

MICHAEL SHAMIYEH (Ed.)
and DOM Research Laboratory (Ed.)

DRIVING DESIRED FUTURES

Turning Design Thinking
into Real Innovation



**NOTES
ON THE ROLE
OF LEADERSHIP
& LANGUAGE
IN REGENERATING
ORGANIZATIONS ◀**

HUGH DUBBERLY
PETER ESMONDE
MICHAEL GEOGHEGAN
PAUL PANGARO ◀

358

Organizations are living systems, and like all living systems, they seek equilibrium and avoid change. (They conserve themselves.) Change occurs in the relationship between organism (organization) and environment (the organization's niche). An organization is fundamentally its language, alive in its conversations (who talks to whom about what). Conversation must precede agreement; agreement must precede coordinated action (and transaction). Thus language is the basis for all business. Narrowing language increases efficiency. In a stable environment, increasing efficiency makes sense, but it creates risk. Certain things can no longer be said or even seen (discerned). They are outside the day-to-day language of the organization. They are not valid in the context of the day-to-day; they are even "unnatural." Inevitably, the environment and its relation to the organization changes; then, having narrowed language (reducing its variety), the organization may become unable to understand these changes or to respond. Conversely, expanding language increases opportunity. To regenerate, an organization must create new language. Creating new language is a responsibility of leadership. Leadership is not a property of an individual; leadership is a condition of an organization. Leadership ensures space in an organization for efficiency, discovery, and invention, and each may be required in different phases of change. Leadership requires that we ask unnatural questions (a source of new language).

This essay emerged from conversations between Hugh Dubberly, Peter Esmonde, Paul Pangaro, and Dr. Michael Geoghegan, who devoted more than twenty-five years to research, development, and strategic planning at DuPont. A distillation of decades of experience, the statements in this essay draw on concepts culled from fields as diverse as economics, philosophy, biology, and cybernetics. The more central concepts and models are called out as sidebars. The statements in this essay are axiomatic. But the insights they contain are anything but obvious.

Reprinted from *Notes on the Role of Language and Leadership in Regenerating Organizations*. 2002. All rights reserved.

An organization is a living system.
To survive in a highly competitive market,
it strives to increase its efficiency.

Language is the defining environment
in which these systems live.
It is how those in the system reach agreement.
It is also a medium for organizational growth and change.

An organization increases its efficiency
by creating and refining a shared language.
This common language helps the organization
arrive at decisions more efficiently.

Yet while this language fosters efficiency,
it also limits the organization's ability to evolve.

Constrained by its limited vocabulary,
the organization becomes unable to adapt
to fundamental changes in its environment.
Unable to change, the organization eventually declines.

It is possible for an organization to learn and grow,
but only if it creates conditions
that help generate new language.
Using new language,
an organization may create new paths to productivity,
and regenerate itself.

The conversations necessary
for generating new language and new opportunities
do not come naturally.
They do not use existing corporate vocabulary.
An organization
does not want to hear these conversations—
even if it could.

This book explains how an organization
may create new language and new opportunities,
find new paths to productivity,
and regenerate itself.

Organizations are living systems.

An organization
is a set of conversations between people.
These conversations
are a living system.

Like all living systems,
an organization seeks to survive and thrive.

An organization struggles
with internal and external challenges.
To remain profitable and competitive,
it seeks to gain efficiencies.
To become increasingly efficient,
it narrows the language it uses.
To become effective in new domains,
it must expand the language it uses.

By continually changing its language—
and its conversations—
an organization may continually regenerate itself.

Humberto Maturana and Francisco Varela refer to this self-making activity, common to all living systems, as autopoiesis. Autopoietic systems act to ensure their self-perpetuation, specifying their boundaries through preferential transactions within the network.

Recognizing an organization as a dynamic, living system helps us identify and analyze the continual change inherent in an organization, and in its surrounding environment. It allows us to analyze its social structures, activities, and evolution in valuable new ways.

