp these structures, it is necessary to look at the boundaries of complex systems, and to the role of hierarchies within them." — Paul Cilliers

"If you ask a person to draw a complex object—such as a human face—[t]he[y] will almost always proceed in a hierarchic fashion."

— Herbert Simon

Herbert Simon's Parable of the Watchmakers

"Let me introduce the topic of evolution with a parable. There once were two watchmakers, named Hora and Tempus, who manufactured very fine watches. Both of them were highly regarded, and the phones in their workshops rang frequently -new customers were constantly calling them. However, Hora prospered, while Tempus became poorer and poorer and finally lost his shop. What was the reason?

The watches the men made consisted of about 1,000 parts each. Tempus had so constructed his that if he had one partly assembled and had to put it down-to answer the phone say-it immediately fell to pieces and had to be reassembled from the elements. The better the customers liked his watches, the more they phoned him, the more difficult it became for him to find enough uninterrupted time to finish a watch.

The watches that Hora made were no less complex than those of Tempus. But he had designed them so that he could put together subassemblies of about ten elements each. Ten of these subassemblies, again, could be put together into a larger subassembly; and a system of ten of the latter subassemblies constituted the whole watch. Hence, when Hora had to put down a partly assembled watch in order to answer the phone, he lost only a small part of his work, and he assembled his watches in only a fraction of the man-hours it took Tempus."

Source: "The Architecture of complexity" by Herbert Simon

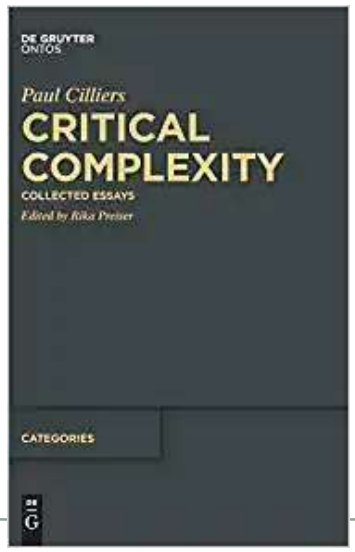
Characteristics of Complex Systems

1. Complex systems consist of a large number of elements that in themselves can be simple.

2. The elements interact dynamically by exchanging energy or information. These interactions are rich. Even if specific elements only interact with a few others, the effects of these interactions are propagated throughout the system. The interactions are nonlinear.

3. There are many direct and indirect feedback loops.

— Paul Cilliers



Source: "What can we learn from a theory of complexity?" by Paul Cilliers

"Since the nature of a complex organization is determined by the interaction between its members, relationships are fundamental. [..] The point is merely that things happen during interaction, not in isolation."

"Part of the vitality of a system lies in its ability to transform hierarchies."

— Paul Cilliers

Paul Cilliers: What Characterizes Complex Systems

4. Complex systems are open systems—they exchange energy or information with their environment—and operate at conditions far from equilibrium.

5. Complex systems have memory, not located at a specific place, but distributed throughout the system. Any complex system thus has a history, and the history is of cardinal importance to the behavior of the system.

6. The behavior of the system is determined by the nature of the interactions, not by what is contained within the components. Since the interactions are rich, dynamic, fed back, and, above all, nonlinear, the behavior of the system as a whole cannot be predicted from an inspection of its components. The notion of "emergence" is used to describe this aspect. The presence of emergent properties does not provide an argument against causality, only against deterministic forms of prediction.

7. Complex systems are adaptive. They can (re)organize their internal structure without the intervention of an external agent.

Certain systems may display some of these characteristics more prominently than others. These characteristics are not offered as a definition of complexity, but rather as a general, low-level, qualitative description."

Source: "What can we learn from a theory of complexity?" by Paul Cilliers

Complexity has to do with dynamic (inter)relationships

Complexity

complexity (n.)

1721, "composite nature, quality or state of being composed of interconnected parts"

Etymology: https://www.etymonline.com/word/complexity

Complex: from the Latin complecti

Completi: from com (“together”) and plectere (“to braid”)

Mirriam Webster

Image source: *Visual Complexity*, Manuel Lima

Complexity: Parts and Dynamic Relationships

While complexity may be associated with many parts, a pile of sand, composed of many grains (parts), is not complex. Relationships, interconnection, gives rise to complexity. And yet, complexity as originally defined (in terms of composites of entwined or related parts), including notions of intricacy, could today be more associated with “complicated.” A mechanical watch, for all its intricate, and intricately interconnected, parts, is complicated, not complex. Generally, when we talk about complexity and complex systems, we’re addressing not just “not simple” or “not obvious,” but nondeterminism in system behavior, with interactions over time and changing contexts, influencing the system in non-deterministic ways.

Mereology (from the Greek μερος, 'part') is the study of system structure: of the relations of part to whole and the relations of part to part within a whole.

That’s a very nice word you have there, but what’s it good for? Well. It’s like this. When (system and software) architecture isn’t defined in terms of “the important stuff” or “the stuff that’s hard to change” or the “stuff that makes you fail, if you get it wrong,” it’s defined in terms of structure. System structure; parts and relations of part to part and part to whole. But we’re designing dynamic systems in dynamic, shifting, evolving contexts. And we can’t merely ignore that. Or ought not to.

"Roughly, by a complex system I mean one made up of a large number of parts that interact in a non-simple way. In such systems, the whole is more than the sum of the parts, [..] in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole.”

— Herbert Simon

Quote source: “The Architecture of Complexity,” Herbert Simon, 1962

Dynamic Behavior

"a double pendulum is a pendulum with another pendulum attached to its end, and is a simple physical system that exhibits rich dynamic behavior"

TECHNICAL LEADERSHIP

Gif from https://en.wikipedia.org/wiki/Double_pendulum

"In a complex system, the interaction among constituents of the system and the interaction between the system and its environment, are of such a nature that the system as a whole cannot be fully understood simply by analysing its components."

— Paul Cilliers

More Than Connections

"A double pendulum executes simple harmonic motion (two normal modes) when displacements from equilibrium are small. However, when large displacements are imposed, the non-linear system becomes dramatically chaotic in its motion and demonstrates that deterministic systems are not necessarily predictable." (harvard.edu)

The human leg wouldn't be much good if it was a simple double pendulum. The knee is a hinge joint with a limited range of motion (0, straight, to roughly 140 degrees). We'll return to constraints in a later section; suffice it to say, relationships, including constraints, enable higher level (subsystem and system) behavior.

"A complex system cannot be reduced to a collection of its basic constituents, not because the system is not constituted by them, but because too much of the relational information gets lost in the process."

— Paul Cilliers

Quote source: *Complexity and Postmodernism*, Paul Cilliers, 1998

Complex systems are dynamic and adaptive, and intertwingled in more complex systems

Complex Systems

are characterized by

- interactions, feedback, and emergence
- open to the environment
- have history/are influenced by what has happened

"this means each system is unique" — Vesna Vukovic

Image source: by Sue Borchardt, @contemplatethis

Complex Systems and Systems of Systems

Is a car a complex system? For combustion engine cars, there's a dominant design that's being advanced to be sure, but is fairly well-understood, so it's just complicated? I'd argue that from the perspective of software *design* it is complex, because we're taking a myriad interactions under dynamic, and dynamically evolving, conditions into account — or trying to. As more sense-and-respond capability is moved into the car (anti-lock braking and skid control, and ever more "driver assist" capabilities), there's more complex interaction among more dynamic parts, and parts and (surprises from the) environment. Further, with evolutionary design and even progressive delivery/pushing code changes to cars beyond the point of manufacture, there's a sense in which the developer-car system is adaptive. Some systems more so than others. From the perspective of Lyft or Uber, however, a car, and even its driver, is playing a role in a larger system of passengers and routing and billing and more.

We're drawing boundaries for various reasons, including to conceptualize the system, and identify responsibilities for building and repairing all the interwoven webs of relationships that create and sustain the system, and its containing and interacting systems.

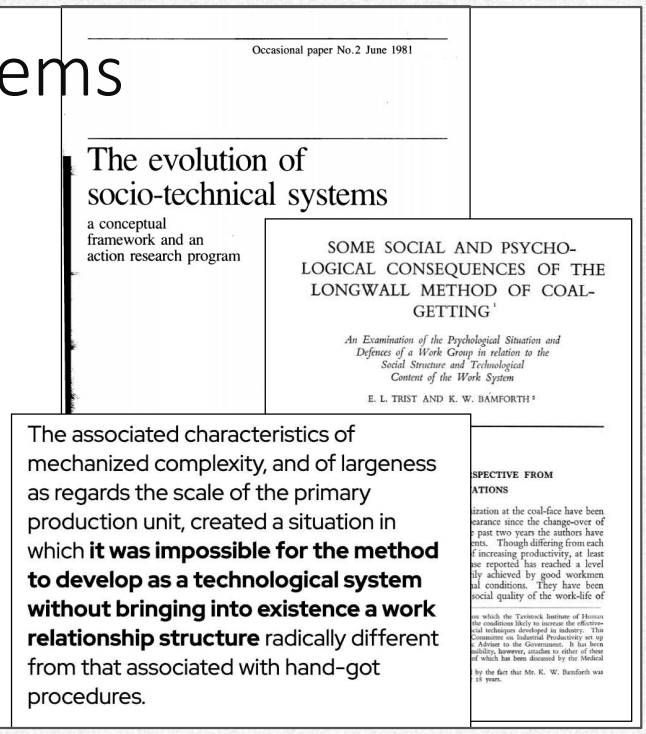
"This may serve as one definition of a complex system: namely, a system in which the actions of users have direct effects that they cannot see, and indirect effects that they might not be able to anticipate." — Daniel Jackson https://groups.csail.mit.edu/sdg/pubs/2015/concept-essay.pdf

"Boundaries are simultaneously a function of the activity of the system itself, and a product of the strategy of description involved. In other words, we frame the system by describing it in a certain way (for a certain reason), but we are constrained in where the frame can be drawn."

— Paul Cilliers

Sociotechnical Systems

Sociotechnical systems refers to systems that have social and technical elements, and there is mutual influence and interaction of technical and social elements



Occasional paper No.2 June 1981

The evolution of socio-technical systems

a conceptual framework and an action research program

SOME SOCIAL AND PSYCHO-LOGICAL CONSEQUENCES OF THE LONGWALL METHOD OF COAL-GETTING

An Examination of the Psychological Situation and Defences of a Work Group in relation to the Social Structure and Technological Content of the Work System

E. L. TRIST AND K. W. BAMFORTH

The associated characteristics of mechanized complexity, and of largeness as regards the scale of the primary production unit, created a situation in which **it was impossible for the method to develop as a technological system without bringing into existence a work relationship structure** radically different from that associated with hand-got procedures.

Sociotechnical Systems

Sociotechnical systems draws attention to this partnering of people and technology in complex systems, where people add capability to technical systems, and especially their adaptive capacity. Technical systems, in turn, extend capabilities of people involved in some way, but also impact how work is done, changing the "work relationship structure," affecting interactions, groups and individuals (potentially lowering adaptive capacity, making work unsatisfying, etc.).

