

KM Egypt Conference 2010

BIOTEAMING: the adoption of nature's most successful principles in organizations

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THE POSTMODERN metamorphosis

THE ENGINE OF KNOWLEDGE SHIFTS WORLDVIEWS FROM MODERN TO POSTMODERN

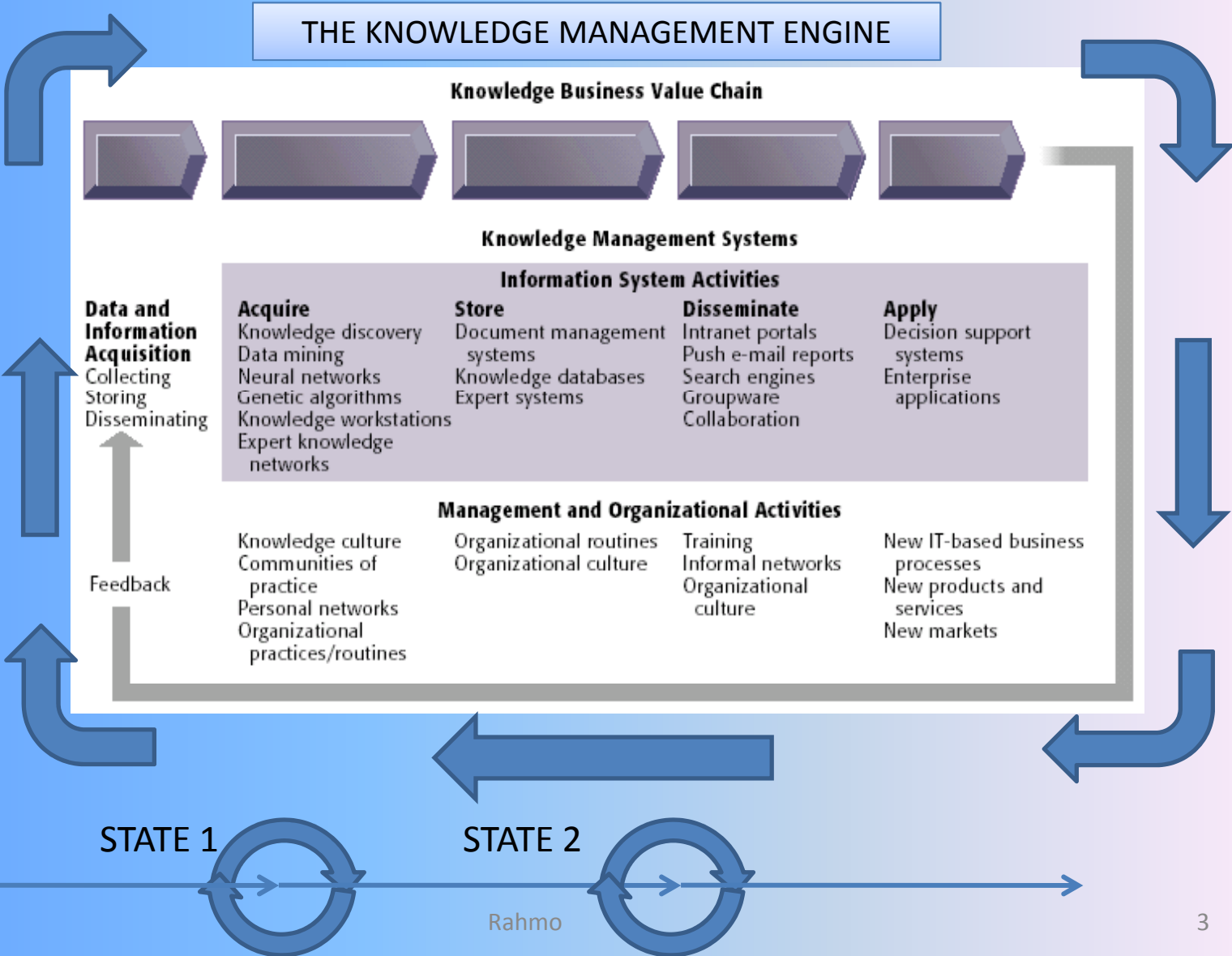
quantum mechanics (1900-1927), chaos (complexity) theory, self organization (autopoiesis) in the 1970s, punctuated equilibrium (1970s)

- FROM MECHANISTIC DETERMINISM TO OPEN CONTINGENCY
- FROM A CLOCK WORK UNIVERSE TO A PARTICIPATORY UNIVERSE
- FROM PHYSICAL TO RELATIONAL REALITY
- FROM CONTINUOUS EVOLUTION TO PUNCTUATED EQUILIBRIUM



Optimization of Knowledge Management enhances system transformation

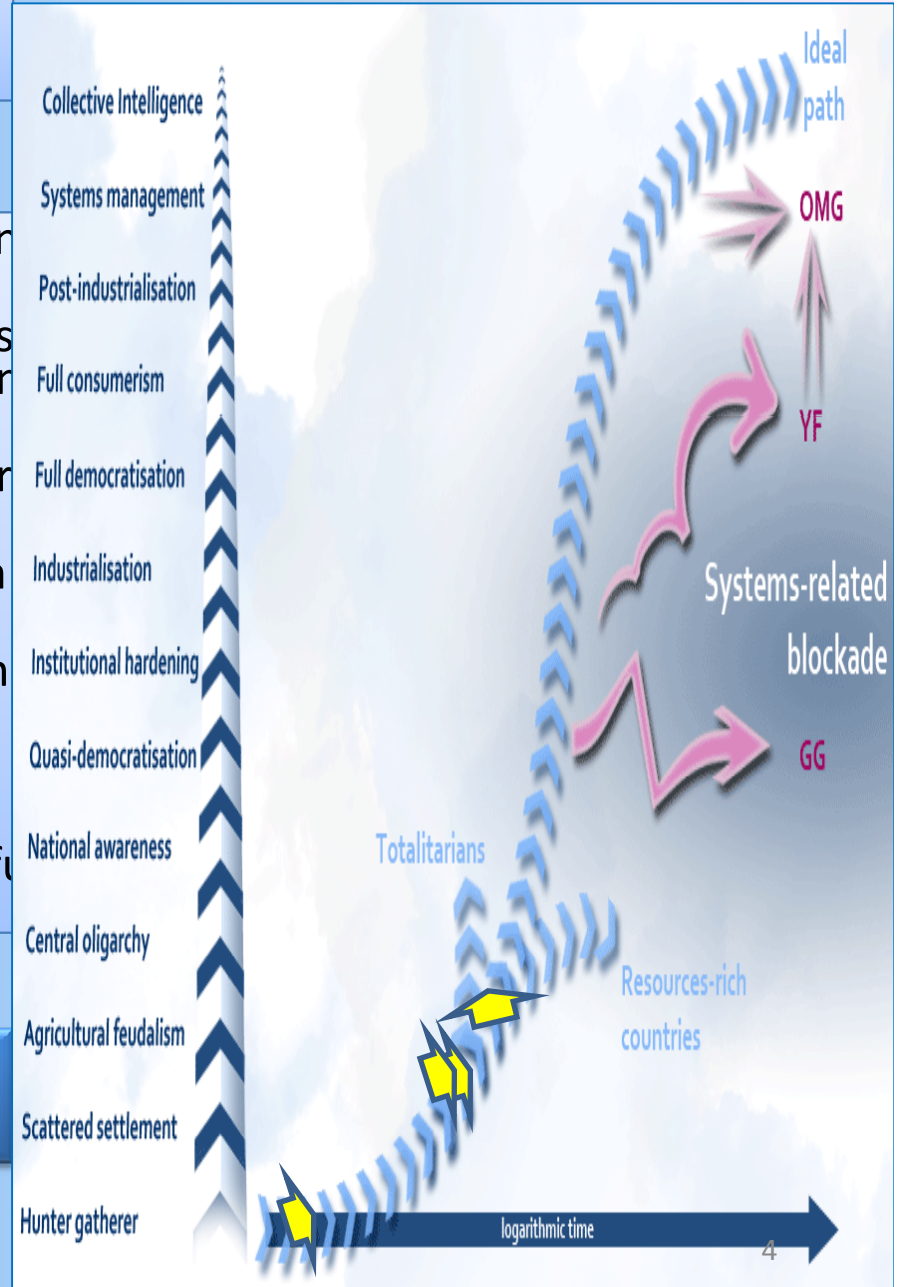
- Identify
- Collect
- Organize
- Represent
- Store
- Locate
- Retrieve
- Extract
- Discover
- Visualize
- Interpret
- Share
- Transfer
- Adapt
- Apply
- Monitor
- Evaluate
- Create



THE TRANSFORMATION OF ORGANIZATION STRATEGY AND POLICY

- from mechanistic to organ format for enterprises
- emphasis shifts from stars from individualism to team esprit de corps
- from forecasting the future responses to surprise
- from top down to bottom management
- From sequential to pyram networked
- From defined predictable unpredictable
- From structure based to f

Knowledge: the catalyst of change, reform and restructuring of organisations



THE POST MODERN WORLD HOLISTIC CONVERGENCE

SCIENCE: multi, inter and trans disciplinary activities ; balancing reductionism with holistic approach



TECHNOLOGY: merger of various techniques



PEOPLE: collaboration cooperation synergism collective brain, intelligence...



