Conway's Law at a Distance

Building Teams in a Distributed World

Mike Amundsen
CA Technologies
@mamund

Cover slide : Barn Raising

A collective action in which a barn for one of the members is built by all the members of the community.

- Wikipedia

Introduction


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Mike Amundsen
@mamund

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API Academy delivers free online lessons and in-person consulting services covering essential API techniques and tools for business managers, interface designers and enterprise architects

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Get an overview of what an API is and what it does, to help you realize the business value of APIs

API Design Basics

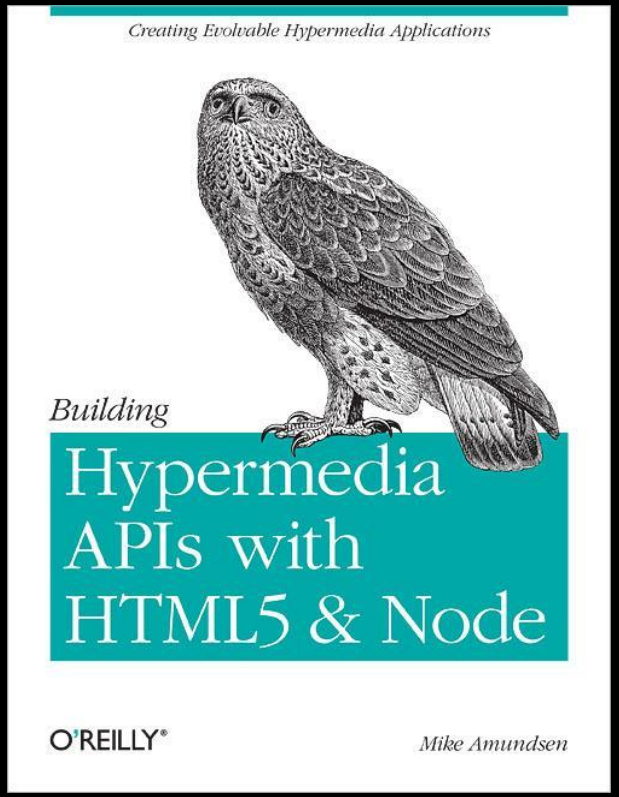
Understand the API architecture process and learn basic design and implementation best practices

Web API Architectural Styles

Get a detailed overview of the main architectural styles for Web and mobile API design

Choosing a Solution

Choose between the various solutions that offer the basic components for enterprise API Management


Creating Evolvable Hypermedia Applications
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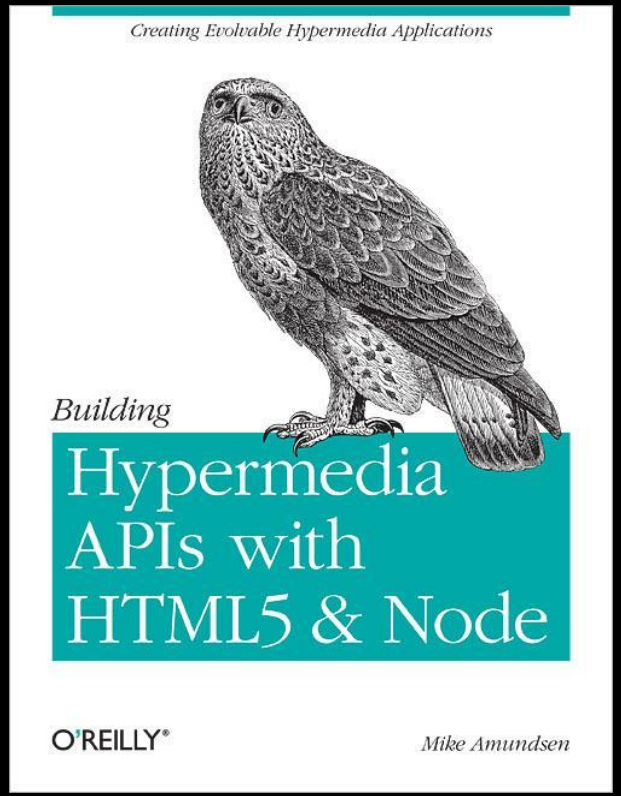
Mike Amundsen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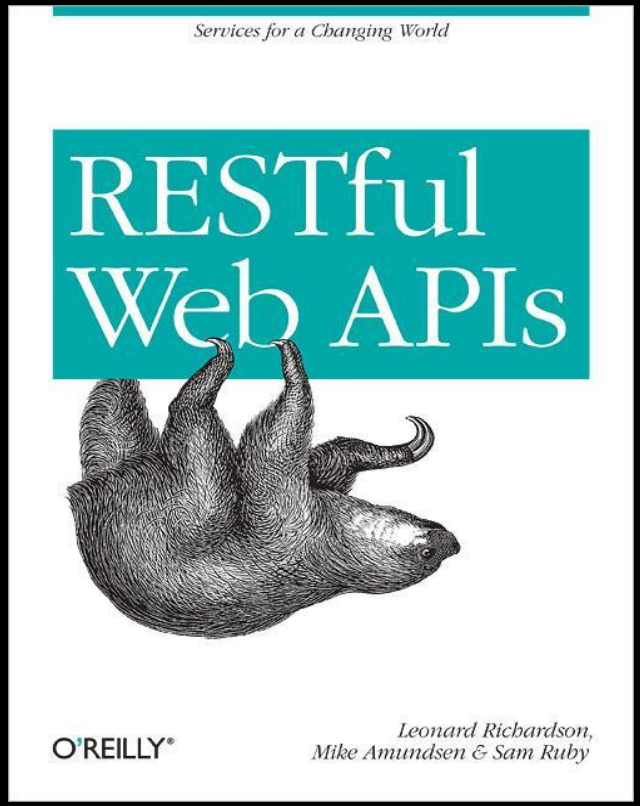
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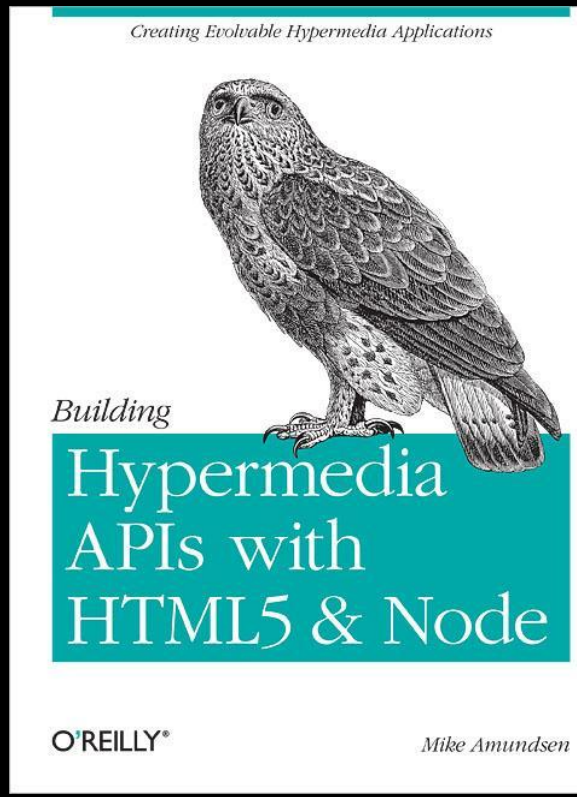
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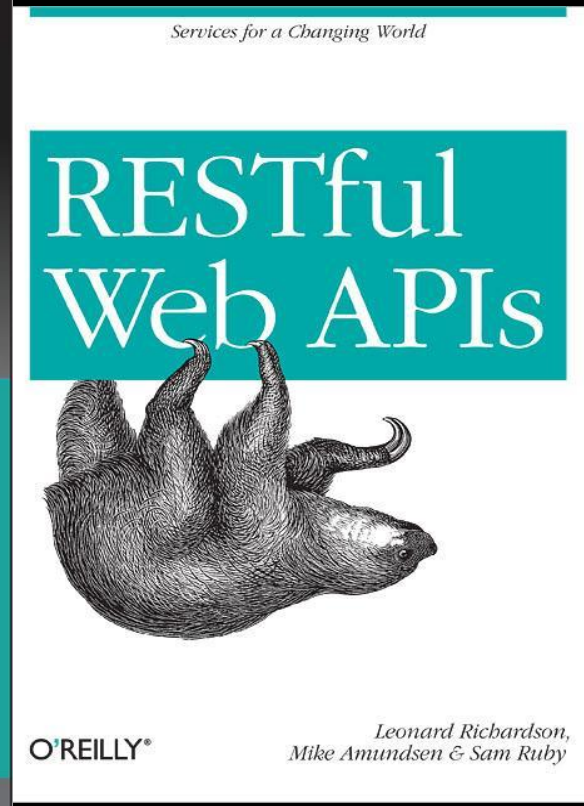
Designing APIs for the Web
Mike Amundsen
VIDEO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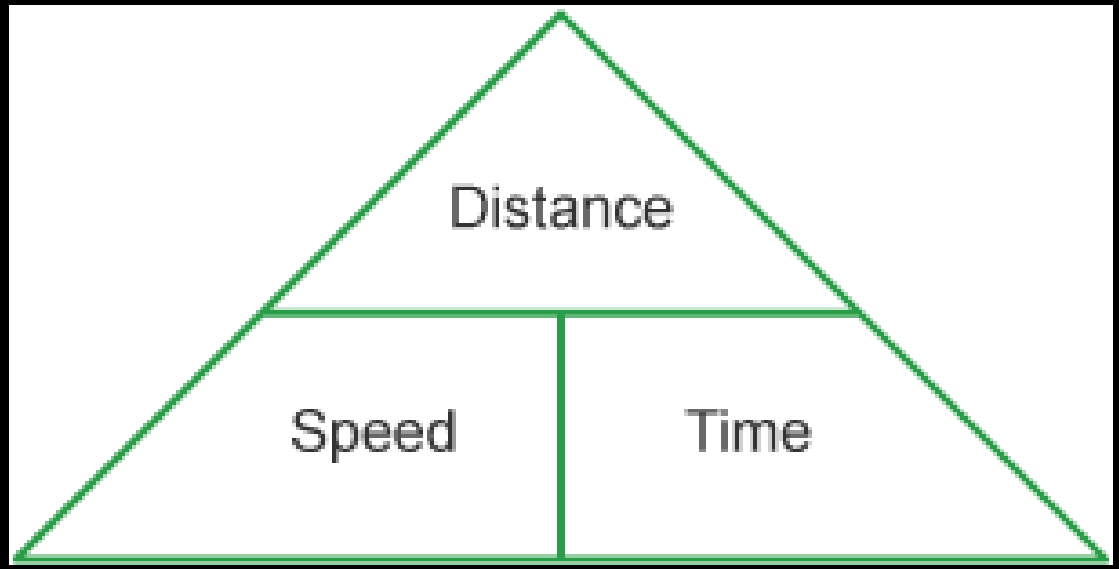
Conway’s Law

