Organizations as Nontrivial Machines:
Resources for Complexity Thinking in Organization Studies

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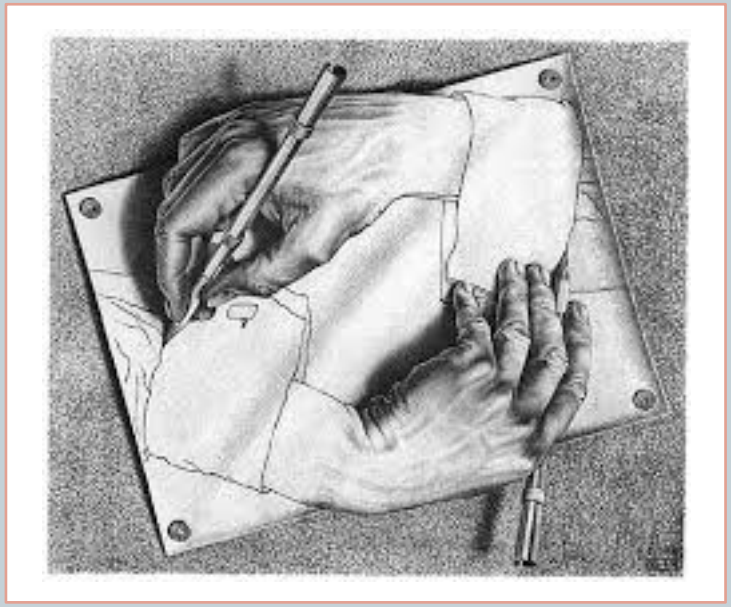
Phenomenon – Inquiry: A loop

Complexus – what is woven together

- Complexity thinking as “generalized complexity”, *Morin (2005:25)*

  i.e. “a system of picturing the structure of the world”, *Harre (1985: 16)*

Phenomenon – Inquiry: A loop



Phenomenon I: Trivial Machines

- Organizations as Trivial Machines (TM): patterns of regularized, determinate and predictable interactions

- A TM consists of an input, a transformation rule, and an output; A TM takes an input and reliably produces an output

A TM is (von Foerster, 1984: 9-10):

- Predictable
- History-independent
- Synthetically deterministic
- Analytically determinable

Trivial Machines

x	y
A	1
B	2
C	3
D	4

Source: von Foerster, 1984

Trivial Machines

x	f	y
Input	Operation	Output
Independent variable	Function	Department variable
Cause	Law of Nature	Effect
Minor premise	Major premise	Conclusion
Stimulus	Organism	Response
Motivation	Character	Deeds
Goal	System	Behavior

Source: von Foerster, 1984

Inquiry I: The Newtonian Style

a. Driven by the "decontextualized ideal" – search for the universal, the general, and the timeless, *Toulmin, (1990:22-36)*

b. The Invisible Designer

Newtonian language of description:
deterministic, *acontextual* and *ahistorical*

"If every administrative action, and every outcome of such action, is entirely unique, then there can be no transferable knowledge or understanding of administration"

J.D. Thompson (1956: 103)

"We use "routine" in a highly flexible way, much as "program" (or, indeed "routine") is used in discussion of computer programing. It may refer to a *repetitive* pattern of activity in an entire organization, to an individual skill, or, as an adjective, to the *smooth uneventful* effectiveness of such an organizational or individual performance" (emphasis added)

Nelson & Winter (1982: 97)

"[...] most of what is *regular and predictable* about business behavior is plausibly subsumed under the heading "routine", especially if we understand that term to include the relatively constant dispositions and strategic heuristics that shape the approach of a firm to the nonroutine problems it faces" (emphasis in the original)

Nelson & Winter (1982:15)

"Most behavior, and particularly most behavior in organizations, is governed by performance programs"

March & Simon (1958: 142)

"The rational individual is, and must be, an organized and institutionalized individual"

Simon (1957: 102)

Underlying image:

Organizations simplify – by accepting organizational value and factual premises, individual behavior is bounded and circumscribed

Stochastic elements

"Stochastic elements" in decision making generate nonroutine problems, which are discernible by a participant but cannot be predicted by an observer

Nelson & Winter, (1982: 15)

