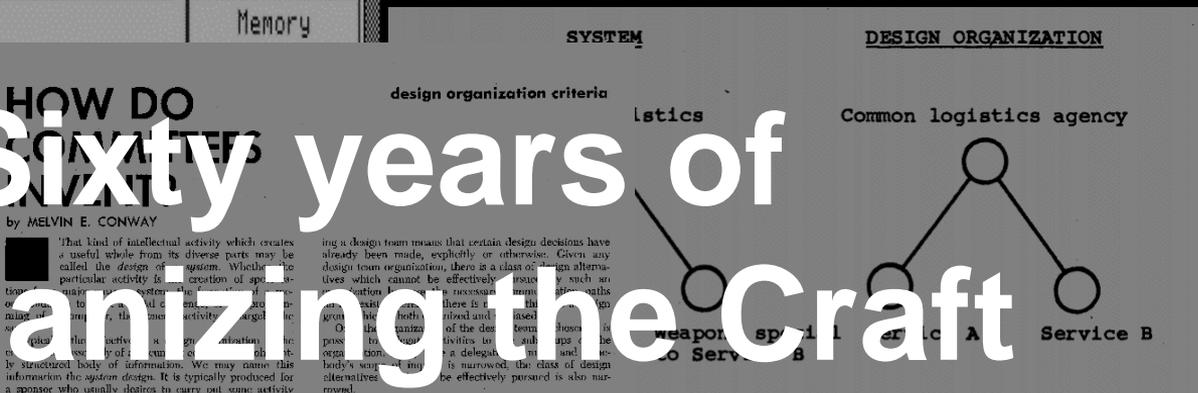


# Sixty years of Humanizing the Craft

## A conversation with Mel Conway



ing 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. In a necessary sense, the class of alternatives which can be pursued is narrowed. There is a class of design alternatives which cannot be effectively pursued by such an organization. In a necessary sense, the class of alternatives which can be pursued is narrowed. There is a class of design alternatives which cannot be effectively pursued by such an organization. In a necessary sense, the class of alternatives which can be pursued is narrowed.

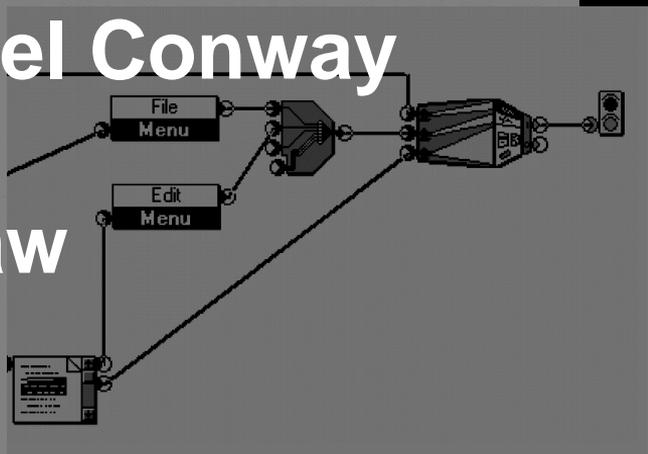
3a. A Weapon System

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 loose preliminary design to the user.
2. Choice of preliminary design concept.
3. Organization of the design task into design tasks.
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 regress 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



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**stages of design**

The initial stages of design effort are concerned more with structure of the system than with its details. The full-blown design of the system occurs in the later stages of design.

1. Understanding of the problem and 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.

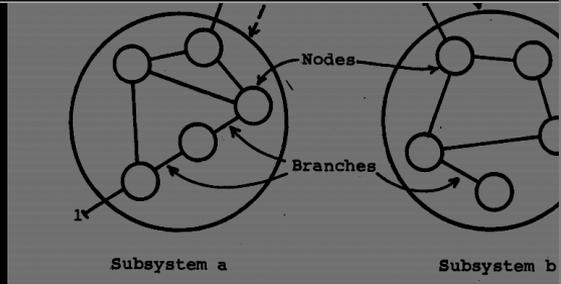
We shall see in detail later that the very act of organiza-



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 of Case Western Reserve Univ., and a software consultant. He has an MS in physics from Caltech and a PhD in math from Case.