CONVERGENCE OF SPACE, TIME:
THE GLOBAL NETWORKED VILLAGE

THE EMERGENCE OF THE RELATIONSHIP ECONOMY

THE NEW ORDER OF THINGS TO COME



BY SCOTT ALLEN
JAY T. DERAGON
MARGARET G. OREM
CARTER F. SMITH

New energy

Nanotech



AL SYSTEMS

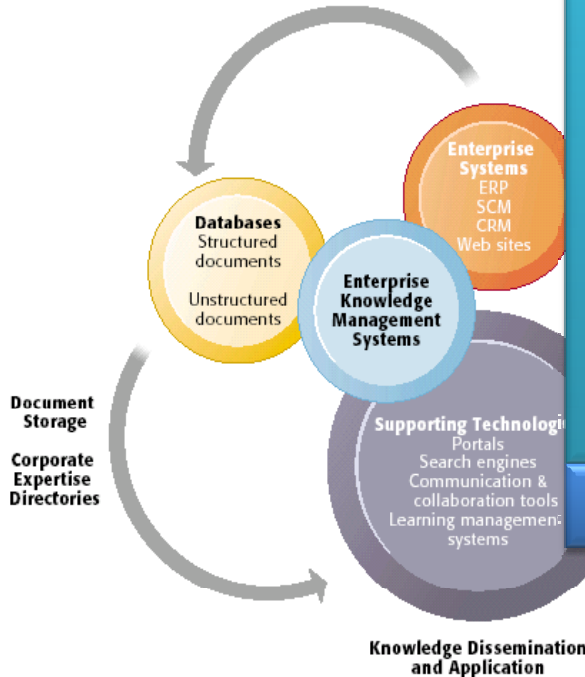
LOOPS ARE SYMPTOMS OF GLOBAL CONVERGENCE

Viral Marketing Loops

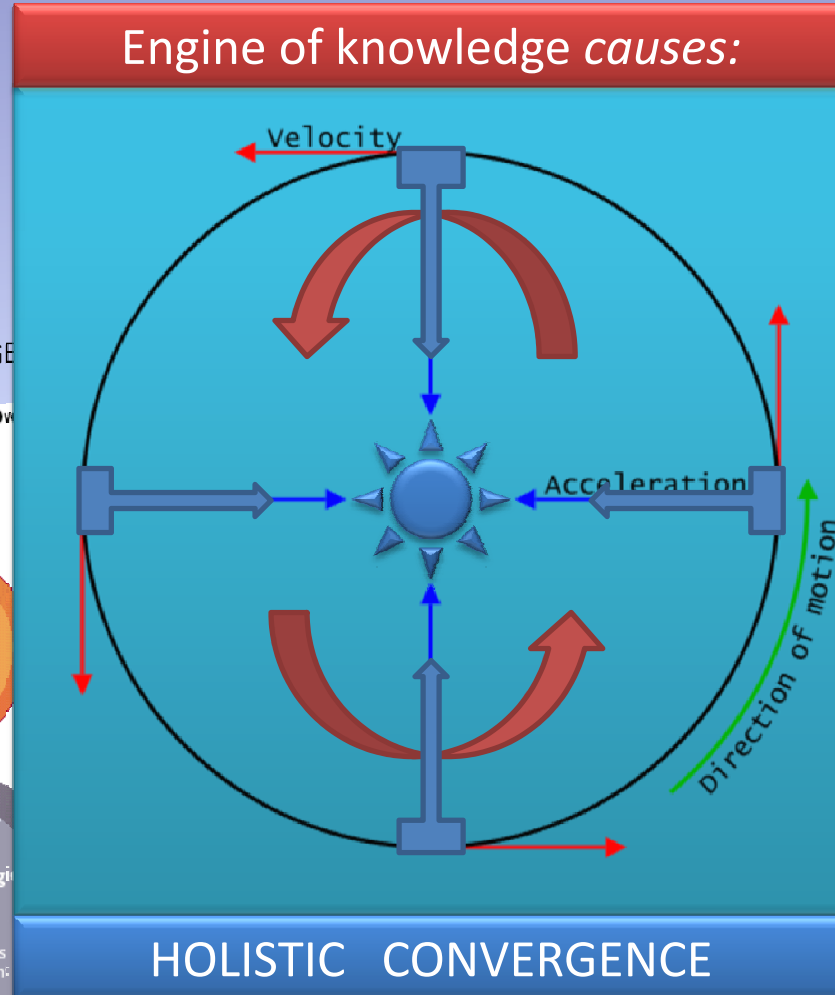


ENTERPRISE-WIDE KNOWLEDGE MANAGEMENT

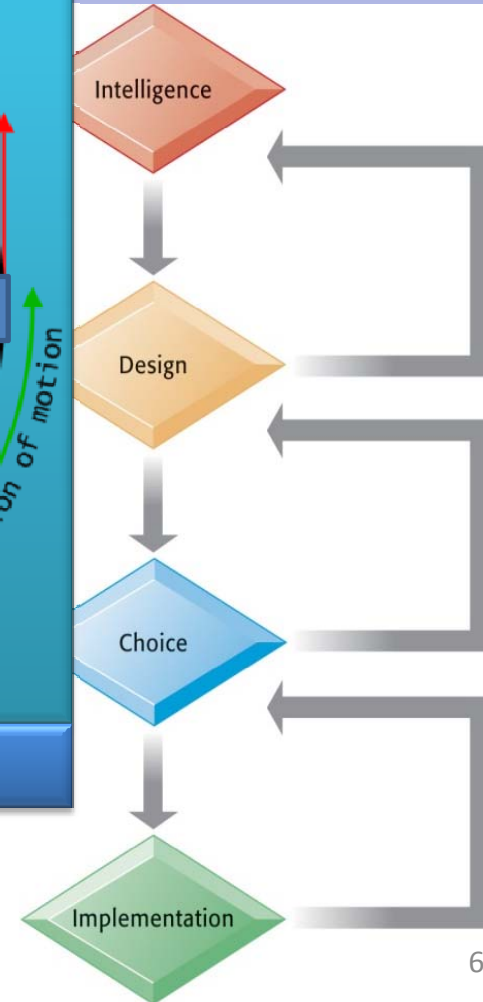
Enterprise-Wide Knowledge Management Systems Over
Data and information generation



Engine of knowledge *causes*:

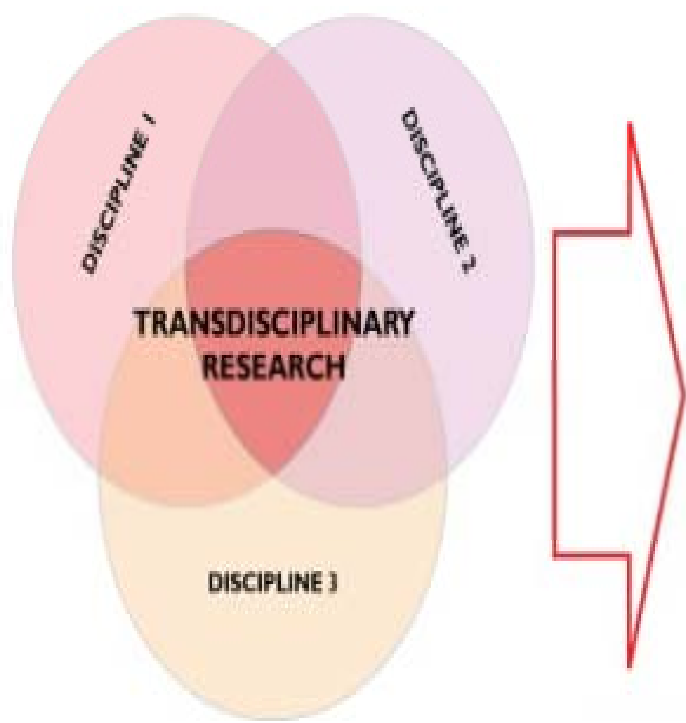
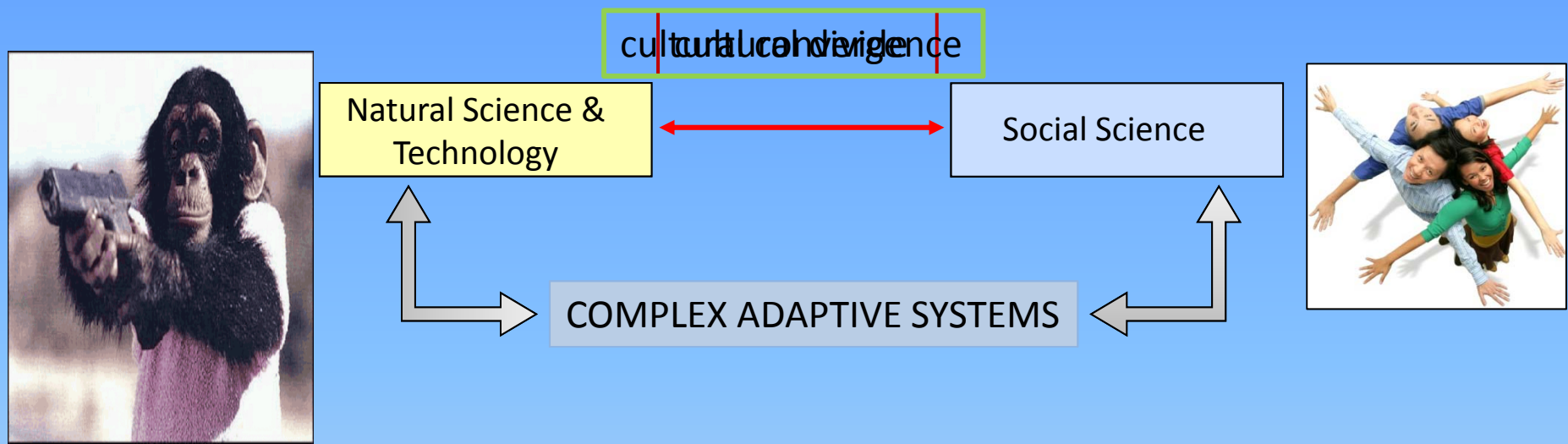


and Information Systems Stages in Decision Making



Solution testing:
Is the solution working?
Can we make it work better?

THE ISSUE OF OPTIMIZATION OF ORGANIZATIONS IS BECOMING A *TRANS-DISCIPLINARY* SUBJECT



major fundamental mechanisms extracted from biosystems that appear to be of substantial relevance to modern organizations

- Organizational sustainability: AUTOPOIESIS: mechanism of self organization and autonomy.
- Organizational intelligence: COLLECTIVE INTELLIGENCE: intelligence based on organization.
- Organizational learning: GENETIC ALGORITHMS: knowledge generation based on evolutionary mechanism.

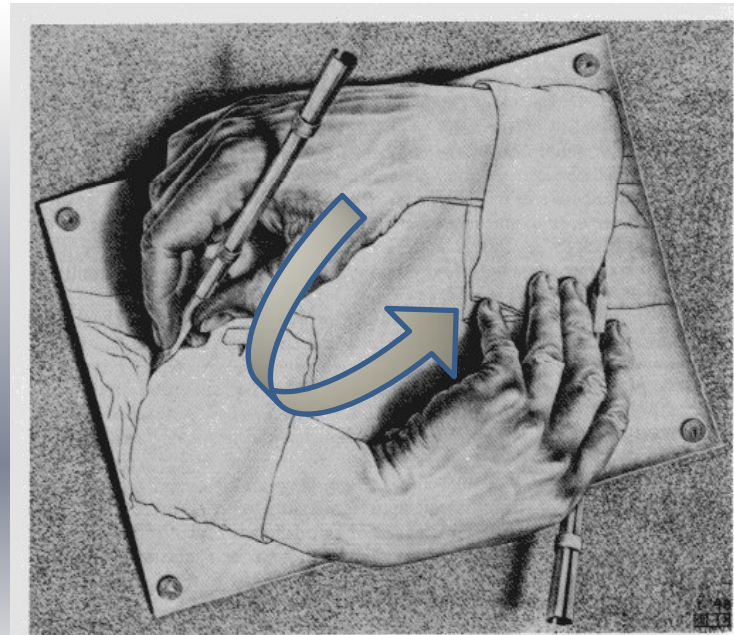
ORGANIZATIONAL SUSTAINABILITY

AUTOPOIESIS (circular organization)

Definition: Self-maintaining systems distinct from their environment, exhibiting autonomy and dynamic self organization= self production

The process through which an organisation is able to Produce itself (self-production)

- Components continuously regenerate and produce the network that produces them; self production.
- Components constitute the system as a distinguishable unity in the domain in which they exist “ (Varela 92); autonomy.

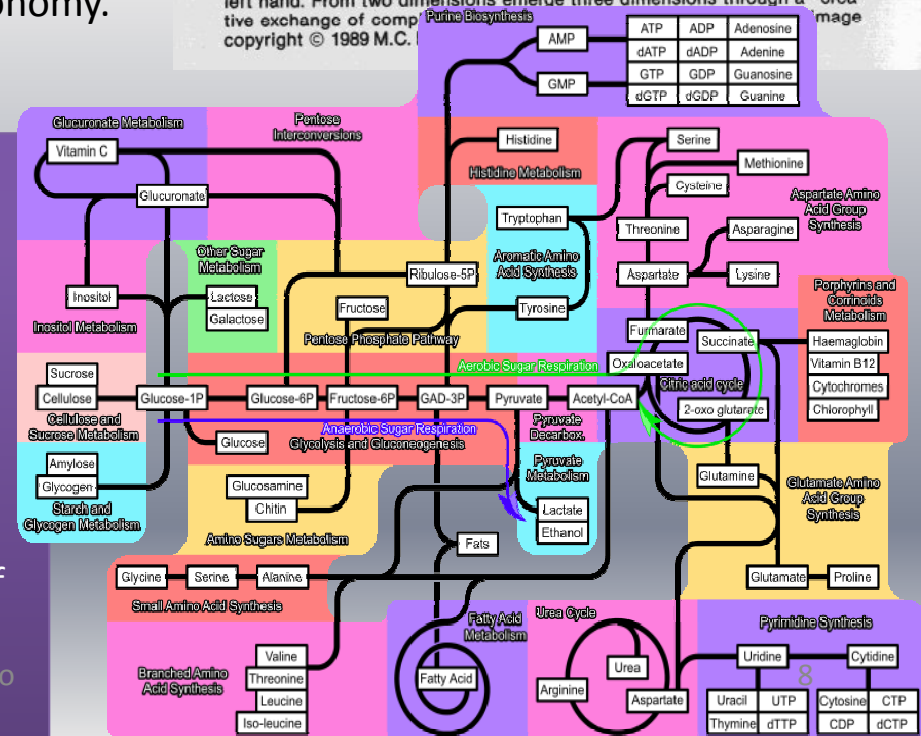


Drawing Hands by M.C. Escher. An artistic representation of the process of Autopoiesis. The left hand draws the right hand and the right hand draws the left hand. From two dimensions emerge three dimensions through a “creative exchange of comp” image copyright © 1989 M.C.

Applies to : Biological cells

- A cell is made of various components (acids, proteins)
- Components are organised into structures
 - cell nucleus, a cell membrane, ...
- Structures produces the components
 - through an external flow of molecules (“food”) and energy
- Components continue to maintain the structure that produces the components (circular organization)
- one or more of the components define a border of the system, so that the system is a single unity (structure).