Features of *objectivist/representational* forms of inquiry (inquiry from outside):

a. discrete entities with distinct properties,

b. epistemological subject-object relation,

c. cognitive activity re-presents pregiven features of discrete objects,

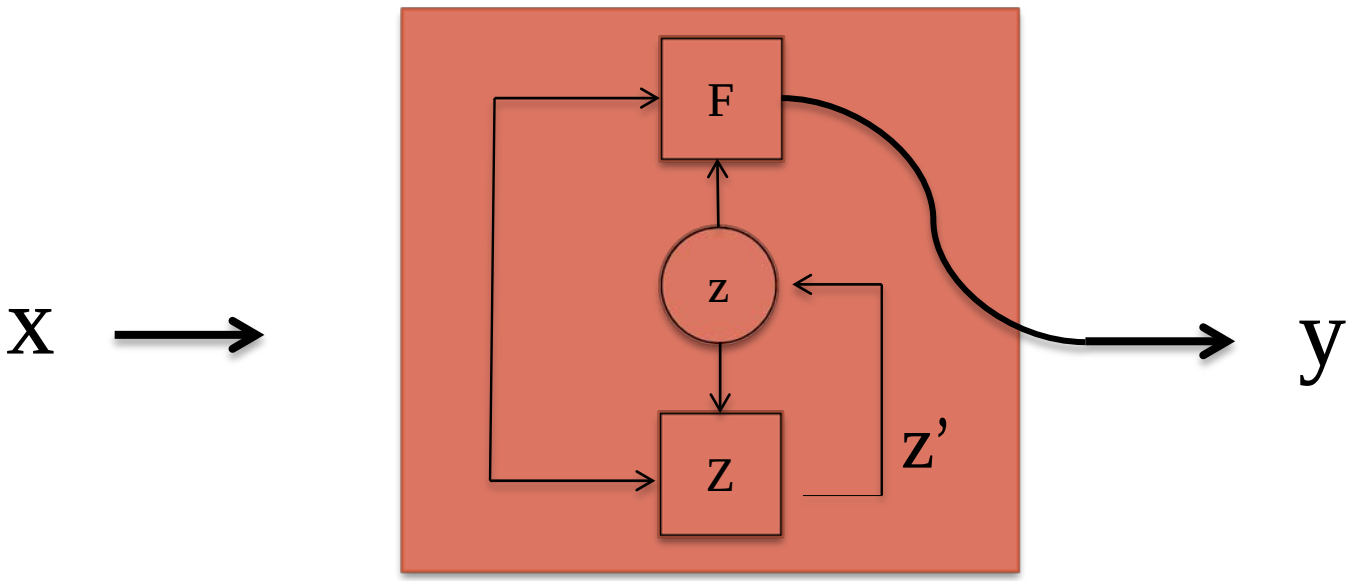
d. contingency models of explanation

Theory and practice are homologous

Phenomenon II: Nontrivial Machines

- Nontrivial machines (NTM): “a response once observed for a given stimulus may not be the same for the same stimulus given later” (von Foerster, 1984:10)
- NTM: The internal state (z) co-determines the input-output relation (X-Y)
- NTMs are recursive; always change their internal structure and their transformation rules

Nontrivial Machines



Source: von Foerster, 1984

Nontrivial Machines

In state I

x	y	Z’
A	1	I
B	2	II
C	3	I
D	4	II

In state II

x	y	Z’
A	4	I
B	3	I
C	2	II
D	1	II

Source: von Foerster, 1984

NTMs are:

- Synthetically deterministic
- History-dependent
- Analytically indeterminable
- Analytically unpredictable

Source: von Foerster, 1984

- In NTMs *experience* counts – it has an epistemic value
- Recursive operations: the results of an operation are run again through the operation
- Recursivity generates *closure*: the ‘end’ coincides with the ‘beginning’

Stability emerges out of the ongoing interaction of NTMs (eigenvalues)

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- e.g. Apply the operator “Take the Square Root” recursively to an arbitrary initial value -

  The eigenvalue 1 emerges
- Eigenorganization: stability emerges out of nontriviality – Constrained ongoing interaction generates quasi-stability

Examples of approaches to organizations as NTMs: (1/2)

Organization as an immanently generated and constantly recreated order

a. Organizing is a process of enactment-selection-retention. Through sustained interaction, individuals interlock their behaviors over time and have their cause maps converge.