The term socio-technical systems was coined by Eric Trist, Ken Bamforth and Fred Emery, based on their World War II era work with workers in English coal mines, studying the impact of replacing the manual and team-intensive "hand got" method with the "longwall method" (using mechanical conveyors and coal-cutters). They pointed out that a technological system impacts the social system it interacts with:

"So close is the relationship between the various aspects that the social and the psychological can be understood only in terms of the detailed engineering facts and of the way the technological system as a whole behaves in the environment of the underground (mining) situation."

— Eric Trist and Ken Bamforth, 1985

"the claim is that the technology and the sociology cannot be seen as independent parts, that the system as a whole can only be improved by joint optimization of those parts. Productivity and wellbeing are seen as emergent properties of the system"

— Trond Hjorteland

Trist, Eric. "The evolution of socio-technical systems." Occasional paper 2 (1981): 1981.

Trist, Eric. "A concept of organizational ecology." Australian journal of management 2.2 (1977): 161-175.

Elbanna, Amany, "Doing Sociomateriality Research in Information Systems," 2016

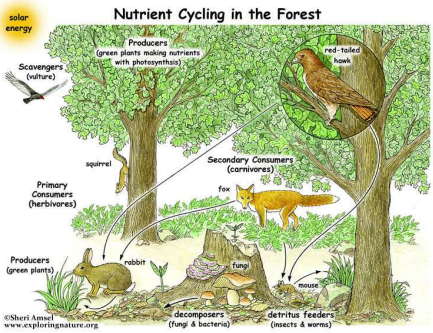
Ecosystems

ec·o·sys·tem
/ˈēkōˌsistəm/

noun ECOLOGY

a biological community of interacting organisms and their physical environment.

- (in general use) a complex network or interconnected system.
  "Silicon Valley's entrepreneurial ecosystem"



Images: https://www.exploringnature.org/
https://www.cgma.org/resources/reports/the-extended-value-chain.html

Ecosystem

"A (biological) community of interacting organisms and their (physical) environment."

"Complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space."

— Encyclopedia Britannica

"Ecotones are where two ecosystems converge, such as coastline, the edge of a forest, or a reed bed. They are transition areas between two habitats, where two biological communities meet and integrate." — Tom Geraghty

Source*: James F. Moore, *The Death of Competition: Leadership & Strategy in the Age of Business Ecosystems*. 1996.

Business Ecosystem

"An economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles." — James F. Moore*

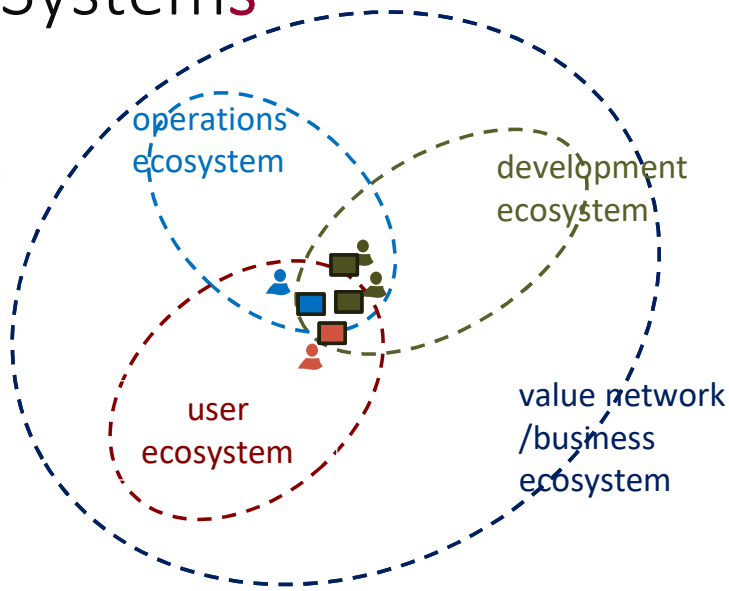
An ecosystem is not only a system of innovation-driven change, but of weaving relationships that stabilize and repair. Adapting to change, coping with uncertainty, these are things we talk about in a VUCA (volatility, uncertainty, complexity, ambiguity) world. Ecosystem activities involve flows and transformations, using and creating value. As well as activities by which stability is maintained, including repair, and building what we learn back into our systems. Or at least, we should. Maintenance (reducing tech and environmental debt), should play a larger role in our organizations and communities.

Sociotechnical Systems

Often, when we talk about sociotechnical systems, we mean the dev org and technical systems we interact with(in)

But there are various sociotechnical systems (and ecosystems) to consider:

- development
- operations
- user
- value network



Sociotechnical Systems

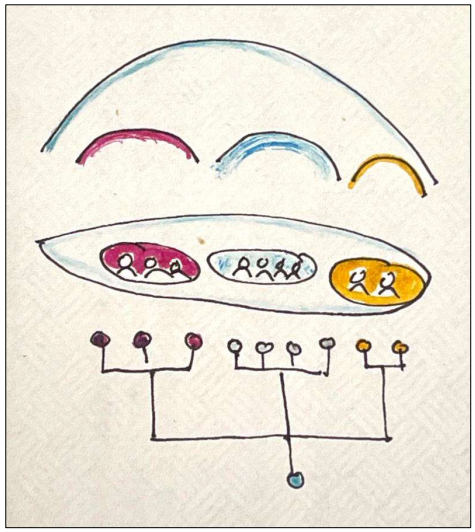
Much of the emphasis on sociotechnical systems in our field has been on ourselves in the development context, and the impact of technology on our work — how we organize to build and evolve systems, the way we structure our code and how that impacts the organization and vice versa (Conway's Law/Mirroring Hypothesis), how our development environment and CI/CD platform impacts developer experience, and more. Or we focus on users and how the systems we're building impacts their work and direct and indirect experience. In either case, noting that we need to jointly design the system and how work is done, and factor the mutual impact of technology and people and organizations. And so on. The point here is simply to remind ourselves that this needs to happen in multiple dimensions, considering these various interacting spaces of sociotechnical systems (STS) — dev STS (code, development platform, team and organizational concerns like team responsibilities, and more); user STS (software in use, user workflows and their organizational contexts as relevant, and more); etc.

"A central tenant of the ecosystem approach is that the path to sustainability is one of tradeoffs. Science can illuminate the tradeoffs but a resolution, that is, the choice of path, is a political decision"

— Michele Boyle, et al

But… Leadership?

What do systems, boundaries, complexity, sociotechnical systems, ecosystems, … have to do with… leadership??



TECHNICAL
LEADERSHIP

but… What Does This Have to Do With Leadership?

This is a good question to ask oneself, as we build up concepts and conceptualizations, that are the "material" or substance we "think with," and that informs our doing (or reflective practice). I did this as a personal exercise too; some observations:

We work within complex sociotechnical systems on complex sociotechnical systems, and these systems play a role in larger ecological webs or ecosystems. This complexity is demanding, and the cognitive and relational load means that we both look for and create boundaries within the organizational system and the system we're building and operating.

Obvious of course, but this ties back to the concepts of scope or span of complexity and timespan of discretion. Roles that are focused at broader scope, have the opportunity, and responsibility, to "see" across the system, and attend to the system in the context of the ecosystem. Yes, this is the purview of strategy: shaping identity and value contributions or role within the value network. And. It is fractal, in the sense that strategy and design occur at different scopes. And. Other "across" roles include SREs and system security and quality. Different boundaries are spanned, and boundary objects play a role, but the integrative nature of what humans do, interpersonally and in interweaving mental models, is so important too.

The more narrow the scope and more tangible the action-outcome, the more attention is drawn to the more immediate term. Pushing responsibility to strategically scan and anticipate, to broader scope.

"interesting idea to think with. Some roles, like Product Management, manage the "seams" between different time perceptions."

— @PropCazhPM

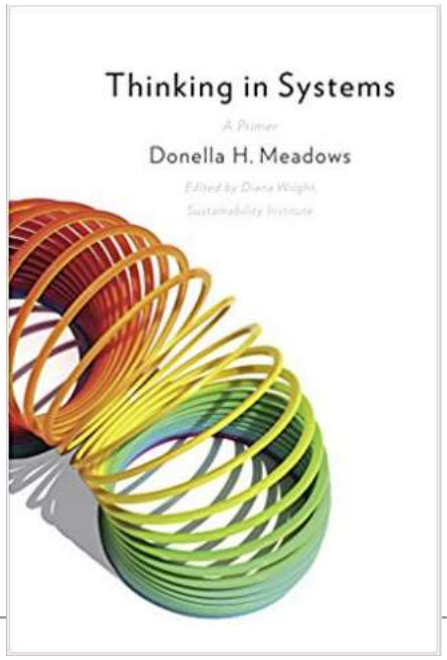
"think and play along the seams of things rather than stopping at boundaries/disciplines/ borders"

— @PropCazhPM

System Integrity

"A system is an interconnected set of elements that is coherently organized in a way that achieves something"

— Donella Meadows



"a system must consist of three kinds of things: elements, interconnections, and a function or purpose."
— Donella Meadows

"A system is a whole that is defined by its function(s) in a larger system (or systems) of which it is a part and that consists of at least two essential parts, parts without which it cannot perform its defining functions." — Russ Ackoff

Formative Characterization

While we generally think of cyberneticists when we think of early systems thinkers, Ernest Fernollosa's discussion in "The Lessons of Japanese Art" (1891) hits key points:

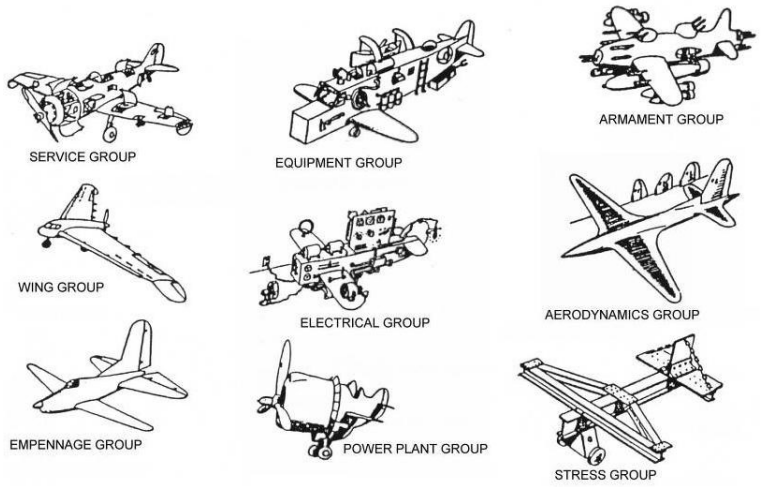
"When several things or parts, by being brought into juxtaposition, exert a mutual influence upon one another, such that each undergoes a change, and as the result of these simultaneous changes each becomes melted down, so to speak, as a new constituent of a new entity, we have synthesis... . Here the parts are not left behind; they persist altogether transfigured by the organic relation into which they have entered. Such a synthetic whole is never equal to the sum of all its parts; it is that plus the newly created substance which has been formed by their union. Such a whole we cannot analyze into its parts without utterly destroying it. Abstract one of the units, and the light which irradiated it is eclipsed; it is like a hand cut off, limp and lifeless."

Coherence and purpose give the system distinct identity.