An organization is best analyzed through its language, its conversations. The agreements, decisions, actions—and transactions—that define the organization all emerge from conversation.

For more on autopoiesis, see: Humberto Maturana and Francisco Varela.
For more on conversation theory, see: Gordon Pask.

Organizations seek equilibrium and avoid change.

Most organizations have a vested interest in preserving their way of living and doing business.

They tend to adjust or react to their environment in order to remain the same.

When an organization changes from within, it does not redefine itself, or its mission. It simply seeks to gain greater equilibrium, to become more efficient at what it already does.

Any change that alters an organization's ideas of truth and identity is threatening. The change erodes the conserved identity of those in the organization. It seems to ignore lessons learned from previous experience. It seems to question the legacy that made the organization successful.

So: The organization resists conversations that question its ways of doing business and its role in the world.

The organization naturally resists new learning, change, and the stress of evolution.

Donald A. Schön called this tendency to remain the same 'dynamic conservatism'. He contrasted this static view of the organization with the dynamism of a learning organization: "A learning system ... must be one in which dynamic conservatism operates at such a level and in such a way as to permit change of state without intolerable threat to the essential functions the system fulfills for the self. Our systems need to maintain their identity, and their ability to support the self-identity of those who belong to them, but they must at the same time be capable of transforming themselves."

For more on dynamic conservatism, see: Donald A. Schön.

Change involves both organism and environment.

An organization's evolution cannot be understood in isolation.

An organization creates itself by conserving certain sets of relationships. It preserves these essential relationships through its language.

Organizational change can be understood only in the context of these essential relationships and this particular language.

So: The direction of an organization's change is determined by its own structure.

All evolution is co-evolution.
All organizational change is relational.

Co-evolution consists of successive changes in two or more interdependent species that affect their interactions. Development occurs within a single species. By seeing evolution as occurring among species, we recognize the interdependencies, co-adaptations, and modifications species make in order to remain viable.

For more on development, co-evolution, and structural determinism, see: Charles Darwin, Richard Dawkins, Paul Ehrlich, Stephen Jay Gould, Humberto Maturana.

An analogy: The mouse teaches the cat.

The cat's nervous system
compels it to respond to every small thing that moves.

Trying to catch a mouse,
a cat observes the mouse's actions closely.
The cat actively learns
from the mouse's behaviors,
continually changing its capture strategy
in response.

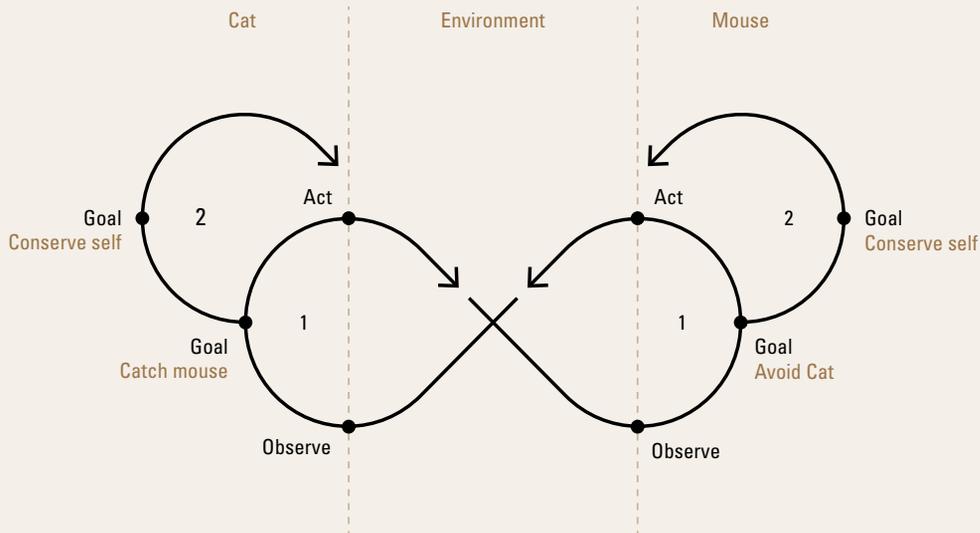
So: The mouse teaches the cat.