Conway’s Law at a Distance

11,766 km

Distance from China to Kentucky


100
120
140
160
180
200
220
240
260
280
300

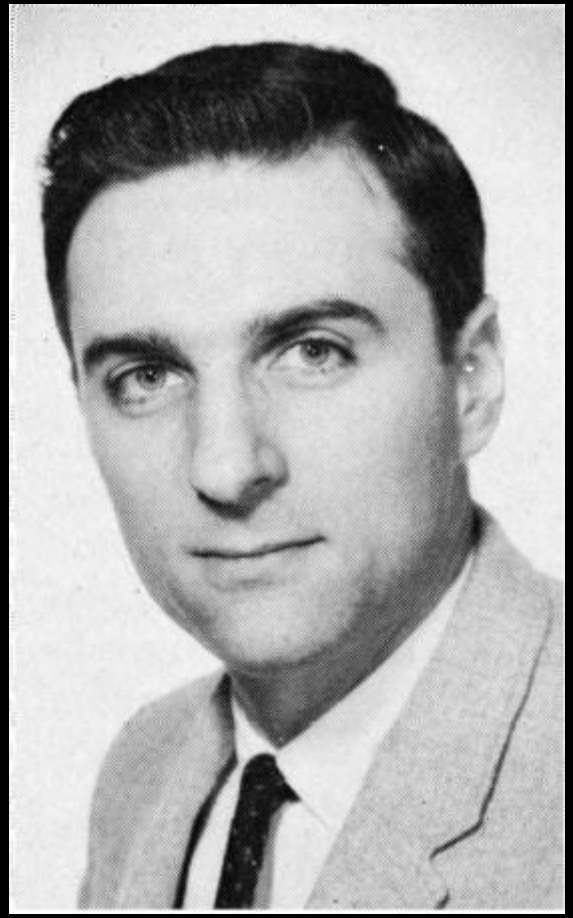

Distance
Speed
Time

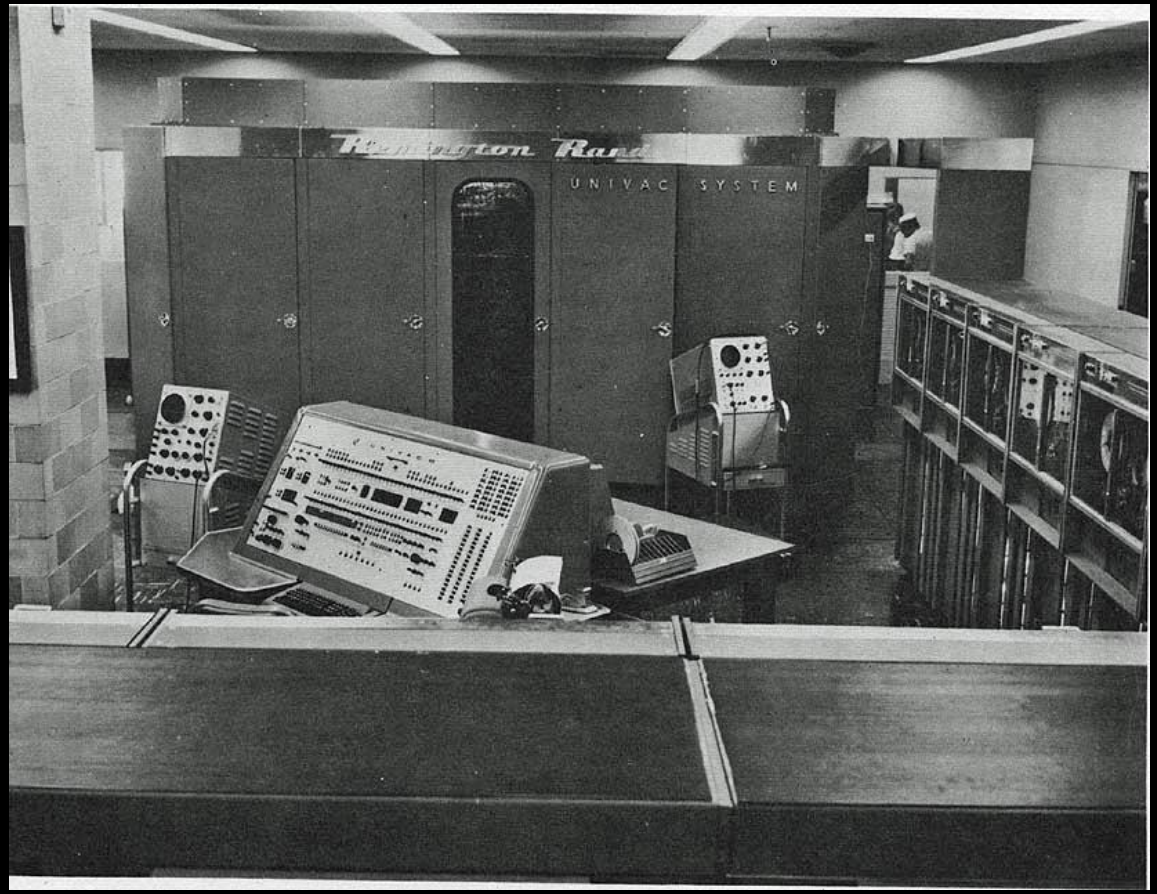
Distance

Speed

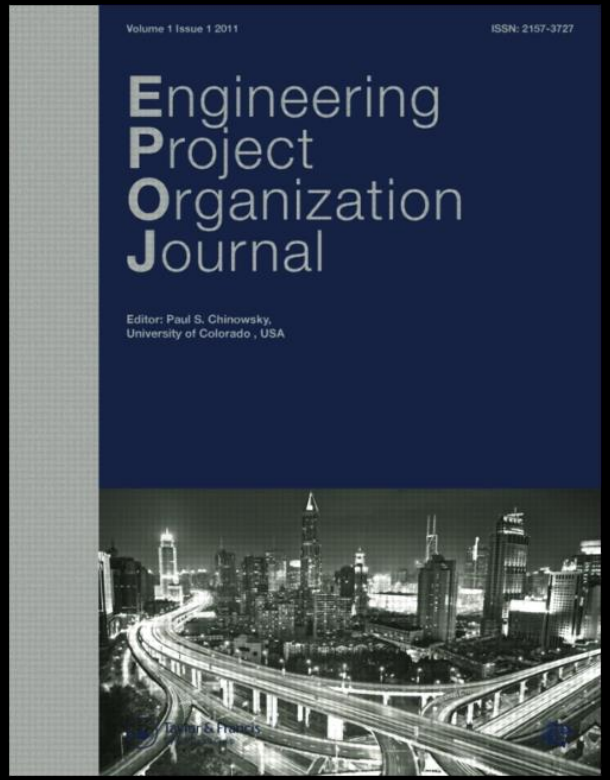
Time

Melvin Conway




Remington Rand
UNIVAC SYSTEM

Project-Based Organizations



“Project-based organizations revolve around the concept that a group of individuals or firms join together with the explicit purpose of producing a tangible set of outputs”

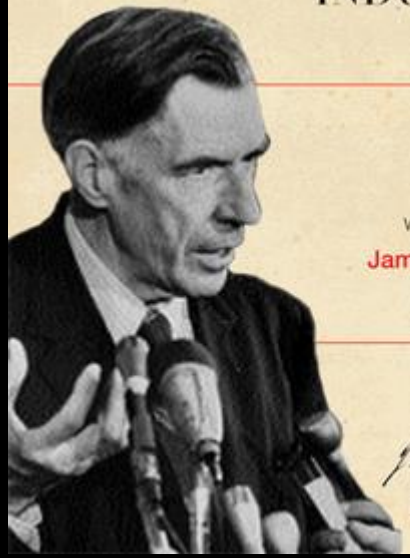
-- Paul Chinowsky, EPOJ 2011

“How Do Committees Invent?”

1967

John Kenneth Galbraith

The NEW INDUSTRIAL STATE



With a new foreword by

James K. Galbraith

JAMES MADISON LIBRARY
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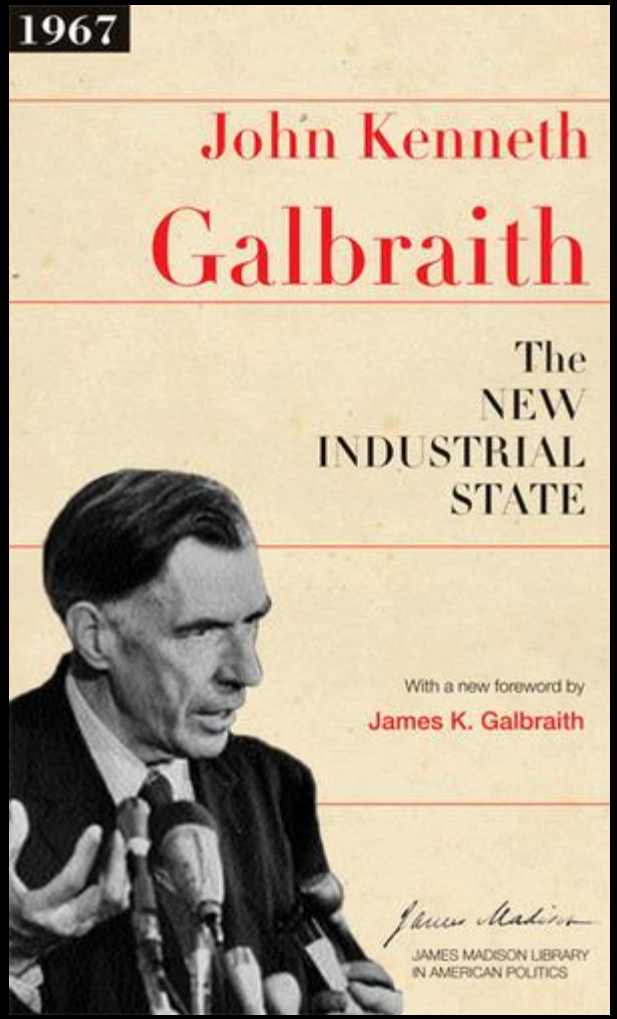
Technostructure



Technostructure

The group of technicians within an enterprise with considerable influence and control.

-- John Kenneth Galbraith

“How Do Committees Invent?”

Harvard Business Review


REJECTED

HOW DO COMMITTEES INVENT?

by MELVIN E. CONWAY

That kind of intellectual activity which creates a useful whole from its diverse parts may be called the *design* of a *system*. Whether the particular activity is the creation of specifications for a major weapon system, the formation of a recommendation to meet a social challenge, or the programming of a computer, the general activity is largely the same.

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stages of design

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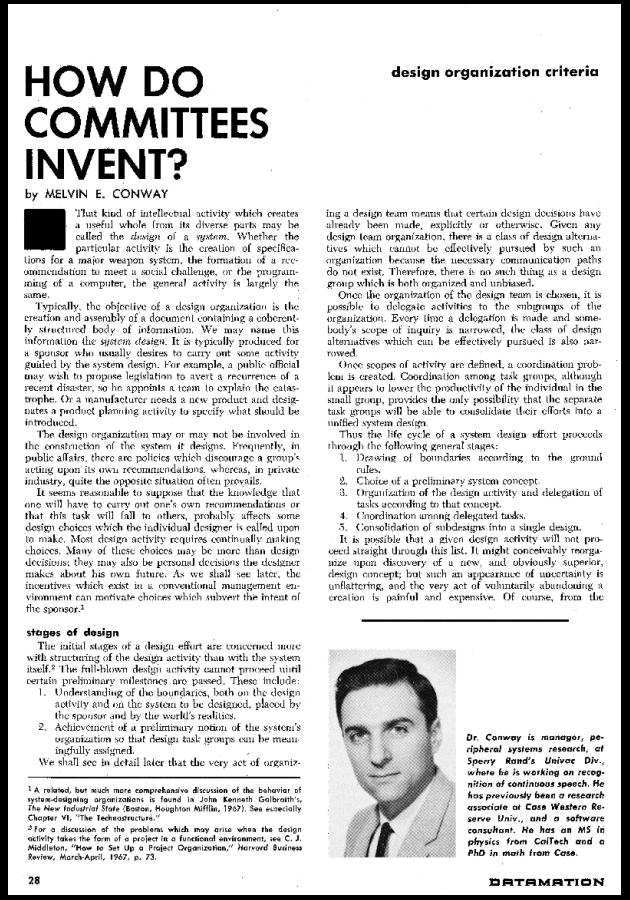

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“Any organization that designs a system (defined more broadly here than just information systems) will inevitably produce a design whose structure is a copy of the organization's communication structure.”

-- Mel Conway, 1967

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Communication dictates design.

-- Mel Conway, 1967

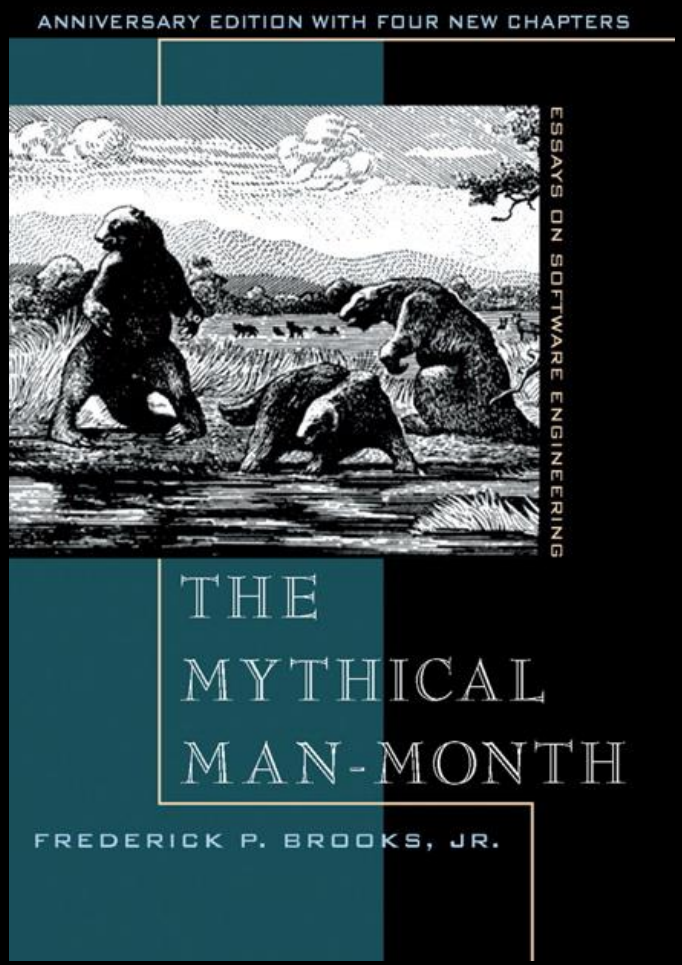
Conway's Law

ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS

ESSAYS ON SOFTWARE ENGINEERING

THE MYTHICAL MAN-MONTH

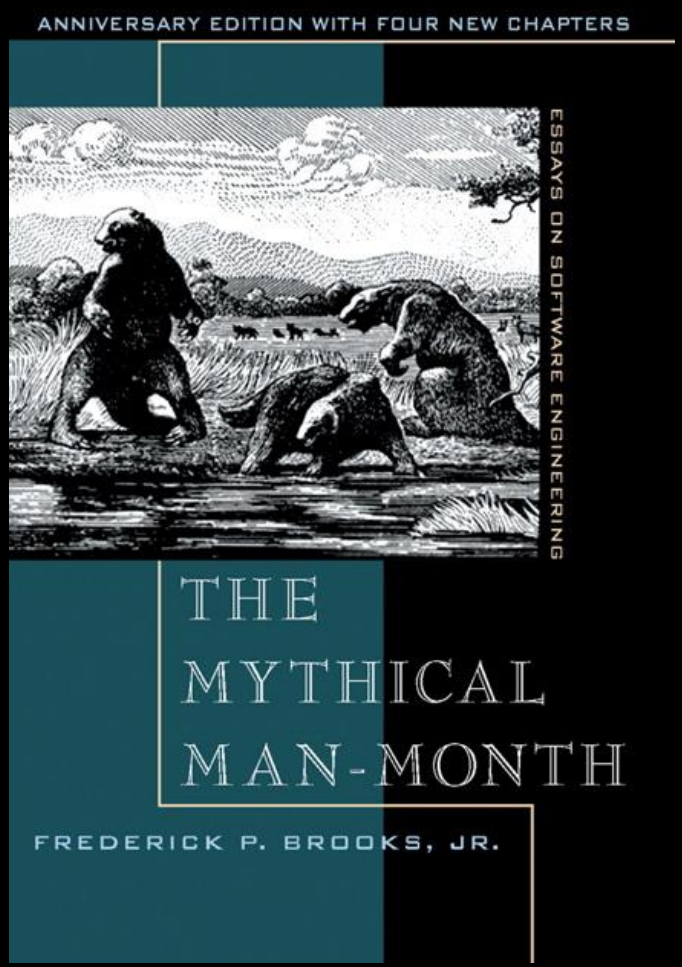
FREDERICK P. BROOKS, JR.