Systems that are coherently organized, "have the quality of forming a unified whole." From a design point of view, we're also interested in coherence in the sense that it makes sense, it hangs together in a way that has congruity (things fit together in a way that makes sense), consistency, conceptual integrity.

System Integrity

- Conceptual and design integrity (requisite cohesion in the context of requisite variety, ...)
- Structural integrity (resolves forces; in contexts of complexity, co-evolution, ...)
- Organization integrity (ethics, ...)



We know it by its absence, like absence of balance

Image source: "Dream Airplanes" by C.W. Miller

"The essence of architecting is structuring, simplification, compromise and balance."

— Eberhardt Rechtin

"working on some architecture guidelines with a team: "rule #1: computers were a mistake and will stab you in the back when you're not looking."

— Amy Tobey

Integrity, Coherence and Purpose

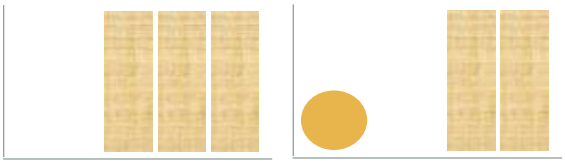
To reiterate: From a design point of view, we're also interested in coherence; the design makes sense, has congruity (things fit together in a way that makes sense) and consistency — properties that have to do with conceptual integrity. Balance, too — the illustration (by C.W. Miller, who was a Design Engineer at Vega Aircraft Corporation), indicates that overemphasis on any subset of stakeholder concerns and system properties they care about, unbalances the system; disturbs fit.

By counterexample, a failure-prone system has compromised integrity. System integrity, for example, strives not just for internal integrity, but integrity in interactions with other systems: "When one complex system, with all its interactions, takes out other complex systems, you quickly get an avalanche of other failures" (quote from the pilot of Quantas Flight 32). We're in the paradoxical situation of accepting failures and getting good at both preventing what we can but also growing our capacity to respond to them.

Structural integrity goes beyond conceptual integrity to include properties like reliability and robustness and recovery. System integrity would include resilience and sustainability, or adaptive capacity and coping mechanisms to deal with failures and with context shifts. (Though often we rely on people in the socio-technical system to add this capacity.)

System Integrity

- Artistry of Engineering: innate sense of the fitness of things



Gordon Glegg Design Lecture https://www.youtube.com/watch?v=ezCp3Vy_01k&t=208s

Gordon Glegg on the Fitness of Things

"Now the artistry of engineering is an innate sense of the fitness of things. And let me try and describe by a rather disreputable example what I mean. It is something that commends itself to you without necessarily a rational background — you just say immediately instinctively, that's the way to do it.

There was a director of a firm up in Scotland which made an immense amount of plastic floor covering and many million pounds of it was stored in the warehouses there, and it was reported in a long series of board meetings that quite a large amount of it was being stolen. Now, we could not understand how anyone could steal plastic rolls of floor covering, two meters high, three quarters of a meter diameter, weighing an immense amount with these huge, strong steel doors, concrete floors. There was no sign of the doors being attacked. No signs of any exterior entry. No clues at all. The police couldn't discover a clue of any sort. How you got to those things mysteriously out of a heavily guarded factory until someone in the middle of the night spotted it being done.

And one of the warehouse men each night before he went home, he pushed over one of these plastic rolls and rolled it around 'til it was next to the door. He then proceeded to uncover the outside and stick the edge under the door.. came back in the middle of the night and just wound it up, you see.

Now why you laughed was there was a sense of the right way of doing it. The immediate impact was that if you're going to be a thief, this is a good style of thieving. This disreputable story is solely to produce that sort of sudden impact: That's a good idea. [chuckles] Even though it was a bad idea.

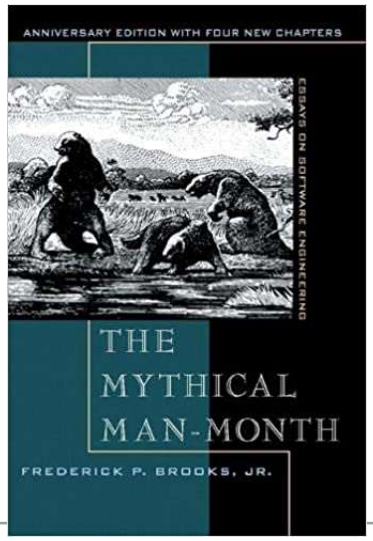
Now, this sort of impact happens in engineering design and is extremely valuable. And if you can develop it, it will censor out silly ideas at source. But there is a sense of paradox linked in with it. And that is this: that all new inventions are embodied to start with, in out of date technology.

Technology always trots along behind the new invention. And therefore a new idea which is extremely good, may look extremely repellant when first produced because the technology is clumsy, awkward and unsuitable. And a sense of style sometimes needs the ability to look through the unsuitable technology to the idea beneath it."

Coherence and Conceptual Integrity

"I will contend that conceptual integrity is the most important consideration in system design."

– Fred Brooks



Architecture and Conceptual Integrity

According to Charles Betz (who researched this in writing his book), the first published use of architecture in a computing setting, was Fred Brooks in 1962:

> "Computer architecture, like other architecture, is the art of determining the needs of the user of a structure and then designing to meet those needs as effectively as possible within economic and technological constraints. Architecture must include engineering considerations, so that the design will be economical and feasible; but the emphasis in architecture is upon the needs of the user, whereas in engineering the emphasis is upon the needs of the fabricator." — Fred Brooks, "Architectural philosophy," 1962.

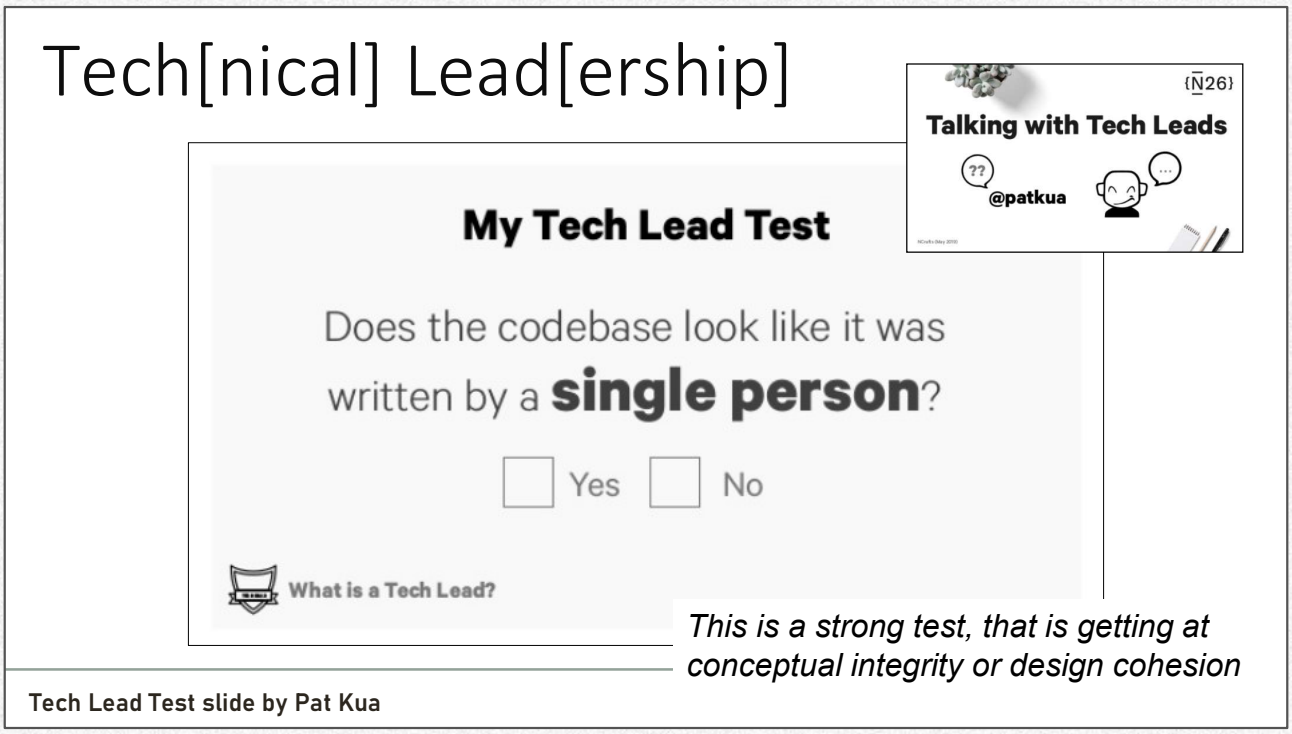
There already, Fred Brooks emphasized the importance of conceptual integrity:

> "The universal adoption of several guiding principles helped ensure the conceptual integrity of a plan whose many detailed decisions were made by many contributors."

And Sharp, at the NATO Conference in Software Engineering in 1969:

> "I think that we have something in addition to software engineering: something that we have talked about in small ways but which should be brought out into the open and have attention focused on it. This is the subject of software architecture. [..] Parts of OS/360 are extremely well coded. Parts of OS, if you go into it in detail, have used all the techniques and all the ideas which we have agreed are good programming practice. The reason that OS is an amorphous lump of program is that it had no architect. Its design was delegated to a series of groups of engineers, each of whom had to invent their own architecture. And when these lumps were nailed together they did not produce a smooth and beautiful piece of software."

Conceptual integrity unifies the design; it gives the design ideas coherence – fit to purpose, fit to context, and fit to form a system. One that doesn't seem brute forced or unnaturally wrangled into a "frankstein" whole.



"Conceptual integrity is the most important consideration in system design. It is better to have a system omit certain anomalous features and improvements, but to reflect one set of design ideas, than to have one that contains many good but independent and uncoordinated ideas."

— Fred Brooks

Technical Leadership and Roles

When we think of technical leadership, we readily think of roles that invoke technical leadership responsibilities, like tech lead, architect (at various levels of scope), test lead, .. and CTO. And those who lead or influence technical roles, such as product owners or product managers. And those who step up to lead on something that needs doing. So we're addressing a broad set of us, brought together, because our systems have a technology dimension.

Technical Leadership, Cohesion and Integrity

Pat Kua's 'Tech Lead Test" (slide above) sheds light on something important here, and that is conceptual integrity. Though Fred Brooks (in *Mythical Man Month*) does not define conceptual integrity, he wrote: "Conceptual integrity in turn dictates that the design must proceed from one mind, or from a very small number of agreeing resonant minds." The idea is that conceptual integrity (or unity of design) is essential to a coherent system. Even Brooks moved away from one mind, but resonance and coherence remains important,

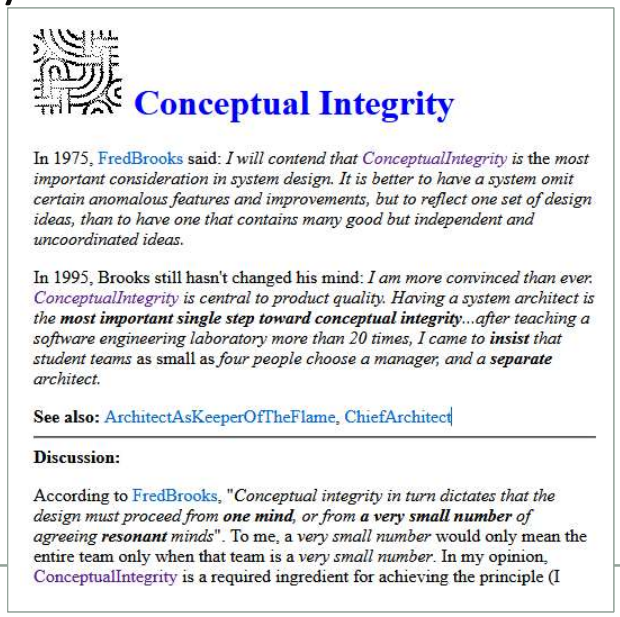
Coherence and integrity bring along concepts of fit. Fit together, fit to context, and fit to purpose. In order for work to fit, in these various senses, we need to provide enough context, including intent and understanding of what "fit" entails, in this context.

