cybernetics reviewed
Gordon Pask
double-loop architectures
conversation theory
applications
CYBERNETICS
OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE

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CYBERNETICS
CIRCULAR CAUSAL AND FEEDBACK MECHANISMS
IN BIOLOGICAL AND SOCIAL SYSTEMS

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communication and regulation in goal-directed systems, organic or constructed first-order cybernetics
communication and regulation in goal-directed systems, organic or constructed first-order cybernetics
Communication and regulation becomes in goal-directed systems, organic or constructed becomes first-order cybernetics
Communication and regulation becomes language and agreement.

Goal-directed systems, organic or constructed becomes linguistic, goal-directed systems, organic or constructed.

First-order cybernetics
communication and regulation in goal-directed systems, organic or constructed

language and agreement in linguistic, goal-directed systems organic or constructed

first-order cybernetics

second-order cybernetics
communication and regulation in goal-directed systems, organic or constructed

language and agreement in linguistic, goal-directed systems organic or constructed

science of observed systems  science of observing systems
system has goal
system aims toward goal
environment affects aim
information returns to system—‘feedback’
system measures difference between state and goal
—detects ‘error’
system acts to correct the error, to achieve its goal
first-order cybernetics

cybernetics explains how circular causal systems work — single loop
double-loop systems

cybernetics explains how circular causal systems work—even when they self-regulate and modify their goals.
cybernetics reviewed
Gordon Pask
double-loop architectures
conversation theory
applications
concepts

double-loop interaction

uncertainty regulation in learning

conceptual learning style

coherence & the kinetics of thinking

entailment meshes

architecture of conversation

consciousness is conserved
Review Papers by Gordon Pask/Relatively Accessible

These materials are offered with the desire to make them available to the widest possible audience. The files are large PDFs with variable download times and variable visual quality. They may be searched using the usual "find" functions in PDF readers. Last updated April 19, 2011.

Details of Pask's cybernetic machines, Musicolour and Colloquy of Mobiles


Review of Pask's approach to conversation, its embodiment and representation


On the nature of goal-directed systems (Heinz von Foerster's favorite Pask paper)

some major collaborators

Dionysius Kallikourdis

Bernard C. E. Scott
reliable reporters

Bernard C. E. Scott
Diana Laurillard
Usman Haque
Ranulph Glanville
The Architectural Relevance of Gordon Pask

Usman Haque reviews the contribution of Gordon Pask, the resident cybernetician on Cedric Price’s Fun Palace. He describes why in the 21st century the work of this early proponent and practitioner of cybernetics has continued to grow in pertinence for architects and designers interested in interactivity.

THE ARCHITECTURAL RELEVANCE OF CYBERNETICS

Gordon Pask

It is easy to argue that cybernetics is relevant to architecture in the same way that it is relevant to a host of other professions; medicine, engineering or law. PERT programming, for example, is unequivocally a 'cybernetic' technique and it is commonly employed in construction scheduling. Computer assisted design is a 'cybernetic' method and there are several instances of its application to architecture, (for example, the WSCC’s planning scheme in which the designer uses a graphic display to represent the disposition of structural modules on a grid and in which the computer summarizes the cost effort consequences of a proposed layout). Of these cases the first (PERT programming) is a valuable but quite trivial application of cybernetics; the second is likely to be of some significance.

In the course of the Victorian era new techniques were developed too rapidly to be assimilated into pure architecture and new problems were posed and could no longer be solved by applying the rules of pure architecture. For example, make a ‘railway station’ or make ‘great exhibitions’. The solution to such (in the Victorian era) was grand and grandiose. The solution to the same problem today is likely to be radically different. We no longer live in the same world and the approach to problem solving must reflect the reality of the situation.

The central theme of cybernetics is organisational, the actions of a whole being the result of the interacting actions of its component parts. Systems theory is based on the assumption that the whole is greater than the sum of its parts and that the interactions between the parts can give rise to new properties and functions which are not apparent when the parts are considered individually.

Cybernetics is concerned with the analysis and synthesis of systems, with the study of feedback and control, and with the study of the relationship between the structure and function. It is concerned with the design and development of systems that are capable of self-regulation and self-organization. It is concerned with the study of the relationships between the parts of a system and the whole system, and between the system and its environment.

The principles of cybernetics have been applied to a wide range of problems in many different fields, including medicine, engineering, economics, psychology, sociology, and computer science. It is a discipline that is concerned with the study of systems, and with the design and development of systems that are capable of self-regulation and self-organization. It is a discipline that is concerned with the study of the relationships between the parts of a system and the whole system, and between the system and its environment. It is a discipline that is concerned with the study of the interactions between the parts of a system, and with the study of the relationships between the system and its environment.