Brooks' Law

"*Adding manpower to a late software project makes it later*."

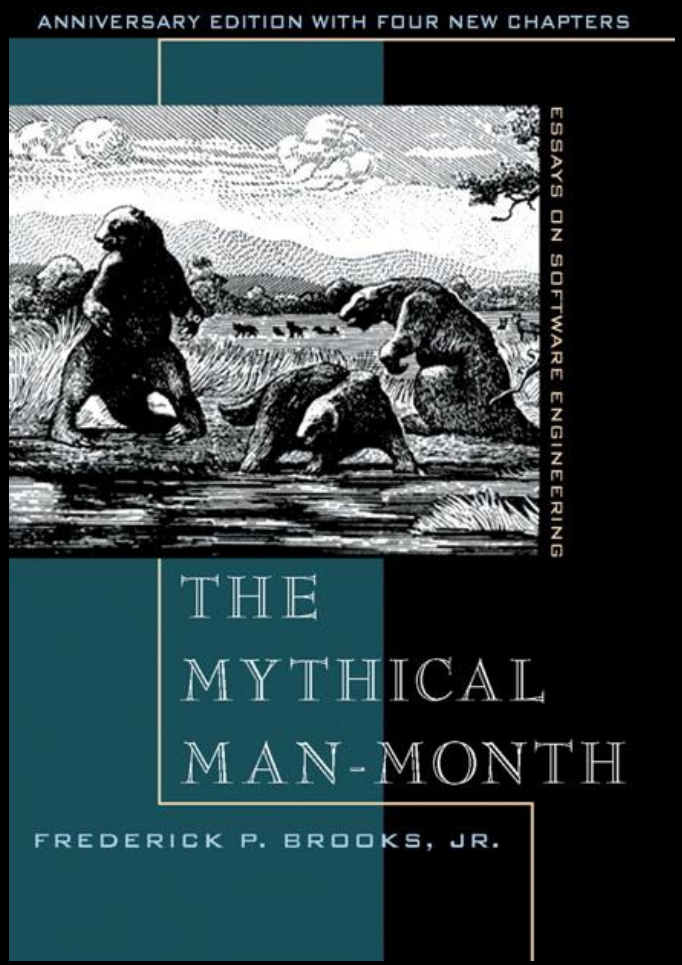
-- Fred Brooks, 1975



Intercommunication formula

$$n(n - 1) / 2$$

-- Fred Brooks, 1975



Intercommunication formula

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5*(5–1)/2 = 10
15*(15–1)/2 = 105
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150*(150–1)/2 = 11,175
```

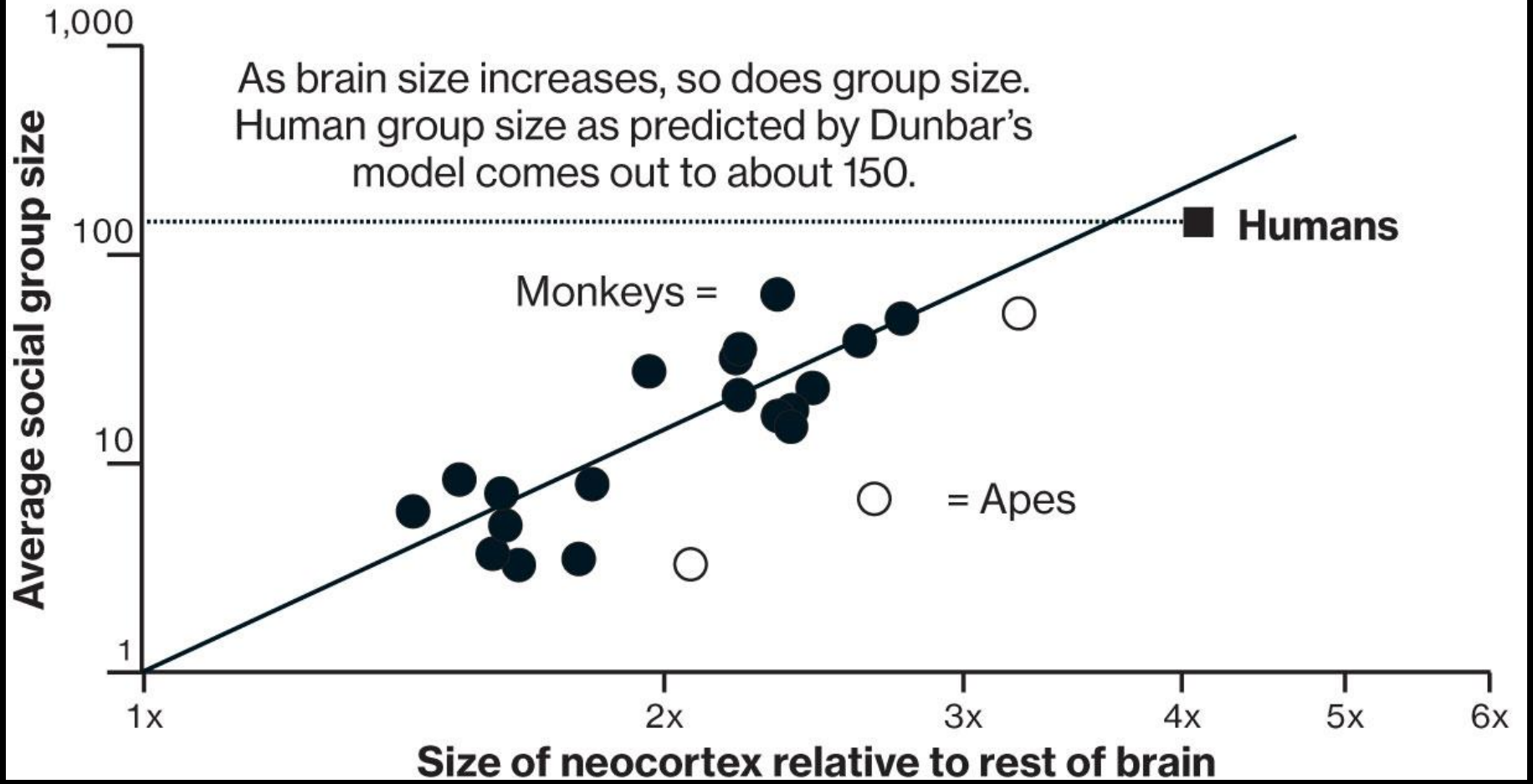
-- Fred Brooks, 1975

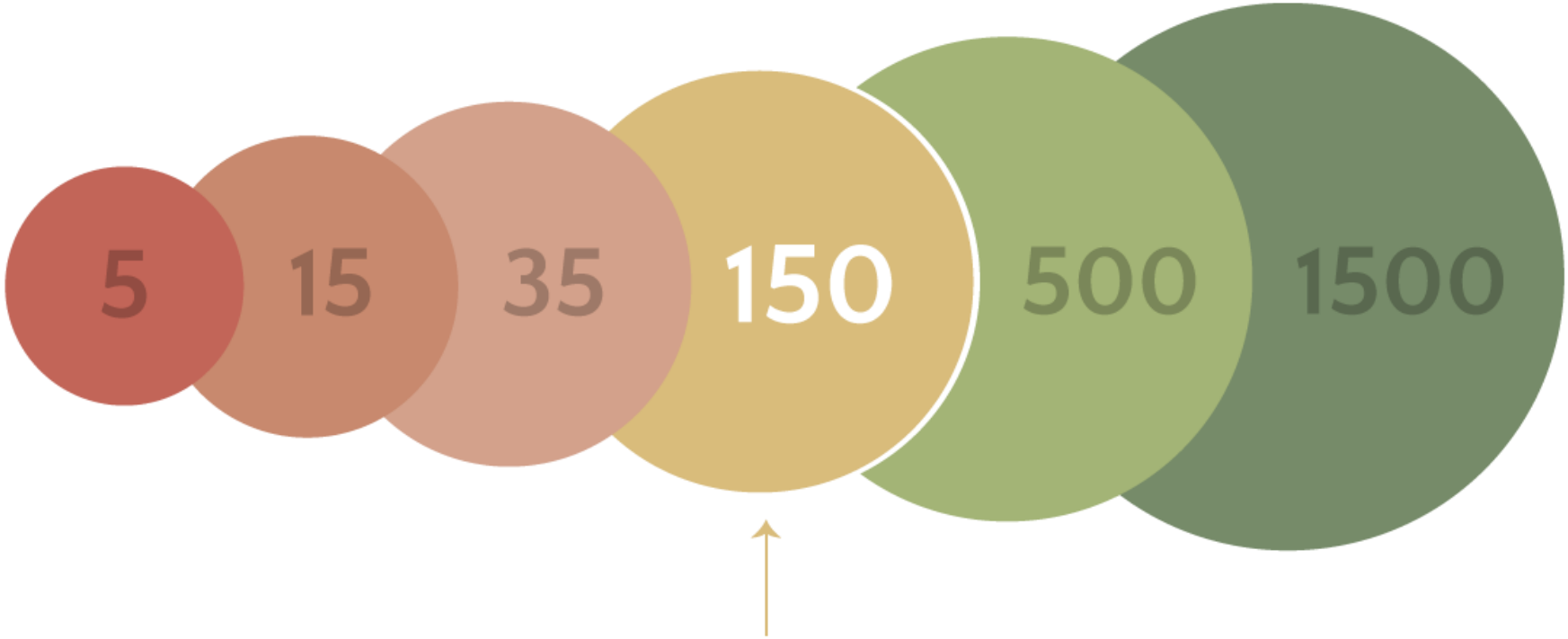
Dunbar's Number

A measurement of the "cognitive limit to the number of individuals with whom any one person can maintain stable relationships."

-- Robin Dunbar, 1992

The Social Cortex





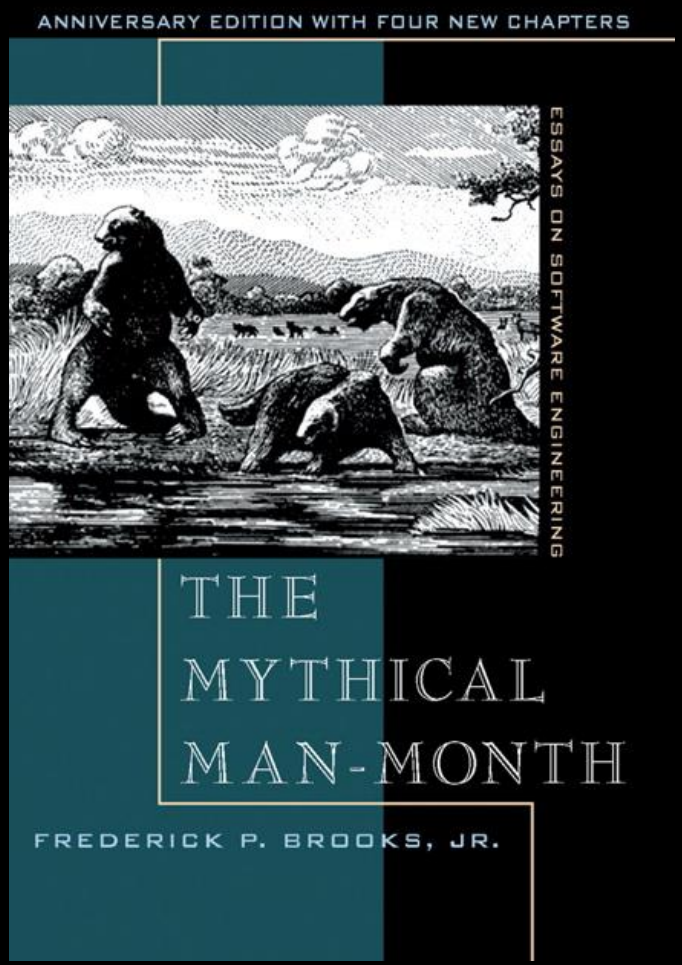
Dunbar's Number

the max number of relationships a person can maintain

Dunbar Groups

Intimate friends: 5
Trusted friends: 15
Close friends: 35
Casual friends: 150

-- Robin Dunbar, 1992



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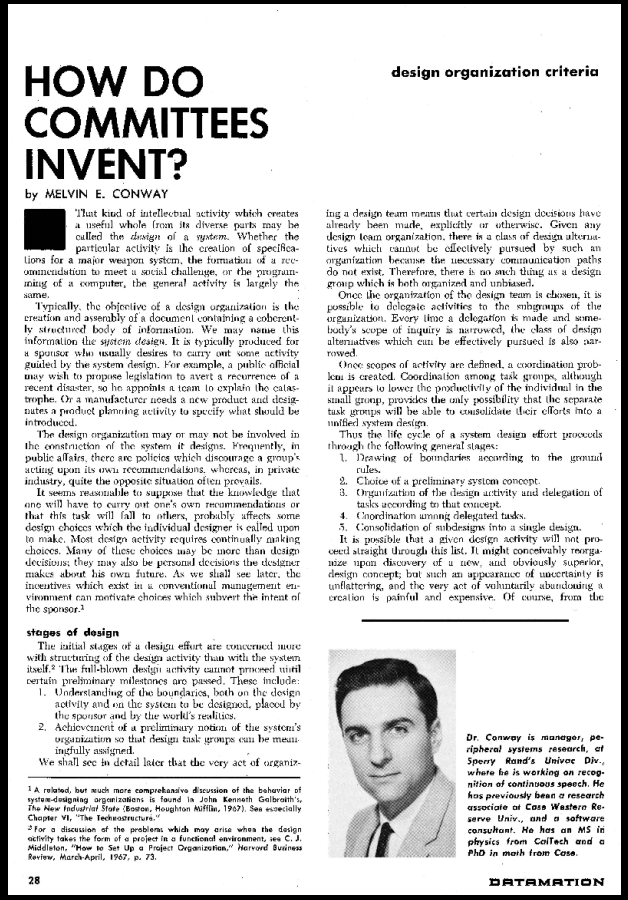
Communication dictates design.

-- Mel Conway, 1967

Conway's (first) Law

So… what about other Conway Laws?

Conway's Second Law



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Doing it Over

"There is never enough time to do something right, but there is always enough time to do it over."

-- Mel Conway, 1967

Trade Offs

Efficiency-Effectiveness Trade Offs (ETTOs)

The ETTO Principle:

Efficiency-Thoroughness Trade-Off

Why Things That Go Right Sometimes Go Wrong

ERIK HOLLNAGEL

Satisficing v. Sacrificing

“Satisficing is explained as a consequence of limited cognitive capacity.

Sacrificing is explained as a consequence of the intractability of the work environment”

-- Eric Hollnagel, 2009

Satisficing v. Sacrificing

Problem too complicated?
Ignore details.

Not enough resources?
Give up features.

-- Eric Hollnagel, 2009

ETTOs are “normal” and result in success more often than failure.

Two interpretations of safety

Region Syddanmark

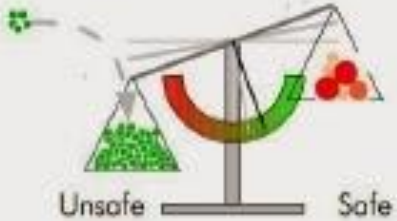
Safety-I

Safety means that the number of things that go wrong (accidents / incidents / near misses) is as low as possible.

Safety can be achieved by first finding and then eliminating or weakening the causes of adverse outcomes.