By listening to customers
and closely observing their behaviors,
an organization gains a fuller understanding
of their needs.

This understanding informs the organization's activities,
and enables it to increase efficiencies
or create new businesses.

Of course,
the mouse's behavior also changes continually,
in response to the cat's shifting tactics.

So: As the mouse teaches the cat,
the cat also teaches the mouse.



The cat's behavior may be thought of as a double feedback loop:
The first feedback loop defines the cat's catching behaviors. The second
feedback loop dominates the first; it conserves the cat itself. (For
example: The cat may want to chase the mouse out a window, but its
system of self-preservation will prohibit that behavior.)

The mutual learning process is also a double feedback loop: Processing
input from the mouse, the cat continually adjusts its capturing behavior,
adaptively increasing efficiency and reducing noise in the message (that
is, limiting extraneous actions). Conversely, the mouse changes its output
based on the cat's input. As a result, the entire system evolves over time.

The 'cat-mouse' analogy is a model of organizational learning behavior.
The organization that continually takes customer behaviors and activities
into account improves its efficiency over time. Concomitantly, customer
behaviors change based on the products or services supplied by the
organization.

For more on the cat-mouse analogy, see: W. Ross Ashby. For more on
cybernetics, see: Heinz von Foerster, Paul Pangaro, Norbert Wiener.

Your organization is a living system of conversations.

Like any organization,
your organization is a set of conversations
among people.

Like any organization,
your organization needs to change
to meet the needs of a changing market.

Your organization seeks to build on previous successes—
but these successes
emerged from internal conversations
that may no longer be as productive
as they once were.

For your organization to evolve effectively,
it must understand the ways
its customers, developers, and competitors
are evolving.
It can understand this evolution
only through its ongoing relationships
with customers, developers, and the market.

Only then can the company change
in ways that better meet market needs.

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.

Therefore, an organization's language
is critically important.
It becomes
more than simply a means for communication.
It becomes
a field for action, and a way of constructing truth.
It becomes
the basis for all transactions,
the basis for all business.

Language affects, even constitutes, the ways people perceive their reality. It is the medium in which decision making and other business activities take place. Language recognizes, selects, and amplifies certain entities, activities, and relationships, while ignoring others.

The structure of an organization's language is directly related to the structure of its culture. Culture creates language, and language shapes culture. An organization's ability to create language is synonymous with its ability to evolve.

For more on the relationship of language to thought, see: Michel Foucault, Humberto Maturana, Benjamin Whorf, Ludwig Wittgenstein.

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.

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.

Typically, managers focus on improving their organization's current performance. They use the organization's language to realize efficiencies.

As an organization grows more efficient, it focuses on increasingly specific sets of problems. In similar fashion, its lexicon grows increasingly narrow.

Often, those outside of the organization will not understand its internal language. For example, to outside observers, conversation among Sun employees around issues concerning "SunShot" may seem impenetrable.

For more on language and conversation, see: Gregory Bateson, Humberto Maturana, Gordon Pask, Claude Shannon, Benjamin Whorf.

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.

Like all of us, they cannot recognize their own limitations. Constrained by the previously successful language, we do not know that we do not know. Consequently, we think we know—and thus cannot learn.

Developed as a tool to increase efficiencies, the organization's language, paradoxically, becomes a trap.

Ignorant of our own ignorance, we cannot ask questions outside our own language experience. An organization's historical language has been responsible for its success; it would seem nonsensical for decision makers to question it. As efficiencies increase, managers fail to recognize the ways in which their internal language fosters a kind of organizational myopia.

For more on language and conversation, see: Gregory Bateson, R. D. Laing, Humberto Maturana, Gordon Pask, Benjamin Whorf.

Expanding language increases opportunity.

The conversations necessary for creating fundamental change do not come naturally.