Weick (1979)

Examples of approaches to organizations as NTMs: (2/2)

Organization as an immanently generated and constantly recreated order

b

"Agency is an important aspect of this perspective on routines. [...] Routines are performed by people who think and feel and care. Their reactions are situated in institutional, organizational and personal contexts. Their actions are motivated by will and intention. They create, resist, engage in conflict, acquiesce to domination. All of these forces influence the enactment of organizational routines and create in them a tremendous potential for change"

Feldman (2000:614)

- Organization-as-a-NTM is capable of generating surprise (hence they are complex), since the interaction of its components cannot be exhaustively mapped out – will always have *emergent* properties
- The complexity of a system, as seen by an observer, is directly proportional to the number of inequivalent descriptions of the system the observer can generate (Casti, 1994:276)
- Organizational phenomena as *interactive accomplishments*

Inquiry II: The Ecological Style (Complexity Thinking)

The ecological style:

The ecological style: embracing complexity by focusing on *acting*, *relating*, *contextualizing*, and *temporalizing*, and, therefore, by highlighting the importance of the particular, the local, and the timely

Emphasis on:

Agency (human and material), multiplicity/heterogeneity, interactivity, relationality, embeddedness, temporality, situatedness, indeterminacy, incompleteness

Complexus – what is woven together

- Complexity thinking as “generalized complexity”, *Morin (2005:25)*

  i.e. “a system of picturing the structure of the world”, *Harre (1985: 16)*

Features of a *performative/enactivist* form of inquiry (inquiry from within):

a) entwinement (being entwined with others and things in sociomaterial practices),

b) organizational phenomena are not treated as *faits accompli* but as (re)created through practice,

c) concepts are not fully defined a priori but are partly emergent creations (e.g. “routines-in-action”, “technology-in-practice”, “strategy-as-practice”, “sensemaking”)

d) capturing *singularities* (once-off novelties) – moments in which something new is created out of something given

Features of a *performative/enactivist* form of inquiry (inquiry from within):

- Purpose of inquiry is not predictability but *elucidation*, in order to enhance agents' capabilities for effective action in changing circumstances
- Theory and practice are homologous – same underlying image

Examples of complexity thinking in organizational research - *Example 1*

Weick, K. & Roberts, K. (1993) Collective mind in organizations: Heedful interrelating on flight decks, *Administrative Science Quarterly* (38:357-381)

- ✓ Collective mind: not a set of given properties but a style manifested in action
- ✓ Individual contributions and the collective mind are mutually constituted
- ✓ The collective mind is always already within the individual; the individual always-already helps reconstitute the collective