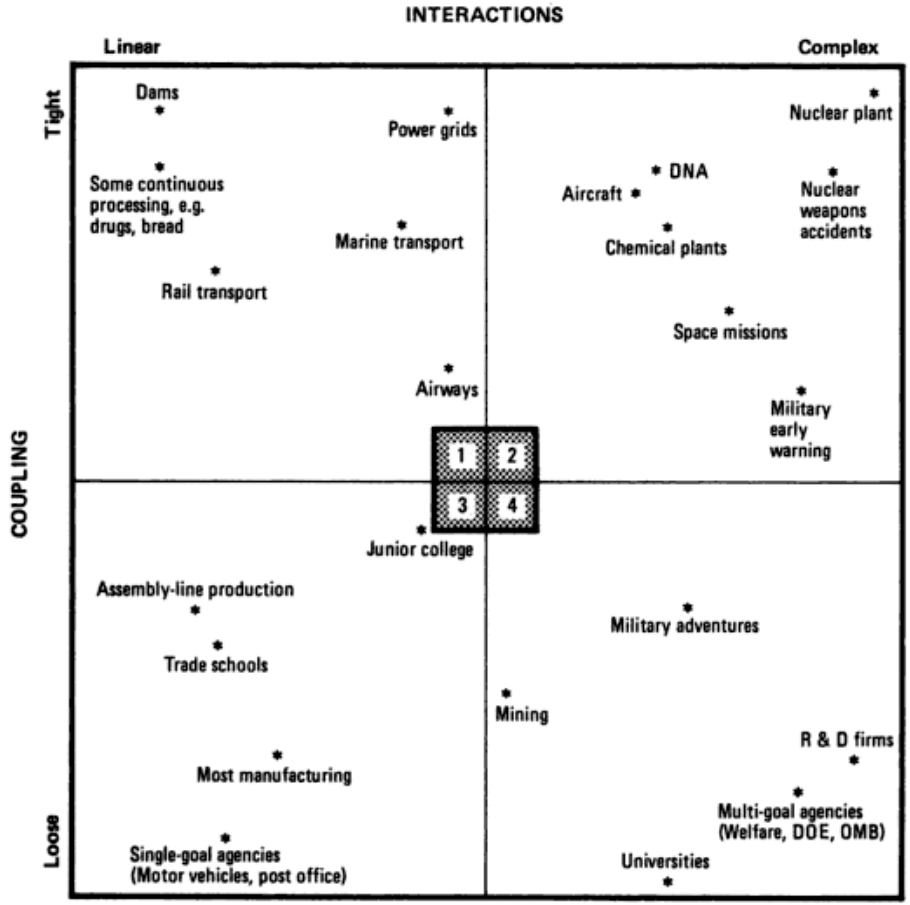
Safety-II Resilience

Safety means that the number of things that go right is as high as possible. Safety is the ability to succeed under varying conditions.



Safety requires an understanding of everyday performance. Safety can be achieved by strengthening this ability.

FIGURE 3.1
Interaction/Coupling Chart



The enemy is intractability.

Increasing Intractability

1. Systems grow too large
2. Rate of change increases
3. Overall expectations keep rising

-- Eric Hollnagel, 2009

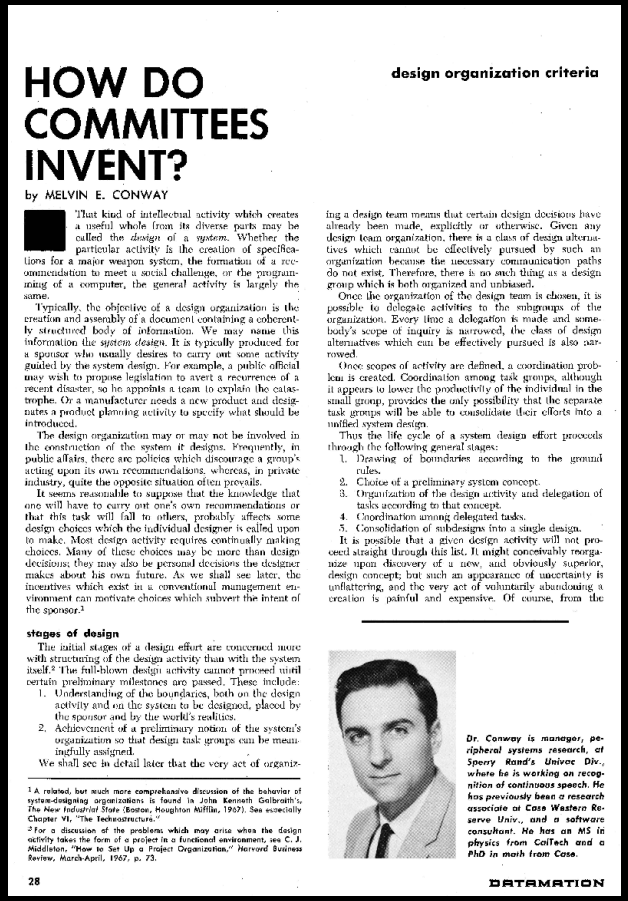
Key benefits of Continuous delivery

Conway's Third Law

Homomorphism

"There is a homomorphism from the linear graph of a system to the linear graph of its design organization"

-- Mel Conway, 1967



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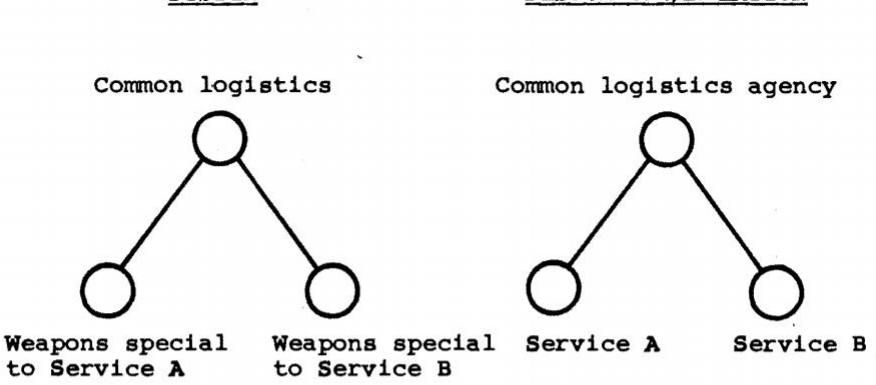
ho·mo·mor·phism

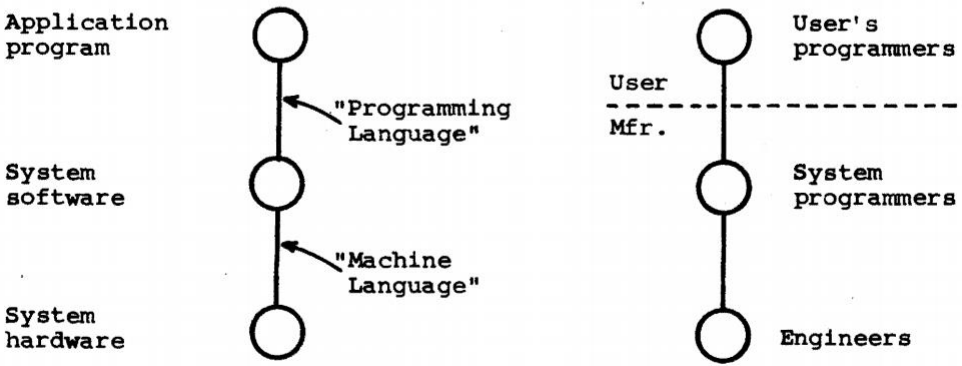
/ˌhōməˈmôrfizəm/

noun MATHEMATICS

a transformation of one set into another that preserves in the second set the relations between elements of the first.

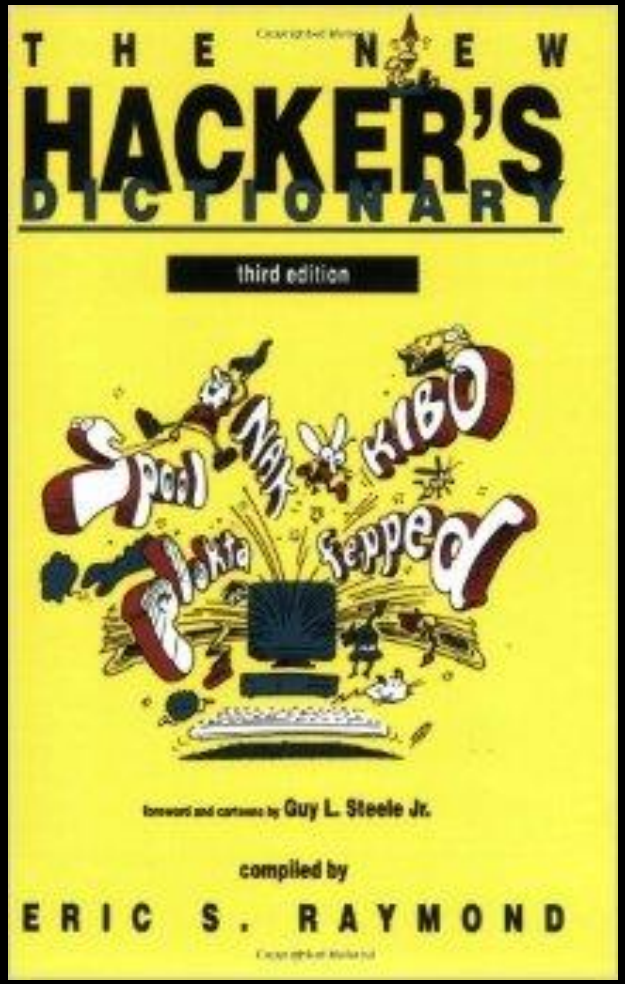


3a. A Weapon System



3b. A Computer System

Figure 3 Two examples of identity of structure between a system and its design organization.

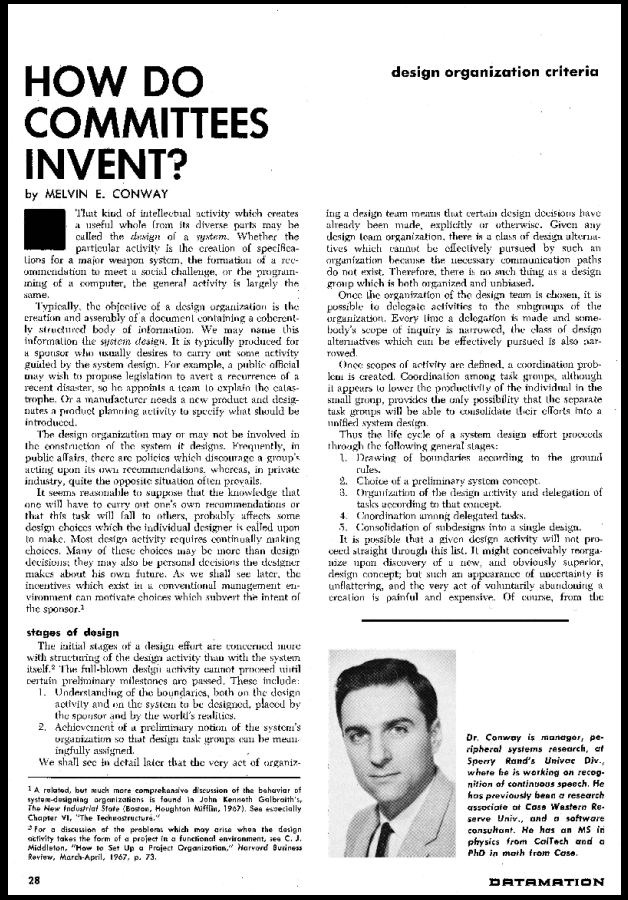


Homomorphism

“If you have four groups working on a compiler, you'll get a 4-pass compiler.”

- Eric S. Raymond, 1991

Conway’s Fourth Law



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Disintegration

"The structures of large systems tend to disintegrate during development, qualitatively more so than with small systems."

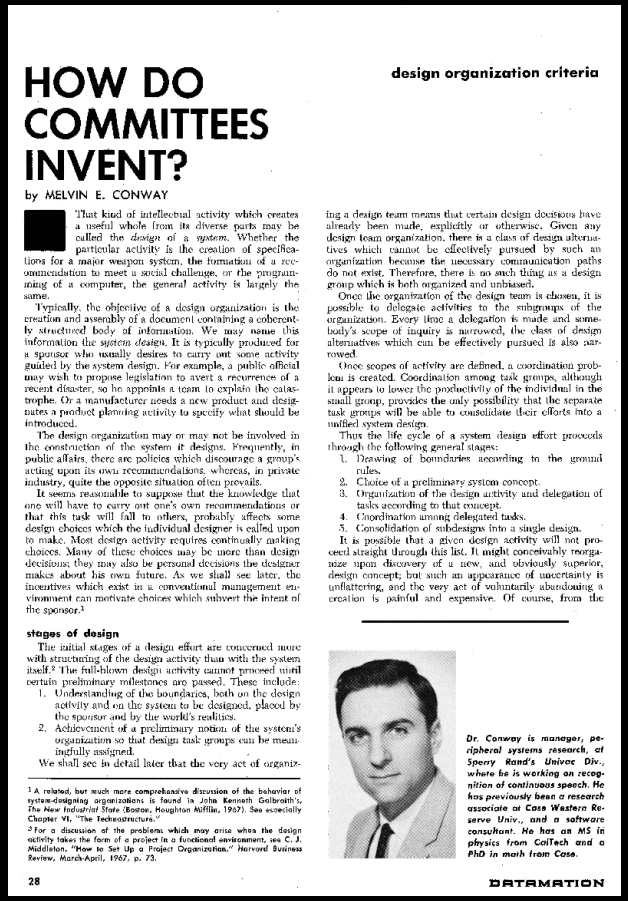
-- Mel Conway, 1967

Three reasons Disintegration occurs…

Disintegration: Reason #1

“The realization that the system will be large, together with organization pressures, make irresistible the temptation to assign too many people to a design effort”

-- Mel Conway, 1967



design organization criteria

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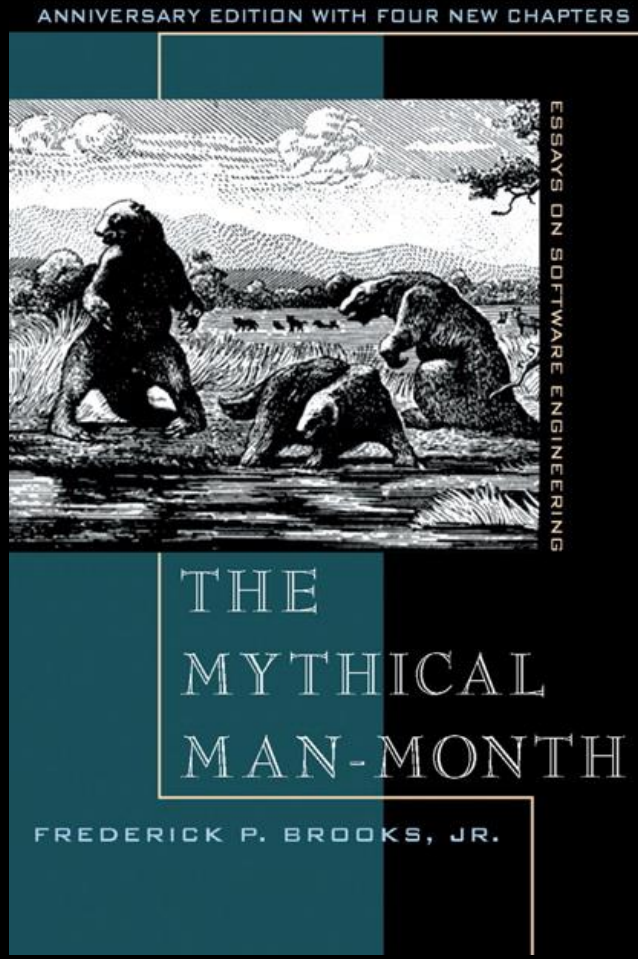
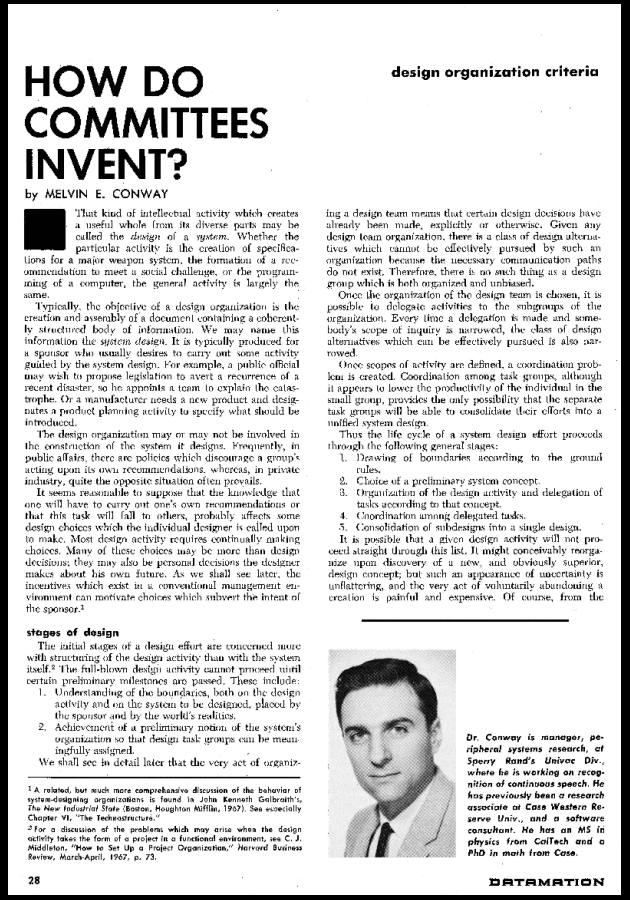


Brooks' Law

Adding manpower to a late software project makes it later.