<sup>1</sup> 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."

<sup>2</sup> 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.



**Incentives Affect the Product**

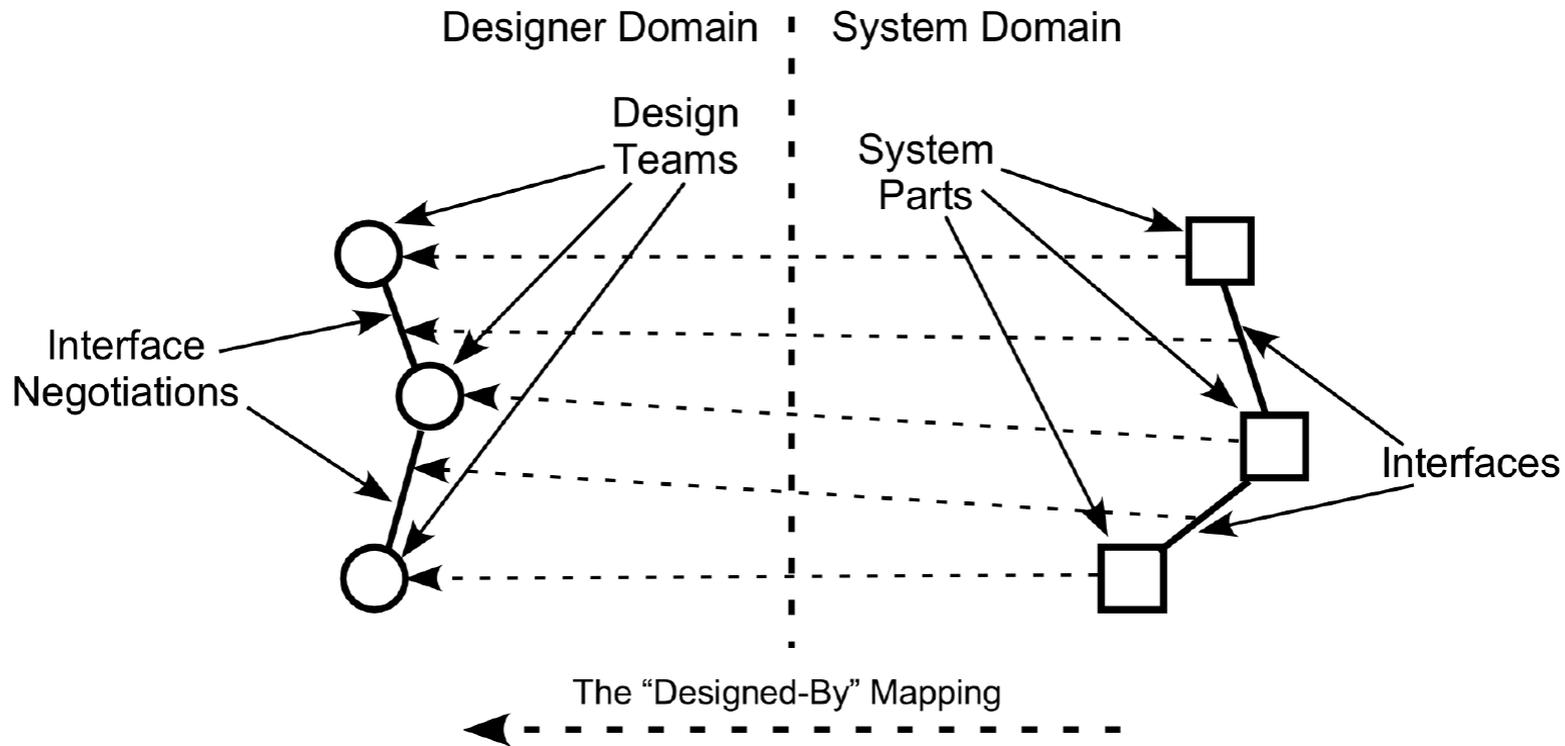
# Incentives Affect the Product

Lesson 1:

*You can make it even simpler if you keep working at it.*

Lesson 2:

*If you want the cleanest possible product find the simplest possible design before organizing to build, or else be prepared to reorganize.*