They pose questions that cannot be understood in the organization's present language.

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

Their language has a different history. It is often technically and intellectually demanding. Consequently, it is often dismissed.

For an organization to survive, it must be able to acquire new, relevant language domains.

364

To avoid being trapped in obsolescent thinking, organizations change their language. A generative organization, aware of the importance of asking unnatural questions, deliberately creates new distinctions and supportive relationships in which new language domains arise.

"The problem is not changing people's consciousnesses," stated Michel Foucault, "but the political, economic, institutional regime of the production of truth." Change the language, change the parameters for discourse, and you change the organization.

Language creation may be thought of as a co-evolutionary process. New language may be created through changing relationships, rather than by overtly confronting an organization's power structure.

For more on power, language, and organizations, see: Michel Foucault, Jürgen Habermas.

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.

In this way, decision makers act as interlocutors and incubators of systemic change.

To maintain an organization's co-evolutionary currency, decision makers must generate the capacity to recognize new domains of discovery, and be able to translate those into new language that reflects the company's self-interest. These activities are absolutely necessary if any new endeavor is to be successful.

The decision maker must provide adequate resources for the incubation of systemic change—even though the specific incubation activities may not easily be understood.

For more on power and language, see: Michel Foucault, Jürgen Habermas.

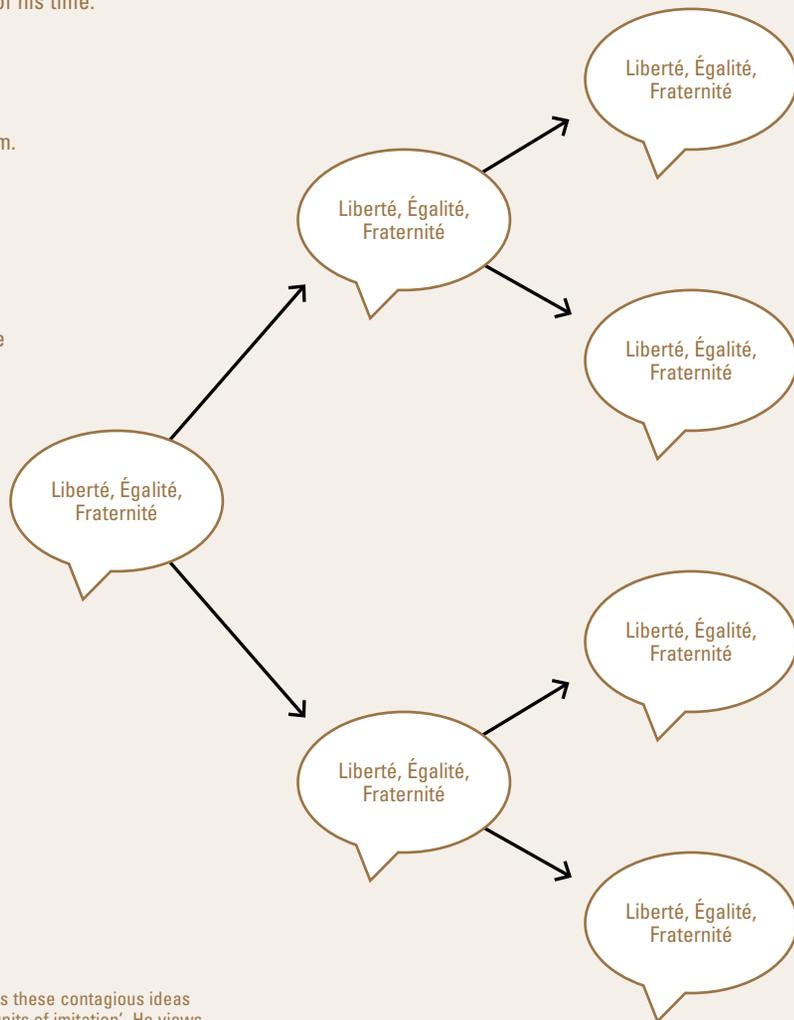
The Voltaire Principle.