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An automatic feedback system (first-order) is controlled by another automatic feedback system (second-order). The first system is 'nested' inside the second.

**Second-order Feedback: Formal Mechanism**

- **Goal** describes a relationship that a system desires to have with its environment.
- **Environment** can affect the input.
- **Disturbances** can affect the input.
- **Comparator** is embodied in subtracts the current state value from the desired state value to determine the error.
- **Sensor** passes the current state value to a Comparator.
- **Actuator** responds by driving an actuator.

... has resolution – (Accuracy) frequency – (Latency) range – (Capacity)

... has resolution frequency range

... has resolution frequency range

... describes a relationship that a system desires to have with its environment

- **Frequency** is measured by
- **Input** is measured by
- **Output** is measured by
**A: Controlling Process**
(alias goal)

**B: Controlled Process**
(alias method)

**D: return of results of execution**

**E: comparator**

**C: injunction to execute**

**F: iterative execution**

*Comparator* when a goal is achieved by executing a successful method is when the controlled process is coherent with controlling processes as when a goal is achieved by executing a successful method.
Du Pont Goal Structure
Snapshot 1910 to 1940

Laid the foundation for a new business—“invention” phase.

Return to growth through diversifying in chemical arena
1910’s to 1930’s

Investigate new chemical knowledge areas

Perform Organized Chemical Industrial Research

Establish Departments centered on technologies and acquisitions

Invest in and operate plants

Make available to the US market

Improve product and process

Customer conversation:
Du Pont makes available chemical products to meet your needs

Acquire diversified portfolio of chemical “products”:
move into coatings, pigments, rayon, industrial chemicals

Invest in and operate plants

Investigate new chemical knowledge areas

Explore the world of macromolecular chemistry

Invent nylon, neoprene and teflon

Expand the concept of Experimental Station

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Explore the world of macromolecular chemistry

Invent nylon, neoprene and teflon

Establish Departments centered on technologies and acquisitions

Invest in and operate plants

Make available to the US market

Improve product and process

Customer conversation: Du Pont makes available chemical products to meet your needs
Du Pont Goal Structure
Snapshot 1940 to 1975

Built on the foundation—
“discovery” phase.
Knock-off Natural Products by understanding natural organic structure and mimicking in synthetic terms

MTM Venture Committees

Investment in plant sites (general solution)

Teach the World

Keep price, production, promotion and place under Du Pont control

Customer Conversation: Du Pont provides solutions to your needs

Improve Process Technology for major reduction in costs

something below here!

any feedback?
Du Pont Goal Structure
Snapshot of 1980’s

Milked the existing structure—“efficiency” phase.

4% Real Growth in Earnings
1980’s

Establish Departments centered on technologies

Generate and Sell Products to Improve Productivity

Improve Internal Productivity

MTM Venture Committees

Squeeze all areas to lower costs

Teach the World

Keep price, production, promotion and place under Du Pont control

Invoked by whom?

Customer Conversation: we know you have greater knowledge and choices

Not very eloquently stated

Not controlled by organization

Still involved with customer?

No longer controlling

No feedback
Du Pont Goal Structure

1980’s

- 4% Real Growth in Earnings
  1980’s

- Establish Departments centered on technologies

- Generate and Sell Products to Improve Productivity

- Improve Internal Productivity

*Invoked by whom?*
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D: return of results of execution

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# LOSURE OCCURS WHEN COMPARATOR CONFIRMS EXECUTION OF CONTROLLED PROCESSES IS COHERENT WITH CONTROLLING PROCESSES

AS WHEN A GOAL IS ACHIEVED BY EXECUTING A SUCCESSFUL METHOD
goal

(set) goal

measure

compare

act

environment

disturbance

act

measure
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Gordon Pask
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conversation theory
application
how does conversation work?

participant A  

participant B

after Dubberly Design Office 2008
a participant has a goal

participant A

participant B

goal
chooses a context
chooses a language

participant A

shared language

participant B

goal

context
begins an exchange
evokes a reaction...
...that evokes a reaction
the exchange may continue
agreement may be reached
a transaction may occur

after Dubberly Design Office 2008
CONVERSATION REDUX

goal
learning
participant A

shared language
agreement
interface
action
(trans)action
exchange
context

goal
evaluating
participant B

exchange

context
CONVERSATION = C-L-E-A-T
CONVERSATION = C-L-E-A-T

CONTEXT — ESTABLISHED
LANGUAGE — SHARED
EXCHANGE — ENGAGED
AGREEMENT — LIMITED
(TRANS)ACTION — COORDINATED
## Communication vs. Conversation

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<td>Conversation theory</td>
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<td><strong>Limitation</strong></td>
<td>Not about new messages</td>
<td>Takes effort to quantify</td>
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Aspects of Machine Intelligence

Introduction by Gordon Pask
Pask’s hand rendering from *Soft Architecture Machines*
architecture—solitary action—individuals
architecture—conversation—participants
architecture—conversation—participants

goals

means

A

B

goals

means
architecture—levels—conversation
gordon pask—circular interactions—modeling

Participant A  |  Participant B

Description (L')

→ Why

The goal of the concept, the role each topic plays.