-- Fred Brooks, 1975

Disintegration: Reason #2



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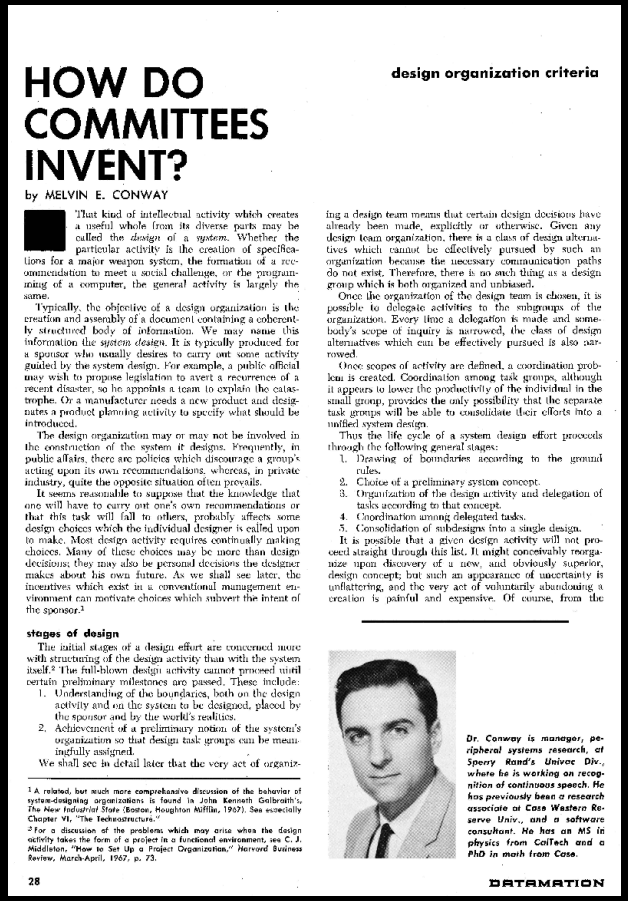
"Application of the conventional wisdom of management to a large design organization causes its communication structure to disintegrate."

-- Mel Conway, 1967

Dunbar's Number

A measurement of the "cognitive limit to the number of individuals with whom any one person can maintain stable relationships."

-- Robin Dunbar, 1992



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It seems reasonable to suppose that the knowledge that one will have to carry out one's own recommendations or that this task will fall to others, probably affects some design choices which the individual designer is called upon to make. Most design activity requires continually making choices. Many of these choices may be more than design decisions; they may also be personal decisions the designer makes about his own future. As we shall see later, the incentives which exist in a conventional management environment can motivate choices which subvert the intent of the sponsor.[1]

stages of design

The initial stages of a design effort are concerned more with structuring of the design activity than with the system itself.[2] The full-blown design activity cannot proceed until certain preliminary milestones are passed. These include:

1. Understanding of the boundaries, both on the design activity and on the system to be designed, placed by the sponsor and by the world's realities.
2. Achievement of a preliminary notion of the system's organization so that design task groups can be meaningfully assigned.

We shall see in detail later that the very act of organizing a design team means that certain design decisions have already been made, explicitly or otherwise. Given any design team organization, there is a class of design alternatives which cannot be effectively pursued by such an organization because the necessary communication paths do not exist. Therefore, there is no such thing as a design group which is both organized and unbiased.