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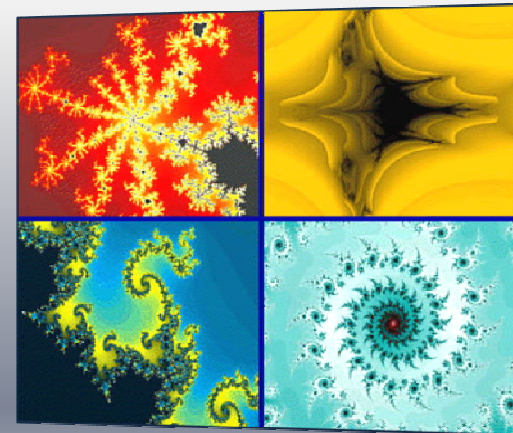
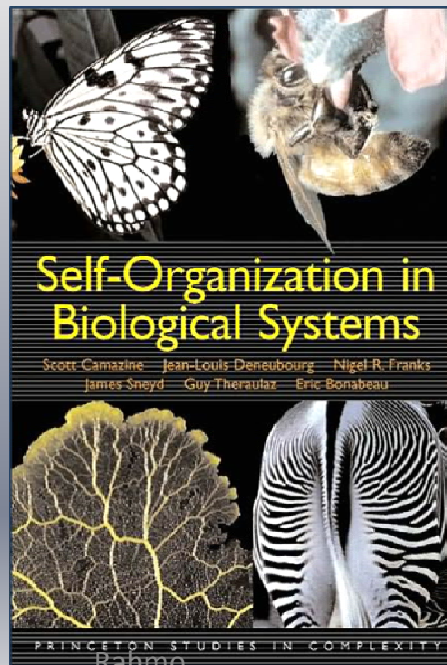
AUTOPOIESIS (circular organization)

Self Organization an ubiquitous phenomenon

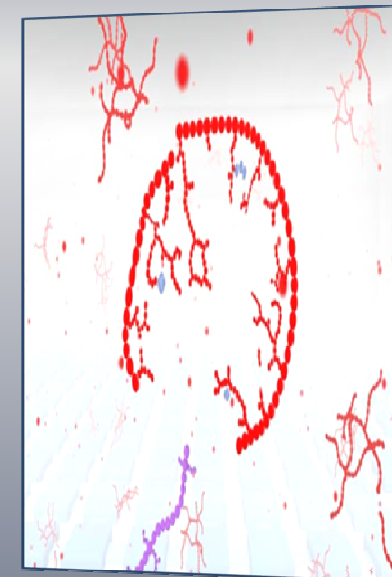
Four Ingredients of reactive dynamic
Self Organization; Auto-regeneration

- **Positive Feedback**
- **Negative Feedback**
- **Amplification of Fluctuations - randomness**
- **Reliance on multiple interactions**

Auto-regeneration



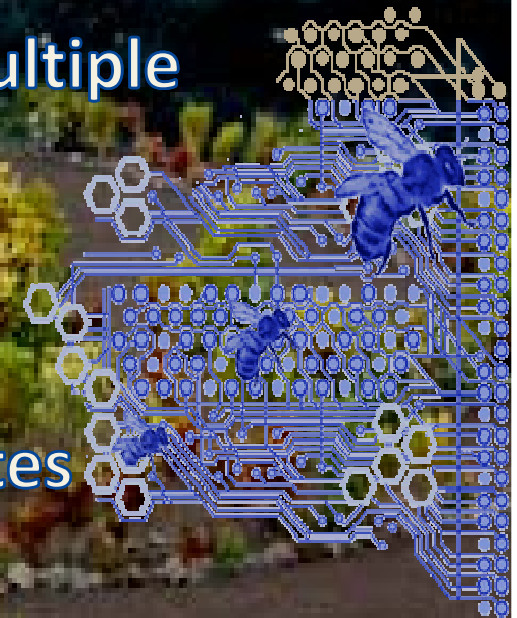
Inorganic matter



organic matter

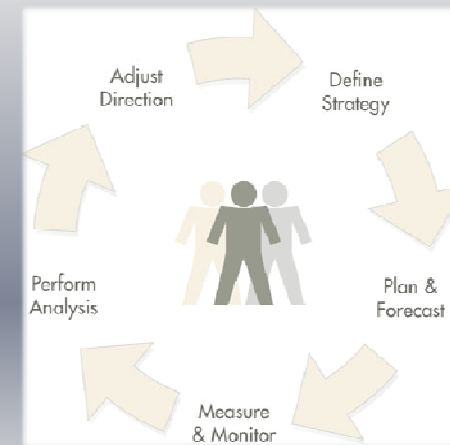
Properties of Self-Organization

- Creation of structures
 - *Nest, foraging trails, or social organization*
- Changes resulting from the existence of multiple paths of development
 - *Non-coordinated & coordinated phases*
- Possible coexistence of multiple stable states
 - *Two equal food sources*

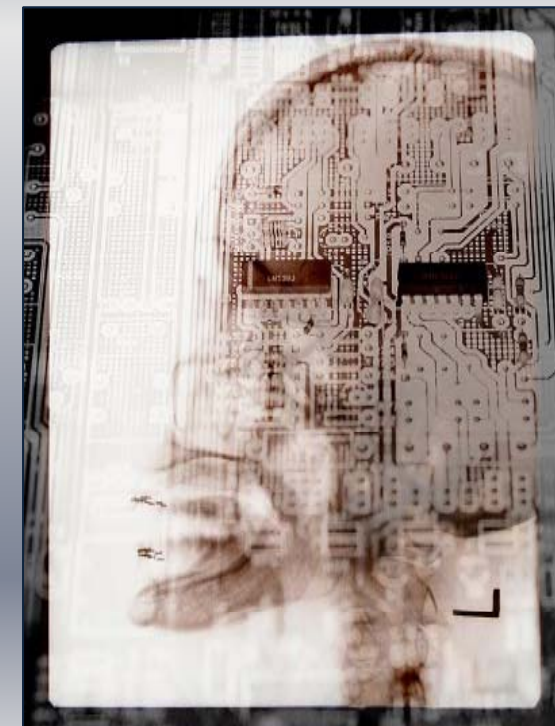


AUTOPOIESIS (circular organization)

- Some consequences from this definition:
 - Systems don't have in- or output
 - Systems define their borders by themselves
 - Systems define their actual state all by themselves (self-reference)
- How can a system interact with its environment if there is no in- and output?
 - Every "interaction" is a perturbation, that has to be compensated inside the system
 - Instructive influence is not possible, the system reacts not (really) predictable

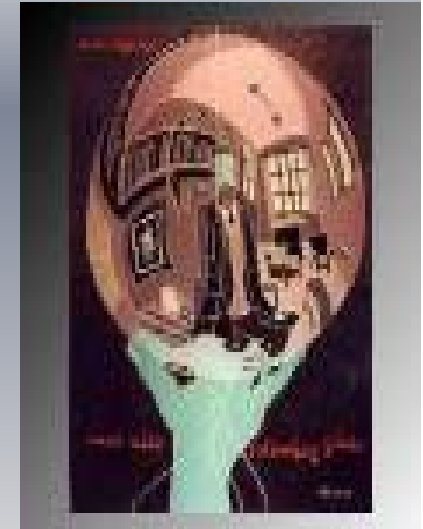


- Structure-Determined Systems
 - The compensation of a perturbation is limited first by structure, second by organization
 - Structural changes are determined by properties and interactions of components
 - Not only autopoietic systems are structure-determined
- Organizational Closure
 - A system is called organizationally closed, if all states of activity must lead to further activity within itself



AUTOPOIESIS IN THE FIELD

- Immunology, psychology, management science, human-computer interaction, family therapy, sociology, economics, post-modern philosophy, public administration, software engineering, artificial intelligence, sociology, and psychotherapy.
- Networks: software agents that rebuild after a catastrophic event without central control.
- Robot/Nanobots: rebuild themselves within a structure as they are needed. Medicine, auto construction units.



AUTOPOIESIS APPLIES TO COMMUNITIES

- DEFINED AS SELF REFERENCE OR SELF CREATING; PROTECTING THE INTEGRITY OF IDENTITY APPLIES TO ALL LIFE
- BODY'S ABILITY TO HEAL WOUNDS ALSO DRIVEN BY AUTOPOIESIS
- AUTOPOIESIS ENERGIZES SELF ORGANIZATION
- RESTORES THE COMMUNITY AFTER MAJOR DISASTERS

PRIMARY IDENTITIES DETERMINE MAIN LOYALTIES GREATER THAN SELF

- FAMILY
- CLAN
- TRIBE
- NATION
- RELIGION
- IDEOLOGY
- ORGANIZATION
- JOB OR PROFESSION

AUTOPOIESIS AND LOYALTY



Intelligence is Polymorph

- ▶ There are many different forms of intelligence, including
 - ▶ Species
 - ▶ Bacterial
 - ▶ Protozoan
 - ▶ Genomic
 - ▶ Immune
 - ▶ Swarm
 - ▶ Metabolic
 - ▶ Animal intelligence
 - ▶ Trewavas, Aspects of Plant Intelligence: Convergence and Evolution, 2008, p. 73-78
- ▶ “apart from the higher animals that use the centralized activity of the brain to process information and in which classical intelligence is located, all other biological systems possess a decentralized intelligence that is a consequence of behavior by the whole system [involving] a network of interacting constituents of varying degrees of complexity, whether it be molecules, cells, or individual organisms, *through which information flows* (Trewavas, 2008)
- ▶ The main opposition is not intelligence vs. non-intelligence but centralized as opposed to decentralized distributed intelligence

social intelligence of Fish



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social intelligence of bacteria