Conceptual integrity is important, and is shaped, but not by just one mind

Conceptual Integrity

"[conceptual integrity]—another contribution from Brooks—is roughly the state of having a unified mental model of both the project and the user, shared among all members of the team."

— Dorian Taylor



Conceptual Integrity

In 1975, FredBrooks said: *I will contend that ConceptualIntegrity is the most important consideration in system design. It is better to have a system omit certain anomalous features and improvements, but to reflect one set of design ideas, than to have one that contains many good but independent and uncoordinated ideas.*

In 1995, Brooks still hasn't changed his mind: *I am more convinced than ever. ConceptualIntegrity is central to product quality. Having a system architect is the **most important single step toward conceptual integrity**...after teaching a software engineering laboratory more than 20 times, I came to **insist** that student teams* as small as *four people choose a manager, and a **separate** architect.*

See also: ArchitectAsKeeperOfTheFlame, ChiefArchitect

Discussion:

According to FredBrooks, "*Conceptual integrity in turn dictates that the design must proceed from **one mind**, or from **a very small number** of agreeing **resonant** minds*". To me, a *very small number* would only mean the entire team only when that team is a *very small number*. In my opinion, ConceptualIntegrity is a required ingredient for achieving the principle (I

Image Source: https://wiki.c2.com/?ConceptualIntegrity

"Conceptual integrity makes the product both easier to develop and easier to use, because this integrity is communicated to both the development team and the user, through the product."

— Dorian Taylor

"Having a system architect is the most important single step toward conceptual integrity."

— Fred Brooks

Whence Conceptual Integrity

Richard Gabriel, in his critical engagement with Fred Brooks' OOPSLA 20007 keynote, offers:

"The ingredients for conceptual integrity are these:

- the talent(s) of the human designer(s)—all of them;
- the thing designed;
- the luck that brought the designer(s) [..] to the right place(s)[/]time(s); the luck of the thing designed to have the right ingredients"

That is, Gabriel is differing with Brooks on the matter of a single architect-designer to achieve conceptual integrity.

Fred Brooks, Collaboration and TeleCollaboration, a keynote at OOPSLA 2007, audio (only) http://www.oopsla.org/podcasts/Keynote_FrederickBrooks.mp3#t=535

Richard Gabriel, "Designed as Designer," https://www.dreamsongs.com/Files/DesignedAsDesignerExpanded.pdf

Designed as Designer

Richard P. Gabriel

IBM Research

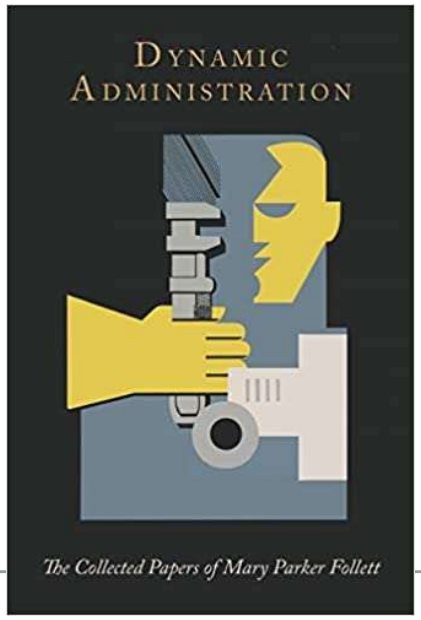
Hawthorne, New York USA

Abstract

The "Law of the Situation"

"Our job [..] how to devise methods by which we can best discover the order integral to a particular situation."

— Mary Parker Follett



The "Law of the Situation"

Conceptual and design integrity includes the degree of fit – fit within the system, fit of the system to its context, and fit to purpose. That opens the question of the thing designed, as designer (at least, playing a suggestive, even formative, role in its own design). So we're attending to what the system is and is becoming, and what that suggests in terms of order. And Mary Parker Follett: discovering what is integral to the situation. (Which many of us would relate to Domain Driven Design.)

So design integrity brings with it fit or coherence, which begs the question: how do we do we build coherent systems? And how do we do this, with teams (of teams, even)?

"Alignment and direction is so hard to get; clarity of what you're doing and how you fit into and contribute to a system is so hard to maintain. But it's so important that it should never be neglected.

*I see executives working on decision matrices, and engineers working on refactoring, and infra building platforms, but I don't see people *actually communicating together*"*

— Hazel Weakly

Requisite Coherence

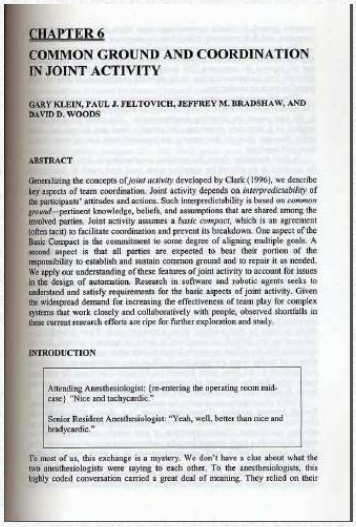
"And requisite coherence is the idea that if everyone is in a Tower of Babel we're not able to speak or work together. So the balancing point here is common ground."

— Jabe Bloom

TECHNICAL LEADERSHIP

Incoherence Penalty: "Whatever time the team members spend re-establishing a common view of the universe"

— Michael Nygard



CHAPTER 6

COMMON GROUND AND COORDINATION IN JOINT ACTIVITY

GARY KLEIN, PAUL J. FELTOVICH, JEFFREY M. BRADSHAW, AND DAVID D. WOODS

ABSTRACT

Generalizing the concepts of *joint activity* developed by Clark (1996), we describe key aspects of team coordination. Joint activity depends on *interpredictability* of the participants' attitudes and actions. Such interpredictability is based on *common ground*—pertinent knowledge, beliefs, and assumptions that are shared among the involved parties. Joint activity assumes a *basic compact*, which is an agreement (often tacit) to facilitate coordination and prevent its breakdown. One aspect of the Basic Compact is the commitment to some degree of aligning multiple goals. A second aspect is that all parties are expected to bear their portion of the responsibility to establish and sustain common ground and to repair it as needed. We apply our understanding of these features of joint activity to account for issues in the design of automation. Research in software and robotic agents seeks to understand and satisfy requirements for the basic aspects of joint activity. Given the widespread demand for increasing the effectiveness of team play for complex systems that work closely and collaboratively with people, observed shortfalls in these current research efforts are ripe for further exploration and study.

INTRODUCTION

Attending Anesthesiologist: (re-entering the operating room mid-case) "Nice and tachycardic."

Senior Resident Anesthesiologist: "Yeah, well, better than nice and bradycardic."

To most of us, this exchange is a mystery. We don't have a clue about what the two anesthesiologists were saying to each other. To the anesthesiologists, this highly coded conversation carried a great deal of meaning. They relied on their

Common Ground

"So there's two ideas: *requisite variety* meaning that a system that's going to address a complex space needs to have complexity inside of it in order to react to the complexity outside of it; it's like a balancing act; so there's this idea that you should have lots of variety in the system. And the other side of it is *requisite coherence*. And requisite coherence is the idea that if everyone is in a Tower of Babel we're not able to speak or work together. So the balancing point here is *common ground*. And it's this idea that we need just enough common concepts to make progress — not maximally but minimally. In order preserve the scanning and perceptual abilities of multiple mental models." — Jabe Bloom, VirtualDDD 1/16/20

"Joint activity depends on interpredictability of the participants' attitudes and actions. Such interpredictability is based on common ground — pertinent knowledge, beliefs and assumptions that are shared among the involved parties. Joint activity assumes a basic compact, which is an agreement (often tacit) to facilitate coordination and prevent its breakdown. One aspect of the Basic Compact is the commitment to some degree of aligning multiple goals. A second aspect is that all parties are expected to bear their portion of the responsibility to establish and sustain common ground and to repair it as needed." — Gary Klein et al.

Ashby's Law: Requisite Variety

"If a system is to be stable, the number of states of its control mechanism [its variety] must be greater than or equal to the number of states in the system being controlled"

– Ross Ashby

Insight: a viable system is one that can handle the variability of its environment. Or, as Ashby put it, only variety can absorb variety." – John Naughton

TECHNICAL LEADERSHIP

Ashby's Law: Address Variety with Variety

"In colloquial terms Ashby's Law has come to be understood as a simple proposition: if a system is to be able to deal successfully with the diversity of challenges that its environment produces, then it needs to have a repertoire of responses which is (at least) as nuanced as the problems thrown up by the environment. So a viable system is one that can handle the variability of its environment. Or, as Ashby put it, only variety can absorb variety." – John Naughton

Jabe Bloom: "The quickest way to explain Ashby's Law is as follows: If I am a fencer and I have 3 ways of thrusting at people, and everybody else has three ways of parrying those thrusts, it will be an even game. [..] I will be as in control as I can be. If someone else figures out another thrust, I will then be required to learn another parry otherwise I will always lose." Implication: The more different kinds of customers your business has, the more complexity you will need to absorb, in order to respond to that.

Brian Marick: 'In the 80's, Robert Glass analyzed bugs in fielded avionics software. Found faults of omission most important. I liked his characterization of them: "code not complex enough for the problem"'

Jabe Bloom: "Sounds like Ashby's Law."

Diversity is crucial to variety in our teams. We build variety in ourselves, too. Our background and experiences, what we read, our relationships and the stories and encounters. But to match external variety and expand adaptive capacity (reach more adjacent possibilities), team diversity is key.

"Ashby's law dictates that complex environments (and wicked problems) require complex organizations."

— Jabe Bloom

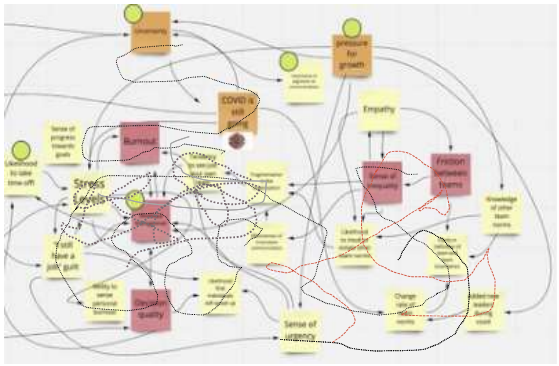
"The Battle Royale: Ashby's Law vs Herbert Simon's Bounded Rationality"

— Jabe Bloom

Messes

"Managers don't solve simple, isolated problems; they manage messes."