Example: My goal is to show you how to use a compass to make a circle on a table.

Prescription (L')

→ How

The relationships among topics; instructions on combining topics to fulfill the goal.

Example: Stick the compass point into the table; swing the other arm around the compass point so that it forms a circle.
gordon pask—circular interactions—modeling
gordon pask—circular interactions—modeling
dance—contention—shared outcomes
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Conversation (Objective)

Required Elements for an Intelligent System

E: comparator

A: Controlling Process (alias goal)

D: return of results of execution

B: Controlled Process (alias method)

C: injunction to execute

F: iterative execution
Conversation (Objective)

Required Elements for an Intelligent System

A: Controlling Process (alias goal)
B: Controlled Process (alias method)
C: injunction to execute
D: return of results of execution
E: comparator
F: iterative execution
G: Communication about goal
H: Reproduction of other’s concept of goal
I: Inference of higher goal
J: Communication about method
K: Reproduction of others concept of method
L: Check of consistency

February 21, 2006
Developed by Paul Pangaro and Dubberly Design Office
coöperation as coordination

Conversation to agree that you will act to achieve my goal; in exchange, I will compensate you. (Receiving compensation is one of your goals.)

Agreement leads to acting in the world.

If you have completed the action that you agreed to take?

Then I should compensate you.

If I have completed the action that I agreed to take?

Then you should compensate me.

If I have not completed the action that I agreed to take?

Then I should not compensate you.
coöperation as collaboration

Conversation to agree on a goal.

Agreement leads to...

Conversation to agree on action.

Agreement leads to acting in the world.
user interfaces / conversing with myself
being DIAGNOSED  

CONSIDERING TREATMENTS

Choosing to undergo TREATMENT

WEIGHING OUTCOMES

may require TREATMENT

may lead to HCP

may require HCP

may lead to RECOVERY

may lead to COMPLICATIONS

may lead to CHRONICITY

participating in COMMUNITY

Hypotheses  

= TERMINAL

leads to

may lead to

leads to

requisite variety

cybernetics has a rigorous definition of the limitations of a system to achieve its goal...

which can be applied to social systems
– variety is defined as capacity for conversation
– local truth controls the “essential variables” that determine the viability system
Given the conversation we've just had, focus on the questions above to make the next conversation successful.

NEW KNOWLEDGE BUILDS EXTERNAL INFORMATION ESTABLISHES GOAL FOR DETERMINES CRITERIA FOR PARTICIPANTS BECOME SELECTION MECHANISM POSSIBLE PARTICIPANTS

1. Bottom-up approach: Keep asking the important questions that ensure the right participants and the right information in every conversation. In short, given where we want to go:
   - Who are the necessary and sufficient participants?
   - What is the necessary and sufficient information?
   - What did we learn?
   - What questions do we answer next?
   - Who can we continue to use who are still essential?
   - What expertise do we need to answer those questions?
   - What information do we need to answer those questions?
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Given the conversation we've just had, focus on the questions above to make the next conversation successful.

What did we learn?

Who can we continue to use who are still essential?

What expertise do we need to answer those questions?

What information do we need to answer those questions?

What questions do we answer next?

Who becomes the new knowledge?

What is the goal for the selection mechanism?

What did we learn?

What questions do we answer next?

Who are the necessary and sufficient participants?

What is the necessary and sufficient information?
Given the conversation we've just had, focus on the questions above to make the next conversation successful.

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What expertise do we need to answer those questions?

What information do we need to answer those questions?

designing the cadence of conversations
Client Engagement can be modeled as a series of stages—catalyst, ideation, solution, delivery, and evaluation—each with specific goals, and therefore specific requirements for participants and information to feed the next conversation.

The engagement lifecycle moves through a series of stages, albeit not always smoothly. Core roles—often the "triumvirate" of account, planning, and creative, but increasingly specialized to a given 360° engagement—are responsible for driving to results, and for communicating across stages and across agency and client groups.

Useful stages that apply across most engagement types are:
- **catalyst stage** (first interaction): initial contact with client
- **ideation**: building a model of desired outcomes
- **solution**: creating a plan to achieve the outcomes
- **delivery**: executing the plan, deploying the solution
- **evaluation**: measuring against goals, then adjusting.

Given the conversation we've just had, focus on the questions above to make the next conversation successful.

1. **Bottom-up approach**: Keep asking the important questions that ensure the right participants and the right information in every conversation.