Once the organization of the design team is chosen, it is possible to delegate activities to the subgroups of the organization. Every time a delegation is made and somebody's scope of inquiry is narrowed, the class of design alternatives which can be effectively pursued is also narrowed.

Once scopes of activity are defined, a coordination problem is created. Coordination among task groups, although it appears to lower the productivity of the individual in the small group, provides the only possibility that the separate task groups will be able to consolidate their efforts into a unified system design.

Thus the life cycle of a system design effort proceeds through the following general stages:

1. Drawing of boundaries according to the ground rules.
2. Choice of a preliminary system concept.
3. Organization of the design activity and delegation of tasks according to that concept.
4. Coordination among delegated tasks.
5. Consolidation of subdesigns into a single design.

It is possible that a given design activity will not proceed straight through this list. It might conceivably reorganize upon discovery of a new, and obviously superior, design concept; but such an appearance of uncertainty is unflattering, and the very act of voluntarily abandoning a creation is painful and expensive. Of course, from the

Dr. Conway is manager, peripheral systems research, at Sperry Rand's Univac Div., where he is working on recognition of continuous speech. He has previously been a research associate at Case Western Reserve Univ., and a software consultant. He has an MS in physics from CalTech and a PhD in math from Case.

[1] A related, but much more comprehensive discussion of the behavior of system-designing organizations is found in John Kenneth Galbraith's, *The New Industrial State* (Boston, Houghton Mifflin, 1967). See especially Chapter VI, "The Technostructure."

[2] For a discussion of the problems which may arise when the design activity takes the form of a project in a functional environment, see C. J. Middleton, "How to Set Up a Project Organization," *Harvard Business Review*, March-April, 1967, p. 73.

Disintegration: Reason #3

"Homomorphism insures that the structure of the system will reflect the disintegration which has occurred in the design organization."

-- Mel Conway, 1967