— Russell Ackoff



TECHNICAL LEADERSHIP

Adapted from an image from John Cutler

Managing – or Leading – as Mess Management

From *Managing Complexity*. Russell Ackoff coined the term "mess" in response to the insights of William James and John Dewey, who recognized that problems are taken up by, not given to, decision-makers and that problems are extracted from unstructured states of confusion (Source: open.edu). Ackoff (1974) argued that:

"What decision-makers deal with, I maintain, are messes not problems. This is hardly illuminating, however, unless I make more explicit what I mean by a mess. A mess is a set of external conditions that produces dissatisfaction. It can be conceptualized as a system of problems in the same sense in which a physical body can be conceptualized as a system of atoms."

"Managers are not confronted with problems that are independent of each other, but with dynamic situations that consists of complex systems of changing problems that interact with each other. I call such situations messes. [..] Managers do not solve problems, they manage messes."

"When a mess, which is a system of problems, is taken apart, it loses its essential properties and so does each of its parts. The behavior of a mess depends more on how the treatment of its parts interact than how they act independently of each other. A partial solution to a whole system of problems is better than whole solutions of each of its parts taken separately. "

– Russell L. Ackoff

"We have also come to realize that no problem ever exists in complete isolation. Every problem interacts with other problems and is therefore part of a set of interrelated problems, a system of problems I choose to call such a system a mess··· Furthermore solutions to most problems produce other problems··· a financial problem, a maintenance problem, and conflict among family members for its use. "

– Russell L. Ackoff

"As a punk-ass programmer, I'd grumble about 'management.' Well, they have a job to do, and it's a really difficult job."

— Kent Beck

Sources: Redesigning the Future, Russell Ackoff, 1974
It's a mess, Russell Ackoff, 1979
The Art and Science of Mess Management, Russell Ackoff, 1981

Wicked Problems

Reflecting on the nature of design problems, Rittel highlighted several of their characteristics:

1. As seen above, analysis and synthesis are not separable, "the problem can't be defined until the solution has been found". Or every formulation of the problem hints at a solution.
2. Every problem can be seen as a symptom of another and problems cannot be separated into disciplines.
3. Unlike in chess, there are no stopping rules that tell us when we are done
4. Solutions are neither true nor false; they are either good or bad. What is good or bad is a matter of values and judgments.
5. There are no immediate, or ultimate tests to design problems. A solution may work at first just as planned only to prove to have deleterious consequences later. DDT ex.
6. Every problem is essentially unique; there are no classes of problems. No matter how similar two problems may look there is always a chance that there is a difference that matters more than all the similarities.
7. Every problem is a "one-shot" operation. Every implemented plan has consequences that cannot be undone. If she doesn't like a wall that has been set up, the architect can always sign a change order, but that has consequences: labor cost, demolition materials to be disposed, etc.
8. There are no grand phases (i.e. analysis-synthesis-evaluation) nor are there any agreed upon, specific procedures.

From: Design Thinking: What is That? By Jean-Pierre Protzen

Wicked Problems are Wickedly Hard

"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."

"1. There is no definitive formulation of a wicked problem: [..] The information needed to understand the problem depends upon one's idea for solving it. That is to say: in order to describe a wicked-problem in sufficient detail, one has to develop an exhaustive inventory of all conceivable solutions ahead of time. The reason is that every question asking for additional information depends upon the understanding of the problem — and its resolution — at that time. Problem understanding and problem resolution are concomitant to each other.

2. Wicked problems have no stopping rule: The planner terminates work on a wicked problem, not for reasons inherent in the "logic" of the problem. He stops for considerations that are external to the problem: he runs out of time, or money, or patience. He finally says, "That's good enough," or "This is the best I can do within the limitations of the project," or "I like this solution," etc. "

Source: Horst Rittel and Melvin Webber, Dilemmas in a General Theory of Planning, 1973

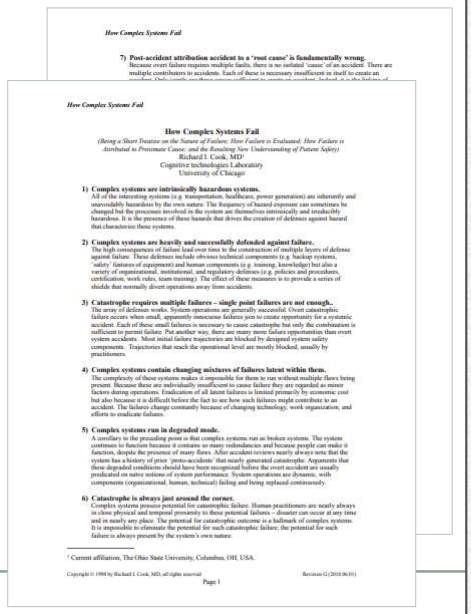
A great collection of references on "messes" and "wicked problems":
https://github.com/lorin/messiness

Complex systems are … work!, to keep working, to sustain, repair, adapt

How Complex Systems Fail

1. Complex systems are intrinsically hazardous systems
2. Complex systems are heavily and successfully defended against failure
3. Catastrophe requires multiple failures – single point failures are not enough
4. Complex systems contain changing mixtures of failures latent within them
6. Catastrophe is always just around the corner
16. Safety is a characteristic of systems and not of their components: Safety is an emergent property of systems

-- Richard I. Cook



How Complex Systems Fail

7) Post-accident attribution accident to a 'root cause' is fundamentally wrong.
Because every failure requires multiple faults, there is no isolated 'cause' of an accident. There are multiple contributors to accidents. Each of these is necessary insufficient in itself to create an

How Complex Systems Fail

How Complex Systems Fail
(Being a Short Treatise on the Nature of Failure; How Failure is Evaluated; How Failure is Attributed to Proximate Cause; and the Resulting New Understanding of Patient Safety)
Richard I. Cook, MD
Cognitive Technologies Laboratory
University of Chicago

1) Complex systems are intrinsically hazardous systems.
All of the interesting systems (e.g. transportation, healthcare, power generation) are inherently and unavoidably hazardous by the own nature. The frequency of hazard exposure can sometimes be changed but the processes involved in the system are themselves intrinsically and irreducibly hazardous. It is the presence of these hazards that drives the creation of defenses against hazard that characterise these systems.

2) Complex systems are heavily and successfully defended against failure.
The high consequences of failure lead over time to the construction of multiple layers of defense against failure. These defenses include obvious technical components (e.g. backup systems, 'safety' features of equipment) and human components (e.g. training, knowledge) but also a variety of organizational, institutional, and regulatory defenses (e.g. policies and procedures, certification, work rules, team training). The effect of these measures is to provide a series of shields that normally divert operations away from accidents.

3) Catastrophe requires multiple failures - single point failures are not enough..
The array of defenses works. System operations are generally successful. Overt catastrophic failure occurs when small, apparently innocuous failures join to create opportunity for a systemic accident. Each of these small failures is necessary to cause catastrophe but only the combination is sufficient to permit failure. Put another way, there are many more failure opportunities than overt system accidents. Most initial failure trajectories are blocked by designed system safety components. Trajectories that reach the operational level are mostly blocked, usually by practitioners.

4) Complex systems contain changing mixtures of failures latent within them.
The complexity of these systems makes it impossible for them to run without multiple flaws being present. Because these are individually insufficient to cause failure they are regarded as minor factors during operations. Eradication of all latent failures is limited primarily by economic cost but also because it is difficult before the fact to see how such failures might contribute to an accident. The failures change constantly because of changing technology, work organization, and efforts to eradicate failures.

5) Complex systems run in degraded mode.
A corollary to the preceding point is that complex systems run as broken systems. The system continues to function because it contains so many redundancies and because people can make it function, despite the presence of many flaws. After accident reviews nearly always note that the system has a history of prior 'proto-accidents' that nearly generated catastrophe. Arguments that these degraded conditions should have been recognized before the overt accident are usually predicated on naive notions of system performance. System operations are dynamic, with components (organizational, human, technical) failing and being replaced continuously.

6) Catastrophe is always just around the corner.
Complex systems possess potential for catastrophic failure. Human practitioners are nearly always in close physical and temporal proximity to these potential failures - disaster can occur at any time and in nearly any place. The potential for catastrophic outcome is a hallmark of complex systems. It is impossible to eliminate the potential for such catastrophic failure; the potential for such failure is always present by the system's own nature.

[1] Current affiliation, The Ohio State University, Columbus, OH, USA.

 Revision G (2005.Dec.01)

Source: Richard I. Cook, How Complex Systems Fail

Complex Systems (Guard Against) Fail(ure)

From Adrian Colyer's notes on Richard Cook's classic paper:

- *Complex systems are intrinsically hazardous*, which drives over time the creation of defense mechanisms against those hazards. (Things can go wrong, and we build up mechanisms to try and prevent that from happening).
- *Complex systems are heavily and successfully defended against failure*, since the high consequences of failures lead to the build up of defenses against those failures over time.
- Because of this, a *catastrophe requires multiple failures* – single point failures are generally not sufficient to trigger catastrophe.

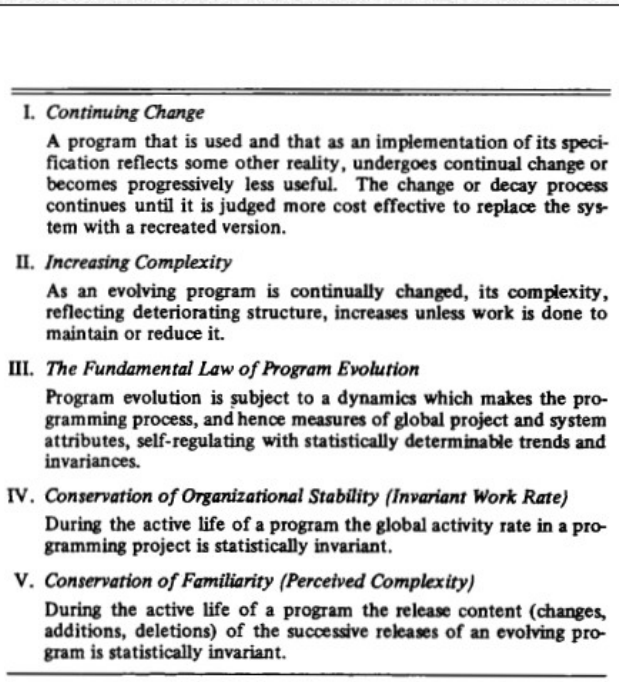
"The state of safety in any system is always dynamic; continuous systemic change insures that hazard and its management are constantly changing." – Richard I. Cook

- The complexity of complex systems makes it impossible for them to run without multiple flaws being present. Because these are individually insufficient to cause failure, they are regarded as a minor factor during operations.
- *Complex systems* therefore *run in degraded mode* as their normal mode of operation!
- *Changes introduce new forms of failure*.

Much of Richard Cook's and others work in resilience engineering and safety and human factors, is addressed at users and operations and the role of operators in the continuous creation of safety: "Recognizing hazard and successfully manipulating system operations to remain inside the tolerable performance boundaries requires intimate contact with failure." (Cook, 2000). This is true too, for system designers and architects, looking at implications for design and (co)evolution.

