Theories of Open Innovation

Ilkka Tuomi

Agenda

- The concept of knowledge

- What do we mean by "openness"?

- Theories of knowledge creation

- Four open innovation models

  - Von Hippel: "Distributed Innovation"

  - Chesbrough: "Open Innovation"

  - Nonaka: "Knowledge-Creating Ba"

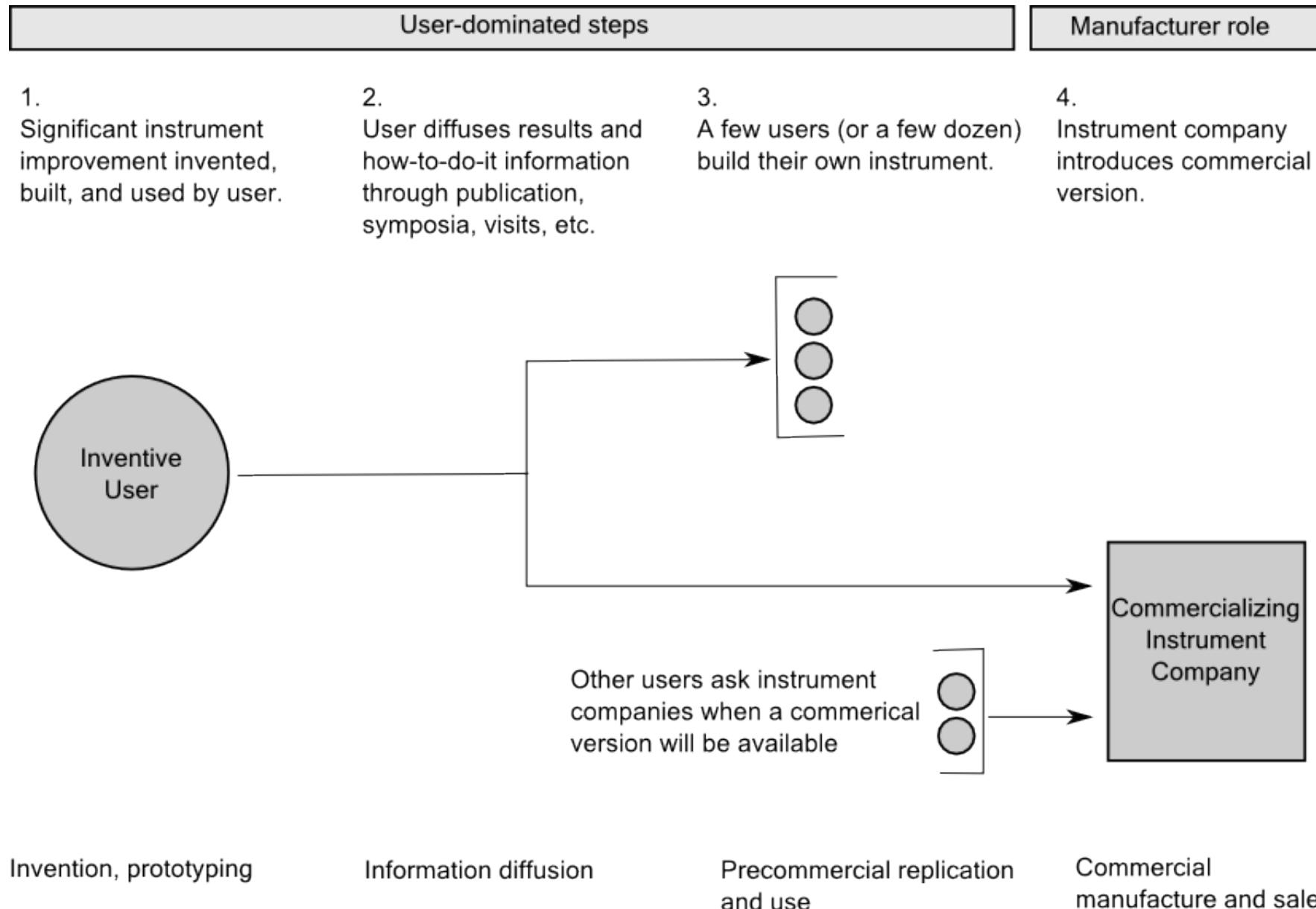 - Tuomi: "Downstream Innovation"

Von Hippel, 1988
Distributed Innovation

- Why a new model of innovation?
  - The manufacturer-as-innovator assumption is wrong: We need a new way to categorize innovators
  - A better understanding of how profits from innovation are captured is as important as understanding transaction costs and economies of scale
- The Concept of Innovation
  - New useful materials, machines and processes (that generate economic rents)
  - First-of-kind, major & minor improvements over best preexisting practice
- Locus of Innovation
  - Several sources of innovation (not only the commercializer); many functional relationships can exist between innovation and innovator (user, supplier, manufacturer, distributor,...)
  - Informal trading of know-how is important
- Expected rents and economic rationality can predict the likely source of innovation
- Main Consequences
  - Distributed innovation processes can be managed by changing expectations, profits and costs (E.g., product designs may enable or constrain user innovation by allowing or restricting user modifications)
  - Lead users are important in generating commercially promising innovations
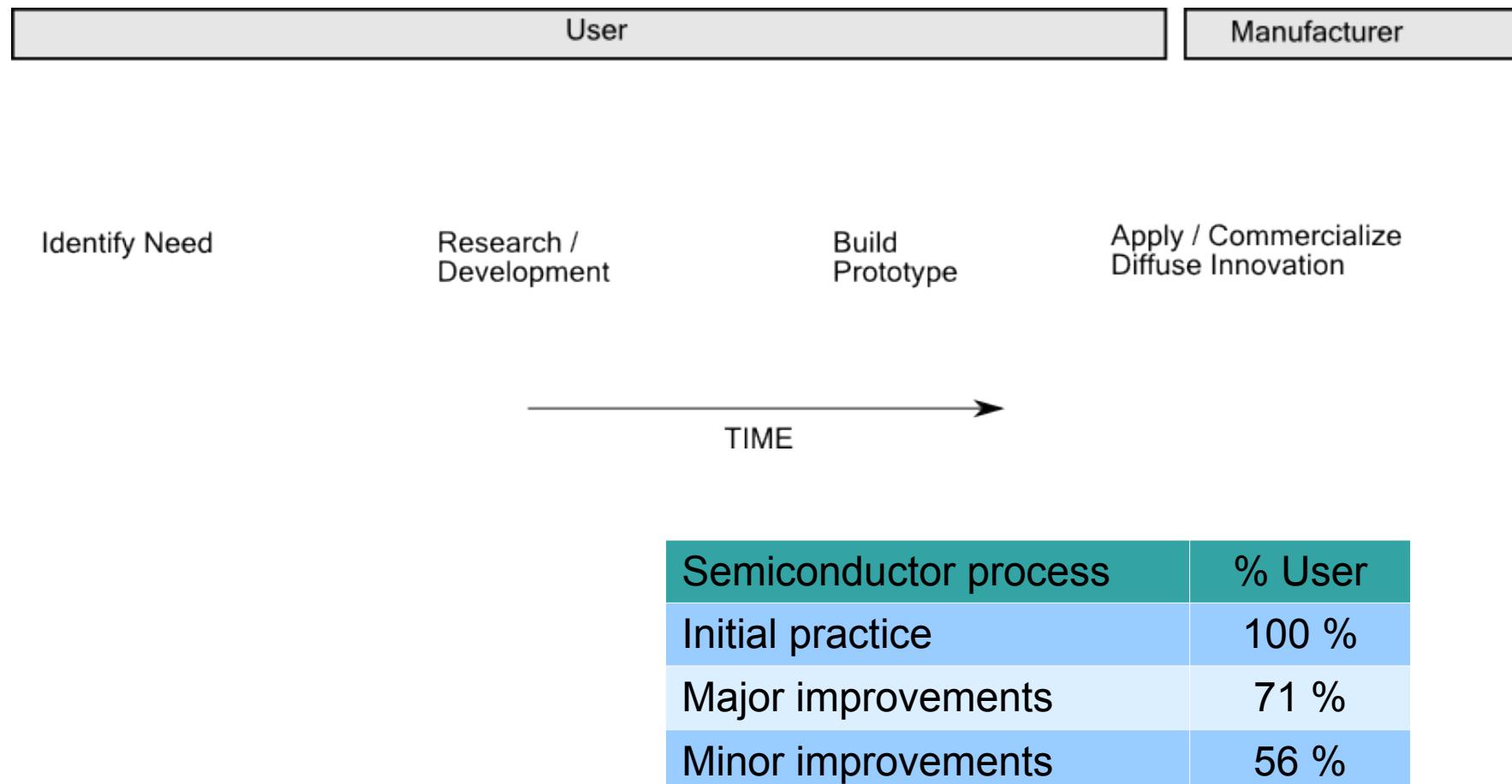
Von Hippel, 1977 / 88
Scientific Instrument Innovation

User-dominated steps			Manufacturer role
1. Significant instrument improvement invented, built, and used by user.	2. User diffuses results and how-to-do-it information through publication, symposia, visits, etc.	3. A few users (or a few dozen) build their own instrument.	4. Instrument company introduces commercial version.

Inventive User

Other users ask instrument companies when a commerical version will be available

Commercializing Instrument Company

Invention, prototyping   Information diffusion   Precommercial replication and use   Commercial manufacture and sale

Different Types of Innovations

- New Product-User category
  - Electron microscope
  - Nuclear magnetic resonance spectrometer
  - Tractor shovel
  - Semiconductor integrated circuits
- Usability improvement
  - The self-cleaning aperture for electron microscope
  - Stable high-voltage power supply that replaces a stack of batteries in electron microscope
- Functional improvement
  - Sample spinning in nuclear magnetic resonance spectrometer
  - Optical pattern generator for integrated circuits
  - Hydraulic bucket control for tractor shovel
- Technique only
  - Modifying the way in which existing equipment is operated

The User-Dominated Innovation Process

User			Manufacturer

Identify Need   Research /   Build   Apply / Commercialize
                       Development   Prototype   Diffuse Innovation

TIME →

Semiconductor process	% User
Initial practice	100 %
Major improvements	71 %
Minor improvements	56 %

Von Hippel (1988) Sources of Innovation, p. 22-5

Not Everything is User-Driven

	% Manufacturer
Basic shovel	100 %
Major improvements	100 %
Major accessories	80 %

Von Hippel Hypothesis and Its Preconditions

- The Hypothesis
  - Innovating firms can be found among those whose analyses lead them to expect an attractive economic rent.
- Basic Assumptions
  - The functional role of innovator (manufacturer, user, supplier, etc.) can be used to categorize the loci of innovation.
  - Although other things may matter, the expected economic rent predicts the source of innovation "usefully often."
- Necessary Preconditions
  - It must be difficult for innovators to adopt new functional relationships to their innovations. (E.g., users cannot become manufacturers.)
    - If role-switching is easy, profit expectations are relatively independent of the functional role of innovator
  - Innovators must have a poor ability to capture rent by licensing their innovation-related knowledge to others.
    - If licensing is easy, innovator can capture returns that are independent of its own functional role

Intensity of Innovation

resources   dynamic competence   time

capability (ability to mobilize human, social, and financial capital)

effort (capital + labor)

cost (capital)

expected benefit
- private benefit
- public benefit
- vision

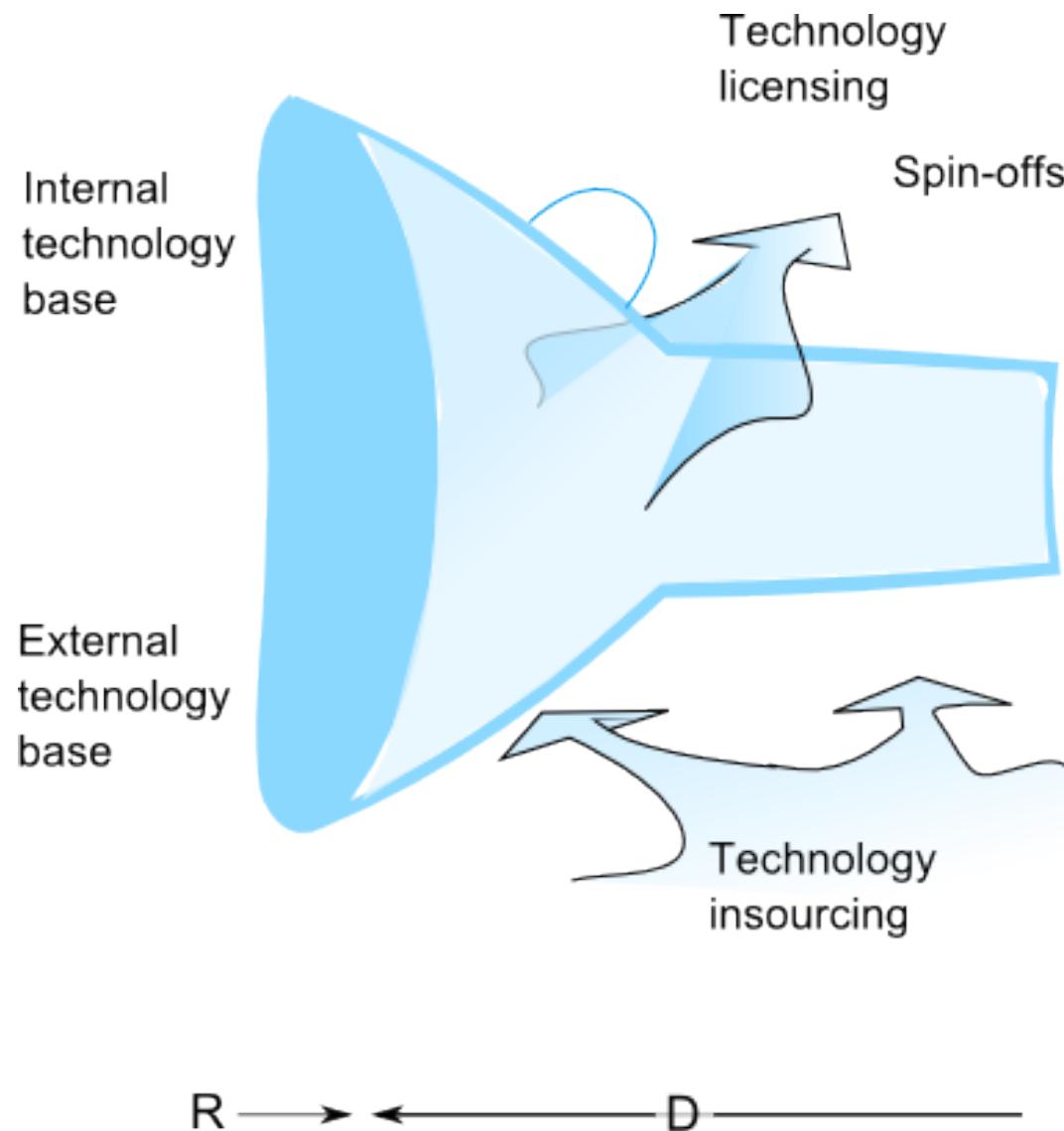high probability of innovation
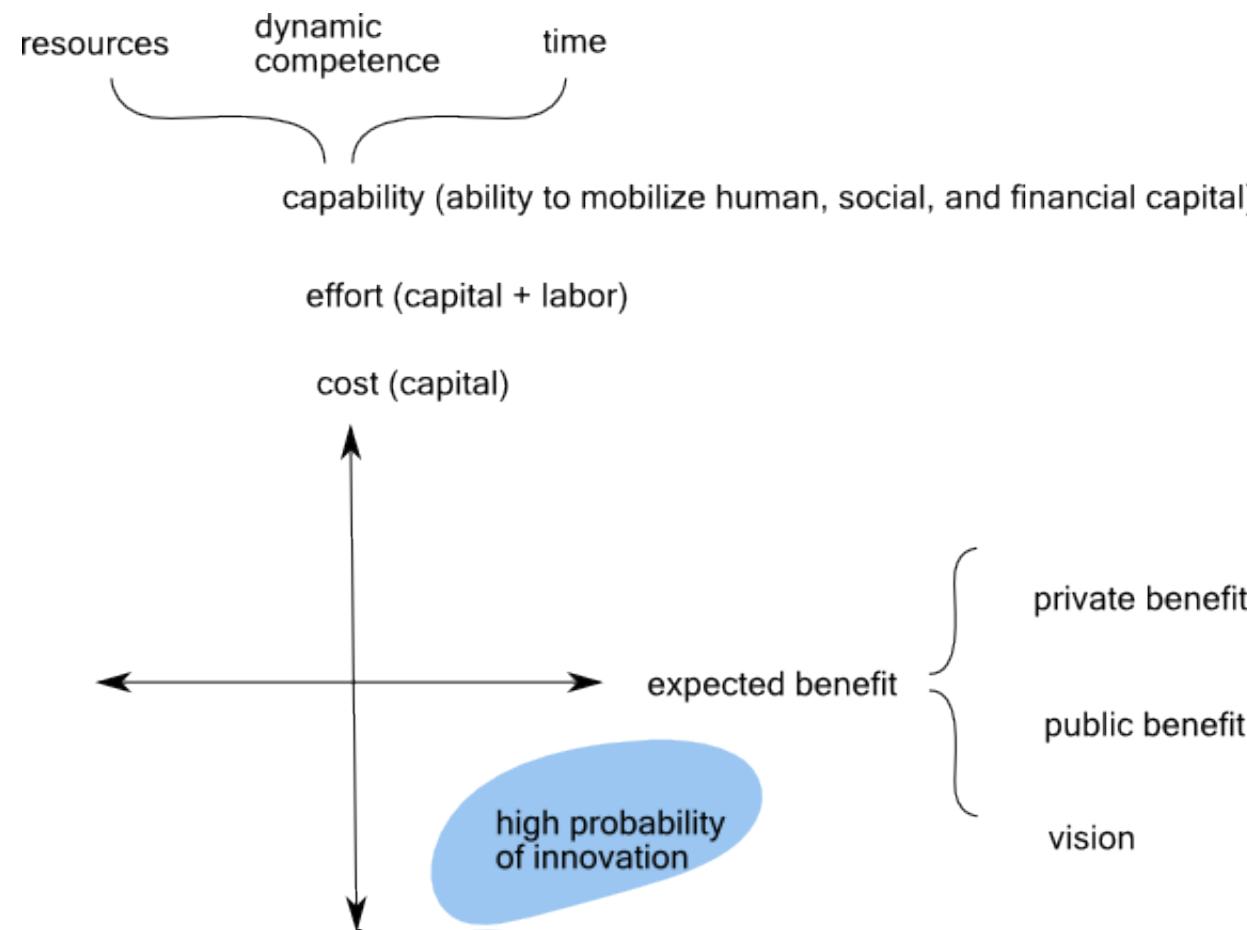
Chesbrough, 2003 "Open Innovation"