HOW DO COMMITTEES INVENT?

by MELVIN E. CONWAY

That kind of intellectual activity which creates a useful whole from its diverse parts may be called the *design* of a *system*. Whether the particular activity is the creation of specifications for a major weapon system, the formation of a recommendation to meet a social challenge, or the programming of a computer, the general activity is largely the same.

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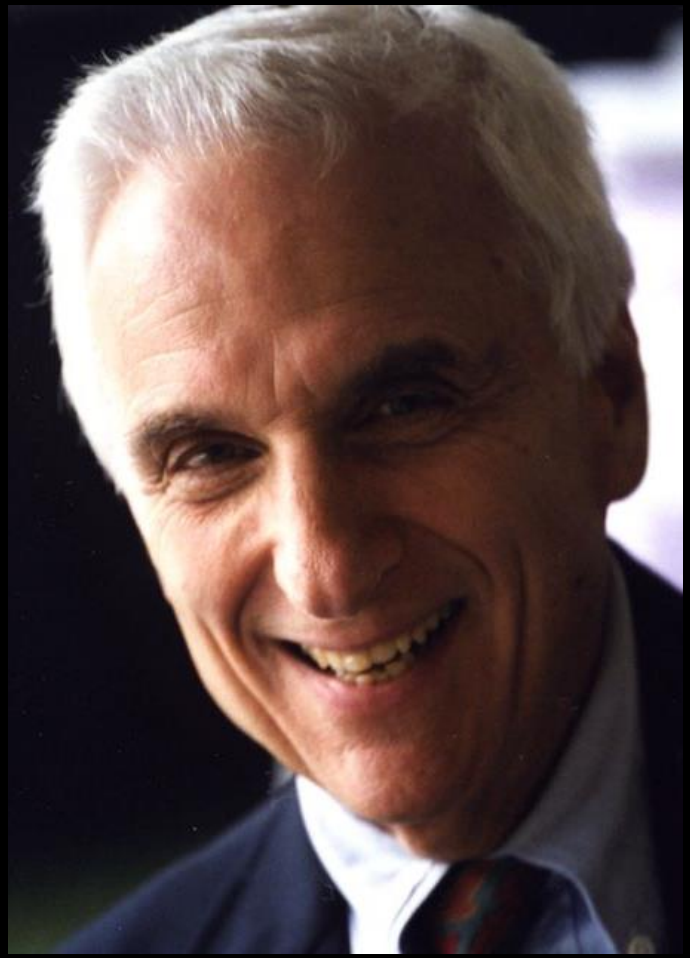
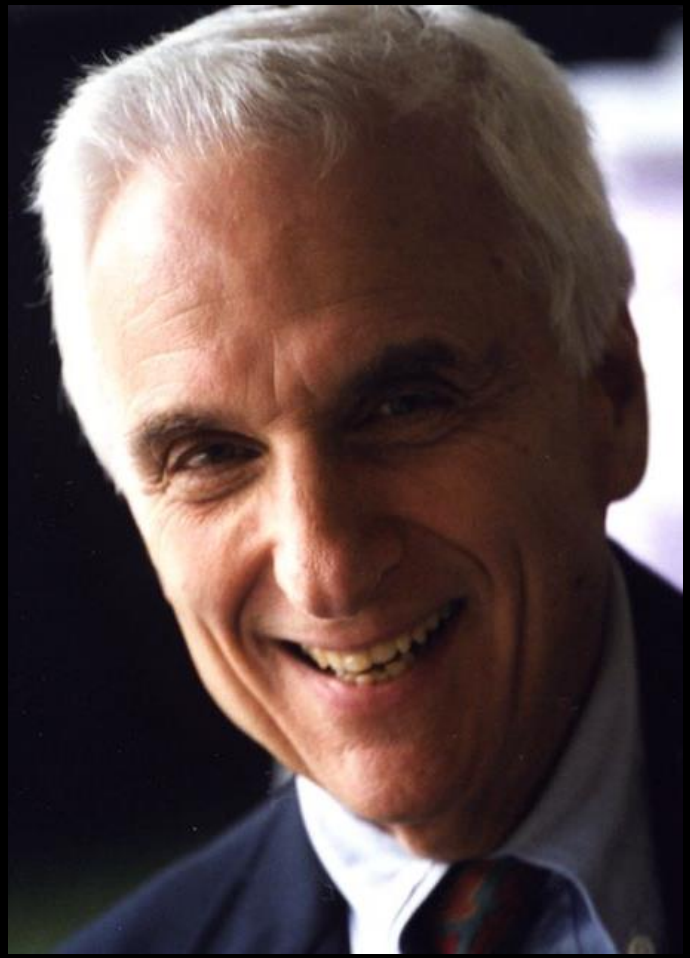
Communication dictates design.

-- Mel Conway, 1967

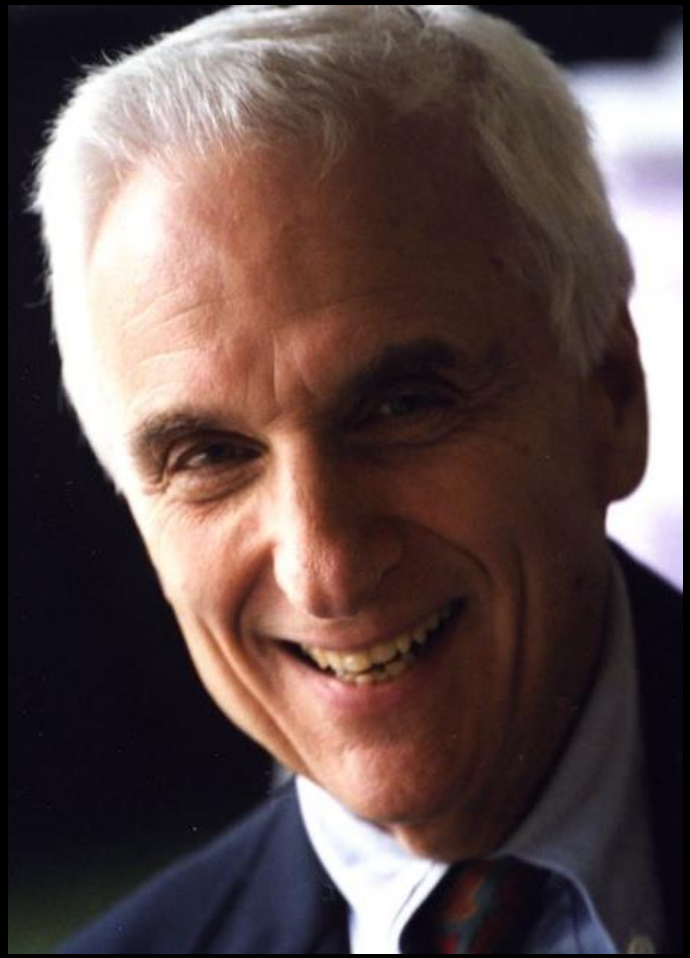
So, what can we do about this?



Conway's Laws
can help us succeed

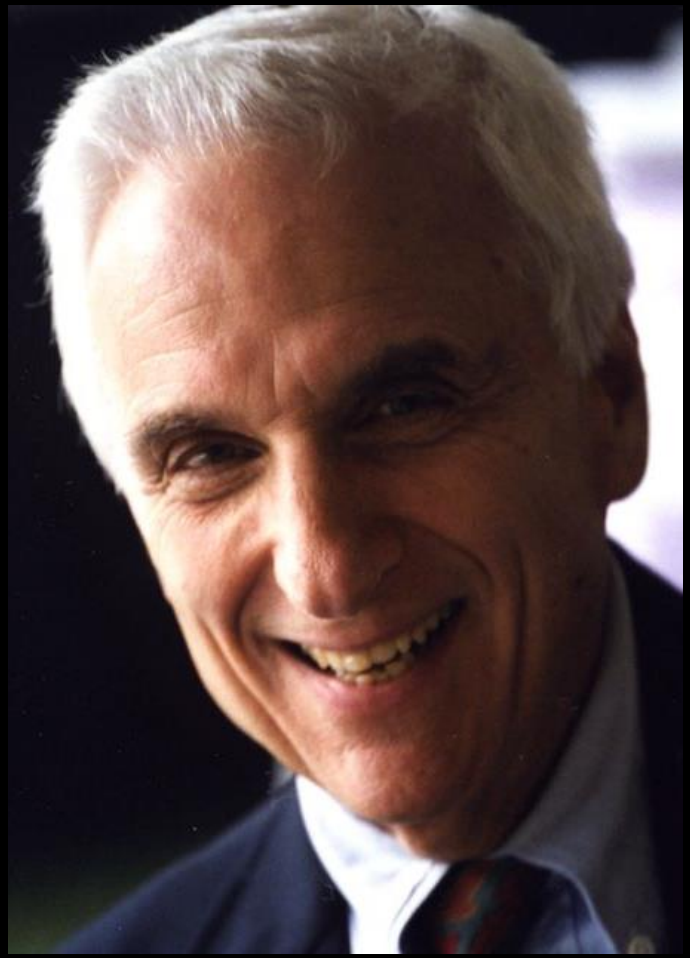


Conway's Laws can help us succeed when working with distributed teams.



Conway's First Law

A system's design is a copy of the organization's communication structure.



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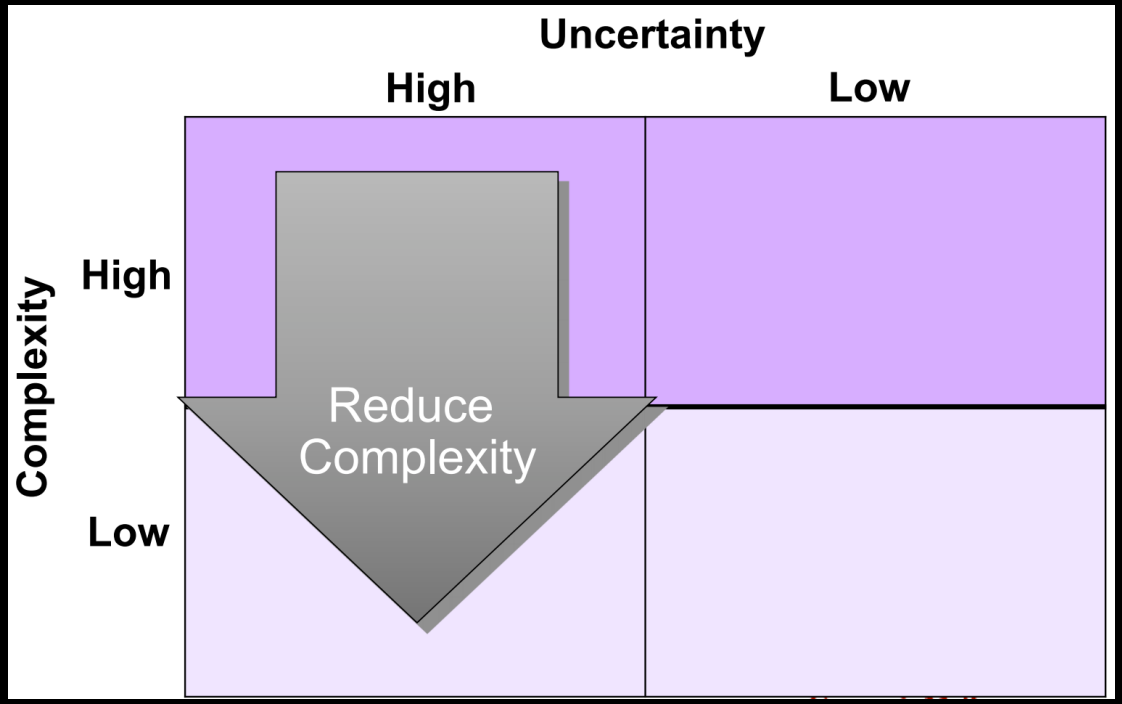
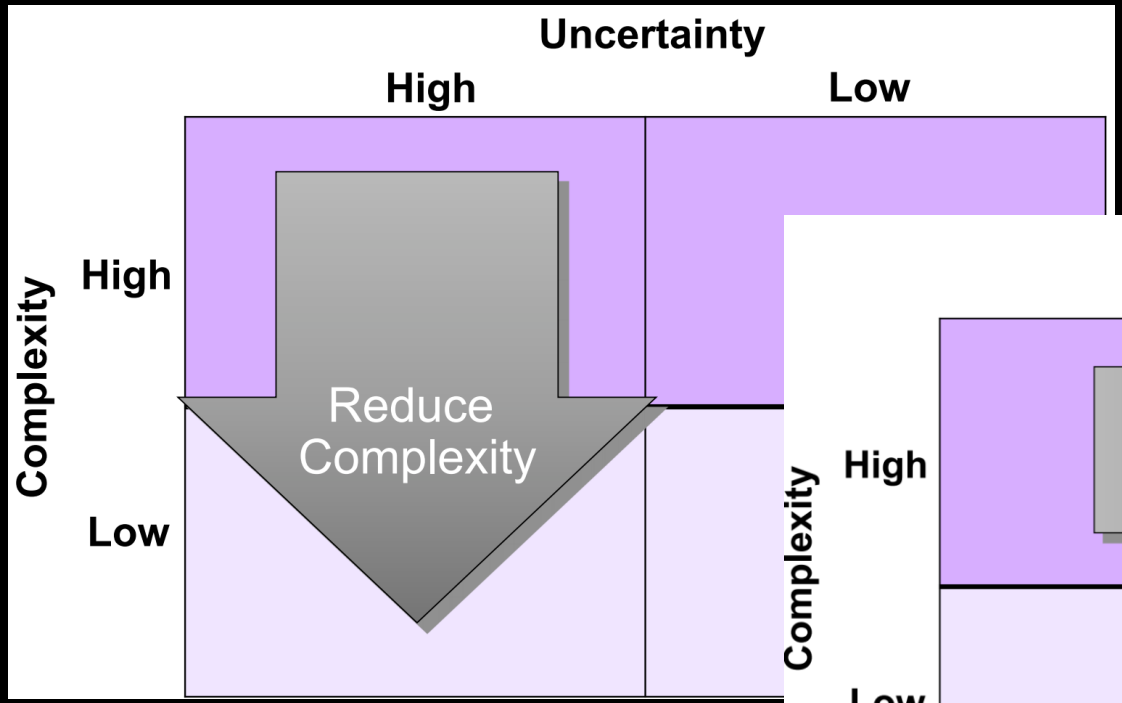
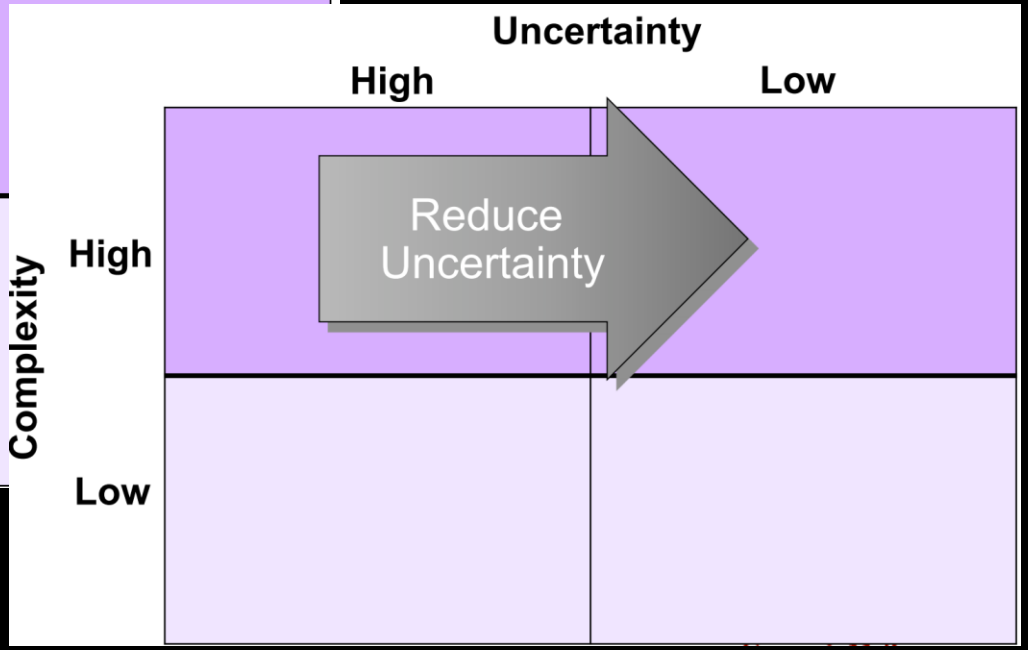
Actively manage communications within the teams and across teams.



James Herbsleb: *“Tactics for Global Software Development”*





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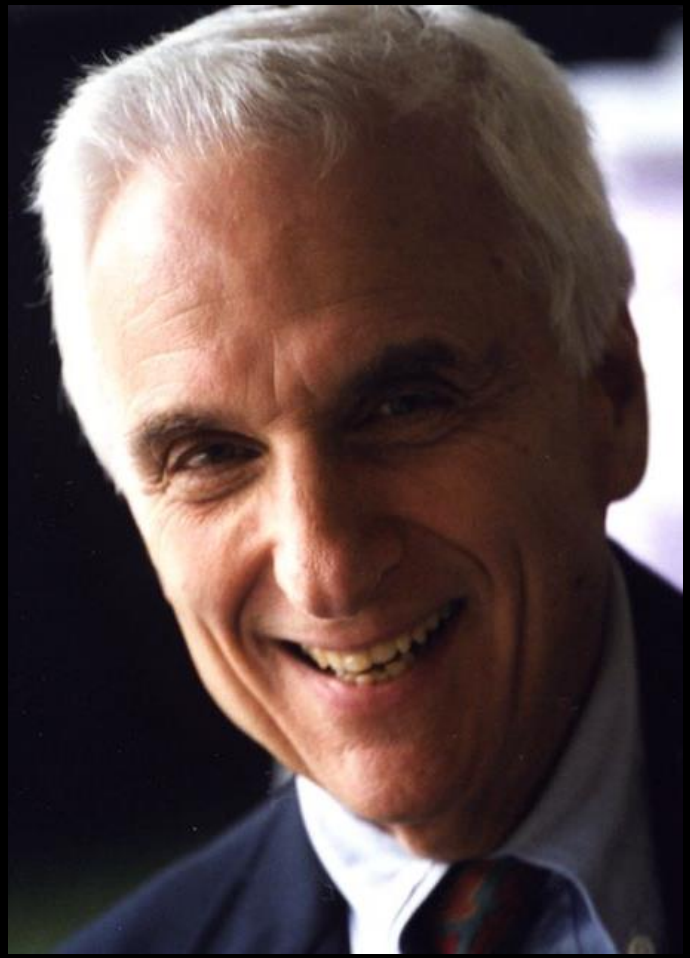
Increase communications

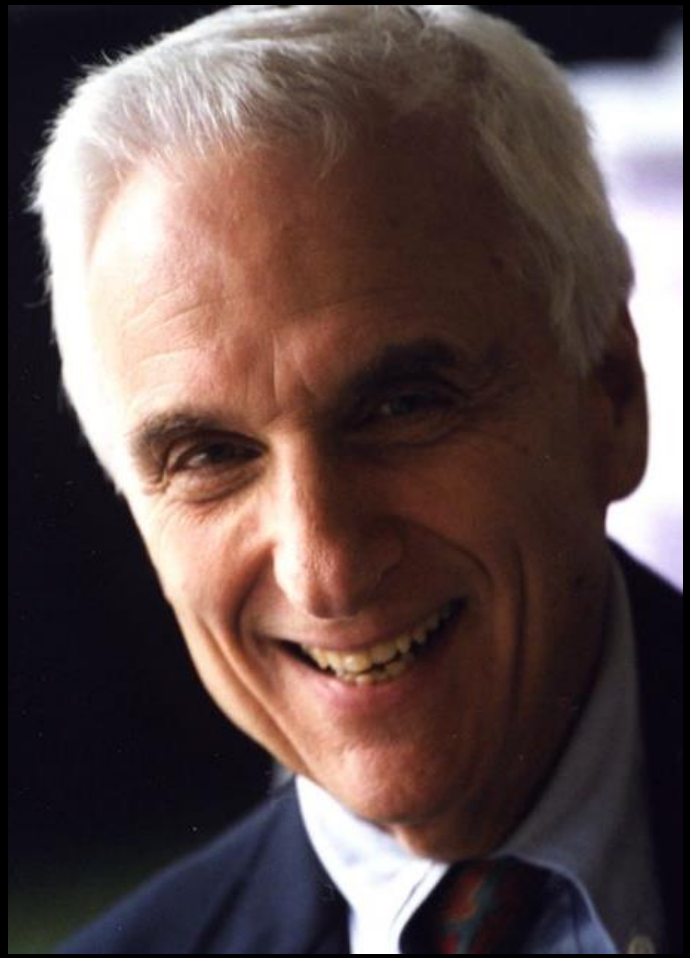
- Real-time Chat Tools
- Video Conferencing
- Online Forums/News Groups
- Wiki and Web Sites

Reduce the effort required to locate and interact with the ‘right people’



Conway's Second Law

There is never enough time to do something right, but there is always enough time to do it over.



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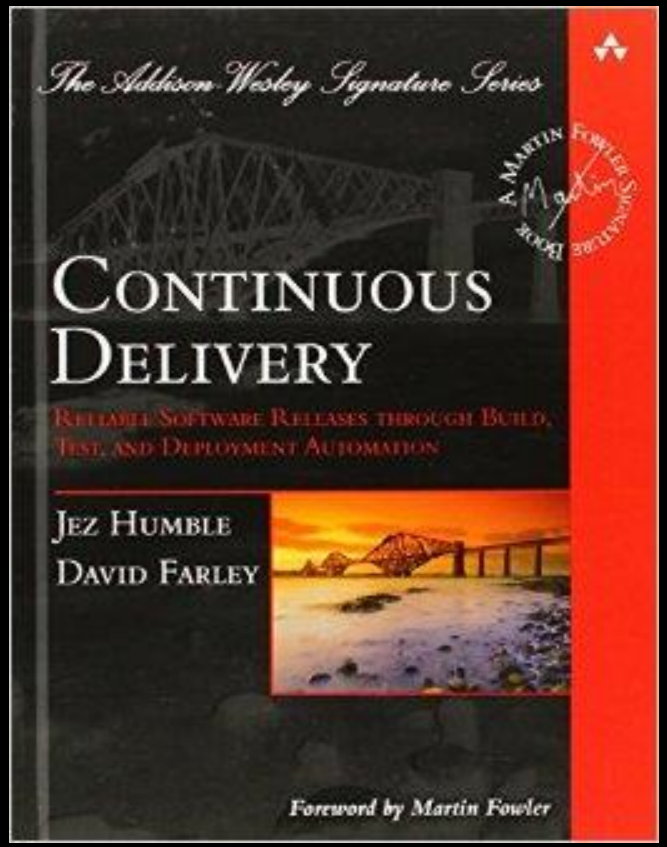
Remember the process is continually repeating.



Continuous Delivery

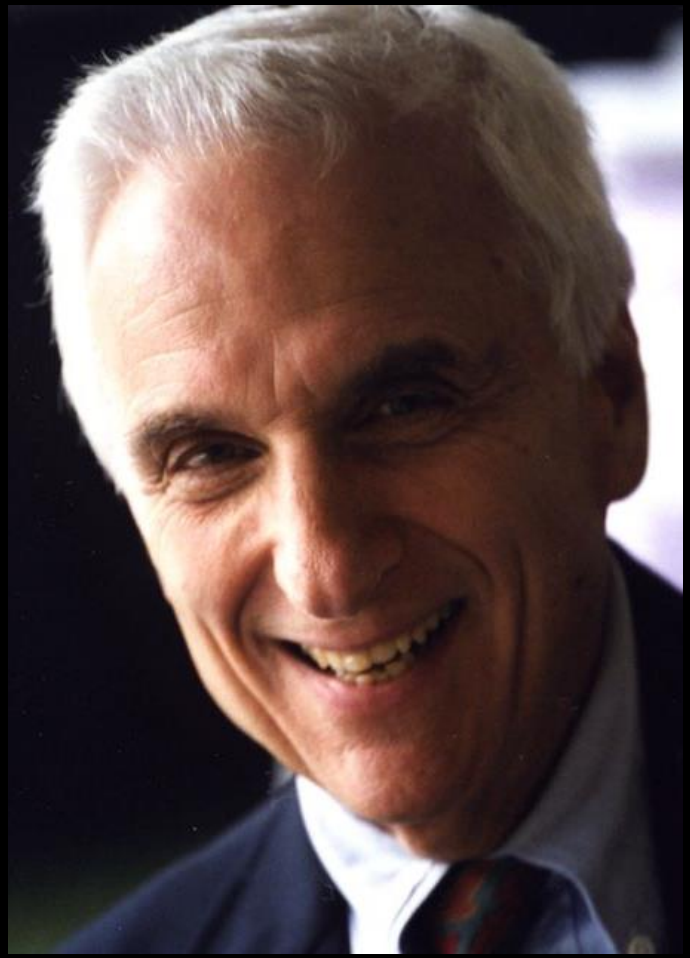
"The core concept of making small frequent changes, and testing at every step, reduces the risk inherent in deploying new code."

Jez Humble, Thoughworks.

Support continuous processes

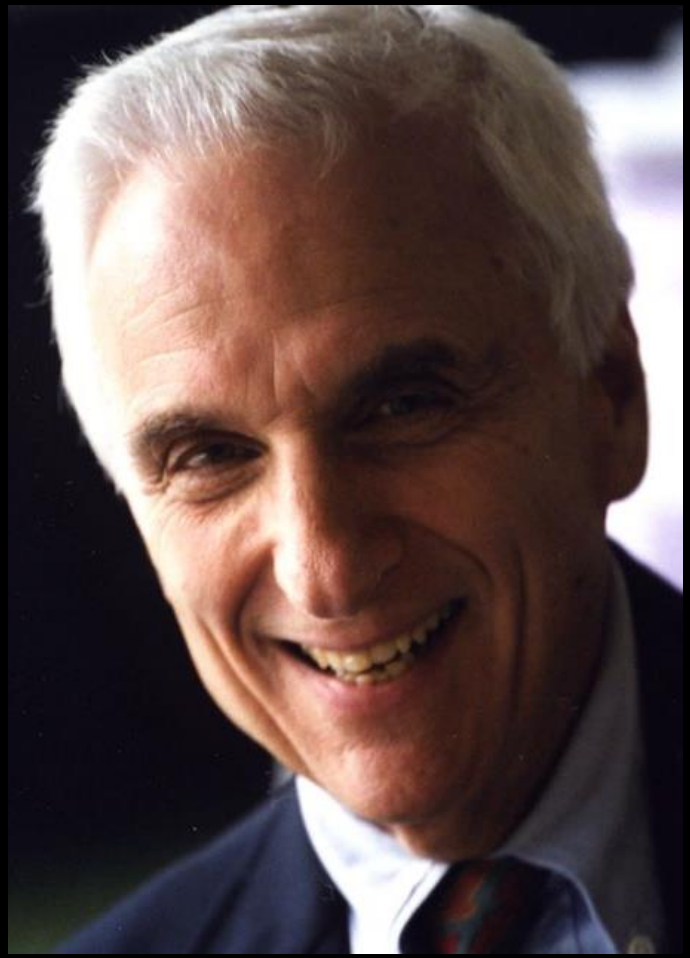
- Implement small changes
- Test immediately
- Deploy constantly

Shorten the feedback loop as much as possible.