Sources: "How Complex Systems Fail," by Adrian Colyer, Morning Paper
Richard I. Cook, How Complex Systems Fail, https://how.complexsystems.fail/

Lehman's Laws of Software Evolution



I. *Continuing Change*

A program that is used and that as an implementation of its specification reflects some other reality, undergoes continual change or becomes progressively less useful. The change or decay process continues until it is judged more cost effective to replace the system with a recreated version.

II. *Increasing Complexity*

As an evolving program is continually changed, its complexity, reflecting deteriorating structure, increases unless work is done to maintain or reduce it.

III. *The Fundamental Law of Program Evolution*

Program evolution is subject to a dynamics which makes the programming process, and hence measures of global project and system attributes, self-regulating with statistically determinable trends and invariances.

IV. *Conservation of Organizational Stability (Invariant Work Rate)*

During the active life of a program the global activity rate in a programming project is statistically invariant.

V. *Conservation of Familiarity (Perceived Complexity)*

During the active life of a program the release content (changes, additions, deletions) of the successive releases of an evolving program is statistically invariant.

Lehman's Laws

Lehman's Laws recognize that complexity comes from (necessarily) adding value and adapting, AND it takes *work* and rigor to keep that complexity from being compounded by structural decay.

In particular,

1. a system must be continually adapted or it becomes progressively less satisfactory

2. as a system evolves, its complexity increases unless work is done to maintain or reduce it

Lehman's laws of software evolution in "Programs, Life Cycles, and Laws of Software Evolution" -- Meir Lehman, Proc. IEEE

Law of Stretched Systems

Law of Stretched Systems: Every system is stretched to operate at capacity. Improvements, regardless of aim, tend to be exploited for capacity and efficiency. (Woods & Hollnagel, Joint Cognitive Systems: Patterns in Cognitive Systems, 2006)

Zawinski's Law

"Every program attempts to expand until it can read mail. Those programs which cannot expand are replaced by ones that can."

What is systems design?

"What is systems design? It's the thing that will eventually kill your project if you do it wrong, but probably not right away. It's macroeconomics instead of microeconomics. [..] It's knowing when a distributed system is or isn't appropriate, not just knowing how to build one."

— Avery Pennarun

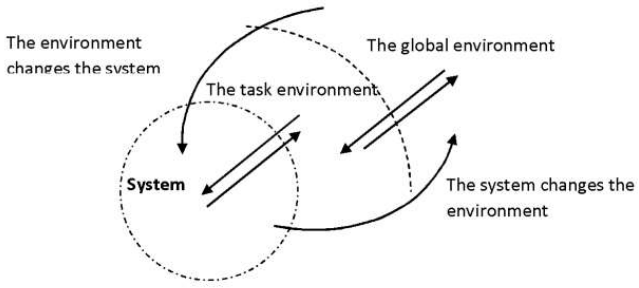


Figure 2. System in two levels of environment

Image Source: Merrelyn Emery, "Self management of the self managing organization: an update" (via Trond Hjorteland)

What is Systems Design?

"Most of all, systems design is invisible to people who don't know how to look for it. At least with code, you can measure output by the line or the bug, and you can hire more programmers to get more code. With systems design, the key insight might be a one-sentence explanation given at the right time to the right person, that affects the next 5 years of work, or is the difference between hypergrowth and steady growth. "— Avery Pennarun (@apenwarr)

Source: https://apenwarr.ca/log/20201227

Conway's Law is important here — the systems we design-evolve reflect the system that design-evolves them (the communication structure, so the organizational structures that support and inhibit the communication structures, and more — power, too).

This mutual influencing of context and system (in the diagram from Merrelyn Emery's "Self management of the self managing organization: an update") means that complex system design continues as people adapt and exapt (from exaptation), and practices are adapted, and more. With implications for the practice of system design.

"That's all the motorcycle is, a system of concepts worked out in steel. There's no part in it, no shape in it, that is not out of someone's mind."

— Robert M. Pirsig

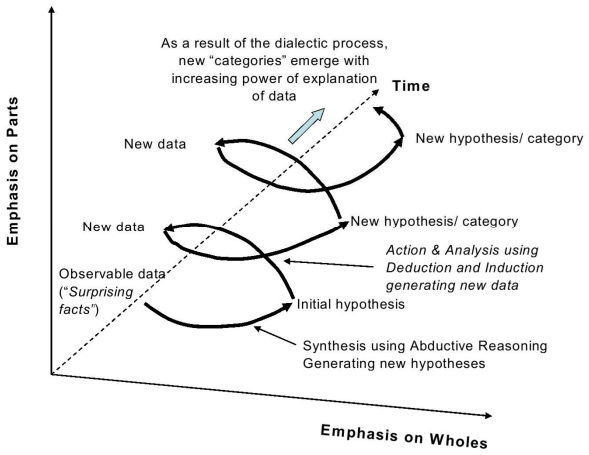
"the wish [or intention] confronts an environment as altered by the wish; the environment confronts a wish as altered by the environment"

— Mary Parker Follett, Creative Experience, 1924

Evolutionary Design

"A complex system that works is invariably found to have evolved from a simple system that worked. A complex system designed from scratch never works and cannot be patched up to make it work. You have to start over, beginning with a working simple system."

— John Gall



From: *Barton and Haslett*

Image used for its emphasis on iterating and returning to wholes (and our theories of the whole, in relationship to other systems), as the system evolves over time.

"complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not."

— Herbert Simon

"A complex system, such as a living organism or a growing economy, has to develop its structure and be able to adapt that structure in order to cope with changes in the environment."

— Paul Cilliers

Evolutionary Design

The diagram is from a paper about evolution in science, but holds a nice image for us (in systems design/evolution), moving between synthesis and analysis and synthesis, whole and part and whole. In the large, and in smaller movements, continually.

"This is the most important word, not only for business relations, but for all human relations: not to adapt ourselves to a situation — we are all more necessary to the world than that; neither to mold a situation to our *liking — we are all, or rather each, of too little importance to the world for that; but to take account of that reciprocal adjustment, that interactive behavior between the situation and ourselves which means a change in both the situation and ourselves." — Mary Parker Follett*

Evolutionary Design

"Chicken-egg problems appear all the time when building software or launching products. Which came first, HTML5 web browsers or HTML5 web content? Neither, of course. They evolved in loose synchronization, tracing back to the first HTML experiments and way before HTML itself, growing slowly and then quickly in popularity along the way."

— Avery Pennarun

Co-Evolutionary Design

Donald Schön, *Reflective Practitioner :* Design is a "reflective conversation with the situation" and "a conversation with the materials of the situation" and "the situation 'talks back' and [the designer] responds to the situation's 'talk back'"

Fred Emery: "Such mutual determination can only be a result of a process of co-evolution. Our perceptual and affective systems have evolved so that we are, as a species adapted to living in the environment the world provides. [..] We have shaped that world with a view to it supporting the purposes we consistently pursue."

Winnograd and Flores: "The significance of a new invention lies in how it fits into and changes this network. Many innovations are minor—they simply improve some aspect of the network without altering its structure. The automatic transmission made automobiles easier to use, but did not change their role. Other inventions, such as the computer, are radical innovations that cannot be understood in terms of the previously existing network. The challenge for design is not simply to create tools that accurately reflect existing domains, but to provide for the creation of new domains. Design serves simultaneously to bring forth and to transform the objects, relations, and regularities of the world of our concerns"

"all systems are what emerges over its history of adaptation to stressors"

— David Woods

"expert design involves a period of exploration in which problem and solution spaces are unstable until (temporarily) fixed by an emergent bridge which identifies, or frames, a problem-solution pairing."

— Kees Dorst

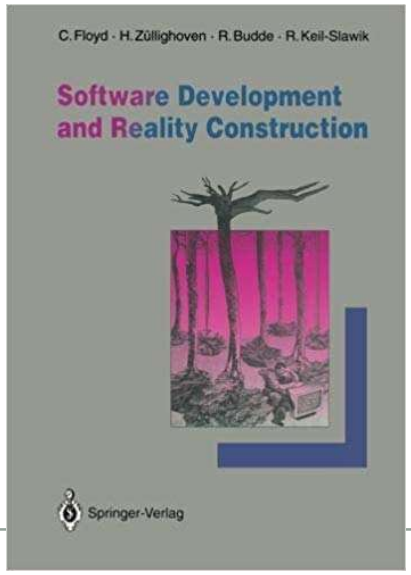
Quote source: *Frame Innovation: Create New Thinking by Design*, Kees Dorst, 2015

Floyd: Reality Construction

"We do not analyze requirements; we construct them"

"Their emergence is specific to the individual design process; it is not determined by the given problem. Instead the problem itself is grasped in the course of the design process."

— Christiane Floyd



Co-Evolutionary Design

Meir Lehman (1980):

"The installation of the program together with its associated system [..] change the very nature of the problem to be solved. The program has become a part of the world it models, it is embedded in it. Analysis of the application to determine requirements, specification, design, implementation now all involve extrapolation and prediction of the consequences of system introduction and the resultant potential for application and system evolution. This prediction must inevitably involve opinion and judgment."

Cameron Tonkinwise (2021):

"the ways in which designers design, the ways in which design is ontological, even at a human product scale, because it creates worlds, habits, dispositions. A designer is never [..] just designing a product: they are reinforcing particular models of the human"

Christiane Floyd:

"We do not analyze requirements; we construct them from our own perspective. This perspective is affected by our personal priorities and values, by the methods we use as orientation aids, and by our interaction with others"

"jointly creating computer-supported contexts of action with users"

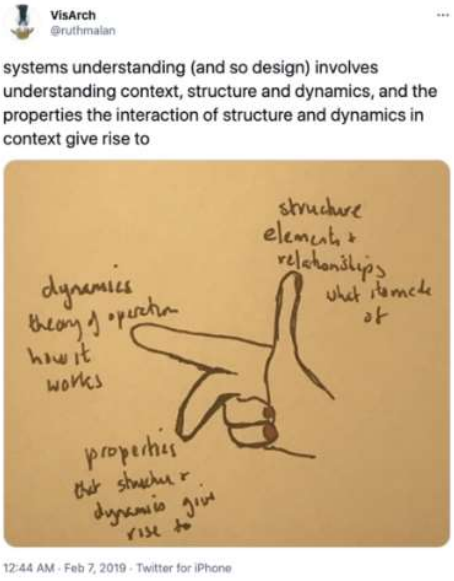
Ref: Software Development as Reality Construction, by Christiane Floyd, 1992

"All that you touch
You Change
All that you Change
Changes you"
— Octavia Butler,
Parable of the Sower

"Design designs"
— Tony Fry

"there is a feedback loop here that says actually designing things [..] changes what we will design in the future, and doesn't stop — it's a loop." — Jabe Bloom

Evolving Understanding and Design




```
(WHOLE) SYSTEMS UNDERSTANDING = {
    UNDERSTANDING "BASIC CONTEXT" {
        STRUCTURE X DYNAMICS
    }
    +
    UNDERSTANDING OF THE "EMERGING CONTEXT" {
        PROPERTIES THAT RISE FROM THE INTERACTIONS THE STRUCTURE AND
    DYNAMICS IN THE CONTEXT
    }
}
```

"Code" Image Source: Eduardo da Silva

"After all, if architecture is about a system's being, behaving, balancing, and becoming, we should be clear about "what is the system?" and "what isn't the system?"