Plant Intelligence

- The picture emerging from the research conducted during the past ten years holds numerous surprises
- The main one is that having a brain is far from being a necessary condition for exhibiting intelligent behavior
- Define intelligence as an organism's capacity to detect signals and to adjust its behavior to them
- If intelligence is defined this way, plants are definitely intelligent beings
 - ▶ Signal detection: resources such as light, minerals, and water figure strongly in a signals list that also includes numerous mechanical influences such as wind, rain, and touch; gases such as ethylene and nitric oxide; soil compaction and particle structure; and numerous biotic features, such as identity of neighbors and disturbance, among many others
 - ▶ Plasticity helps to deny resources to other individuals by active competition
 - ▶ Environment modification: The individual plant modifies its own environment by resource exploitation and growth
 - ▶ Anticipation: Present signals are used to predict likely future changes in resource supply



Stigmergy

Pierre-Paul Grassé, French biologist, 1959

- Proposed theory of stigmergy while observing termites.
- Meaning: “incite to work”

- **Definition:** Indirect communication among components of a self-organising system. It occurs through modifications brought by the individual components to their local environment
- **Modification to environment**
 - Pheromone (quantitative stigmergy)
E.g. foraging ants trails
 - Work-in-progress (qualitative stigmergy)
E.g. wasps nests construction



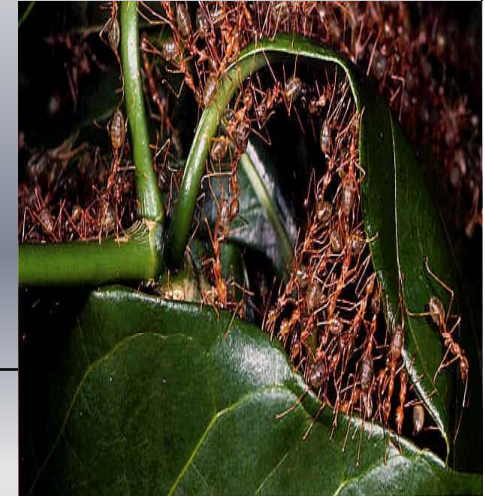
Ants \equiv Agents

Types of Interactions For Social Insects

- **Direct Interactions**
 - Food/liquid exchange, visual contact, chemical contact (pheromones)
- **Indirect Interactions (Stigmergy)**
 - Individual behavior modifies the environment, which in turn modifies the behavior of other individuals

- **Problem solving benefits include:**

- Flexible
- Robust
- Decentralized
- Self-Organized



Stigmergy can be operational

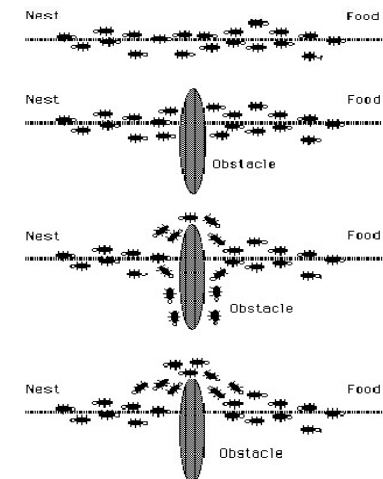
- Coordination by indirect interaction is more appealing than direct communication
- Stigmergy reduces (or eliminates) communications between agents

Stigmergy

The term indicates communication among individuals through modification of the environment.

For example, some ants leave a chemical (pheromone) trail behind to trace the path. *The chemical decays over time.*

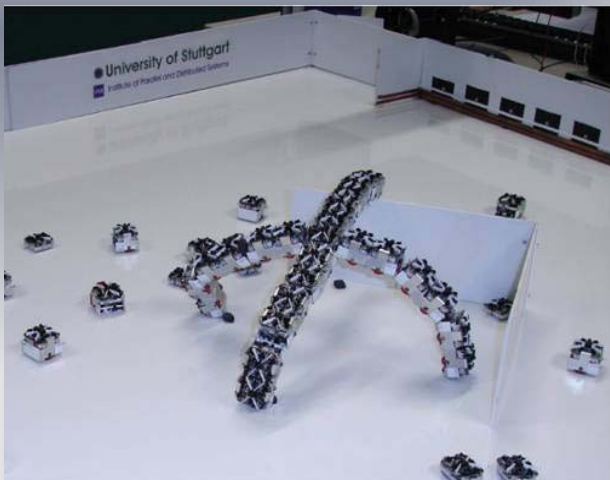
This allows other ants to find the path between the food and the nest. It also allows ants to find the shortest path among alternative paths.



ORGANIZATIONAL INTELLIGENCE

Collective intelligent insects

- The complexity and sophistication of Self-Organization is carried out with no clear leader
- What we learn about social insects can be applied to the field of Intelligent System Design
- The modeling of social insects by means of Self-Organization can help design artificial distributed problem solving devices. This is also known as Swarm Intelligent Systems.



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SWARM

ORGANIZATIONAL INTELLIGENCE

Antifing Website Searching

- WWW

A stigmergic communication medium for human
Everybody can upload (write) / download (read) information

- Wiki

Wikipedia

- Initial user leaves an idea
- Other users attracted by idea (add / modify content)
- Result: Complex structure of ideas / explanations / concepts

- Blogs

- Communication through “boards”
- Trails of information and links

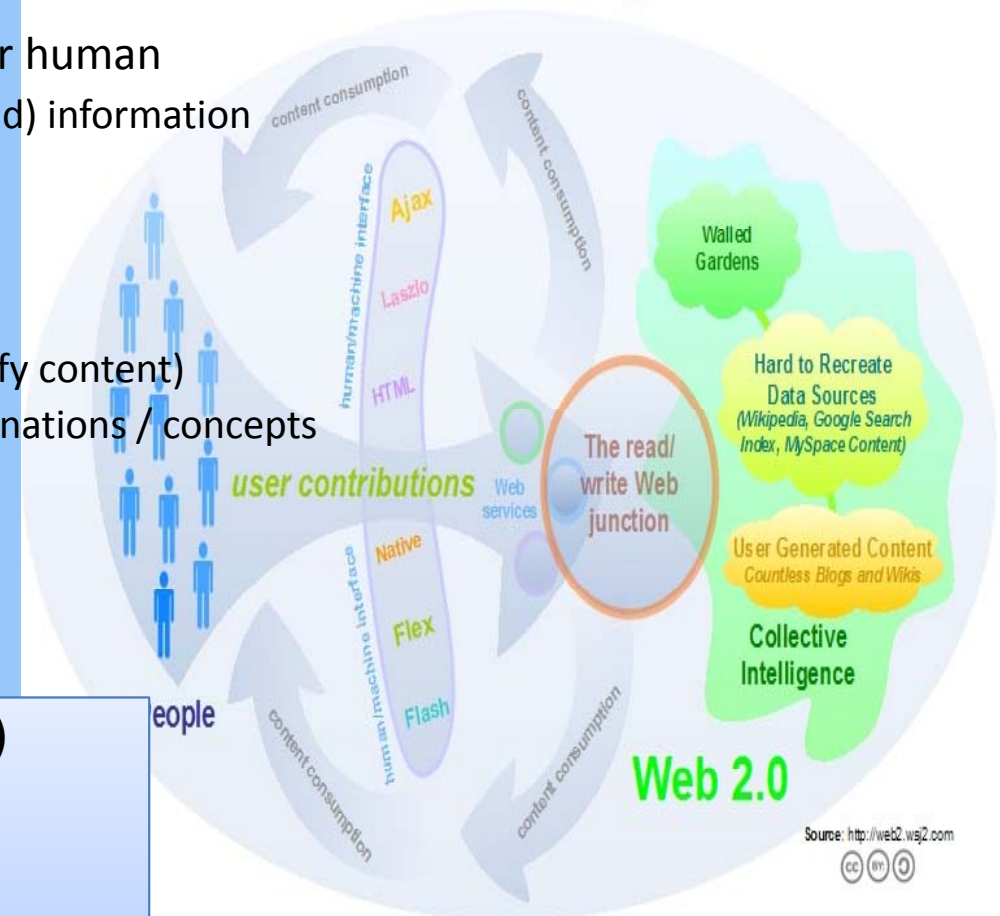
- **Digital-Information Pheromones (DIPs)**