- Why a New Innovation Model?
  - Ideas are generated both inside and outside the focal firm.
  - Ideas and intellectual property rights can be valuable also when they are not used for product development inside the focal firm.
  - Business models define how firms create and capture value that is created in the open R&D system.
- The Concept of Innovation
  - "Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively."
  - "Open Innovation processes combine internal and external ideas into architectures and systems."
- Locus of Innovation / Product Development
  - The firm, as a combiner of ideas, knowledge and technology
- Main Consequences
  - Managers need to manage knowledge flows.

The Open Innovation Funnel

Technology licensing

Spin-offs

Internal technology base

External technology base

Technology insourcing

R → ← D

Chesbrough: What is New?

- "The first difference is that external knowledge played a useful, but supplemental role in prior theorizing about innovation... In Open Innovation, external knowledge plays an equal role to that afforded to internal knowledge in the earlier conception."

- "A second area of differentiation is the centrality of the business model in the Open Innovation paradigm...In Open Innovation, companies actively seek people of genius from both inside and outside the firm to provide fuel for the business model."

- "A third distinction is that earlier innovation theories effectively assumed the absence of any measurement error (either of a Type I or Type II kind) in the evaluation of R&D projects."

- A fourth and related distinction is that prior concepts accorded little or no recognition to purposive outbound flows of knowledge and technology (in contrast to the unwitting outbound flows that are termed 'spillovers')...In the Open Innovation paradigm, enabling outward flows of technologies allows firms to let technologies that lack a clear path to market internally seek such a path externally."

- "A fifth point of departure lies in the assumptions of the underlying knowledge landscape...In Open Innovation, useful knowledge is generally believed to be widely distributed, and of generally high quality."

- "A sixth differentiation is the new and proactive role for IP management in the Open Innovation model."

- "A seventh area of difference is the rise of intermediaries in innovation markets."

- "The eight and last distinguishing point out of this new approach is the development of new and different metrics for assessing the performance of a firm's innovation process."

"Points of differentiation, relative to prior theories of innovation"

1.	Equal importance given to external knowledge, in comparison to internal knowledge
2.	The centrality of the business model in converting R&D into commercial value
3.	Type I and Type II measurement errors (in relation to the business model) in evaluating R&D projects
4.	The purposive outbound flows of knowledge and technology
5.	The abundant underlying knowledge landscape
6.	The proactive and nuanced role of IP management
7.	The rise of innovation intermediaries
8.	New metrics for assessing innovation capability and performance

Source: Chesbrough, H. (2006) In: Chesbrough, Vanhaverbeke & West: Open Innovation: Researching a New Paradigm, Oxford University Press, p.11.

Von Hippel vs. Chesbrough

Von Hippel Analyzed

- Knowledge base
  - Detailed case studies in many industries
  - Economics of innovation (appropriation of rents)
  - Sociology of science and technology (knowledge diffusion, technology transfer)
- Novel contributions
  - Strong evidence of the fact that there are multiple sources of innovation
  - Extension of the Schumpeterian argument that inventors and entrepreneurs are not the same
  - An implicit evolutionary view: innovations pop up where the conditions are right
  - Lead users and product modifiability are important
- Key assumption
  - Innovators are predominantly motivated by profit seeking
- Data constraint:
  - The starting point is that the manufacturer-centric view on innovation is wrong; yet only innovations that eventually are embedded in manufactured products (or become standard methods) are taken into account
  - Only innovations that have become economically important are counted
- No emergent uses or users; "user-innovators" are the current users

Chesbrough Analyzed

- Knowledge base
  - Business history (the rise of the corporate R&D lab, the failure of Xerox PARC)
  - Economics of innovation (the anomaly of spill-overs, appropriation of IPR, the impact of external knowledge)
  - Organization theory (resource-based view, strategic alliances, absorptive capacity)
  - Open source software development model (for the title and the IPR challenge)
- Typical sources of literature:
  - Academy of Management Review / Journal; Administrative Science Quarterly; California Management Review; Journal of Management Studies; Organization Science; Research Policy; Strategic Management Journal; Harvard Business Review; Management Science
  - Little use of "external sources of knowledge" (e.g. history of technology, sociology of science,...)
- Novel contributions (post 1995 business practice)
  - The emphasis on the role of business models: <u>innovation capability</u> is a key source of competitiveness, you have to define the business model based on it. (Cf. R.A. Burgelman, 1983).
- Key assumption
  - Innovators are motivated by business strategy

Chesbrough's Implicit Assumptions

- An implicit "heroic innovator" model
  - "A second area of differentiation is the centrality of the business model in the Open Innovation paradigm...In Open Innovation, companies actively seek **people of genius from both inside and outside the firm** to provide fuel for the business model."
  - Little concern for the social basis of innovation
- Innovation or Product Development?
  - "A third distinction is that **earlier innovation theories** effectively **assumed** the absence of any measurement error (either of a Type I or Type II kind) **in the evaluation of R&D projects**."
  - Should read: "Earlier **R&D management models** effectively assumed the absence of any measurement error in the evaluation of R&D projects."
  - There is no real discussion on innovation theories; innovation remains in a black box

Von Hippel vs. Chesbrough

"Manufacturer"

Technology licensing

Spin-offs

Internal technology base

External technology base

User / Supplier /Other

Business model adjusted to maximize innovation returns

Technology insourcing

(User) / "Supplier" / (Other)

von Hippel's preconditions: no easy licensing, no switching from one functional category to another

R ⟶ ⟵ — D ——————
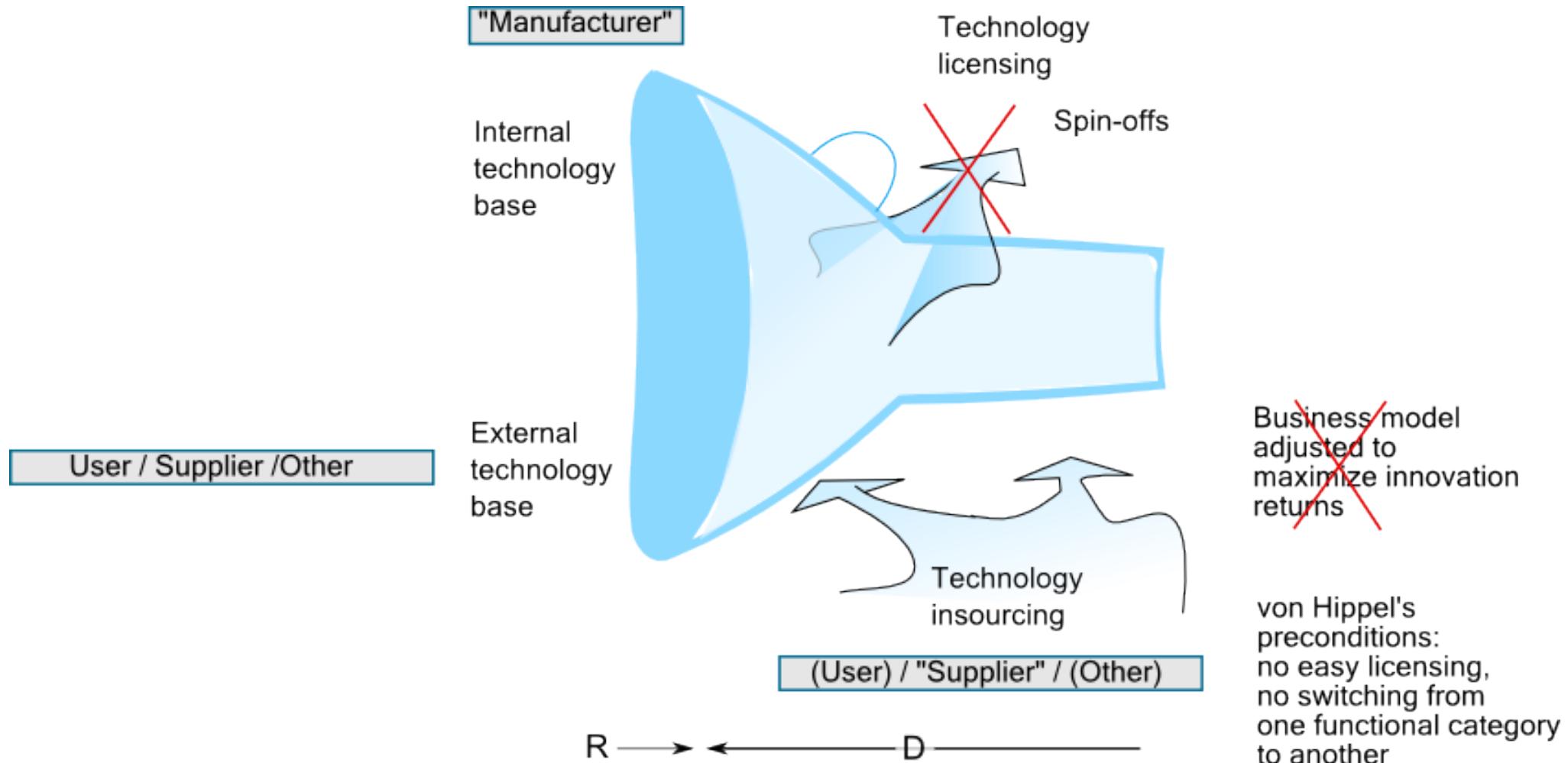
Alternative Theories of Open Innovation

What Do You Mean by "Openness"?

- Technical
  - Open interfaces
  - Interoperability
- Social
  - Open access to resources (transparency, visibility, right to use)
  - Open source (modifiability)
  - Access to decision-making ("democracy", distributed control)
  - Open boundaries (inter-organizational collaboration, "legitimate peripheral participation")

Open Resources: Three Levels

- Resource is something that generates a flow of service

- <u>Open resources</u> are sources of services

  - That do not diminish their capability to produce services when enjoyed, and which

  I. Provide non-discriminatory <u>access</u> to information and knowledge about the resource (level I openness)

  II. The services <u>can be enjoyed</u> by anyone with sufficient non-discriminatory capabilities (level II openness)

  III. <u>Can be contributed</u> to (level III openness)

- At level III, an implicit (social) theory of "contribution" is necessary

- An explicit evaluation process can be based on the Mertonian <u>norms</u> of open science

  1) Disclosure

  2) Non-discriminatory participation

  3) Presentation of contributions in a way that does not explicitly reflect personal interests

  4) Originality

  5) Organized critical evaluation

  ➡ Contribution

Let's Open the Black Box of Innovation:

**How, Exactly, New Ideas and New Knowledge
are Generated?**

Nonaka:
Knowledge Creation in the SECI Spiral

	Tacit knowledge	**To**	Explicit knowledge
Tacit knowledge	Socialization *Sympathized knowledge*		Externalization *Conceptual knowledge*
From			
Explicit knowledge	Internalization *Operational knowledge*		Combination *Systemic knowledge*
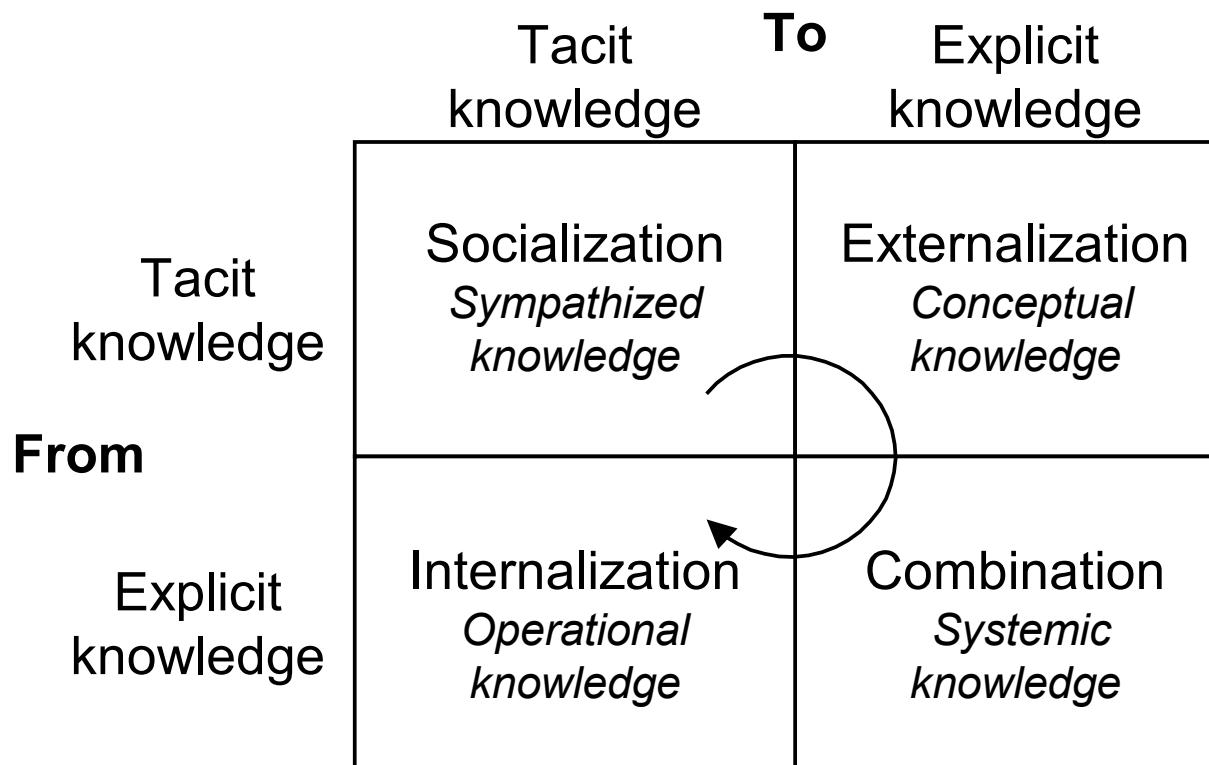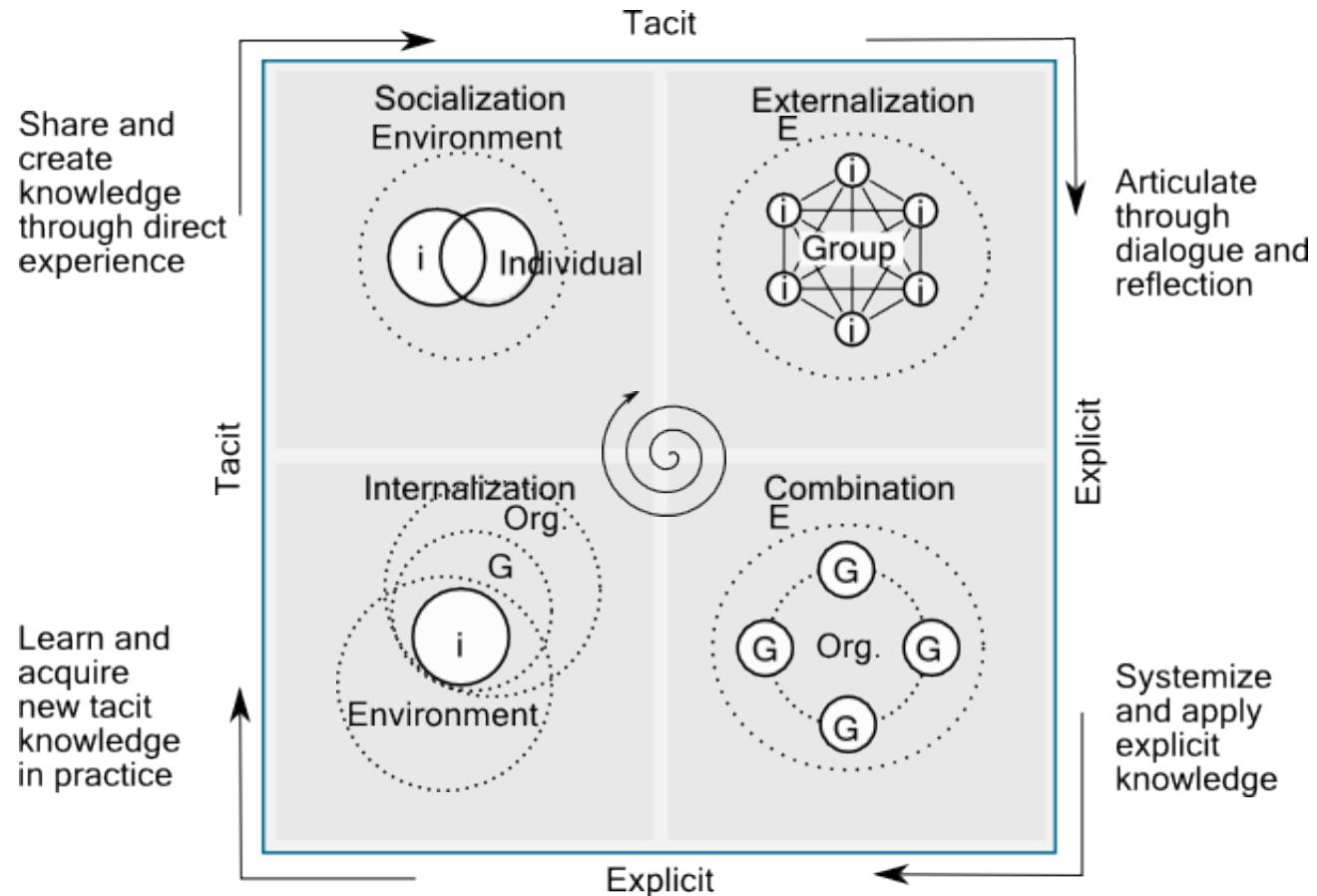
Nonaka

Based on Nonaka, Toyama, Hirata (2008) Managing Flow, p.19.

The Concept of "Ba"

Nonaka: "I will try to explain as much as I can. About the concept of ba."

- "In 1995 it is clear that we didn't talk about the concept of ba. But after my field research it occurred to me that the SECI process does not occur in a vacuum. It occurs in a specific context. Knowledge is in a sense information in a context. It is contextual, that's why it generates meaning.

- From there I introduced the concept of ba. Our definition of the concept of ba is a shared context in motion.

- Knowledge needs context. Without context to specify time, place and relationship with others it's just information. Ba is a context that is shared by participants to create meanings. Participants understand the context of others and oneself and through interaction create the context. Hence it's constantly moving.

- The key to understand the context is interaction. It does not reside in one's mind, contexts are shared and created through interaction. That's the basic idea I tried to introduce. "

Tuomi (2001) Interview with Ikujiro Nonaka, unpublished

A Process Model of Knowledge-Creating Organization
Nonaka, Toyama, Hirata, 2008
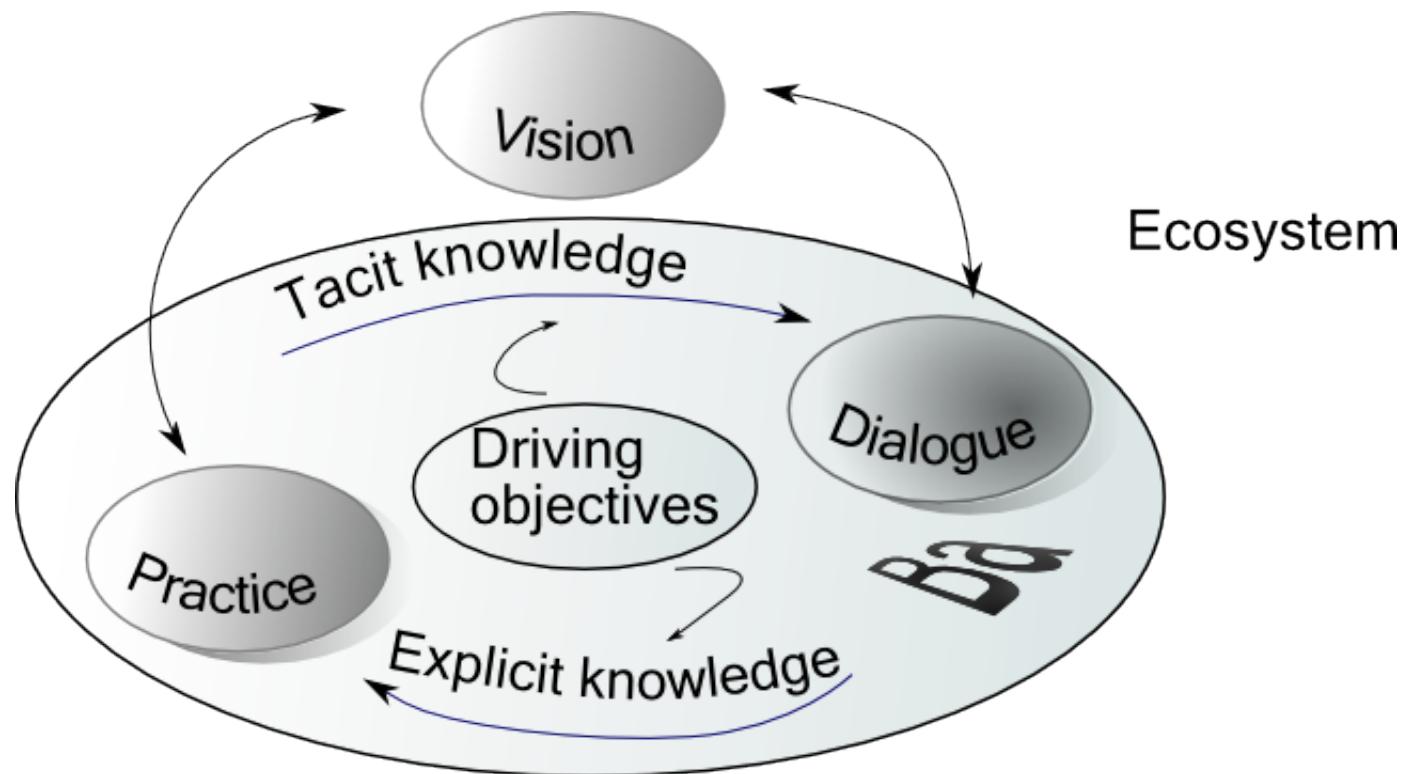
Based on Nonaka, Toyama, Hirata (2008) Managing Flow. Palgrave Macmillan, p.27

"Ba"

- "Space," "place," "field"
- The constantly evolving context of interaction with others and with the world
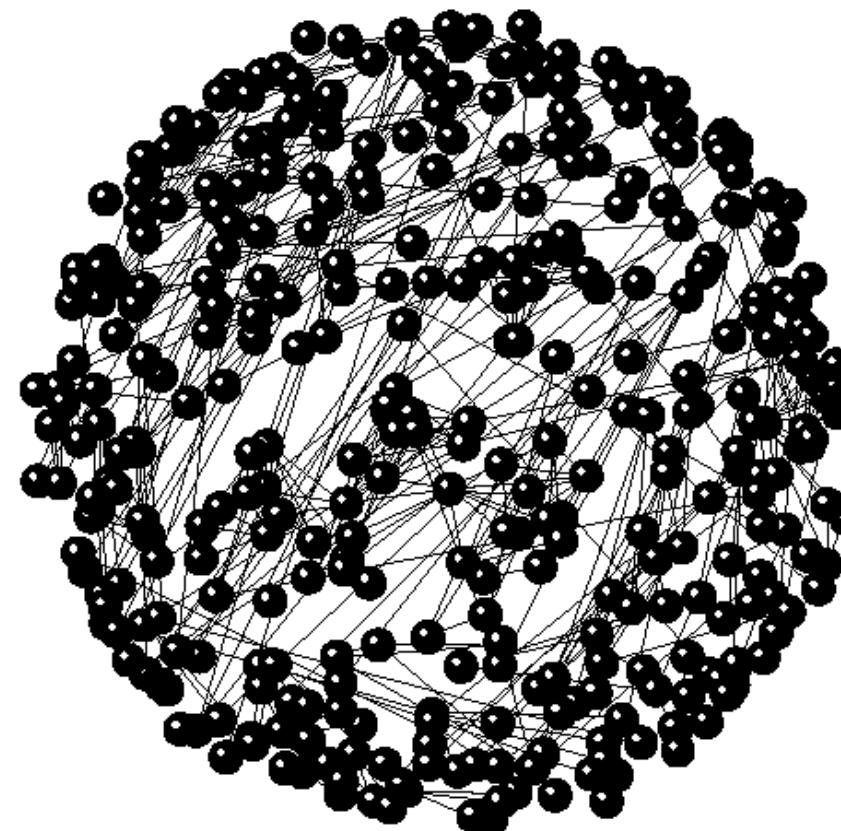
Nonaka Open Innovation
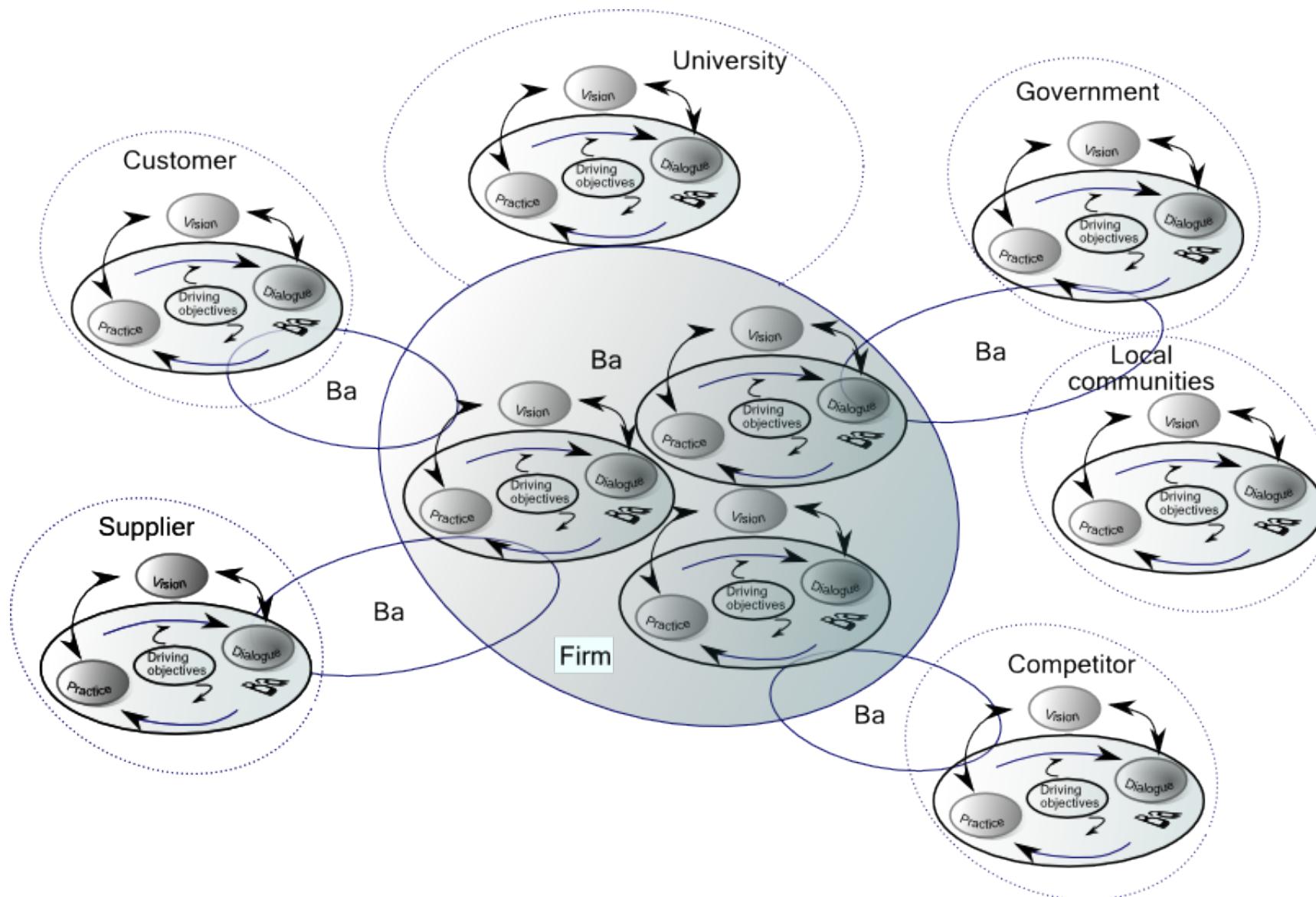
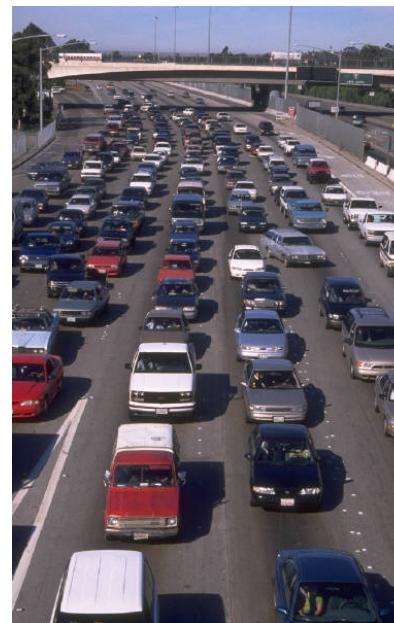Based on Nonaka, Toyama, Hirata (2008) Managing Flow, p.41

Now We Need Some Heavier Stuff

(Which They Don't Often Teach You at Business Schools)

Founders of Semiconductor Firms in Silicon Valley

Source: Castilla, E.J., Hwang, H., Granovetter, E., & Granovetter, M. (2000). Social networks in Silicon Valley.