In 1764, Voltaire published his *Philosophical Dictionary*, critiquing not only Church teachings, but the naively optimistic philosophy of his time.

The heretical text was widely read by the intelligentsia. Debating Voltaire's provocative ideas behind closed doors, they spread them.

Twenty-five years later, a revolution fueled by these ideas toppled the French monarchy.

The Voltaire Principle:
An outsider introducing new language may incite radical change.



Evolutionary biologist Richard Dawkins defines these contagious ideas as memes, 'units of cultural transmission, or units of imitation'. He views them as living entities, analogous to genes in the gene pool. Dawkins posits thought as the primary element in living systems. Technological evolution is memetic evolution.

For more on memes, see: Richard Dawkins.

Your organization must create new language.

Like any organization,
your organization has its own internal language.
Like any language, it is a field for action,
a way of constructing truth,
a basis for transaction and business.

To regenerate itself,
your organization must first recognize the limitations
inherent in its current language.
Then it must seek out new language domains,
and translate them into conversations
that the organization may understand and embrace.

When initiated by management,
this process is highly specific.
It requires a deliberate, organized, dedicated search
for new classes of input
into the organization's language.

Your organization
must generate the specific means to converse
about new research, discoveries, and approaches
in ways that help the organization
consider future opportunities.

Leadership is a condition of an organization.

Leadership is not a property of a person.
Leadership has little to do with personality type.

Leadership is the reduction of uncertainty
in an organization.
It comes from clear messages,
which lead to focused actions
that cannot easily be misinterpreted.
It comes from developing channels
for continuous feedback.

All these characteristics reduce cost and stress
to the individual working in the organization.

366

Leadership is not wisdom, personal charisma, or will-to-power. It is a condition that arises when clarity of purpose (which permits unambiguous action) exists within the organization.

Multiple venues for feedback into the system are a necessary condition for its growth. Therefore, back channels must carry a variety of information.

Leadership must not be confused with the role of manager. Managers are a class of decision makers in the organization; leadership is a condition of the organization.

For more on cybernetics and leadership, see: Heinz von Foerster, Humberto Maturana.

Leadership is the reduction of uncertainty.

When clarity and validity of purpose exist within the organization, the feeling of ambiguity decreases. Stress and cost to the system are lowered. Uncertainty is reduced.

Those working in the system perceive an expansion of personal potential and increased security. As they become aware of opportunities for growth, they participate more openly in the system. Feedback increases.

Leaders reduce uncertainty, give clear and meaningful messages, and provide opportunities to act in ways that cannot easily be misinterpreted.

Within the organization, clarity of purpose leads to unambiguous action, resulting in lower systemic cost. A sense of valid purpose creates an expansion in personal potential, or 'ego space', which reduces stress.

As people grow more comfortable, they communicate more. A back channel grows, informing clarity and validity of purpose, and completing a feedback loop.

Uncertainty arises from ambiguity, which increases both cost and stress to the system. As uncertainty and ambiguity increase, 'ego space' shrinks. The entire environment is affected, as those in the system are much less likely to provide effective feedback.

Political philosopher Jürgen Habermas defines the ways social systems legitimize their rule, justify their right to power, and promote their authority as 'legitimation'. If legitimation is not commensurate with an organization's de facto legitimacy, a 'legitimation crisis' occurs, resulting in upheaval and change.

For more on conditions for system survival, see: W. Ross Ashby, Heinz von Foerster, Jürgen Habermas.

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.

In cybernetic terms, leadership may be thought of as the ability of a regulator to extrapolate the behavior of the system, and act in anticipation of its future state.

The organization's everyday decision makers (i.e., its managers) act to ensure the organization's future viability. But they are limited by their language, which views the future in terms of entities and activities successful in the past. Hence, the managers' future vision will be a retelling of the past, using old language. It will not be evolutionarily current.

For more on cybernetics, leadership, and anticipation, see: W. Ross Ashby, Heinz von Foerster, Humberto Maturana.