- **Ant World Server**

- **Transform the web into a **gigANTic** neural net**

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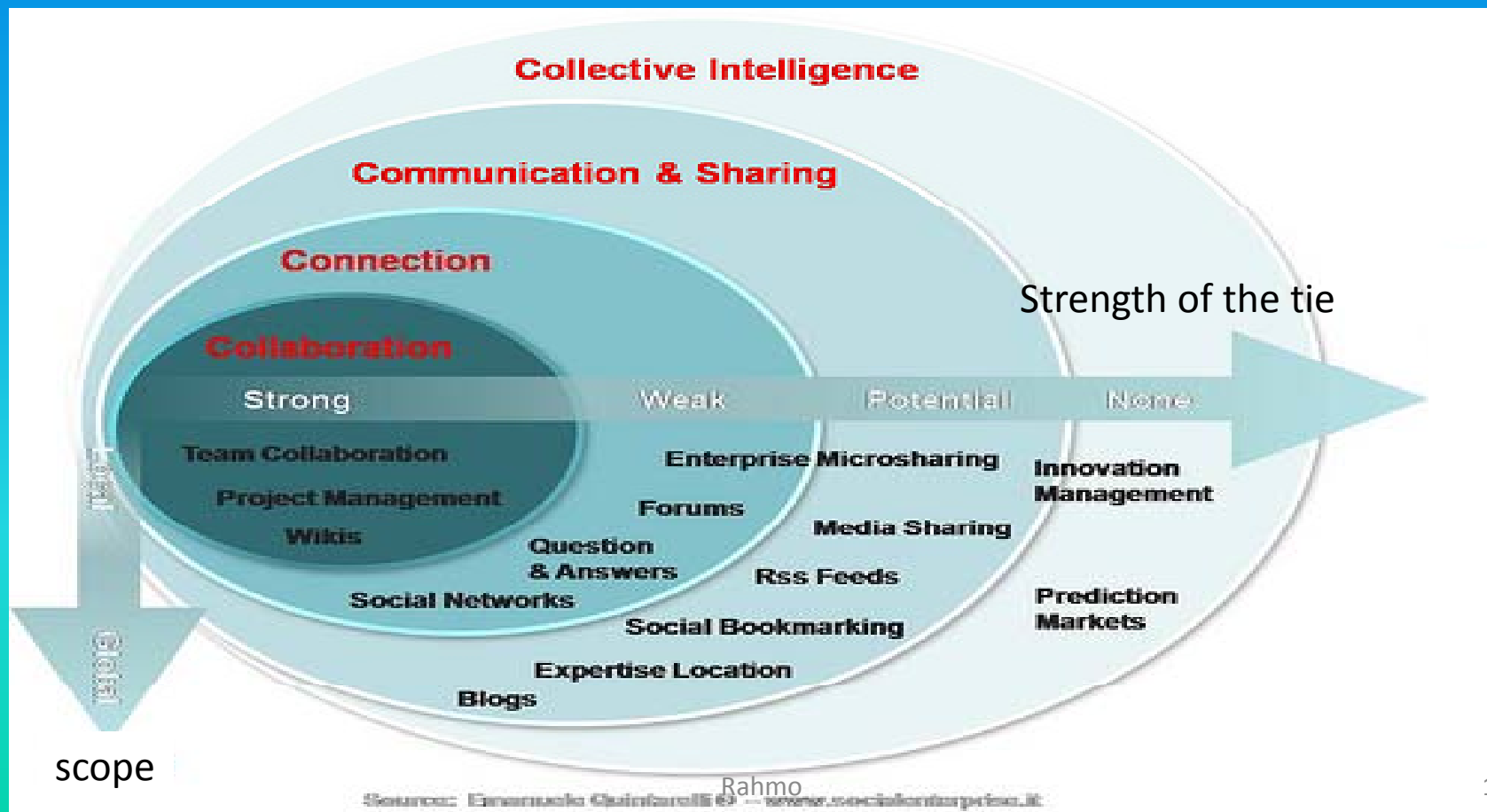
Web 2.0 as an Ecosystem of Collective Intelligence



ORGANIZATIONAL INTELLIGENCE

Collective Intelligence

Definition: Collective intelligence is the **capacity** of groups and organizations **to evolve** towards higher order complexity and integration through collaboration and innovation. -- George Pór



ORGANIZATIONAL INTELLIGENCE

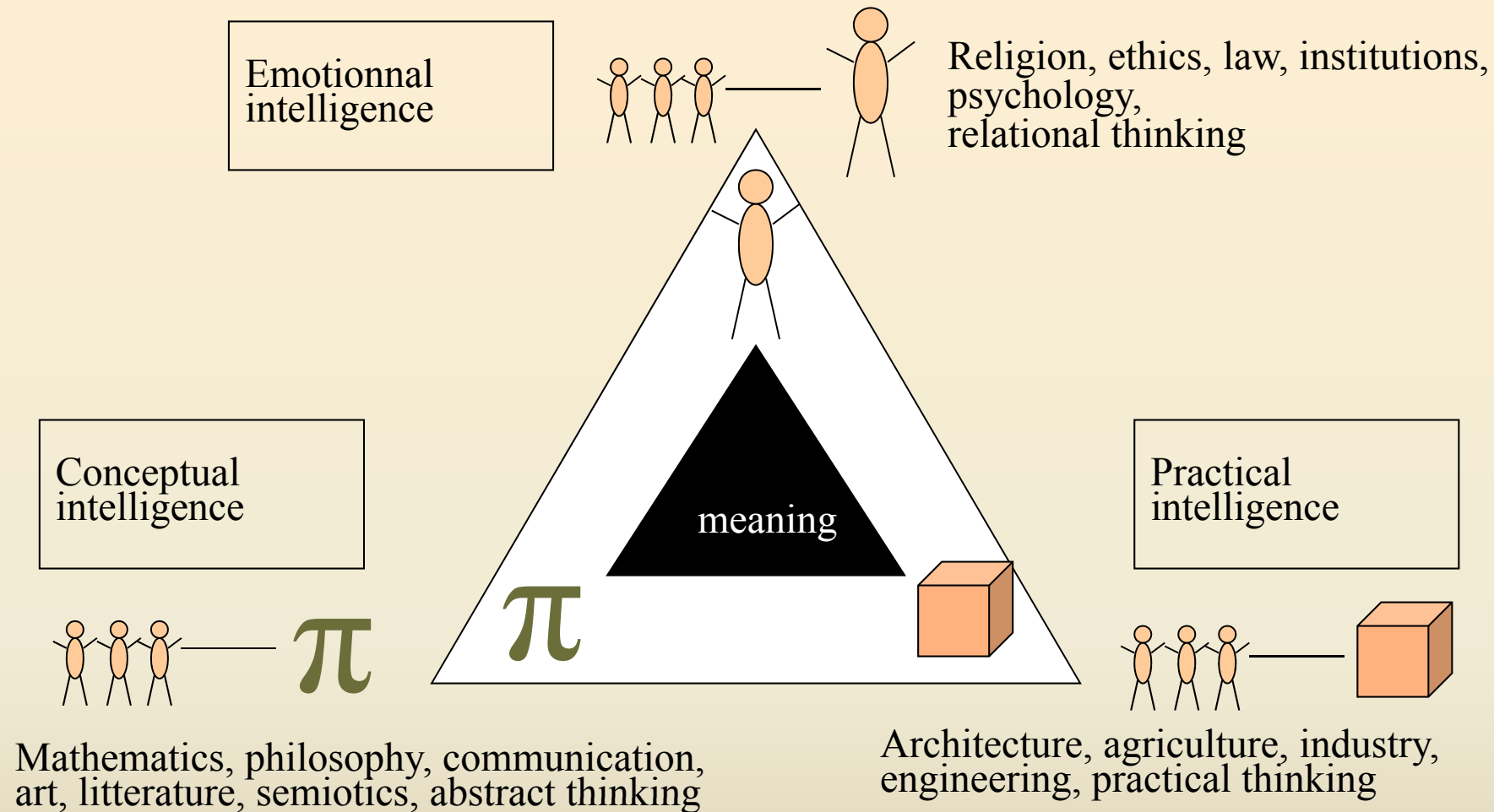
Collective intelligence a new source of empowerment