"The modern space,..

...with bridges, flows, and networks"

The Medieval Space

Dimensions of Space

- Relational
  - In front of, behind, next to, ... went hiding...
- Contextual
  - Narrative (from where – here – to where; actor trajectory)
  - Sedimentation and history (after which, on top of which; layers of accumulation)
  - Field of pure experience
- Distance
  - Proximity
  - Metric and coordinates
- Extension
  - Space taken by a body, abstracted space, trajectory in space
- Accessibility
  - Topology (interior, boundary, permeability, path, space-time path)
- "Obliqueness" and orientation
  - Force and field
- Interaction
  - Participation in a process

Homestead in Namibia

Fig. 100 'Chiefly' kraal of the Ambo people, after Walton.
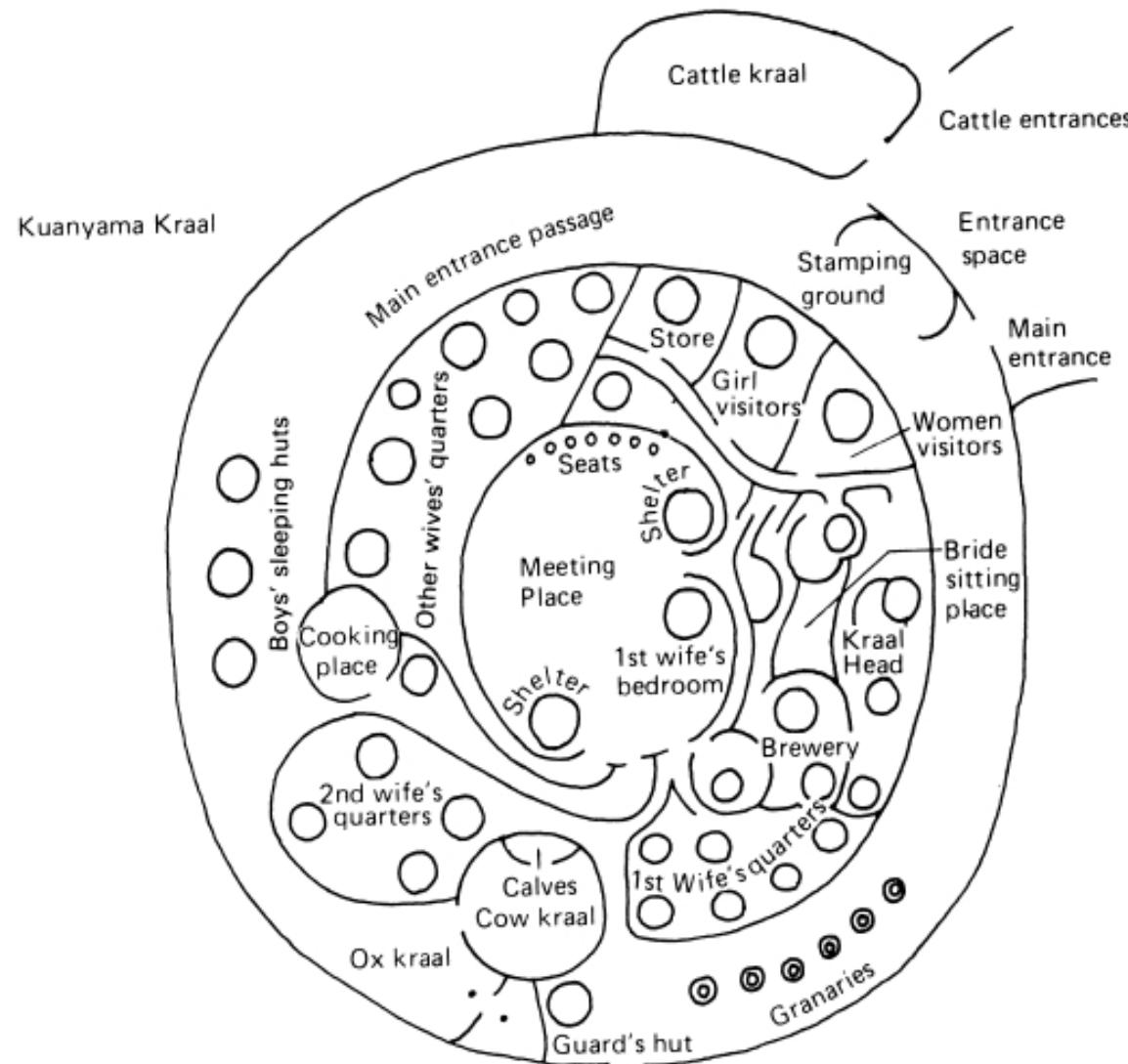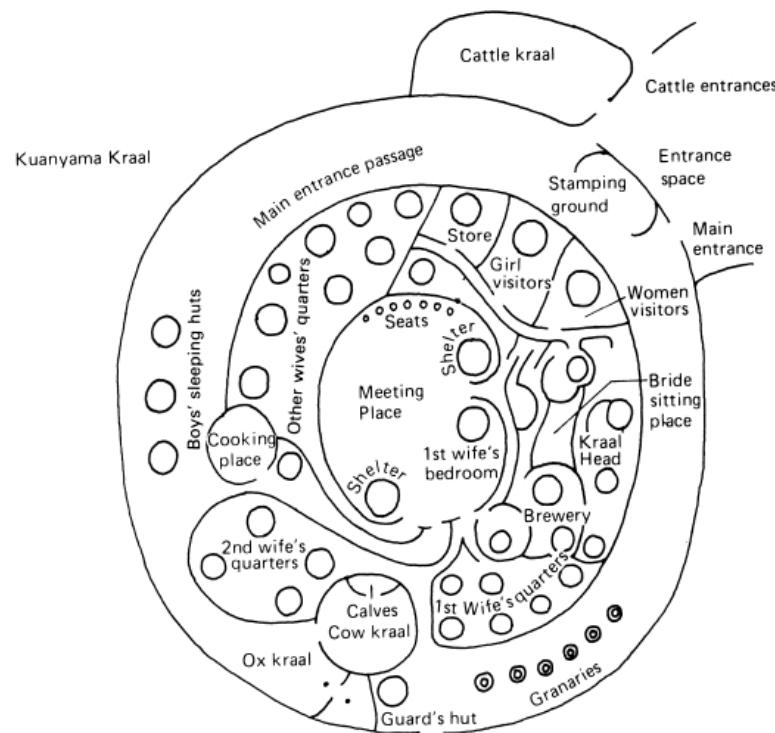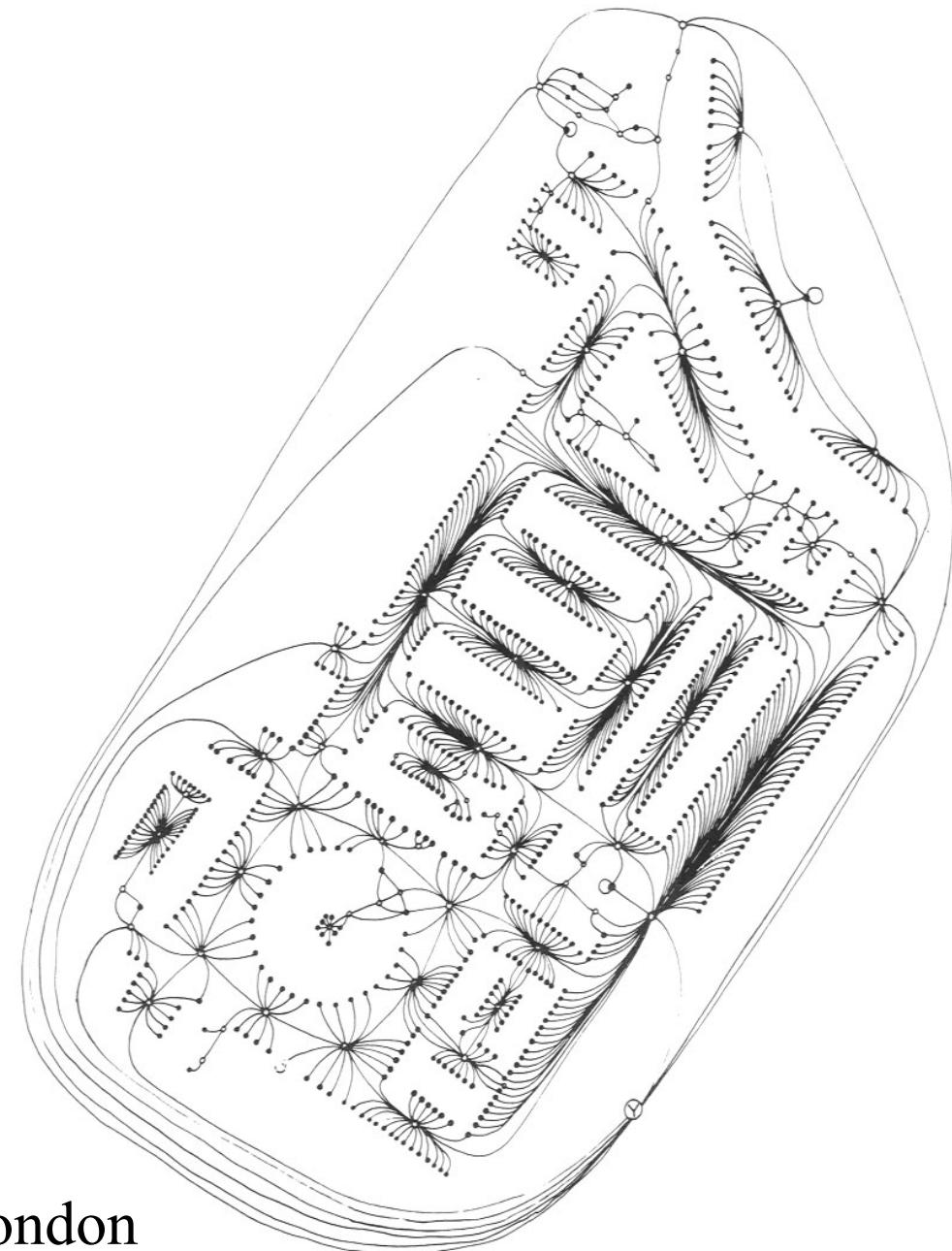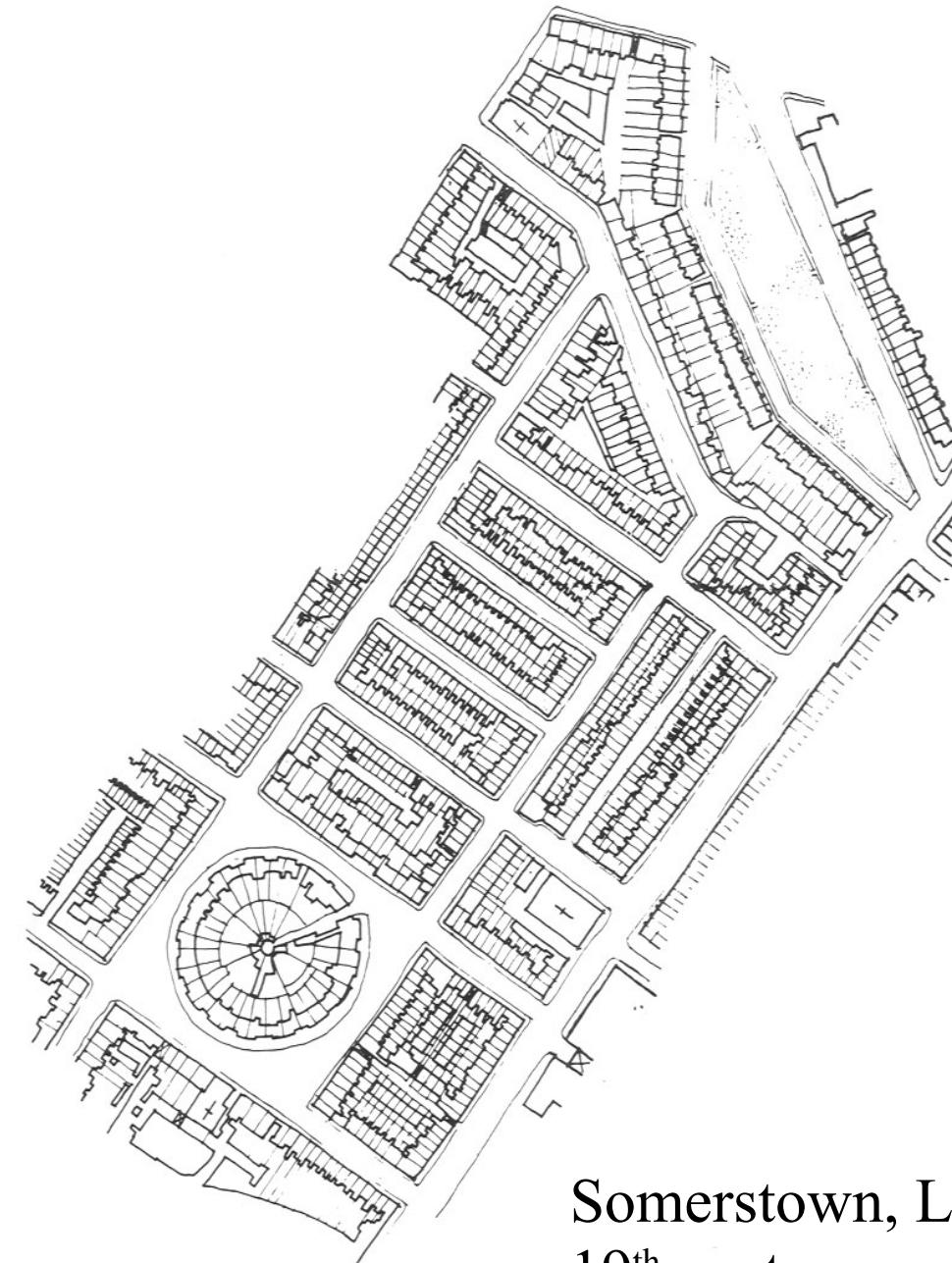
Permeability Map
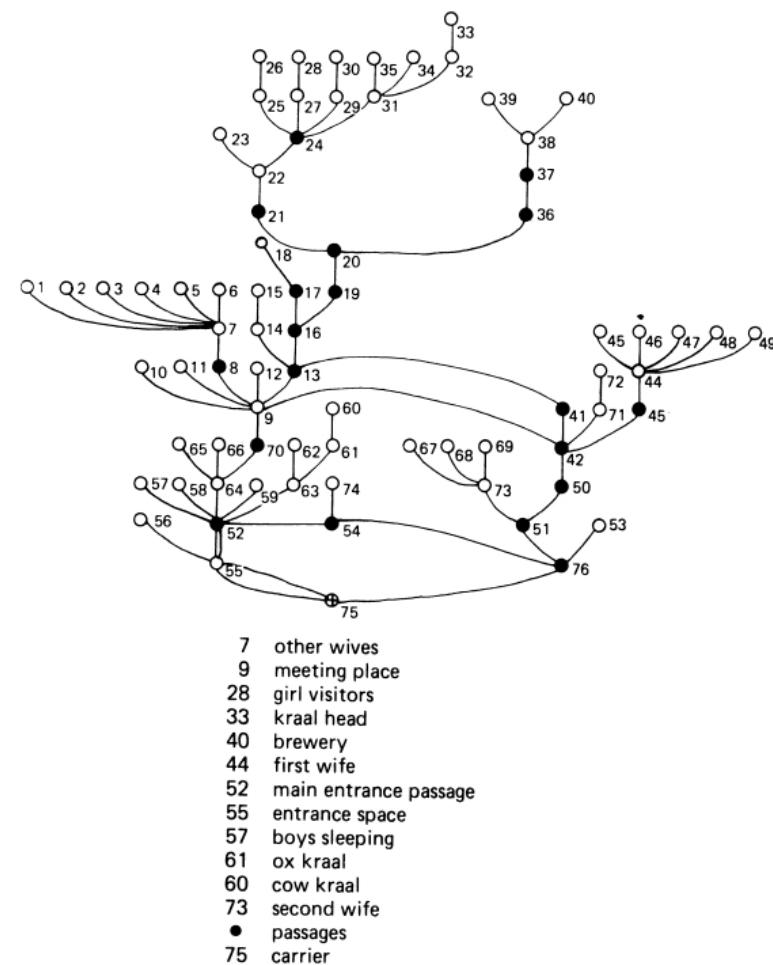
Fig. 101 Justified permeability map of Fig. 100.