Manager and Entrepreneur.

To better understand organizational regeneration, compare the activities of a 'Manager' and an '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 Manager does not have the resources to recognize new domains or new businesses. Such recognition would require new language skills, which would demand his interest, time, and attention.

368 The Manager is complemented by the Entrepreneur, who recognizes new domains of invention, and translates them into language that the organization understands. She selects potentially profitable discoveries, and lends them structure and purpose.

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.

The activities of the Manager and the Entrepreneur are complementary.

Relying on data, feedback, and current language, the Manager works inductively.

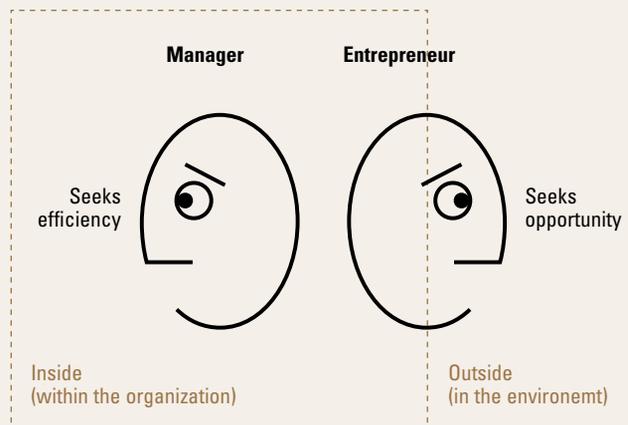
Relying on theory, hypothesis, and co-evolving language, the Entrepreneur works deductively.

Together, they share all the requisite functions of management.

The organization needs both Managers and Entrepreneurs.

The former focus on the short term, increasing efficiency and ensuring profitability.

The latter focus on the long term, increasing opportunity and co-evolving with the environment.



Your organization needs different languages to discuss its present and future business.

Like all organizations, your organization must recognize two businesses: present and future.

Some within your organization are tasked with improving performance of the present-day business. They use the current language to increase efficiencies.

Others are tasked with generating opportunities for your organization's future business. They recognize new domains of invention and translate them into new language that may lead to profitable new endeavors.

For your organization to learn and grow, both kinds of people are necessary.

ON CHANGE

Creativity = Recognizing invention. Profiting from discoveries. Developing efficiencies.

Successful organizations support at least three orders of creativity.

They provide resources to recognize invention, which opens up new domains of language. In these new domains, profitable discoveries may be made.

They provide the necessary conditions for discovering and marketing products and services that emerge from these new domains.

Then, they develop more cost-effective ways of producing and delivering these new products and services.

369

Any invention may result in multiple discoveries; any discovery may be brought to market more efficiently. Organizations co-evolve with the marketplace only if they remain continually attentive to invention and discovery. Internal organizational development results in greater efficiencies.

For example: Maxwell created a new domain by positing the existence of radio waves. Hertz subsequently discovered them via experiment. From that pioneering work, Marconi, Sarnoff, et al., built the business of radio.

History provides many cautionary tales of creative failure in organizations. Some did not recognize the importance of a new field or discipline (e.g., Kodak, Polaroid); others could not permit or sanction discussion of new products or processes as a source of profit (e.g., Xerox PARC).

Though organizations may tout the importance of creativity, true invention is rarely recognized, and even more rarely exploited.

Change = Defining...

New domains.

Systems within a domain.

Efficiencies in a system.

Change takes place only in relationship—
in the context of conserving a way of living.
Change can be understood
only in the context of what remains unchanged.

First-order change
creates new domains
and new generative languages.

Second-order change
affects system rules within a new domain.

Third-order change
seeks increased efficiency within that system.

370

Levels of change
are analogous to orders of creativity
(invention, discovery, efficiency).

Change moves in only one direction:
from identification, to selection, to efficiency.

For more on types of change, see: Gregory Bateson, Richard Dawkins,
Stephen Jay Gould, Humberto Maturana.