- Tools : digital communication, sharing of memory, perception and imagination
- Process : collective learning and creativity, exchange of knowledge, competitive cooperation and cooperative competition in the production of knowledge
- The Art of multiplying intelligence
- Games where the winners enhance and use the available intelligence and cooperate more efficiently
- Ground : living unity and diversity of the noosphere: the living world of ideas interconnected in cyberspace

the networked society needs and reinforces a collective intelligence



HUMAN INDIVIDUAL INTELLIGENCE IS POLYMORPH



Collective intelligence = harmony between the three dimensions of human social learning

ORGANIZATIONAL INTELLIGENCE

Human Collective Intelligence is polymorph

- a. **Dialogic CI** – A group of participants suspend their old mental models and engage in dialogue that values the emergent whole higher than its parts. This approach include Bohmian dialogue, "generative conversation" (Otto Scharmer) and "enlightened communications" (Andrew Cohen).
- b. **Co-evolutionary CI** – This form of CI builds on the power of such evolutionary mechanisms generating intelligence over time as trial and error, differentiation and integration, competition and collaboration, etc. Its examples include: ecosystems, sciences, and cultures.
- c. **Flow-based CI** – A group of people become so absorbed in a shared activity that they experience being completely at one with it and one another. Ensembles, high-performance sport teams, astronauts, and others in that state of communion, report on both an enhanced state of autonomy, and collective intelligence.
- d. **Statistical CI** - Individuals thinking separately in large crowds can reach successful conclusion about their collective cognitive, coordination or predictive challenges. Examples include the "intelligence" of markets and cases popularized in the "Wisdom of Crowds" by James Surowiecki.
- e. **Human-machine CI** – This form of CI leverages the synergy of the human mind and its electronic extensions, drawing on the best capacities of both. The "collective" includes symbiotic networks of humans and computers working together and developing compound capabilities. It can also support all other forms of CI.

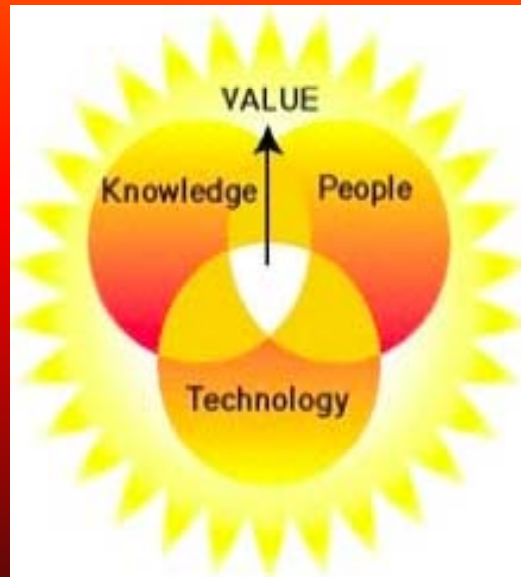
There are many forms, manifestation of CI, and correspondingly, many "tribes" of its practitioners. This is an abbreviated overview. A more detailed inventory by Tom Atlee can be found here:

http://www.community-intelligence.com/blogs/public/2004/05/notes_on_forms_of_collective_i.html

ORGANIZATIONAL INTELLIGENCE

Higher Collective IQ Results from An enabling Knowledge Ecosystem

- Boosting your group's/organization's collective intelligence,
- its capacity to evolve, requires to *feed and be fed by*
- its knowledge ecosystem.
- A “knowledge ecosystem” is a value-creating, self-organizing system, defined as a triple network comprised of:

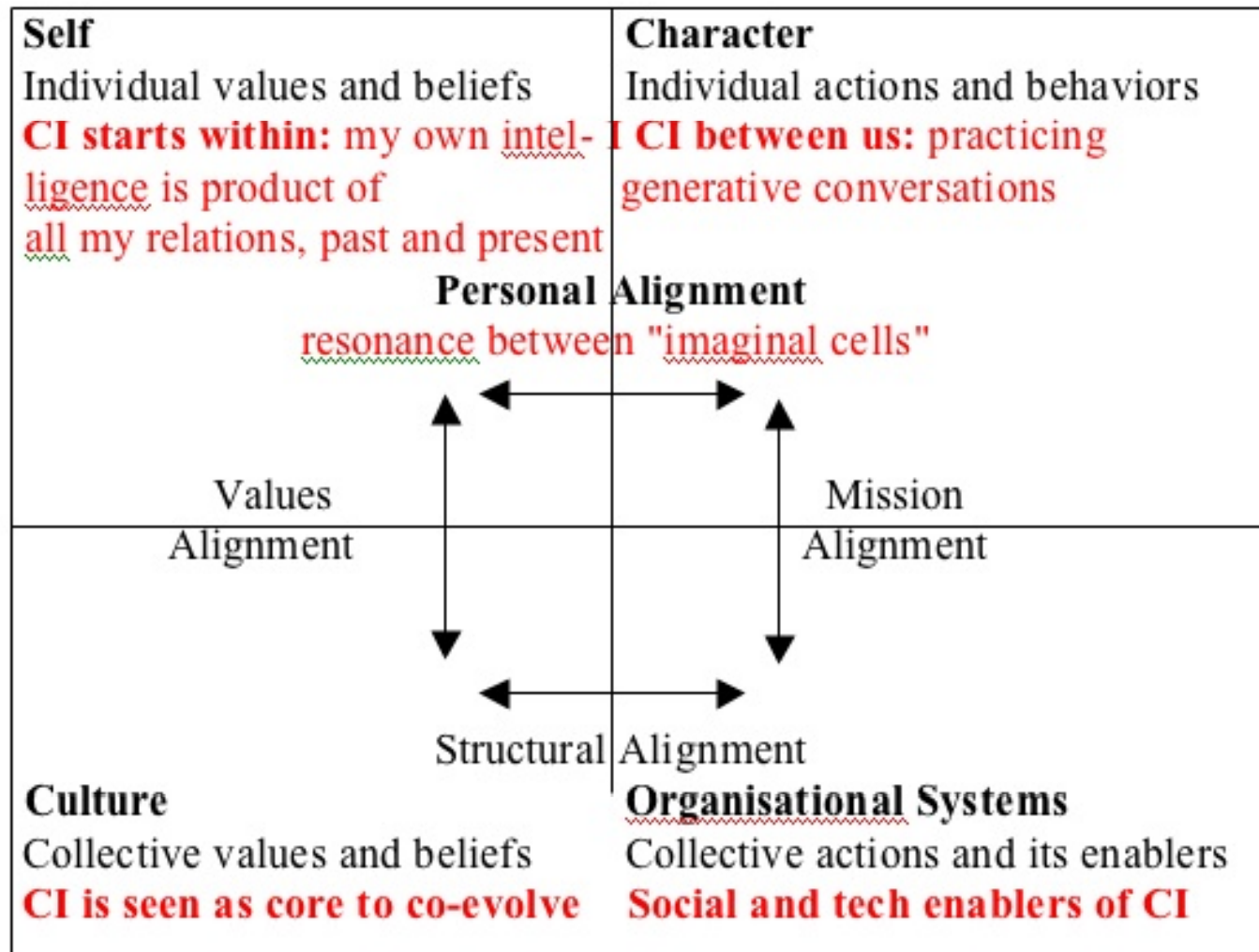


- a **People** network of co-creative conversations that creates
- a **Knowledge** network of shared insights, inspirations, successful practices and frameworks
- both of which is supported by a **Technology** network of tools, and virtual environments.