# Partition the Solution

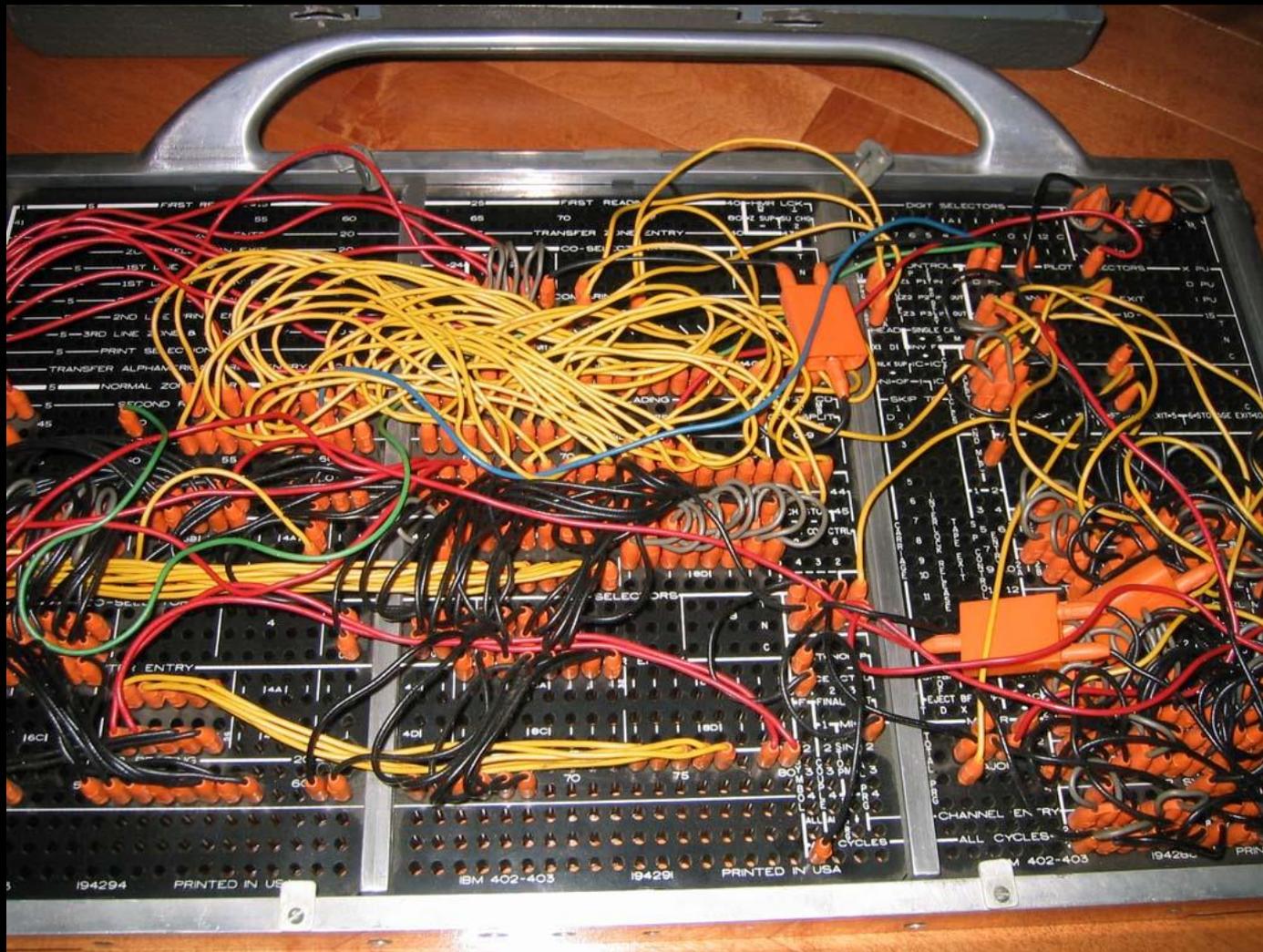


# Partition the Solution

Lesson 3:

*Expressive domain-specific intermediate languages give the combined solution a lot more bang for the buck.*