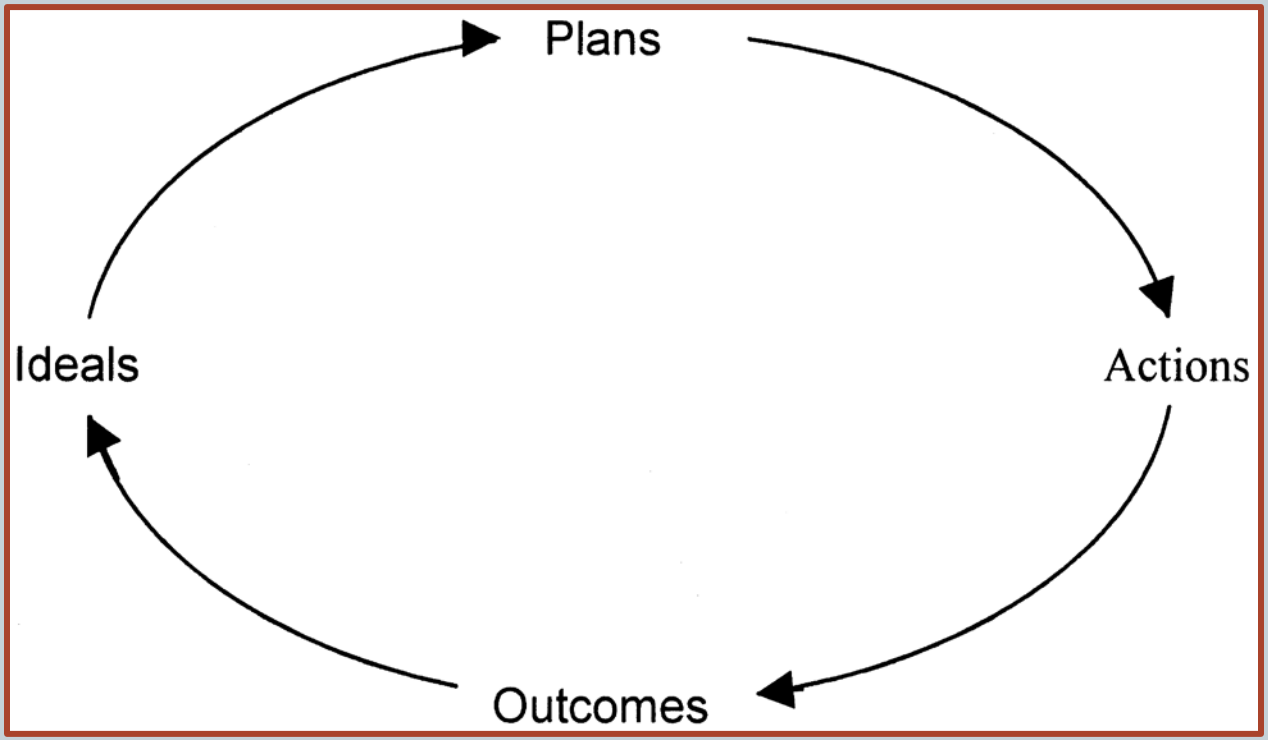
Examples of complexity thinking in organizational research - *Example 2*

Feldman, M. (2000) Organizational routines as a source of continuous change, *Organization Science* (11:611-629)

A performative model of organizational routines:

"Plans and actions produce outcomes that influence in conjunction with ideals or values what makes sense to do next. Outcomes at the "end" of each "round" can be compared with ideals as well as with previous plans and can feed into the plans for the next iteration of the routine. Outcomes also influence ideals or values when they change what people see as the possibilities. The interactions between the elements in the performative model as well as the cyclical quality of the model support the actions of *repairing*, *expanding* and *striving* that change routines" (Feldman, 2000: 623)

Examples of complexity thinking in organizational research - *Example 2*



Source: Feldman, 2000:623

Examples of complexity thinking in organizational research - *Example 3*

Garud, R., Gehman, J. & Kumaraswamy, A. (2011), Complexity arrangements for sustained innovation: Lessons from 3M Corporation, *Organization Studies*, 32:737-767

- ✓ Nonlinear innovation at 3M is generated through the interweaving of actors, artifacts, and practices over time
- ✓ Different combinations of practices (designed structure, relational processes, temporal dynamics, regulative guidelines) represent "complexity arrangements" (Garud et al, 2011:758)
- ✓ Complexity arrangements trigger multiple "agentic orientations" (exploration and exploitation)
- ✓ "Endogenizing time" (*chronos* an *kairos*, "time to wait", "time in between", "time across")
- ✓ Anti-dualist ontology: *chronos* is connected with *kairos*, design with improvisation, intentionality with serendipity, collective memory with personal initiative

Conclusions (1/2)

- The challenge for organization and management studies: to complicate its language of description

- "We are observing the birth of a science that is no longer limited to idealized and simplified situations but reflects the complexity of the real world, a science that views us and our creativity as part of a fundamental trend present at all levels of nature", *I. Prigogine (1996: 7)*

- Economists must "complicate some categories of economic discourse", A. *Hirschman (1984: 89)*

Conclusions (2/2)

- "Alongside [...] the experience of repetition, human s have a second experience, that of creativity. These two experiences are not incompatible, nor a matter of choice. We have both experiences, and both experiences are part of reality. Science, in its most universal form, has to be the search for 'the narrow passage; between the determined and the arbitrary", *I. Wallerstein (1999)*

- "Complicate yourself", *K. Weick (1979: 261)*