Optimizing Teams in a Distributed World

Conway's three other laws

Mike Amundsen CA Technologies @mamund

Introduction





RETURN TO HOMEPAGE

API ACADEMY SERVICES

The API Academy team consists of industry experts who have been brought together by CA Technologies to provide expert consulting services for organizations that want to take their API programs to the next level.

Contact us to find out more about how we can help you understand the API economy, plan a program strategy, architect effective interfaces, build a secure, manageable API infrastructure and empower your developers to create truly valuable client apps.

Email: apiacademy@ca.com





































Effective Teams

"Organizational metrics can predict software failure-proneness with a precision and recall of 85%"

> -- Nachi Nagappan, MS Research (2009)



Effective Teams for Microservices

"[Microservices] allow organizations [to align] the architecture of their systems to the structure of their teams."

-- Sam Newman, "Demystifying Conway's Law" (2015)



Mel Conway



Mel Conway

- Burroughs assembler (SAVE) 1950s
- UNCOL (universal compiler language) 1958
- First paper on Coroutines 1963
- "How Do Committees Invent"? (1967)
- MUMPS medical computing (1970s)
- Pascal for Mac & Apple II (1980s)
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Project-Based Organizations

Volume 1 Issue 1 2011

ISSN: 2157-372

Engineering Project Organization Journal

Editor: Paul S. Chinowsky, University of Colorado , USA



"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?**

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 some

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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

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DATAMATION

Communication dictates design.

-- Mel Conway, 1<u>96</u>7

Conway's Law



THE MYTHICAL MAN-MONTH

FREDERICK P. BROOKS, JR.



Brooks' Law

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

THE MYTHICAL MAN-MONTH

FREDERICK P. BROOKS, JR.

-- Fred Brooks, 1975



THE MYTHICAL MAN-MONTH

FREDERICK P. BROOKS, JR.

Intercommunication formula

n(n - 1) / 2

-- Fred Brooks, 1975



THE MYTHICAL MAN-MONTH

FREDERICK P. BROOKS, JR.

Intercommunication formula

5*(5-1)/2 = 10 15*(15-1)/2 = 105 50*(50-1)/2 = 1,225 150*(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."





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



ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS



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Conway's (first) Law



Conway's (first) Law tells us TEAM SIZE is important

Conway's (first) Law tells us TEAM SIZE is important

SO...

Make the teams as small as necessary.



"Scaling Spotify", Kniberg & Ivarrson (2012) https://dl.dropboxusercontent.com/u/1018963/Articles/SpotifyScaling.pdf

ASSESSMENT:

If you don't have a personal relationship with every member of your TEAM, your team is probably TOO BIG.

GUIDANCE:

Aim for TEAM SIZE of "Dunbar level 1" (5), possibly "Dunbar level 2" (15).

So... what about other Conway Laws?

Conway's Second Law



design organization criteria

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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."



Trade Offs

Efficiency-Thoroughness Trade Offs (ETTOs)





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



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.

@ Erik Helinagel, 2015

From "Safety-I and Safety-II", Hollnagel (2014) http://www.ashgate.com/isbn/9781472423085

FIGURE 3.1 Interaction/Coupling Chart



From "ETTO: The Efficiency-Thoroughness Trade-Off", Hollnagel (2009) http://www.ashgate.com/isbn/9780754676782

The enemy is intractability.



Increasing Intractability

Systems grow too large
 Rate of change increases
 Overall expectations keep rising

-- Eric Hollnagel, 2009



"Continuous Delivery" Raphael Carvalho (2014) http://slides.com/raphaelcarvalho/continuous-delivery#/9

Conway's Second Law tells us PROBLEM SIZE is important

Conway's Second Law tells us PROBLEM SIZE is important

SO...

Make the solution as small as necessary.

Deployments Per Day (US/Eastern)



Continuous Delivery – The Dirty Details, Mike Britain, Etsy (2015) http://www.slideshare.net/mikebrittain/continuous-delivery-the-dirty-details/8

ASSESSMENT:

If you (or your team) cannot explain ALL the code in your release package, your release is TOO LARGE

GUIDANCE:

Execute many SMALL releases instead of a few LARGE releases.

Conway's Third Law



design organization criteria

HOW DO COMMITTEES INVENT?

by MELVIN E. CONWAY

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stages of design

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- Understanding of the boundaries, both on the design activity and on the system to be designed, placod by the sponsor and by the world's realities.
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We shall see in detail later that the very act of organiz-

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 3 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," Horvord Business Review, March-April, 1967, p. 73.

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> > DATAMATION

Homomorphism

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





ho·mo·mor·phism

/ homə morfizəm/

noun MATHEMATICS

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



"How Do Committees Invent?", Conway (1967) http://www.melconway.com/research/committees.html

Homomorphism

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

- Eric S. Raymond, 1991



Conway's Third Law tells us CROSS-TEAM INDEPENDENCE is important.

Conway's Third Law tells us CROSS-TEAM INDEPENDENCE is important.

So... Make each team fully independent.
If you have to hold a release until some other team is ready, you are not an INDEPENDENT TEAM



Coordination in Large-Scale Software Teams, Begel, et al (2007) http://research.microsoft.com/en-us/um/people/abegel/papers/coordination-chase09.pdf



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Conway's Fourth Law



Chapter VI, "The Technostructure." ³ For a discussion of the problems which may arise when the design

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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...

design organization criteria

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DATAMATION

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



ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS



Brooks' Law

Adding manpower to a late software project makes it later.

THE MYTHICAL MAN-MONTH

FREDERICK P. BROOKS, JR.

-- Fred Brooks, 1975

Disintegration: Reason #2

design organization causes its

communication structure to

"Application of the

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conventional wisdom of

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-- Mel Conway, 1967

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> > DATAMATION



Dunbar's Number

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





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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

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DATAMATION

Communication dictates design.

-- Mel Conway, 1<u>96</u>7

Conway's Fourth Law tells us TIME is against LARGE teams.

Conway's Fourth Law tells us TIME is against LARGE teams.

So...

Make release cycles short and small.

		COMPLEXITY				
		C1	C2	C3	C4	C5
	S1	100	250	400	550	700
SIZE	S 2	175	325	475	625	775
	S 3	250	400	550	700	850
	S 4	325	475	625	775	625
	S 5	400	550	700	850	1000

Standish Group Chaos Report 2015 (via http://www.infoq.com/articles/standish-chaos-2015)

ASSESSMENT:

If your release dates are often missed, your SCOPE is TOO BIG.

GUIDANCE:

Aim for a SCOPE that supports a release cycle of two weeks or less.

So, let's review our options...



Conway's Laws can help us succeed



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



Conway's First Law

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





Conway's First Law

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

Actively manage communications within the teams and across teams.



"Tactics for Global Software Development", Herbsleb (2008) http://herbsleb.org/web-pres/slides/Siemens-conference-7-17-08-dist.pdf



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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.





Conway's Second Law

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

Remember the process is continually repeating.

Continuous Delivery

The Addison Wesley Signature Series

RELIANCE SOFTWARE RELEASES THROUGH BUILD. THST, AND DUPLOYMENT AUTOMATION

Foreword by Martin Fowler

*

JEZ HUMBLE David Farley

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, Thoughtworks.

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.





Conway's Third Law

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



"Microservices", Fowler & Lewis (2014) http://martinfowler.com/articles/microservices.html



"Microservices", Fowler & Lewis (2014) http://martinfowler.com/articles/microservices.html

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 from 1967

Increase communications
Support continuous process
Organize teams by products
Make teams small as necessary









Optimizing Teams in a Distributed World

Conway's three other laws

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