**Static is Good**



5 FIRST READER 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100  
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5  
TRANSFER LINE ENTRY  
CO-SELECTOR  
CON. REFR.  
ADNOG  
DIGIT SELECTORS  
PLOT SELECTORS  
EXIT  
SUSTAIN EXTEND  
SELECTOR  
SELEC ORS  
ENTRY  
CHANNEL ENTRY  
ALL CYCLES  
CYCLES  
194294 PRINTED IN USA  
IBM 402-403 194291 PRINTED IN USA  
M 402-403 194294 PRIN

# Static is Good

Lesson 4:

*Making application development accessible to a large number of people requires elimination of algorithms.*

Lesson 5:

*An effective application language presents a static parameterization of the implicit run-time algorithm.*

Lesson 6:

*One purpose of an application-development language is not to express algorithms, but to **hide** them.*

**Simplify the Developer's Life**



Apple // Instant Pascal®

©1985,1986 **THINK** Technologies, Inc.

Release 1.5

Engineered by:

Robert Swerdlow, Robert Herold

Robert Alpert, Russell Finn

Melvin Conway, Michael Byrne

Peter Maruhnic, Stephen Stein

Current program file:

(none)

Serial #6178635590

OK ↵

Memory  
in use



# Simplify the Developer's Life

Lesson 7:

*Give the developer immediate feedback.*

Lesson 8:

*Don't make the developer distinguish between "programming" language and "execution" language*

**Humanize the Craft**

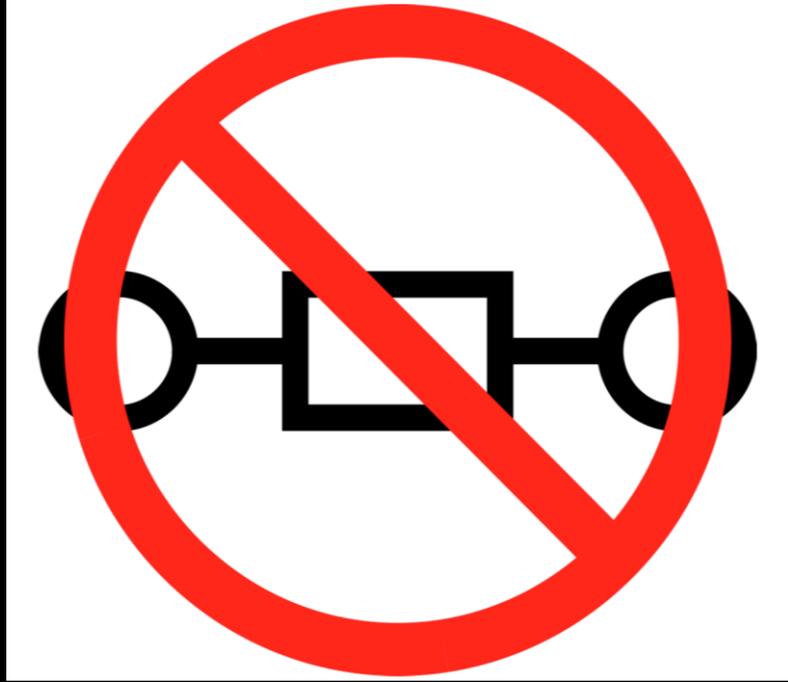
# Humanize the Craft

Lesson 9:

*Event-driven applications can be described with unidirectional flow diagrams.*

Lesson 10:

*The way to make application development universally accessible is to harness the hand-eye-brain system.*



# Humanize the Craft

Lesson 11:

*The input-process-output application-building model must be replaced by a transform-in-place model.*

Lesson 12:

*To simplify application development, tools must act like hands on tools.*

# **Six Hands-On Principles**

<p><b>Unity</b></p> <p>No translation Always on</p>	<p><b>Transparency</b></p> <p>Illusion: the tool is invisible. Your hands are on the working material</p>	<p><b>Continuity</b></p> <p>No surprises. Small changes produce predictable effects</p>
<p><b>Immediacy</b></p> <p>The brain immediately understands the result of each change</p>	<p><b>Interactivity</b></p> <p>The feedback you receive suggests your next action</p>	<p><b>Reversibility</b></p> <p>Undo</p>