7	other wives
9	meeting place
28	girl visitors
33	kraal head
40	brewery
44	first wife
52	main entrance passage
55	entrance space
57	boys sleeping
61	ox kraal
60	cow kraal
73	second wife
●	passages
75	carrier

Door-to-Door connectivity

Somerstown, London
19th century

Spaces of Interaction in Knowledge Organizations

Team A

Interest group

Interest group

Interest group

Team B

Community of Practice

Community of Practice

Business Processes

Process Team

23 April. 2009 page: 38

Tuomi, I. (1998) Collaborative learning as a source of corporate competence.
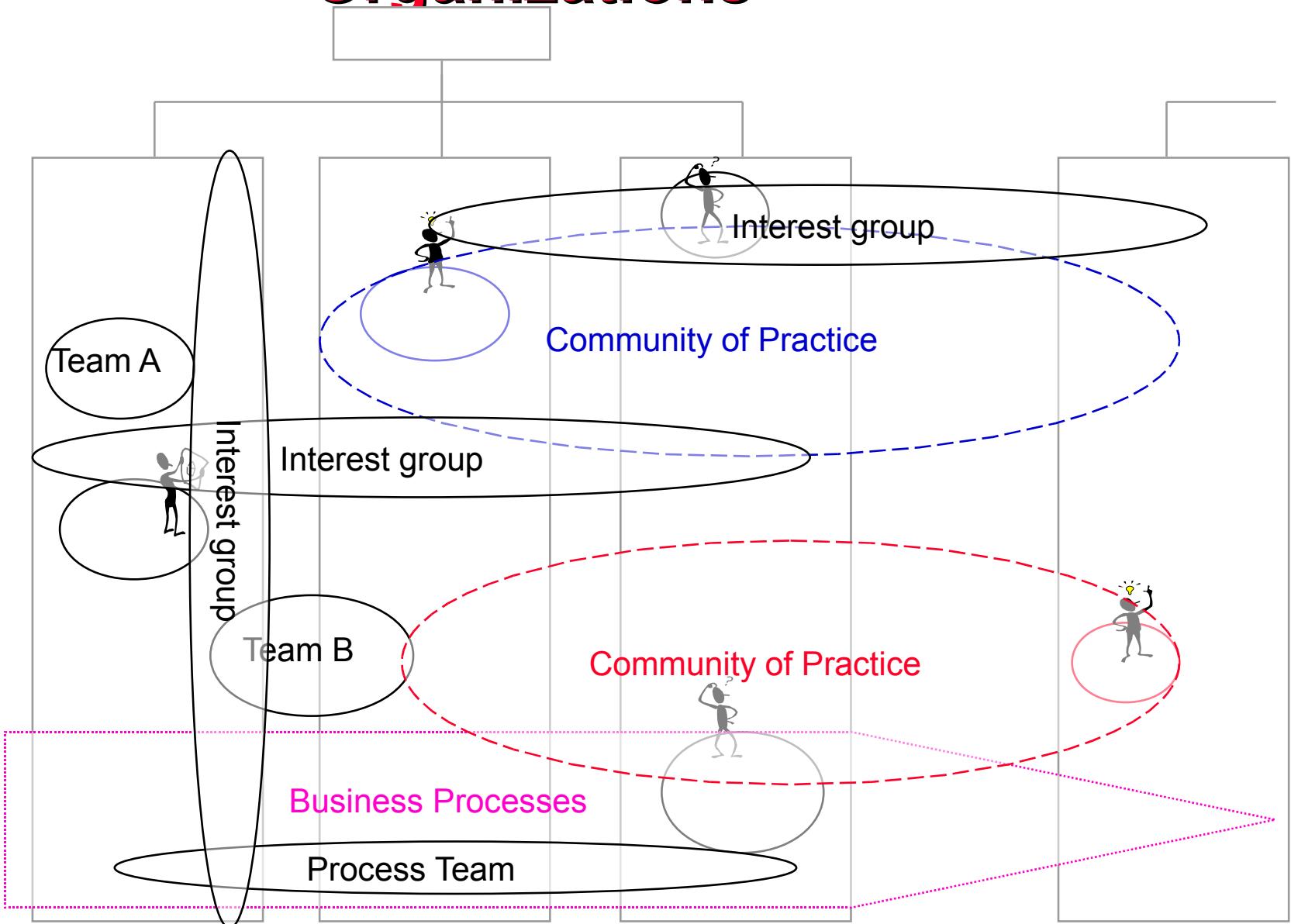
Basho and the "Shared Context in Motion"

- The concept of *ba* originates from *basho*, a concept developed by the Japanese philosopher Kitarō Nishida (1870-1945).

- The concept was further developed by Hiroshi Shimizu in the context of innovation research and "holonics" in the 1980s and 1990s.

Nishida

- According to Nishida, the place where pure experience occurs is *basho*. It is the space of interaction, where the world and the consciousness meet.

- In *An Inquiry into the Good* (1911), Nishida started from Wilhelm Wundt's philosophy of direct experience and William James's radical empiricism. Nishida argued that they didn't go far enough: Even when they understood that knowing is based on pure experience, they still assumed a subject that knows the world as an outsider. According to Nishida, the world is not "out there"; instead, the knowing subject is simultaneously constructed by the same reality that the knower perceives.

- The objects of the world are, therefore, constructed by the consciousness, and not "out there." (Realism is wrong. Idealism is right.) Yet, they are not "inside" the perceiver (or mind), as the perceiver is also part of the world. (Realism is right. Idealism is wrong.)

- The consciousness and the world have a "contradictory identity." Each constitutes one another, and the distinction between subjects and objects is an illusion.

- The traditional Western "is-or-is-not" logic therefore cannot describe the phenomenon of knowing. The subject-object distinction is the basic starting point for Western philosophies and that's why they have failed in explaining knowledge.

- Nishida then goes on building an alternative epistemology, based on pragmatism (James, Dewey), phenomenology (Bergson, Husserl, Heidegger), and existentialism (Kierkegaard, Nietzsche), and integrating these with Buddhist philosophical thinking.

- The outcome resonates with Whitehead's process philosophy (a development of Bergson) and phenomenologies of Merleau-Ponty, Levinas and Polanyi.

"Space"

"Knowledge"

The Traditional Hierarchy of Knowledge

- Davenport & Prusak, 1998:
  - Data are simple "discrete, objective facts about events"
  - Information emerges as meaning is added to data
  - Knowledge is "something more than data or information, something broader, deeper, and richer"; "knowledge is valuable information"
- Earl, 1994:
  - Organizational events are represented, collected and processed to generate <u>data</u>
  - Data are further manipulated, presented and interpreted to generate <u>information</u>
  - Information then leads to <u>knowledge</u>, as it is tested, validated and codified
- Wiig 1993:
  - Information consists of facts and data that are organized to describe a particular situation or condition
  - Knowledge consists of truths and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how

All the Way, Up to Wisdom

- A typical representation:

Yield =
intellectual dividens per effort invested
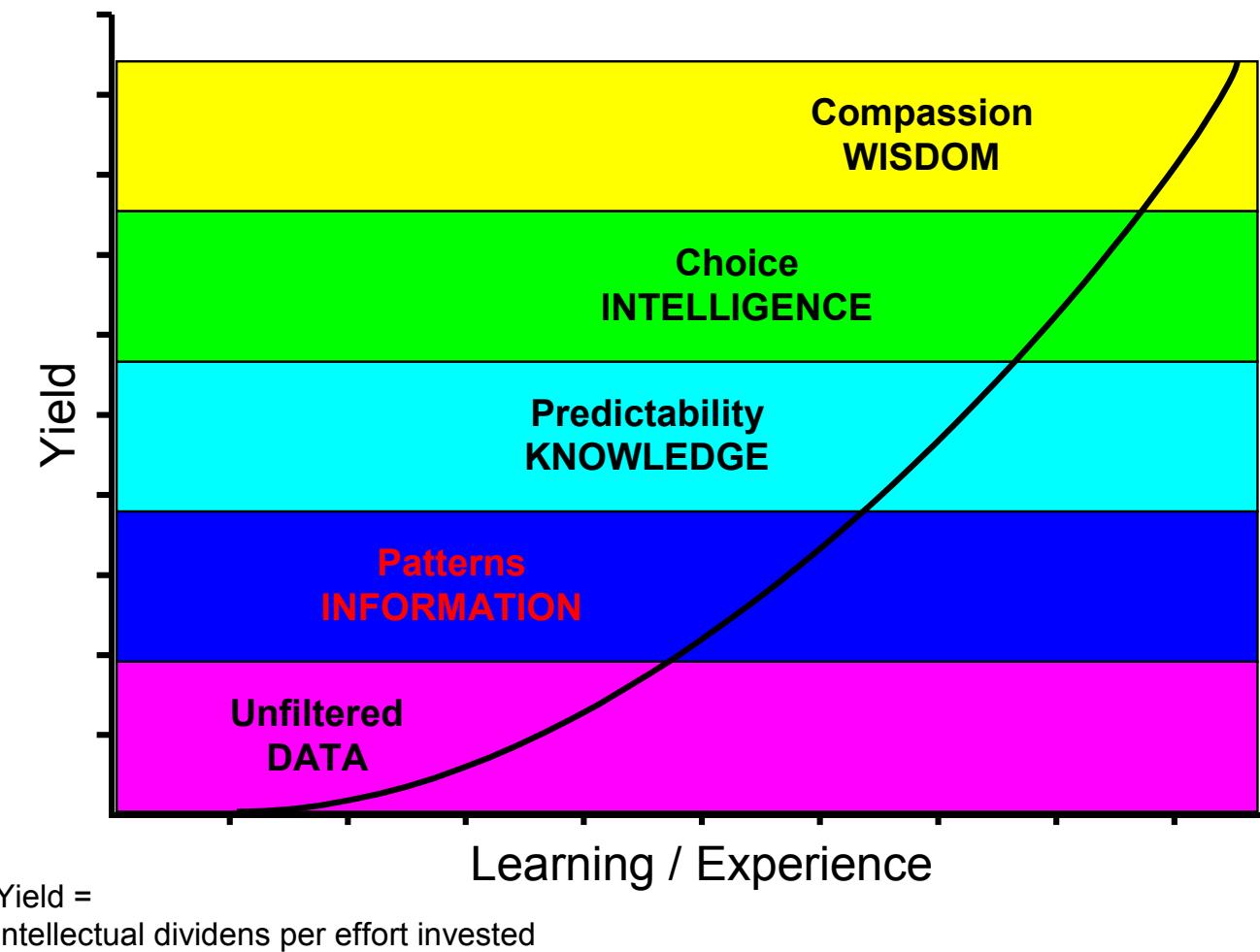
source: G. Pór

Let's Divide the Cake of Knowledge ...

Cake-Cutting Knowledge

- Visual
  - Split the halves
- Algebraic
  - 360 / 4 = 90°
- Geometric
  - Four right angles makes a circle
- Procedural
  - The one who cuts gets the last slice
- Evaluative
  - Use a scale for weighing
- Contextual
  - At kids birthday parties, cakes are divided into equal-sized pieces

Tacit Knowledge

- "Tacit"
  - A contextual frame for interpretation
  - Peripheral (non-focal)
 - Socially shared
  - Non-conceptual
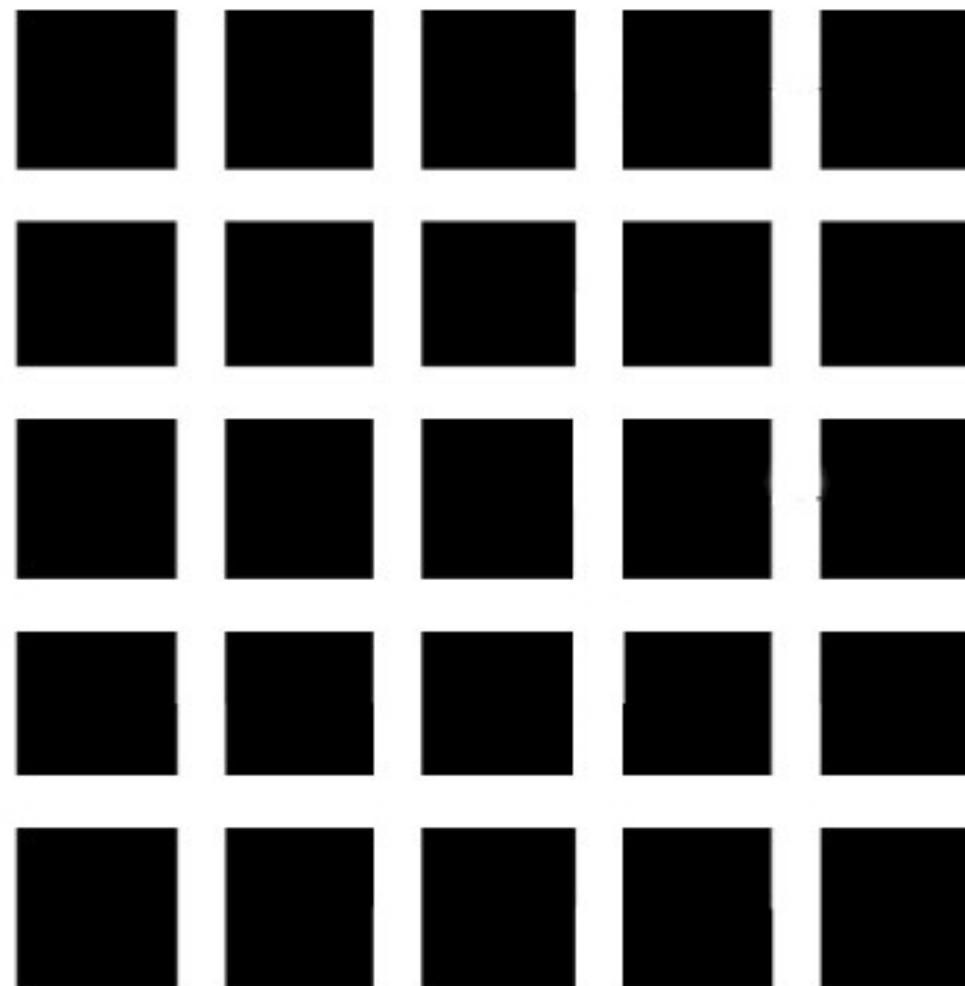
The Field of Meaning as the Foundation of Knowing

Michael Polanyi:

- "... the functional structure of from-to knowing includes jointly a subsidiary 'from' and the focal 'to'. But this pair is not linked together on their own accord. The relation of a subsidiary to a focus is formed by the *act of a person* who integrated one to the other. The from-to relation lasts only so long as a person, the knower, sustains this integration."