The Law of Requisite Variety.

For any organizational endeavor to be successful,
a necessary and sufficient set of disciplines
must be in play.

Each of these disciplines contributes a language
that will frame decisions and actions
for that particular endeavor.

Having discovered the appropriate set of disciplines,
the organization must also structure relationships
between the disciplines.

The task of discovering the critical variety
of disciplines and relationships is iterative.

Valid organizational design
means putting requisite variety into play.
It means establishing relationships
among the necessary and sufficient set of disciplines
to appropriately frame
the conversations, decisions, and actions
of an organizational endeavor.

For appropriate regulation, the variety in the regulator must be equal to
or greater than the variety in the system being regulated. In other words,
a system can model something only to the extent that it has sufficient
internal variety to represent it. Cybernetician W. Ross Ashby defined this
principle as 'requisite variety'.

Typically, the project team iteratively determines the variety necessary
for its endeavor. This is a rigorous, deductive, convergent process:
Failure in designing the organization leads to failure for the entire
endeavor's execution. Cognizant of the scope of the entire project, the
team assembles subgroups; they negotiate languages to best accomplish
their specific tasks.

As a system moves toward equilibrium, it tends to become increasingly
efficient and insular, rejecting external input. To increase efficiencies, it
seeks to reduce variety. Therefore, attempts to increase variety are likely
to be misconstrued as inefficient or even as a failure to execute.

For more on requisite variety and related ideas, see: W. Ross Ashby,
Heinz von Foerster.

The Creative Conservation of Capital.

An organization may learn from the market, co-evolve with it, and regenerate itself—but only if its managers provide the necessary conditions.

Managers must provide the resources to recognize new domains of invention, select those of potential profit, and translate them into language that the organization will readily understand.

Recognizing new domains of invention and creating new language opens up new opportunities for discovery.

Having recognized these new opportunities, the organization must provide the necessary conditions to discover and market the products and services that emerge from them.

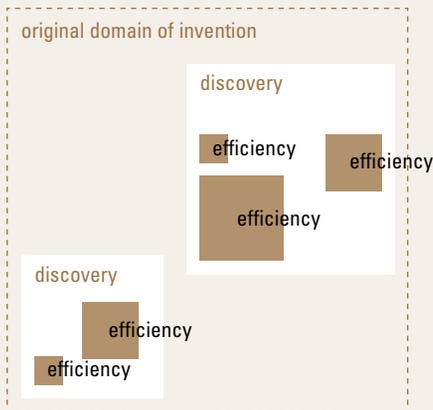
Then, the organization must provide the resources to continually develop more efficient ways of producing and delivering these new products and services.

All these activities are simultaneous: In one domain, the organization realizes efficiencies. In another, the organization discovers products. And new domains may be created at any time.

In each of these domains, the organization is on the path to productivity. To evolve, the organization must participate in all three levels of activity.

Participating means continually reinvesting in the necessary conditions for these domains' survival. Such reinvestment is highly directed, rigorous, and deductive. It requires management to dedicate specific resources.

For an organization to creatively conserve its capital, it must regenerate itself continually—by creating new language; by recognizing and reinvesting in invention, discovery, and efficiency; and by reinvesting in its potential to co-evolve.



To create new language and future business, **your organization** must ask unnatural questions.

To evolve,
your organization must continually reinvest
in all three orders of creativity:
invention, discovery, and efficiency.

Your organization must also recognize and value
the new languages and conversations
that invention, discovery, and efficiency generate.

The source of new language is questions—
questions that spark new conversations,
questions that create controversy.

Ask yourself:
What questions should we ask?
And more important, ask yourself:
What questions are we not supposed to ask?
(Ask those.)

Ask yourself:
Who aren't we conversing with?
And then ask them:
What are your questions?

Ask questions that don't come easily—
questions that are tough, awkward, even taboo.

Ask unnatural questions.