**@conways\_law “Software as Child’s Play”**

# Epilogue

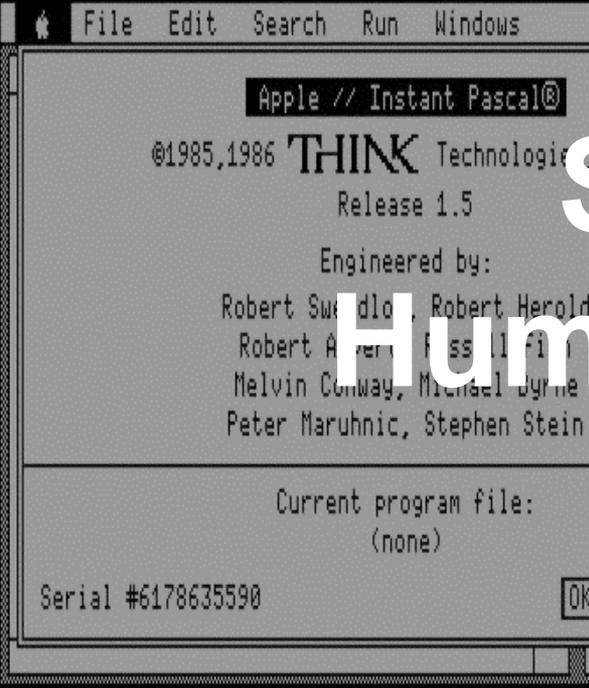
# Epilogue

- Static is Good
- Hands-On
- Transform In Place
- Six Design Principles for Hands-On Tools

# Epilogue

The Challenge:

*The developer must be able to build interactively any application whose components can be anywhere on the network and that is represented in its entirety on the user interface of a tool that conforms to all the hands-on design principles.*



# Sixty years of Humanizing the Craft

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## #HumanizeTheCraft

HOW DO YOU COMMIT TO INVENT?

by MELVIN E. CONWAY

That kind of intellectual activity which produces a useful whole from its diverse parts is called design. It is a process of synthesis, not analysis. It is a process of creating a new whole, not of dissecting an old one. It is a process of getting a job done, not of getting a job done the way it has always been done.

Typically, the objective of a design organization is the creation and assembly of a document containing a coherent, structured body of information. We may name this information the system design. It is typically produced for a sponsor who usually desires to carry out some activity guided by the system design. For example, a public official may wish to propose legislation to avert a recurrence of a recent disaster, so he appoints a team to explore the catastrophe. Or a manufacturer needs a new product and designates a product planning activity to specify what should be introduced.

The design organization may or may not be involved in the carrying out of the system design. It may be a public agency, a private consulting firm, or a manufacturer's industrial design department.

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 organization may in some instances affect the incentives which exist in a design organization.

The initial stages of a design effort are concerned more with structure of the design activity than with the system itself.<sup>2</sup> 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 set of organiza-

<sup>2</sup> 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."

<sup>3</sup> For a discussion of the problems which may arise when the design

ing a design team means that certain design decisions have already been made, explicitly or implicitly. Given any alternative, there is no need to consider it. It is not effective to suggest that separate design task groups be organized and assigned to the design of the design. It is possible to have a delegation of the organization's design activity to the subgroups of the organization's design activity, but the 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 sequential stages:

1. Clarification of the design problem and delegation of the design activity to the subgroups of the organization.
2. Coordination among delegated tasks.
3. 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 regress upon discovery of a new, and obviously superior, design concept, but such an appearance of uncertainty is infrequent and the very act of voluntarily abandoning a creation is a costly and expensive process.

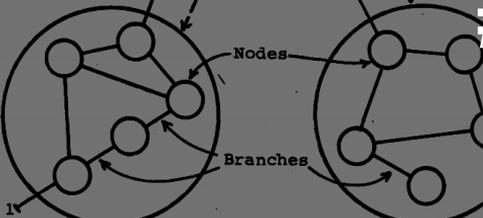
### SYSTEM

### DESIGN ORGANIZATION

#### design organization criteria



3a. A Weapon System



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“Toward Simplifying Application Development, in a Dozen Lessons”