- ..."Such integration cannot be replaced by any explicit mechanical procedure...It can only be lived, can only be dwelt in."

> » Polanyi, M. & H. Prosch (1975) Meaning.The University of Chicago Press, pp.38-41.
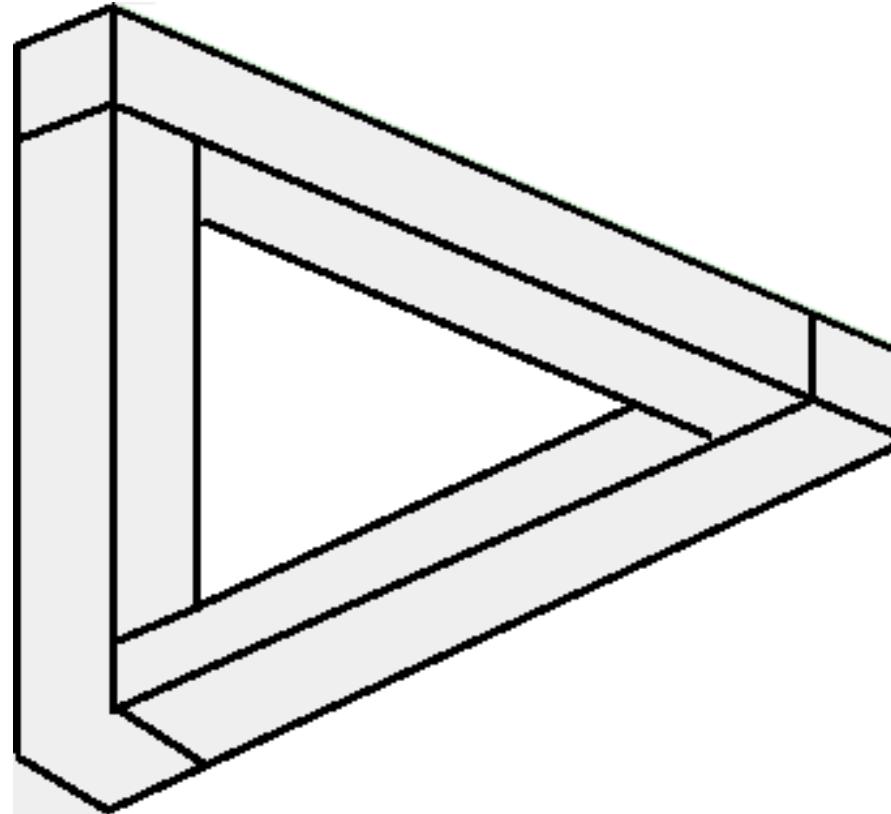
What Is the Meaning of This?

Genesis

- *1:24 And God said, Let the earth bring forth the living creature after his kind, cattle, and creeping thing, and beast of the earth after his kind: and it was so.*

- *1:25 And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.*

So, What Is the Meaning of This?

The Social Foundation of Knowledge

- M. Bakhtin (1930's): linguistic "genres" and "chronotype"
- L. Fleck (1935): "thought communities"
- D. Schön (1983): "communities of reflective practitioners"
- E. Constant (1980, 1984, 1987): "communities of practice"
- Y. Engeström (1987): "activity systems"
- Lave & Wenger (1991): "communities of practice"
- Brown & Duguid (1991, 2000): "communities of practice," "networks of practice"
- Nonaka et al. (1995, 2008) "socialization and "Ba"

**Knowledge is practice-related and activity-oriented**
- articulated in a social process,
- learned through socialization,
- reflected in the conceptual systems that are used in interpreting the world,
- partially embedded in material and technical artifacts,
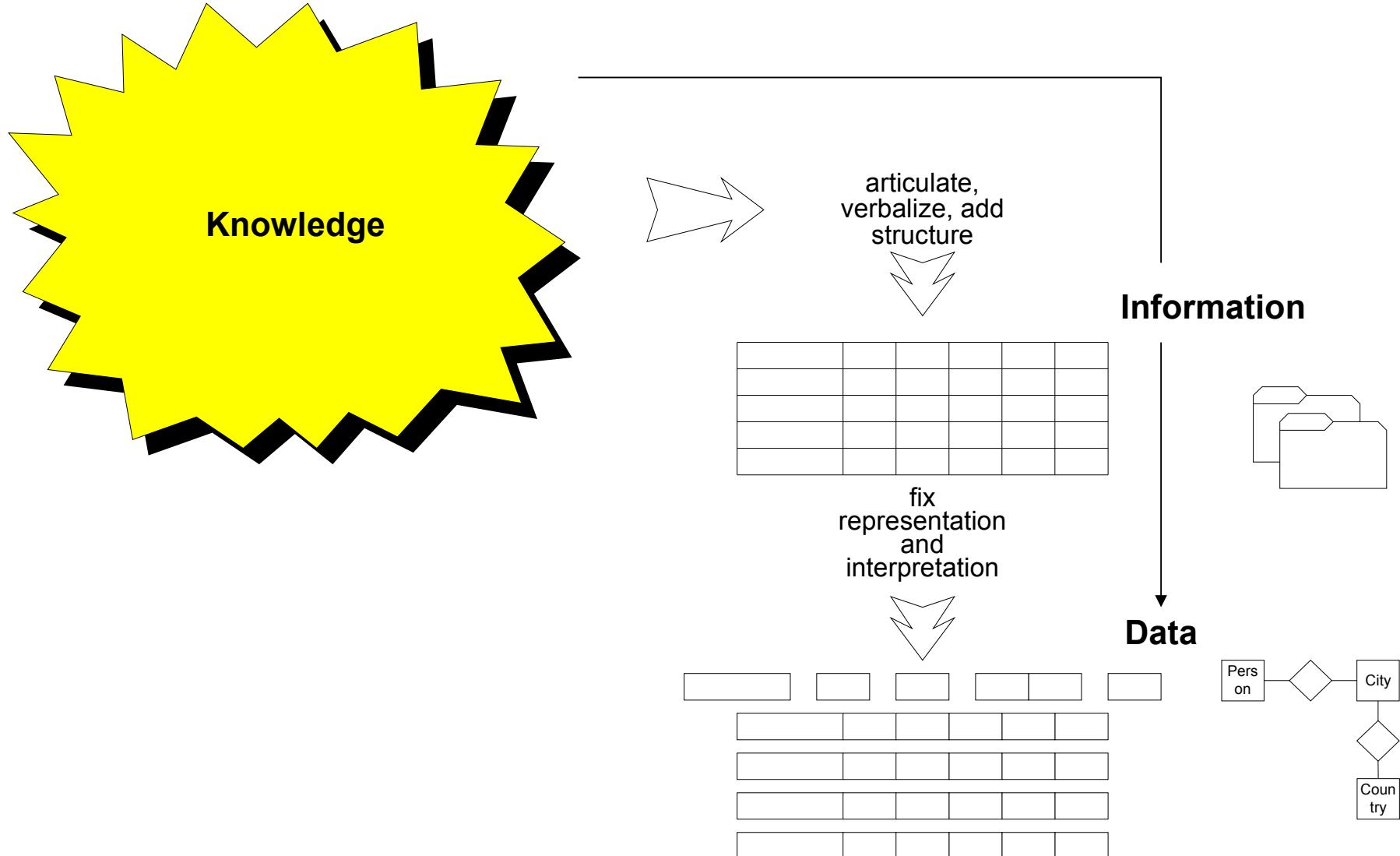- and often not explicitly articulated

and

Knowledge is Relational

Back to the Hierarchy of Knowledge...

Data Is More Than Knowledge
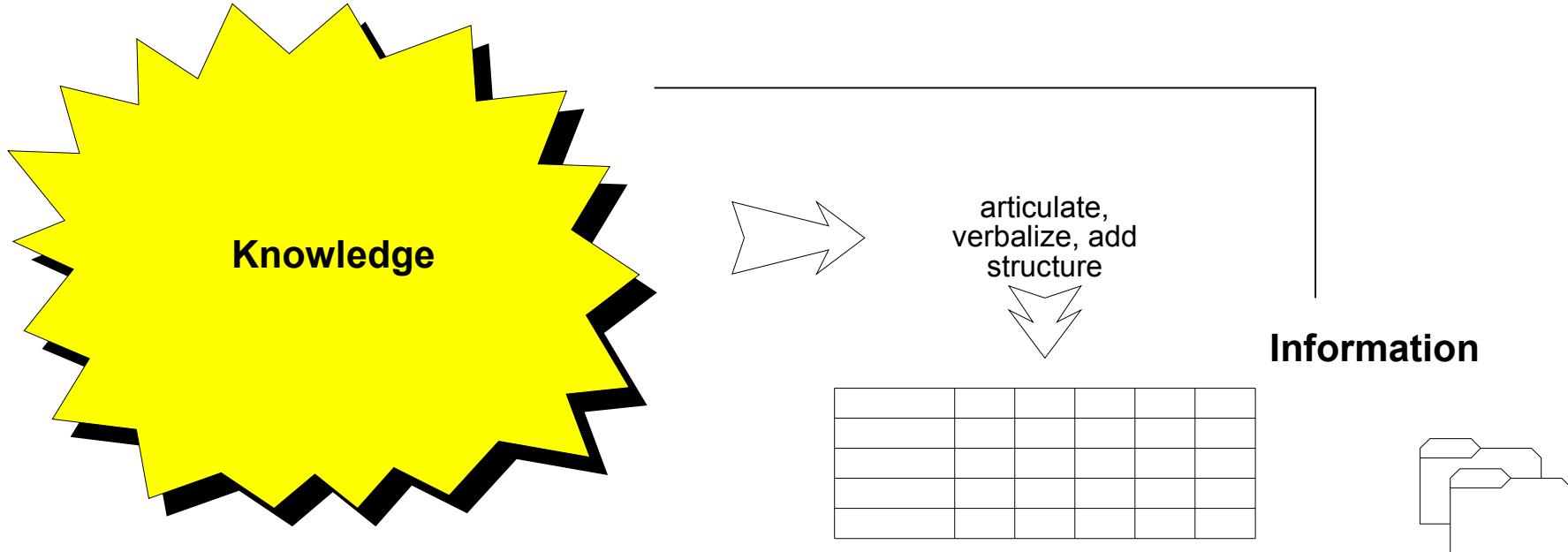
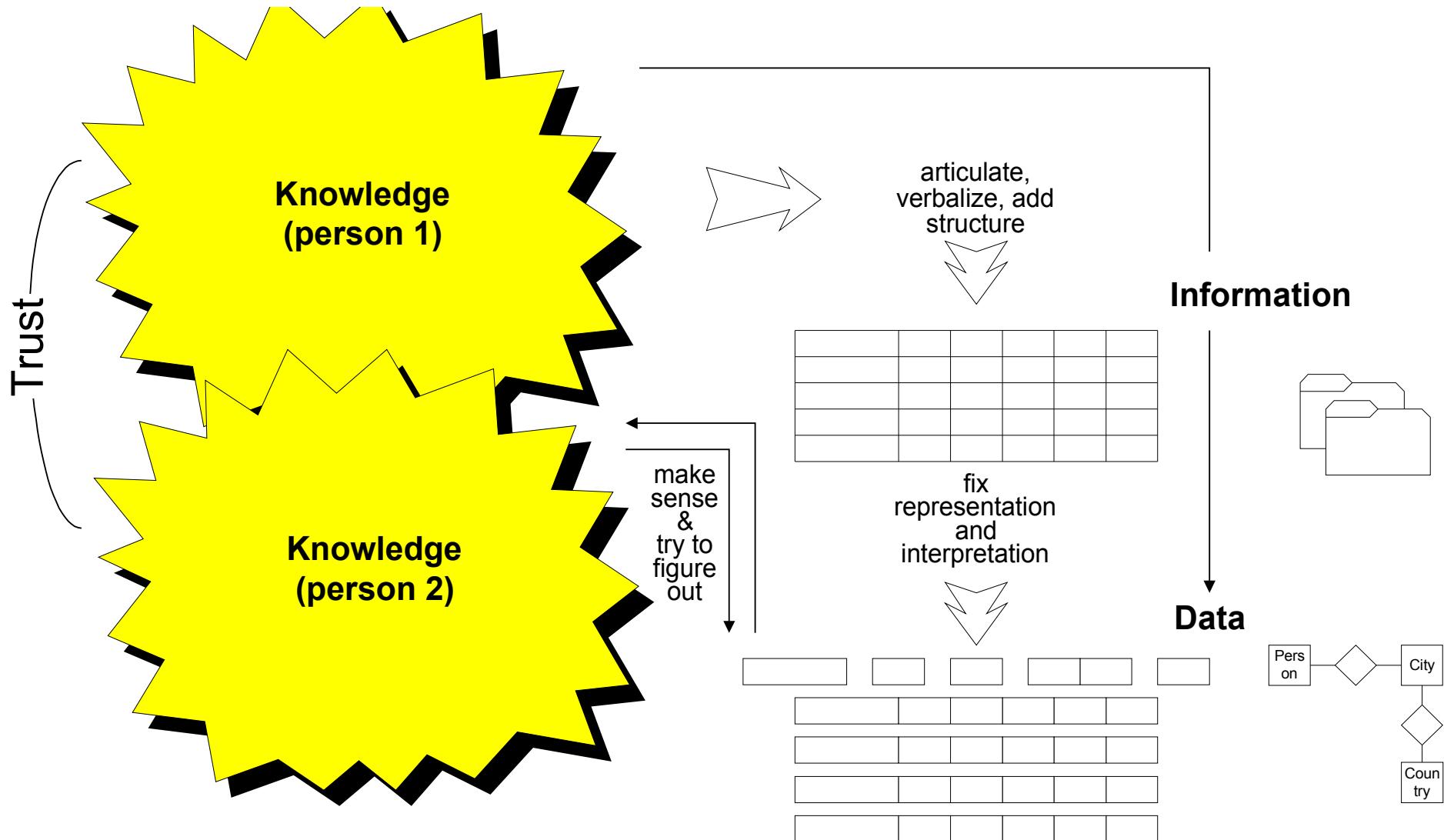**Knowledge** → articulate, verbalize, add structure ↓

Information

I. Tuomi: Data is more than knowledge: implications of the reversed knowledge hierarchy to knowledge management and organizational memory. *Journal of Management Information Systems* 6 (3):103-117, 2000.

Data Is More Than Knowledge

Knowledge

articulate, verbalize, add structure

Information

fix representation and interpretation

Data

| Pers on | | City |
| Coun try |

I. Tuomi: Data is more than knowledge: implications of the reversed knowledge hierarchy to knowledge management and organizational memory. *Journal of Management Information Systems* 6 (3):103-117, 2000.