REFERENCES

- Ashby, W. R. 1955. *An Introduction to Cybernetics*. London: Taylor & Francis.
- Bateson, G. 2002. *Mind and Nature. A Necessary Unity*. New York: Hampton Press.
- Bateson, G., & Reusch, J. 1987. *Communication. The Social Matrix of Psychiatry*. New York: Norton.
- Darwin, Ch. 1859. *On the Origin of Species by Means of Natural Selection or The Preservation of Favoured Races in the Struggle for Life*. London: Murray.
- Dawkins, R. 1976. *The Selfish Gene* (1st ed.). New York: Oxford University Press.
- Dawkins, R. 1999. *The Extended Phenotype. The Long Reach of the Gene*. New York: Oxford University Press.
- Ehrlich, P. R., & Raven, P. H. 1964. Butterflies and Plants. A Study in Coevolution. *Society for the Study of Evolution*, 18(4): 586-608. Malden, MA: Wiley-Blackwell Publishing.
- Faubion, J. D. 2001. *Michel Foucault. Power. Essential Works of Foucault, 1954–1984* (1st ed). New York: The New Press.
- Conant, R. 1981. *Mechanisms of Intelligence. Ashbys Writings on Cybernetics*. Seaside, CA: Intersystems Publications.
- Gay, P. 1967. *Voltaire. Philosophical Dictionary*. Bosten, MA: Harcourt.
- Gould, St. J. 2002. *"The" Structure of Evolutionary Theory*. Cambridge, MA: Harvard University Press.
- Habermas, J. 1975. *Legitimation Crisis*. Boston: Beacon Press.

- Habermas, J. 1984. *The Theory of Communicative Action. Reason and the Rationalization of Society*, 1. Boston: Beacon Press.
- Habermas, J. 1985. *The Theory of Communicative Action. Lifeworld and System. A Critique of Functionalist Reason*, 2. Boston: Beacon Press.
- Laing, R. D. 2008. *Knots*. London: Marbot Ediciones.
- Maturana, H. R. 1980. *Autopoiesis and Cognition. The Realization of the Living*, 42. Dordrecht: D. Reidel Publishing Company.
- Maturana, H. R., & Valera, F. V. 1988. *The Tree of Knowledge*. Boston & London: New Science Library, Shambala Publications Inc.
- Miller, A. I. 1984. *Imagery in Scientific Thought. Creating Twentieth Century Physics*. Basel: Birkhäuser.
- Pangaro, P. 1990. *Cybernetics. A Definition*. <http://www.pangaro.com/published/cyber-macmillan.html>.
- Pask, G. 1971. A Comment, a Case History and a Plan. In Reichardt, J. *Cybernetics, Art and Ideas* (1st ed.): 76-99. New York: Graphic Society.
- Pask, G. 1975. *Conversation, Cognition and Learning. A Cybernetic Theory and Methodology*. Amsterdam: Elsevier.
- Schon, D. 1971. *Beyond the Stable State*. New York: Random House.
- Schumpeter, J. A. 1961. *The Theory of Economic Development. An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, 55. New Brunswick, N. J.: Transaction Books.
- Shannon, C. E., & Weaver W. 1949. *The Mathematical Theory of Communication*, 19(7): 1. Urbana, IL: University of Illinois Press.

Smith, A. 1863. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Edinburgh: A. and C. Black.

Von Foerster, H. 1979. Cybernetics of Cybernetics. In Krippendorff, K. (Ed.). *Communication and Control*: 5-8. New York: Gordon & Breach.

Von Foerster, H. 1981. *Observing Systems. Selected Papers of Heinz von Foerster*. Seaside, CA: Intersystems Publications.

Whorf, B. L., & Carroll, J. B. (Eds.). 1956. *Language, Thought and Reality: Selected Writings of Benjamin Lee Whorf*. Cambridge, MA: The MIT Press.

Wiener, N. 1988. *Human Use of Human Beings. Cybernetics and Society*. Boston & New York: Da Capo Press.

Wittgenstein, L. 1953. *Philosophical Investigations*. New York: Macmillan.