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- What information do we need to answer those questions?
3. Radical approach: Attract participation with new incentives.

Allowing current participants, including the core roles, to choose participants and information for the next conversation will likely lead to success—but less often will it lead to innovation. Current participants have limited variety. And their viewpoint may be constrained by their pre-existing model of the "problem".

What if the core roles made the outcomes of engagement conversations—new knowledge and goals—available via the intranet? Individuals inside the agency could review these and propose their own participation, bringing their skillsets and ideas. Current participants, including but not limited to the core roles, would judge and choose the most promising proposals.

The process would open up possibilities to the broadest variety of agency expertise and likely produce unexpected, innovative solutions.

After any engagement, recognition ought to be given by the core roles to participants who contribute to successful outcomes. But there is a more powerful incentive when the participants are given a small bonus pool to distribute among themselves, based on their judgment of "success" for both client and agency. In addition to providing genuine incentive to propose their own participation, those who are most rewarded are identified as most valuable. This is a reliable predictor of expertise and behaviors that will make the agency successful in the future.
co-evolution

cybernetics models the subjective and objective interactions inherent in any complex system that includes social / linguistic components
Notes on the Role of Leadership and Language in Regenerating Organizations
An organization is its language.

Ultimately, an organization consists of conversations: who talks to whom, about what.

Each conversation is recognized, selected, and amplified (or ignored) by the system. Decisions, actions, and a sense of valid purpose grow out of these conversations.

Conversation leads to agreement. Agreement leads to transaction.
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Conversation leads to agreement. Agreement leads to transaction.
Narrowing **language** increases efficiency.

Organizations create their own internal language to solve specific problems.

This language serves as a kind of shorthand: Managers use it every day, knowing they will be clearly understood.

Over time, this internal language grows increasingly specialized—and narrow.
Organizations create their own internal language to solve specific problems.

This language serves as a kind of shorthand: Managers use it every day, knowing they will be clearly understood.

This internal language is designed to address the needs of the present-day business. It helps the organization’s managers answer familiar questions and thus increases efficiencies.

Over time, this internal language grows increasingly specialized—and narrow.
Narrowing **language** also increases ignorance.

The organization’s internal language is designed to help managers facilitate present-day business—not look beyond it.

Using the internal language, managers increase efficiencies, but cannot recognize new fields of research, new discoveries, new approaches.
The organization’s internal language is designed to help managers facilitate present-day business—not look beyond it.

Using the internal language, managers increase efficiencies, but cannot recognize new fields of research, new discoveries, new approaches.
Past **language** limits future vision.

Managers understand the organization’s past behavior. But this knowledge, and the language that accompanies it, limit their vision of the organization's potential future state.

Using the language of the past, managers may try to provide a vision for the future. But it is an old future—a memory of what the future could be.

Managers may strive for fundamental change, but their language prevents them from achieving it.
Managers understand the organization’s past behavior. But this knowledge, and the language that accompanies it, limit their vision of the organization’s potential future state.

Using the language of the past, managers may try to provide a vision for the future. But it is an old future—a memory of what the future could be.

Managers may strive for fundamental change, but their language prevents them from achieving it.
Expanding **language** increases opportunity.

The conversations necessary for generating new opportunities come from outside the system.

For an organization to survive, it must be able to acquire new, relevant language domains.
The conversations necessary for generating new opportunities come from outside the system.

For an organization to survive, it must be able to acquire new, relevant language domains.
To regenerate, an organization creates a new **language**.

To support an organization’s future viability, effective decision makers actively introduce change into the system.

They do so by generating new language that appropriate groups in the organization come to understand and embrace.

This new language does not overtly challenge the pre-existing, efficient system, but rather creates new distinctions and supportive relationships.
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Manager and Entrepreneur.

The Manager is responsible for improving the organization’s present-day performance. Acting in what he perceives to be his own self-interest, he uses the organization’s current language to improve efficiencies.

The Entrepreneur does not concern herself with present-day business. Acting in what she perceives to be her own self-interest, she strives to ensure the organization’s future by facilitating its evolution.
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Managers’ reaction to Entrepreneurs’ language:

“Don’t distract me with future problems.”

“That’s a waste of time.”

“Stop taking resources away from what’s important.”
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Entrepreneurs’ reaction to Managers’ language:

“You are stuck in the past.”

“What you want to do is no longer relevant.”

“Stop taking resources away from what’s important.”
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But...

Managers and Entrepreneurs are both necessary for the long-term viability of an organization.

Managers’ language improves quality, brings about efficiencies, and focuses on today.

Entrepreneurs’ language increases variety, fosters insight, and focuses on tomorrow.
Notes on the Role of Leadership and Language in Regenerating Organizations
cybernetics reviewed
Gordon Pask
double-loop architectures
conversation theory
applications
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