Interpretation Requires Shared Knowledge

Knowledge (person 1)

Trust

Knowledge (person 2)

articulate, verbalize, add structure

Information

make sense & try to figure out

fix representation and interpretation

Data

Person   City

Country

Two Epistemic Models

	Information Processing	Meaning Processing
Nature of knowledge	Positivist, empirist, objectivist	Constructivist
Knowing subject	Individual cognitive processors of mental knowledge representations	Cultural and historical actors who participate in social processes of knowing, sensemaking and intelligent action

Nonaka Open Innovation, Again
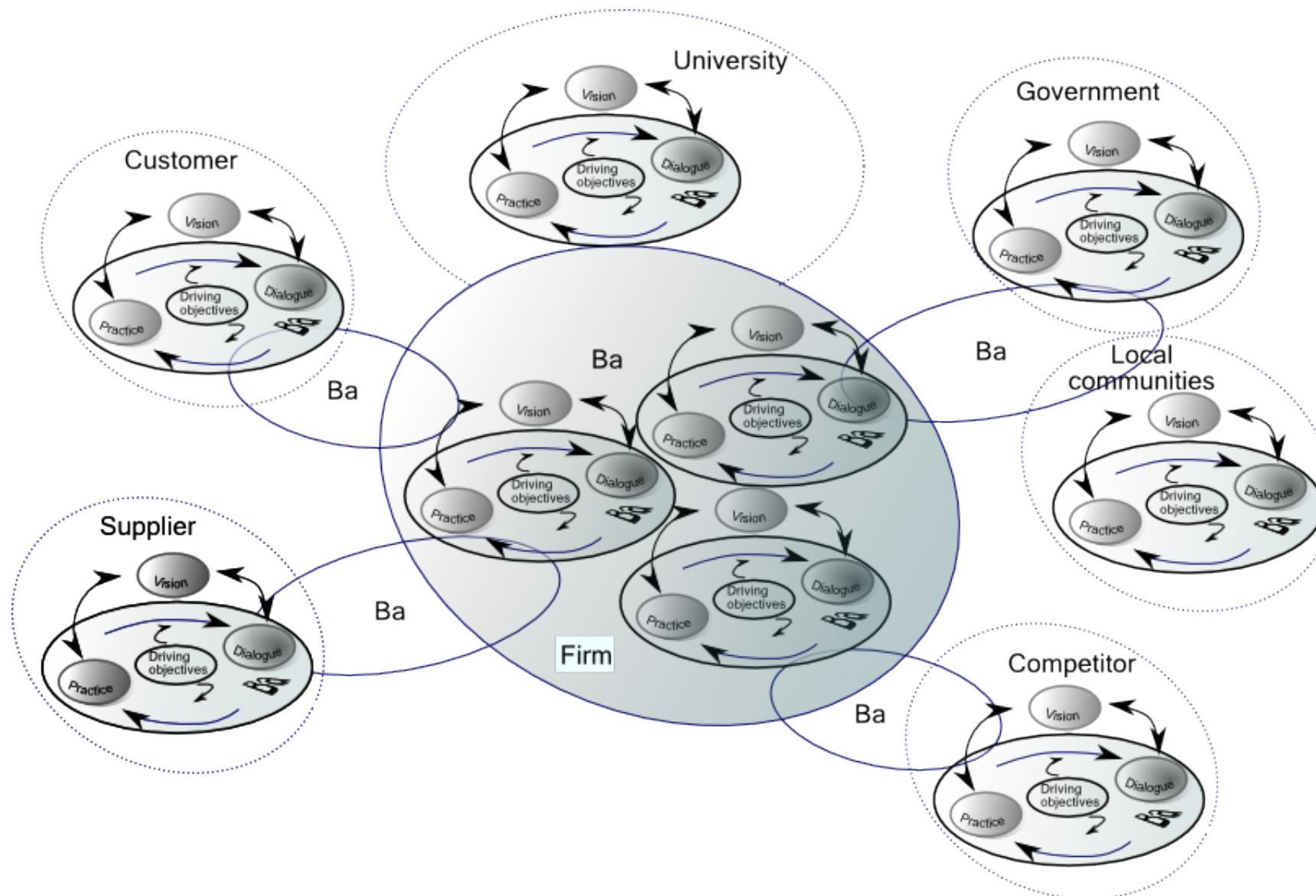
Based on Nonaka, Toyama, Hirotaka (2008) Managing Flow, p.41

Basho and In-Dwelling
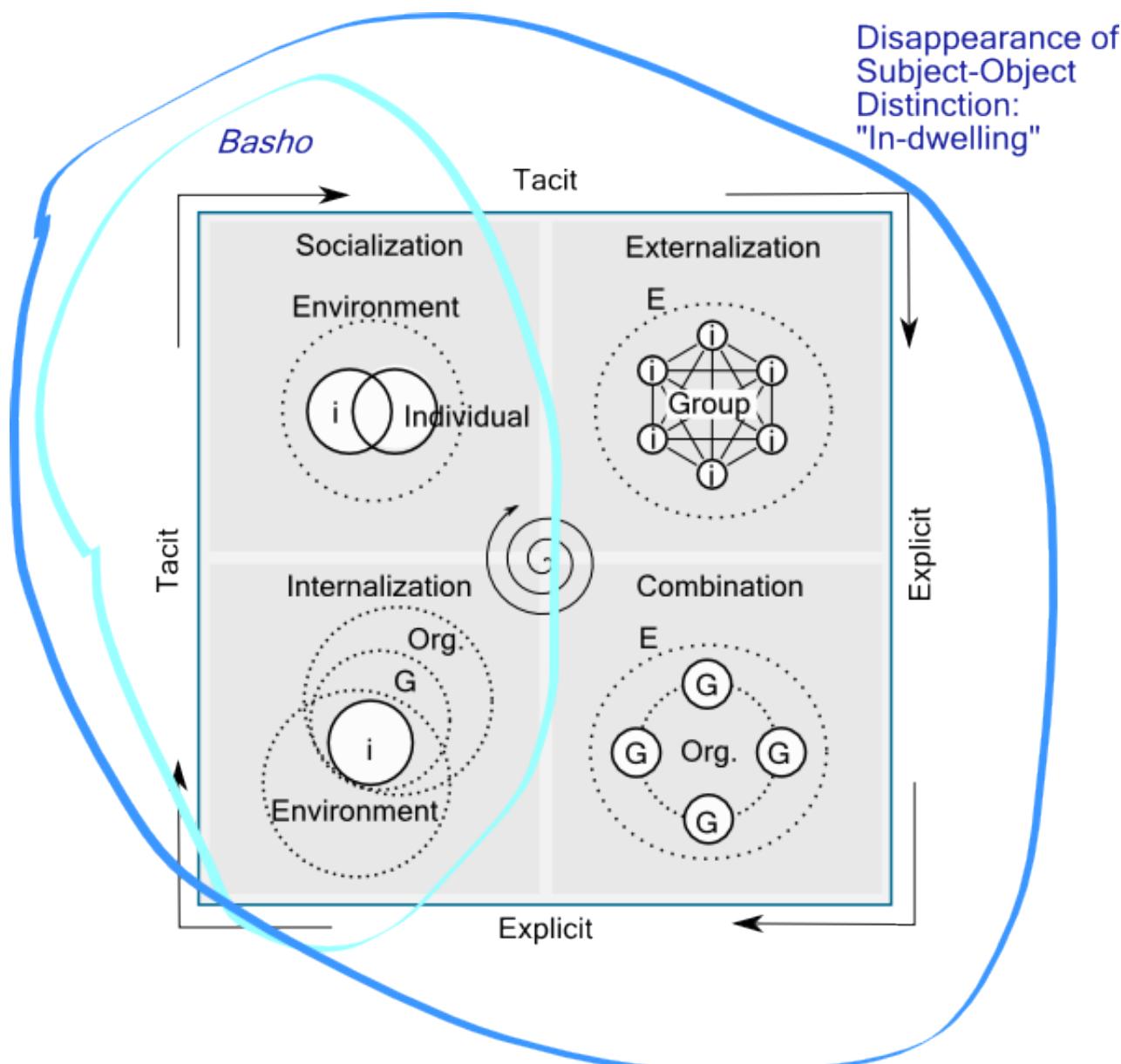
Levels of Knowledge Articulation

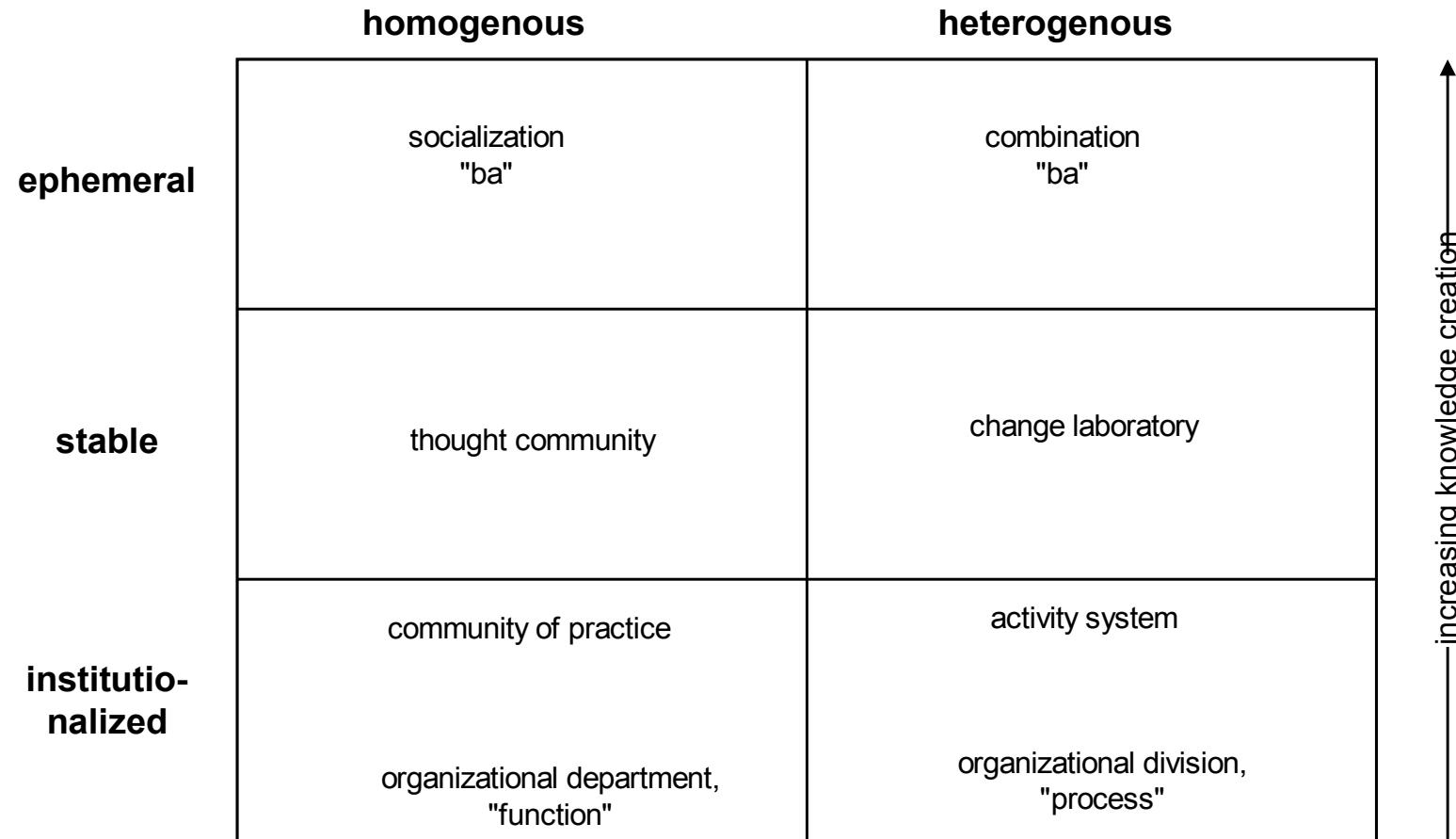| Level of articulation	Characteristics
Tacit	Unorganized and dynamic meaning relations
Focal	Conscious organized patterns of meaning relations
Articulated	Meaning relations sedimented in produced artifacts or expression
Verbal	Meaning relations sedimented within a system of concepts
Socially legitimized	Socially shared conceptual knowledge

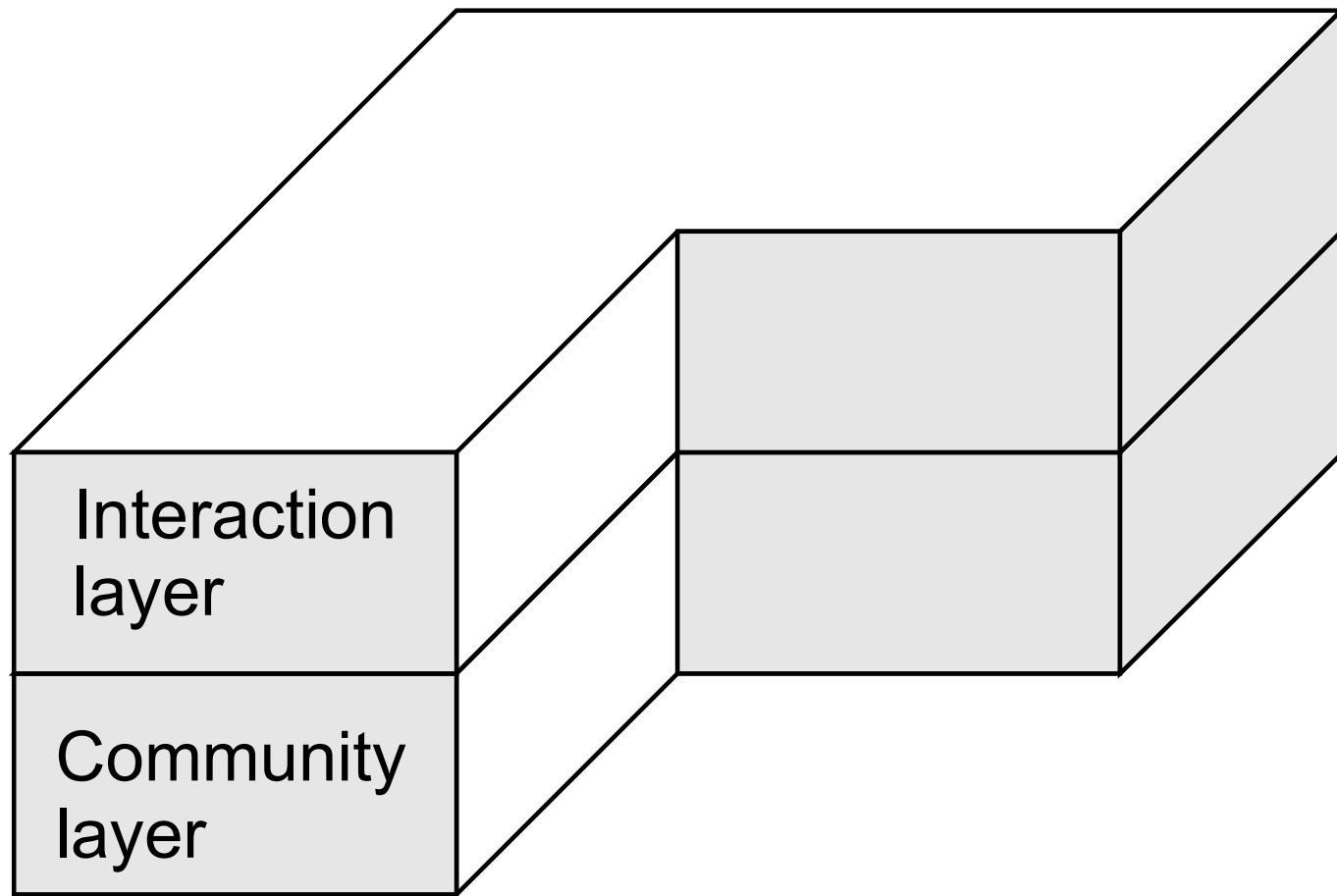Scientific   Critically verified using repeatable procedures

Source: Tuomi, I. (1999) Corporate Knowledge, p. 100.