— Charlie Alfred

The image is a composite created by Eduardo da Silva (using my tweet and ⋯ sketch, and his "code" for the insights) https://esilva.net/articles/evolve_tech_orgs_using_sociotech]

I would (should!) redraw it with system properties (and capabilities) on the thumb, as that is what is emergent.

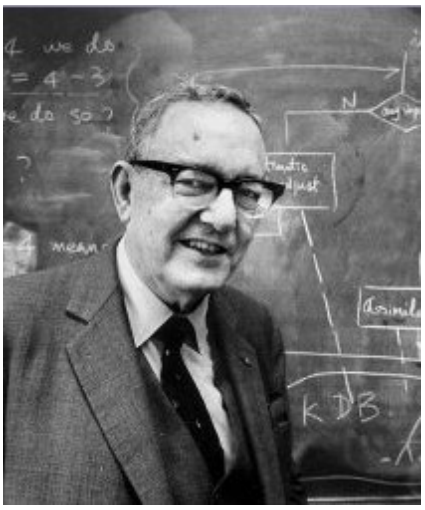
*Systems Evolve **and** Emerge*

"The image [above] [..] In a nutshell: we focus on understanding the structure and the dynamics of the system; and furthermore we also look at properties that emerge from the interactions of structure and dynamics (as in the right hand rule from physics) — and also with context." — Eduardo da Silva

Due to this interaction of parts, wholes emerge and interact within contexts (or situations, or other systems in ecologies or ecosystems), and the context acts back and the system adapts or is adapted (or exapted, if the containing/using system is changing faster than the focal system). And so it goes.

The point, for leaders, being that we're seeking to understand what the system is being and becoming, while balancing demands and forces. As we look across the seams and gaps and what falls between, we're not only considering the system we're building, but the organization that is reflected in the system (Conway's Law) and the situation it alters and is altered by.

Leading



"the designer, is concerned with how things ought to be - how they ought to be in order to attain goals, and to function. "

— Herbert Simon

We lead to enable things to be more the way *they ought* to be

TECHNICAL LEADERSHIP

"natural sciences are concerned with how things are…design [..] is concerned with how things ought to be" — Herbert Simon

Ought is Fraught

Ought carries quite a load. Ethics, integrity, values, play a role in shaping how we see "ought." Perhaps it is design and fit to purpose, perhaps it is about where it leaves society and the environment. And "ought" has a flipside of indefiniteness; a need to explore, to find out. That is, how "things ought to be," is multifaceted. It's not just about what the system (service, product, organization, ⋯) ought to *be* or become, or how it ought to enabled and constrained, but an exploration, where we are trying out, and finding out, what "ought" (or better) is in this context, including discovering what the impacts (across its various contexts) are. Discovering what better is, and how to make it so, together.

Oughts All the Way Up/Down

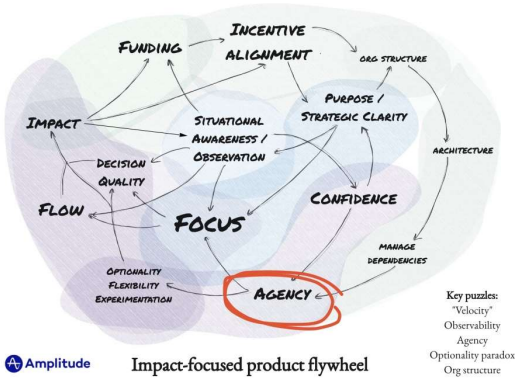
Leadership is about the social dimension to helping things become more the way they ought* to be. Design is intentionally, with reflection, figuring out and shaping things to be "more the way they ought to be." Recognizing that ought is a complex notion. We have to scope our effort, but we need to view design in a wider (including ecological) context. Sure it's paradoxical. But leadership is wrapped up in a notion of helping to bring about outcomes that are bigger than individuals can, by creating something coherent, together. Outcomes that make things better, in ways we, and others, see value in.

We … ought* to … design to make things more the way they ought* to be …

Vision, Purpose, Goals

"From a systems point of view leadership is crucial because the most effective way you can intervene in a system is to shift its goals. You don't need to fire everyone, or replace all the machinery, or spend more money, or even make new laws – if you can just change the goals of the feedback loops."

— Donella Meadows



TECHNICAL LEADERSHIP

Image source: John Cutler, https://twitter.com/johncutlefish/status/1410301039857655808

Direction (without Micro-Directing)

"Leaders are chosen for their ability to impact the trajectory of the business over time. Being strategic means you're able to balance long-term objective setting alongside near-term actions and goal setting." — Jess Iandiorio

"A single persuasive leader working directly on goals and values can shift the functioning of a massive system. So can a leader who opens up or closes down, speeds up or slows down, distorts or clarifies information flows." — Donella Meadows

"The most successful leader of all is the one who sees another picture not yet actualized. He [sic] sees the things which are not yet there. Above all, he should make his co-workers see that it is not his purpose which is to be achieved, but a common purpose, born of the desires and the activities of the group." — Mary Parker Follett

"Common purpose serves as an invisible leader"— Mary Parker Follett

"the leader of our neighborhood group must interpret our experience to us, must see all the different points of view which underlie our daily activities and also their connections, must adjust the varying and often conflicting needs, must lead the group to an understanding of its needs and to a unification of its purpose" — Mary Parker Follett, *The New State*, 1920

Mary Parker Follett wrote in The New State: Group Organization the Solution of Popular Government, *that a leader can only lead the group from within the group. It is within the group that the leader can come to understand what the group's goal(s) means to each member of the group. It is within the group that the leader can determine the varying interests of the group members and harmonize any conflicting interests through two-way communication. Only from within can they reconcile these interests to the group's goal(s)."*

— Dr. Carolan McLarney

Futures Cone

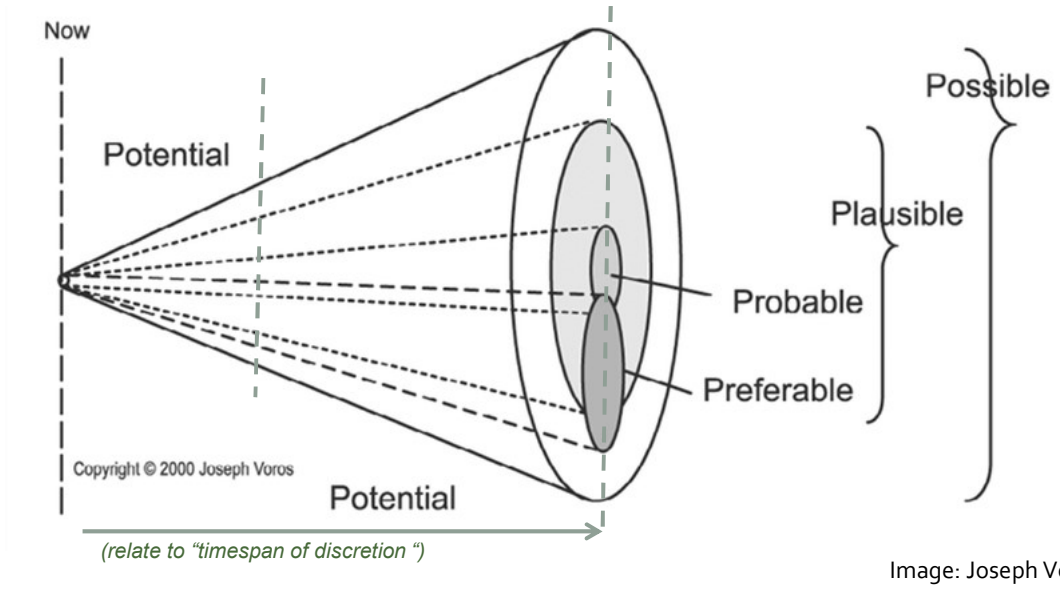


Image: Joseph Voros

Joseph Voros Futures Cone

Potential – everything beyond the present moment is a potential future. This comes from the assumption that the future is undetermined and 'open' not inevitable or 'fixed', which is perhaps the foundational axiom of Futures Studies.

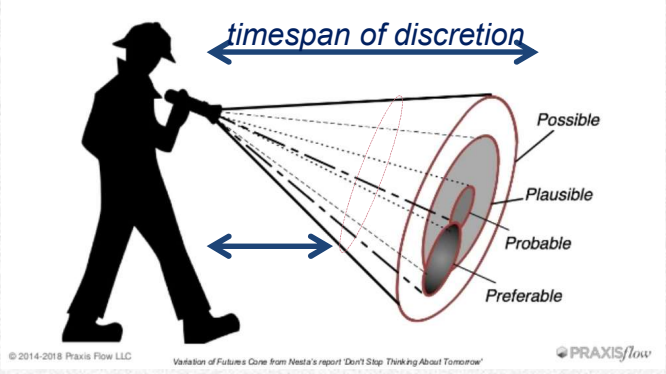
Possible – these are those futures that we think 'might' happen, based on some future knowledge we do not yet possess, but which we might possess someday (e.g., warp drive).

Plausible – those we think 'could' happen based on our current understanding of how the world works (physical laws, social processes, etc).

Probable – those we think are 'likely to' happen, usually based on (in many cases, quantitative) current trends. [Note: The adjacent possible is more probable.]

Preferable – those we think 'should' or 'ought to' happen: normative value judgements as opposed to the mostly cognitive, above. There is also of course the associated converse class—the un-preferred futures—a 'shadow' form of anti-normative futures that we think should not happen nor ever be allowed to happen (e.g., global climate change scenarios comes to mind).

If we look for when leadership is missing, it's often when there is no shared sense of direction, of vision, of a preferable future worth building, and building together. Not that the leader creates this sense of preferred over probable – at least, not alone. But they foster the conditions to do so. Further, we're not thinking of a single futures cone at the level of the ecosystem, or business, or business unit. It's again worth thinking of fractally. So that we're anticipating and refreshing a notion of a preferred future for the system we're building. At the scope of complexity of our system, we "zoom out" to take in its context and wider angle on time span.



The shorter timespan of discretion, the narrower the frame of possible/probable

Image: adapted from Jabe Bloom

… to a future

"You can and you are already organizing your way to a future, but *which* future is it?"

— Cat Swetel

TECHNICAL LEADERSHIP

Leading Across Boundaries and into Future

Leading in a technology setting is – or ought to be – with cognizance of impact, for technology weaves into systems that affect lives and livelihoods; emotions, health and safety – of our team and others in our organization, as well as users and others. As Cat Swetel puts it: "Principles in action matter. Integrity matters." Which can mean that some of our most important and challenging leading is (as Dee Hock pointed out) ourselves first and foremost (getting our contextual and ethical bearings, in dynamic, changing contexts), and leading (or partnering) up and across. Building understanding and building support for doing the right thing right, and with coherence across boundaries.