Conway's Third Law

There is a homomorphism from the linear graph of a system to the linear graph of its design organization.



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There is a homomorphism from the linear graph of a system to the linear graph of its design organization.

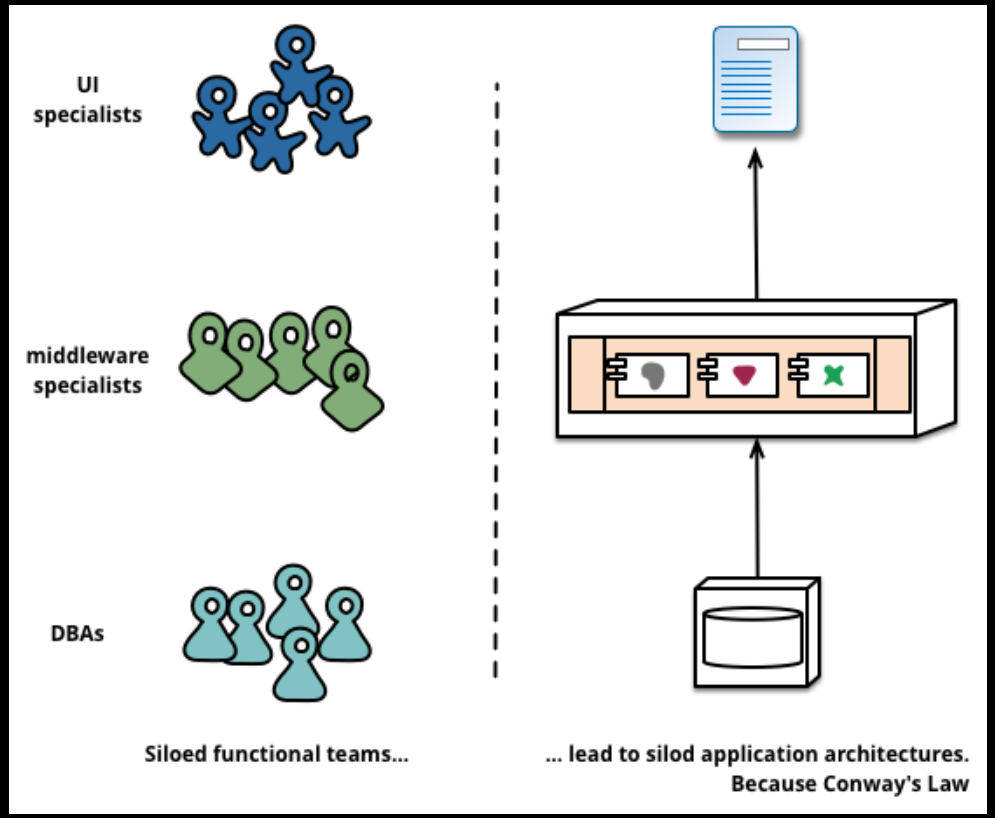
Organize teams in order to achieve desired system.

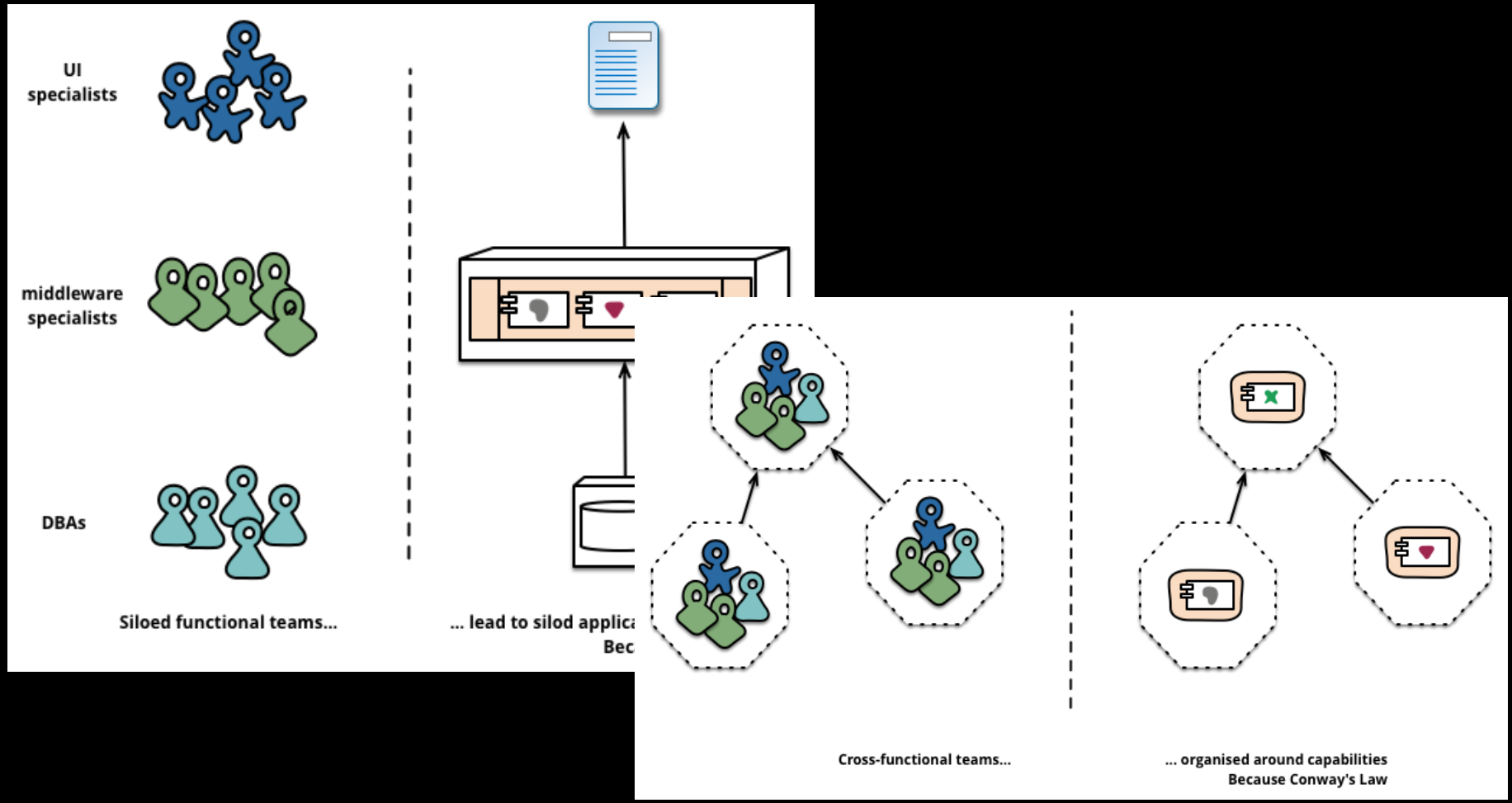
Microservices

Organized around
business capabilities.

Products, not projects.

Martin Fowler, Thoughtworks


UI specialists
middleware specialists
DBAs
Siloed functional teams...
... lead to silod application architectures.
Because Conway's Law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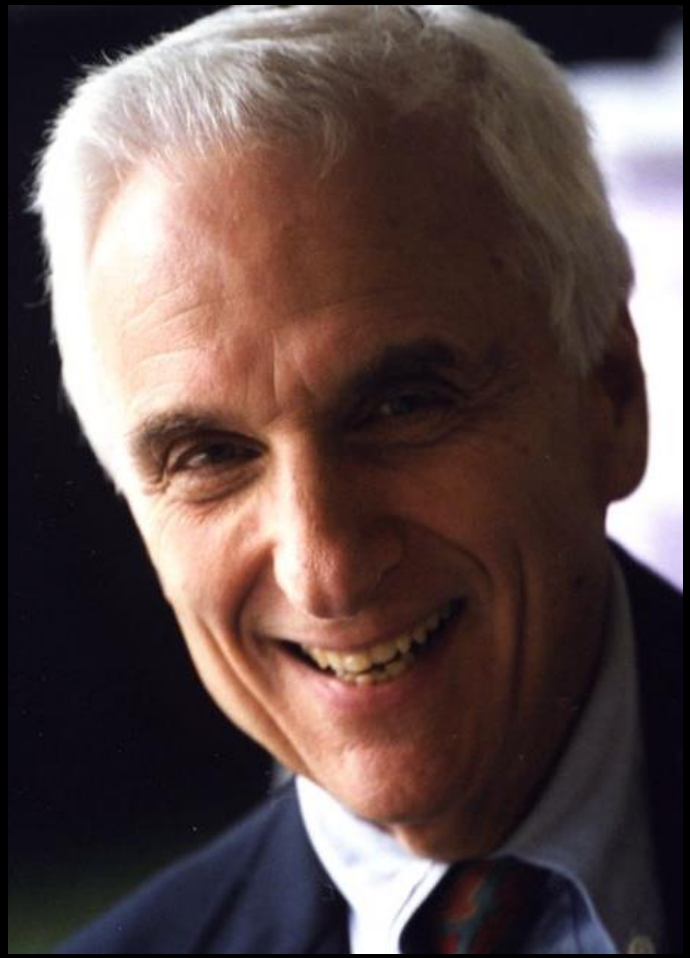
Siloed functional teams...
... lead to silod applica
Bec
Cross-functional teams...
... organised around capabilities
Because Conway's Law

Organize teams by product or BU

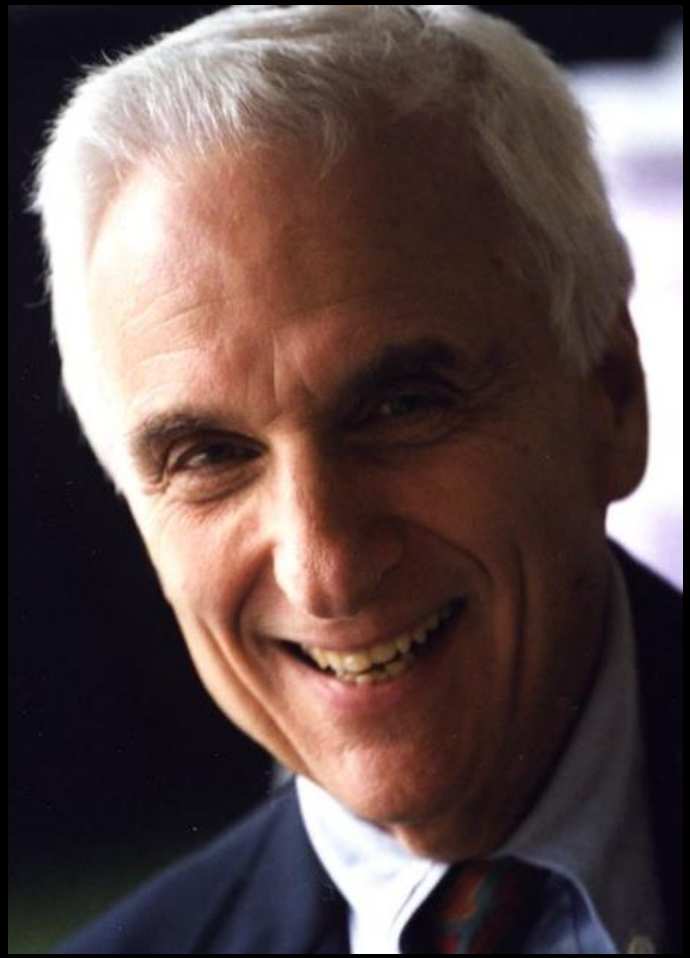
- Combine design, develop, test, & deploy
- Include storage, business process, & UI
- Allow teams autonomy *within* their boundary
- Require teams to *inter-operate,* not integrate

Make sure teams own their complete lifecycle.



Conway's Fourth Law

The structures of large systems tend to disintegrate during development.



Conway's Fourth Law

The structures of large systems tend to disintegrate during development.

Keep your teams as small as necessary, but no smaller.

Sizing Teams

Jeff Bezos, Amazon

Sizing Teams

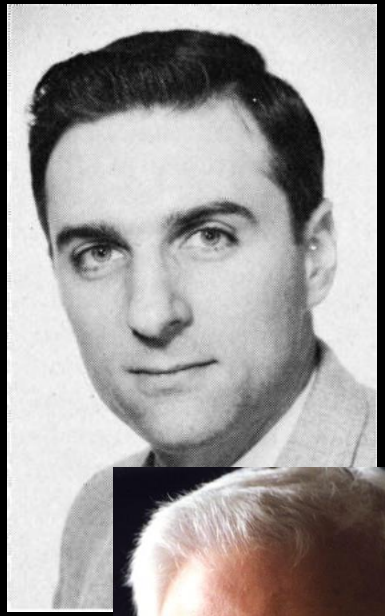
If a team can’t be fed with two pizzas, it’s too big.

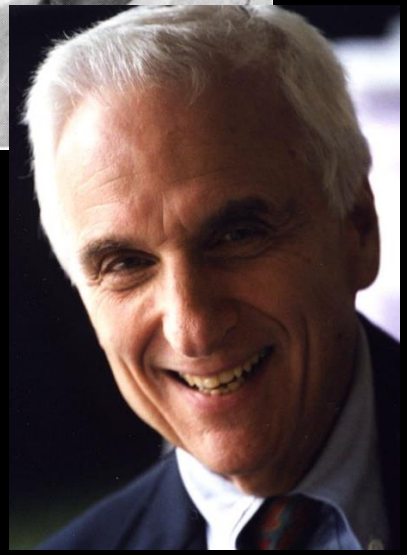
Jeff Bezos, Amazon

Make team as small as necessary

- Resist urge to grow teams in response to deadlines
- Consider Dunbar's groups when sizing teams
- Be prepared to break into smaller teams

It's better to be "too small" than to be "too big."





Conway's Lessons

1. Increase communications
2. Support continuous process
3. Organize teams by products
4. Make teams as small as necessary

Conway's Law at a Distance

Building Teams in a Distributed World

http://g.mamund.com/2014-archsummit

Mike Amundsen
CA Technologies
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