Different Types of Knowledge Communities

	homogenous	heterogenous
ephemeral	socialization "ba"	combination "ba"
stable	thought community	change laboratory
institutio-nalized	community of practice organizational department, "function"	activity system organizational division, "process"

increasing knowledge creation →

Layered BA

sensemaking

practice

Interaction layer

Community layer

The Five Knowledge Creation Processes and the 5-A Model

articulate   appropriate

"learn" ⟶ act

accumulate   anticipate

Tuomi, I. (1999) Corporate Knowledge. Metaxis, Helsinki, p. 343
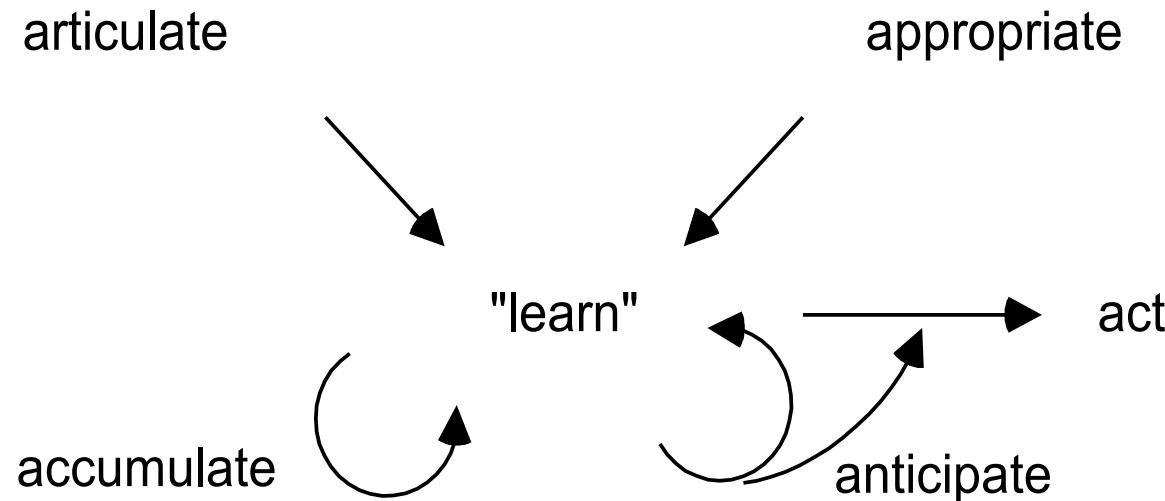
The 5-A Model in More Detail

articulate

abstract / generalize

tacit

focal

explicit

"learn"

subsidiary

accumulate

appropriate

communication

action

anticipate

praxis

tools
signs
words
concepts
language
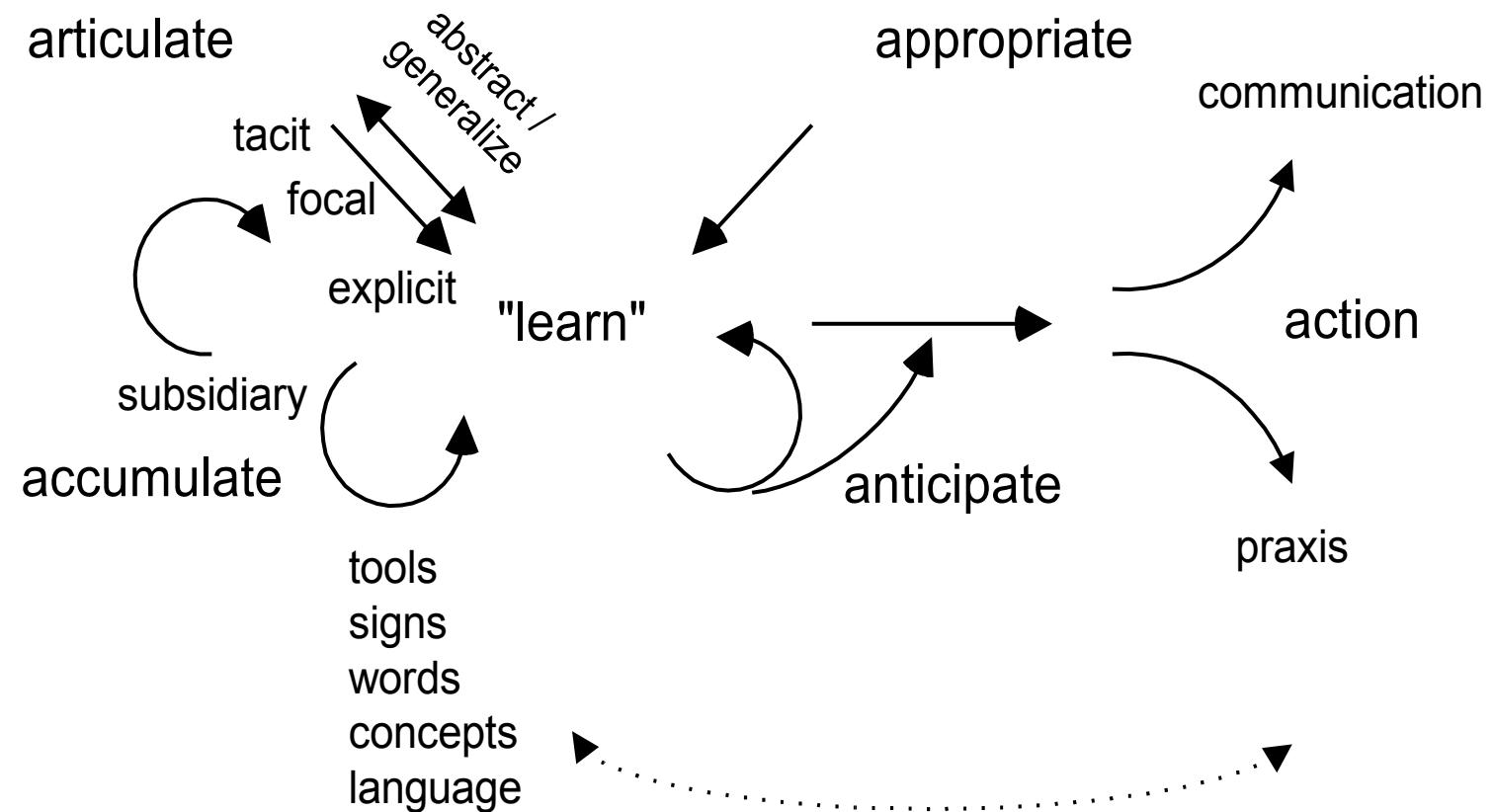
Phases of the SECI model within the 5-A model

CoP_anticipation

CoP_accumulation

CoP_action

CoP_appropriation
(**combination**)

CoP_articulation
(**externalization**)

community of practice

unit_action

unit_articulation

unit_appropriation
(**socialization**)

human-in-society

unit_anticipation

unit_accumulation
(**internalization**)
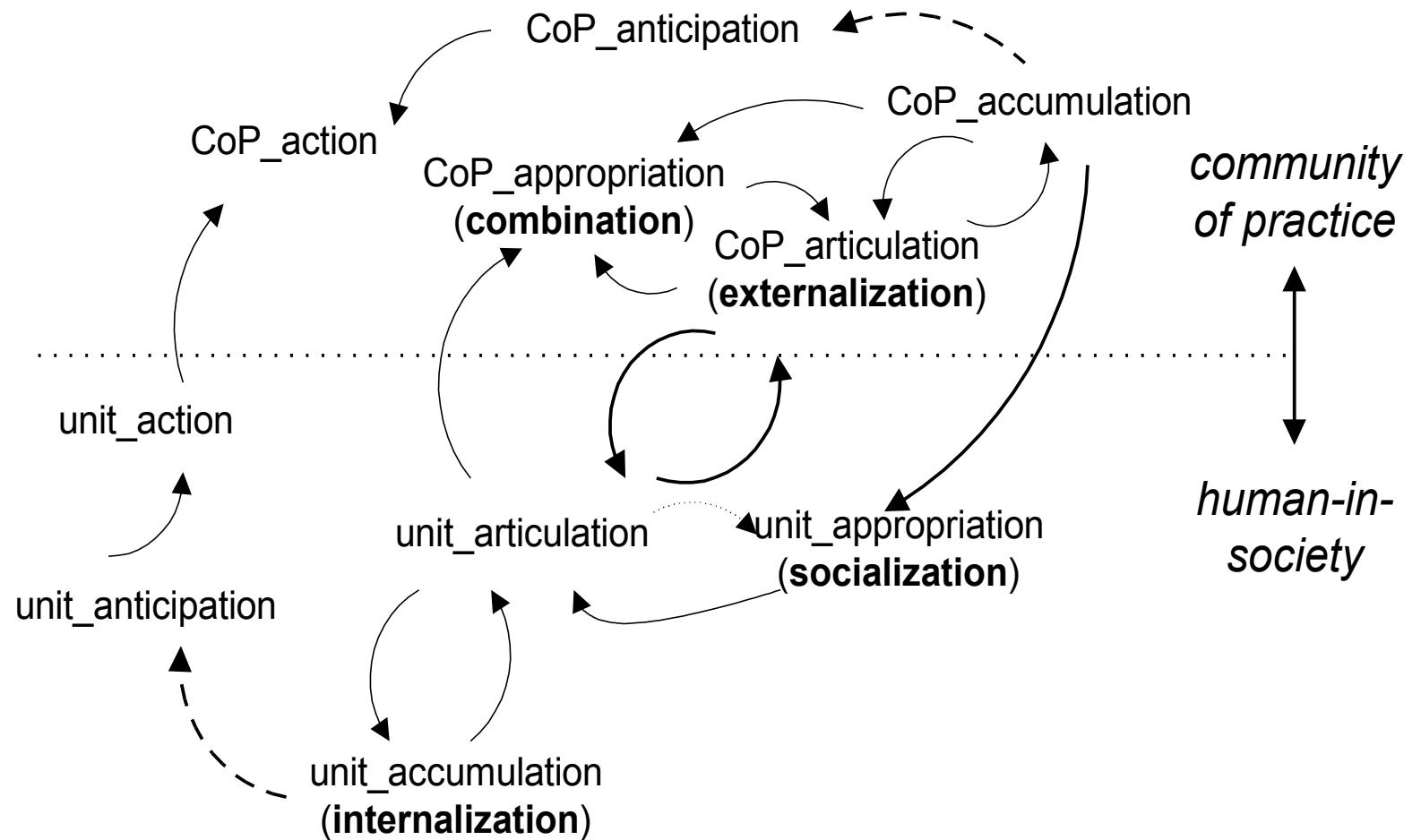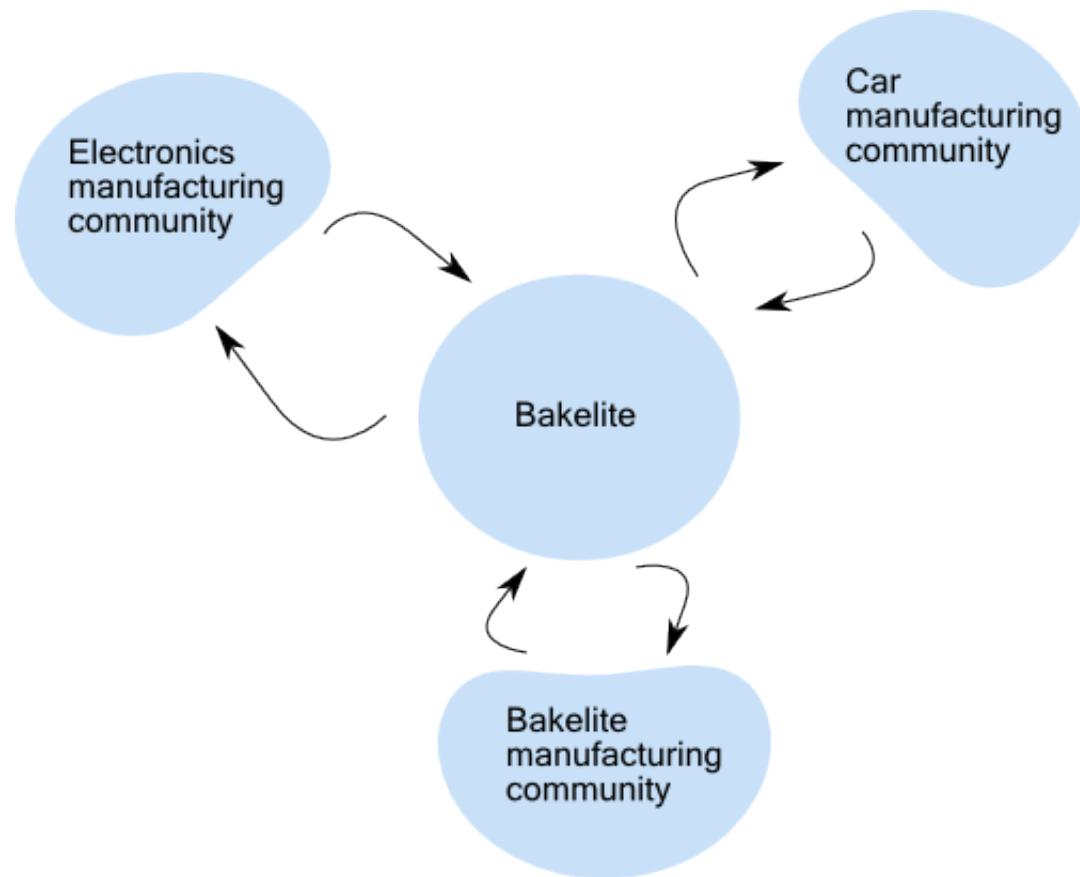
The Downstream Innovation Model

- Now we have a knowledge-creation model that highlights

  - The social nature of knowledge

  - The embeddedness of individuals in a socio-cultural and socio-technical context

  - The fact that these contexts are structured by systems of social practice and division of labor

  - The fact that at least some social learning can be understood as "legitimate peripheral participator's" gradual progress from novice status to "old-timer" and "expert" status, and that these social roles are institutionalized through relatively stable social communities of practice.

- Then we start to see a new model of innovation that is inherently distributed and open (and relatively independent of organizational product development).

"Innovation as Multifocal Development of Social Practice"

Tuomi, I. (2002) Networks of Innovation, OUP, Ch 2.

- Starting points:

  - The adoption of new technical opportunities requires social learning in user communities.

  - Innovations materialize when social practices change, and when latent technical opportunities are taken into use in the society.

  - In the first approximation, "upstream" innovation is taken for granted.

    - History shows that reinvention and parallel discovery dominate in the upstream. Innovative ideas are over-abundant.

  - The heroic innovation model is wrong. This is sometimes difficult to see, as historical accounts retrospectively project the heroic model to generate a linear storyline of progress.

Bakelite as a Structural Coupler

Users and Products

- Upstream and downstream innovators are not simply individuals with bright ideas. Instead, innovation occurs in a social structure that consists of a network of specialized communities.

- The potential for downstream change depends on downstream actors' capabilities to mobilize social and material resources.

- Technical products are often used in several social practices, and become incorporated in many communities of practice. "The" product, therefore, has multiple identities and realizations simultaneously.

- The proper conceptualization is "product-in-use." A physical artifact (e.g., mobile phone) evolves simultaneously along many developmental paths. Some of the uses are perceived as "dominant" uses. Technical evolution can be driven by the dominant use, by the intended use (as determined by the producer and its designers), or by unintended use (think GSM SMS).

Alternative Models of Open Innovation
What's New?

- Shared assumptions
  - Innovation does not happen inside firms
  - Innovation strategy drives business strategy in the innovation-economy
  - Innovation strategy can only be defined in relation to ecosystem evolution
- When the black box of innovation is opened, we need some sophisticated concepts
  - The social dimension becomes important
  - The theory of knowledge has to be explicitly discussed
  - The "user" and the "product" have to be reconceptualized
  - New epistemologies lead to new information system design principles; they require new sources of ideas and utilization of unused stocks of knowledge (e.g., linguistic theory, theory of social practice, cultural-historical theories of learning, architectures of space, social geography,...)
- We need to develop
  - Models for socio-cognitive spaces that structure meaning creation
  - Tools that support meaning processing
  - New computational architectures that can do more than "process information" (iterate differential equations and syntactically manipulate strings)
  - Better models of enablers and constraints for downstream innovation
  - Explicit integration of downstream models with organization theory

Tack! Thank You! Kiitos!

http://www.meaningprocessing.com/personalPages/tuomi/