John Cutler extended this, with leading diagonally up and outside. We're leading customers, offering systems with dispositions — some that take a fair amount of accommodating and adapting to. We're leading vendors, influencing broader ecosystem actions.

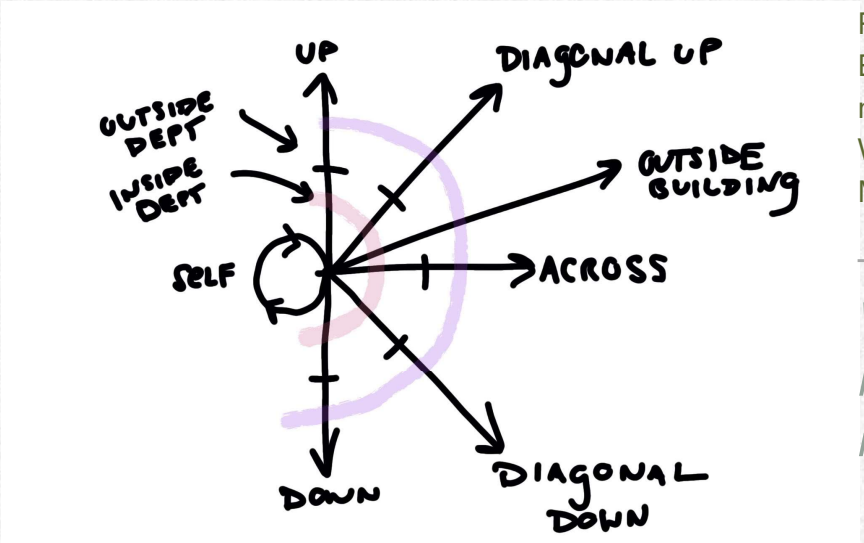


Image: by John Cutler

Recommended: Cat Swetel's discussion of Ethic of Choice and Ethic of Care (starts at minute 42:50 of You Can't 'Organize' Your Way to a Future. Principles Matter, MapCamp2020 on Youtube)

"And that means that we have to stop making crap. It's really as simple as that."

— Allan Chochinov

Common Ground we create …

"requires continuing effort to sustain, extend, and repair common ground."

— Richard Cook

TECHNICAL LEADERSHIP

Image from: *Unflattening,* by Nick Sousanis

Leadership Is/Isn't

Leadership is hard to characterize for there are many styles and situations. But what do we notice when leadership is absent? There's a sense that different ideas and disjoint agendas lead to pulling apart, not pulling together. Things don't get done, or don't get done in time. Indecision mires. Effort is wasted. This, even when the need of a moment looms large, and one might expect that to be sufficient to create an organic alignment of will that organizes effort and creates coherence.

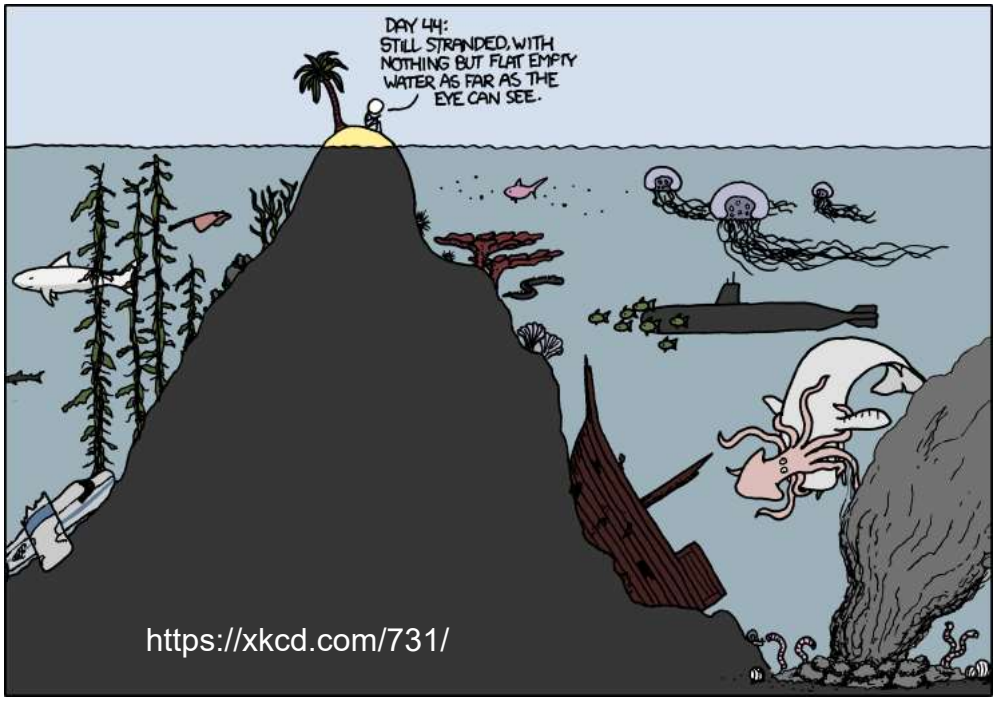
Leadership isn't making all the decisions, or even "just the important ones." But important decisions get made, because there is a sense that actions and effort will add up. Without control and coercion, the contexts and conditions are created for decisions to be made, and acted upon. It's about building organizational will — will to do, *and will to not do*. Prioritizing, focusing, building a sense not just of how fates are shared, but what can be done, to make things more the way *we* want them to be.

Hierarchies are (just) *one* way that organizations meet the need for boundary spanning — for managing resources and priorities and creating synergies across teams, and teams of teams, and other organizational group(ing)s. The more we're seeking to create coherence around a purpose that crosses boundaries and extends out in time (because its ambitious, or bigger than a few can do in just weeks or months), the more leadership plays a role. Our jobs, salaries, play a part, but we're, you know, sentient and doing something meaningful, that contributes to better in some way, plays a role too.

In an important sense, a leader holds a longer and wider frame on what it is they're leading on. Others do so too, but a leader is looking ahead, and across. So we have these interlocking, overlapping meshes of leadership frames (scopes, timeframes), to form something larger. We have initiatives, like leading across individuals or teams to get a tool adopted. And leading across teams to build and evolve a complex system. Whether informal or ad hoc (getting a tool or approach adopted) or formal (role based), we're leading across – intermediate goals, agendas, individual points of view. And time horizons.

"It's so funny how often you lose sight of what your actual goal is Because you have so many intermediate goals"

— Maria Konnikova



Iceberg, or...

We often use the iceberg metaphor for what we don't see, beneath the surface. But there's entire ecosystems below that surface! Failures to learn from? Threats and opportunities, but not where we're looking? And more ecosystems above the water level. It's a lot? To ignore??

Yes, we can't be aware of everything, or be held responsible for so impossible an order. But as our scope (e.g., from design-evolving a feature or mechanism, to system, system-of-systems, ecosystem, or system of ecosystems) of leadership increases, so too does the implicit associated timeframe of discretion/scope of our decision frame.

That is, the broader our scope of leadership, the wider the cast of our decisions and the greater the "downstream" (future) impact of our decisions. Which backs up into the importance of growing our awareness – situational awareness and anticipatory awareness (more on these to come). Not that we can have perfect foresight or even close, but that the very learning, the very discovery process, exposes to view. Brings into our attentional scan. Giving us a chance to focus. Which is a matter of strategic acuity and strategic sensibility – all needing a huge dose of humility, agility (ability to sense and respond quickly) and resilience (adaptive capacity). Because we will be wrong a lot. But the game of life for systems is in getting it righter, adapting and resisting entropy.

'essential to the concept of situation is the concept of "horizon."The horizon is the range of vision that includes everything that can be seen from a particular vantage point. ... A person who has no horizon is a man [sic] who does not see far enough and hence over-values what is nearest to him [sic]. On the other hand, "to have an horizon" means not being limited to what is nearby but being able to see beyond it.'

— Hans-Georg Gadamer

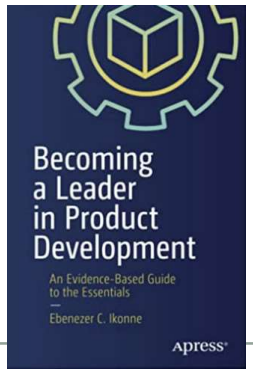
Towards Stewardship

"I got reminded the other day of the notion of stewardship, and we should probably think about our successful systems in these terms – with responsibility for the connections, continuity, and health of the system and the people impacted by it. And part of that stewardship should be – *needs* to be – an engagement in a sustained renewal of necessary expertise."

– Michael McCliment

"People in assigned leadership roles are the primary stewards of the leadership system of any organization."

– Ebenezer Ikonne



Source: https://twitter.com/cornazano/status/1292967631990018049

Towards Stewardship

If we want to be better stewards of our socio-technical systems, that extends to social and ecological impact. As leaders, we ought to include diverse voices to the fullest extent we can (and far more than we do!). This, to help us sense the wider impact. Beyond immediate users, and customers, and other stakeholders. All of those, surely. But also creatures we share the planet with. Rivers and oceans, too. As we (resolve to) integrate a broader sense of integrity and sustainability into our leadership compass, we have great leaders to learn from: foremost, Indigenous peoples who have a cultural tradition of, and deep experience and expertise in, ecological integrity and stewardship. I personally have a lot to learn. Starting with *Mapping Abundance for a Planetary Future*, by Candace Fujikane (via @PropCazhPM).

"our roles as leaders is to steward the socio-technical system as a whole."

– Amy Tobey

"I've done a lot of work over the past few years experimenting with techniques for developing and renewing expertise in a sustainable way, thinking in terms of stewardship of an ecosystem."

– Michael McCliment

"The fundamental job of the imagination in ordinary life, then, is to produce, out of the society we have to live in, a vision of the society we want to live in."

– Northrop Frye

Quote source: Northrop Frye, "The Educated Imagination", 1963

Attribution

The format for these notes is adapted from a template from Nancy Duarte and team.

For more:

https://www.duarte.com/slidedocs/

TECHNICAL
LEADERSHIP

Duarte Slidedocs®

We recommend the Duarte material on slidedocs® in addition to the template; much that is valuable there.

Quotes and Photos

"Act always so as to increase the number of choices.'
— Heinz von Foerster

We have consciously brought various pioneers and contemporaries visibly into our materials for two reasons:

i. to acknowledge and celebrate the extent to which we are because of others. It is a small way to bring into the room, so to speak, with us people whose insights and work has influenced us, and integrated with our experiences, other reading and conversations, and more, to build what we understand and can share.

ii. to recommend to you wonderful work you may want follow up on, and also to draw in our contemporaries who are sharing insights that you too may find useful, and want to follow them on twitter, etc.

Stay in Touch

Ruth Malan:

Twitter: @ruthmalan
Mastodon: @RuthMalan@mastodon.social
Email: training@bredemeyer.com
Web: ruthmalan.com

Workshops

- **Technical Leadership,** July 16 and 23, 2024 at 12pm – 3pm ET
- **System Design and Software Architecture,** Oct 21-23 and Oct 28-30, 2024, at 11 am - 3:30 pm ET

"What we care about is the productive life, and the first test of the productive power of the collective life is its nourishment of the individual. The second test is whether the contributions of individuals can be fruitfully united"
— Mary Parker Follett