ORGANIZATIONAL INTELLIGENCE

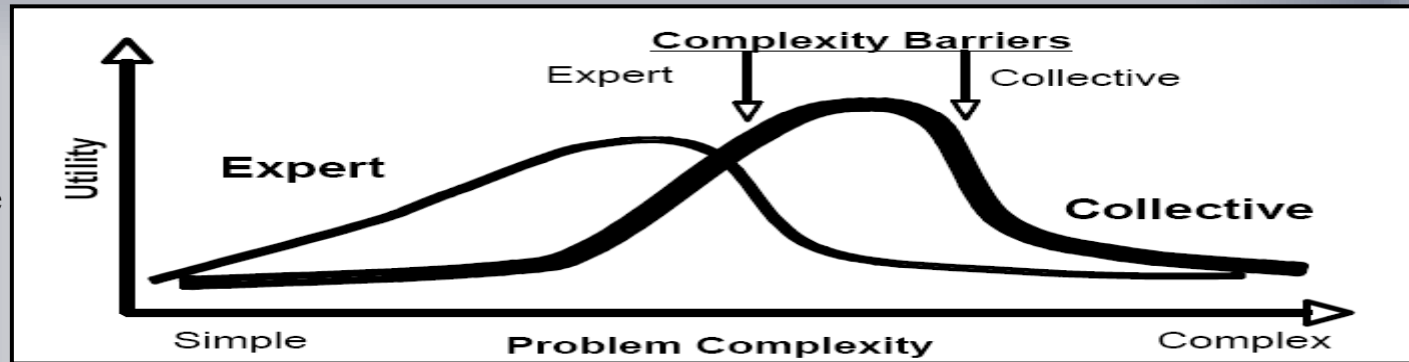
Collective Intelligence CI in Wilber's 4 Quadrants



Source: **Richard Barrett** – Text in red font added by **George Pór**

the organizational value of Boosting CI

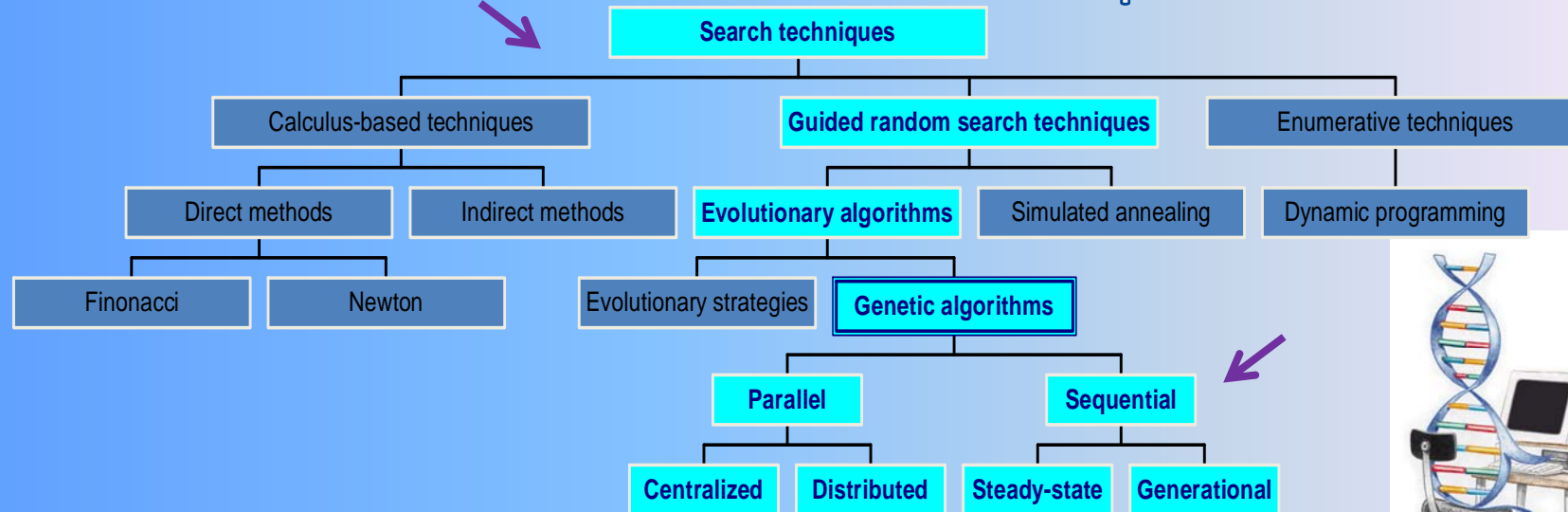
Ref. Science of CI:
Resources for change
by N. L. Johnson.



- Find **solutions to tough challenges** faster, by mobilising dispersed expertise and talent.
- Increase the chance for breakthrough discoveries and **innovation** to occur with some level of consistency
- Have successful methods and practices in one part of the company **spread rapidly to all teams and units** where they can make a difference.
- **Increase** the size of the web of **expertise available to any employee** to solve specific problems or make complex decisions.

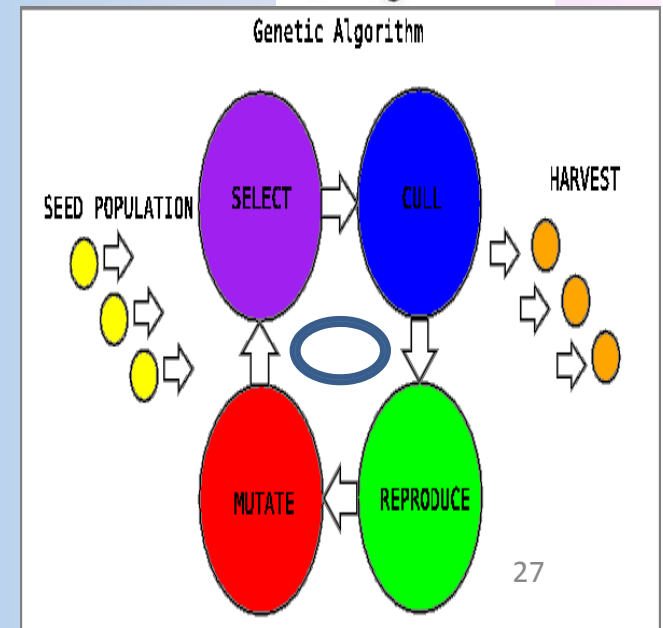
ORGANIZATIONAL LEARNING

Classes of Search Techniques



GENETIC ALGORITHMS

- Find the optimal solution for a specific problem by examining very large number of alternative solutions for that problem.
- Based on techniques inspired by evolutionary biology: inheritance, mutation, selection, etc.
- Work by representing a solution as a string of 0s and 1s, then searching randomly generated strings of binary digits to identify best possible solution
- Used to solve complex problems that are very dynamic and complex, involving hundreds or thousands of variables or formulas



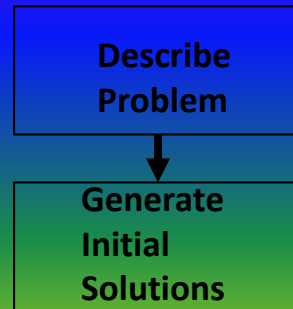
ORGANIZATIONAL LEARNING

Flow Diagram of the Genetic Algorithm Process

- Genetic Algorithms are a type of machine learning for representing and solving complex problems.
- They provide a set of efficient, domain-independent search heuristics for a broad spectrum of applications.
- A genetic algorithm interprets information that enables it to reject inferior solutions and accumulate good ones, and thus it learns about its universe.

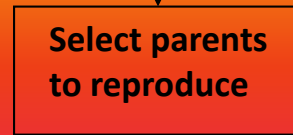
Intelligent Systems for Decision Support

Step 1



Step 2

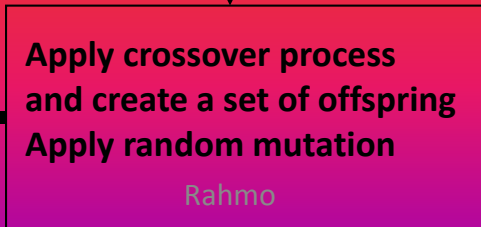
ITERATIVE



Step 3

Step 4

Step 5



The Components of a Genetic Algorithm

	Length	Width	Weight	Fitness
1	Long	Wide	Light	55
2	Short	Narrow	Heavy	49
3	Long	Narrow	Heavy	36
4	Short	Medium	Light	61
5	Long	Medium	Very light	74

A population of chromosomes

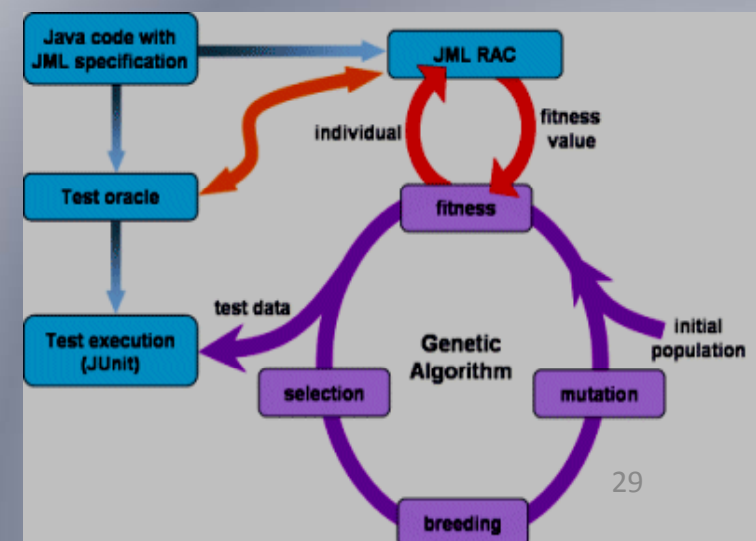
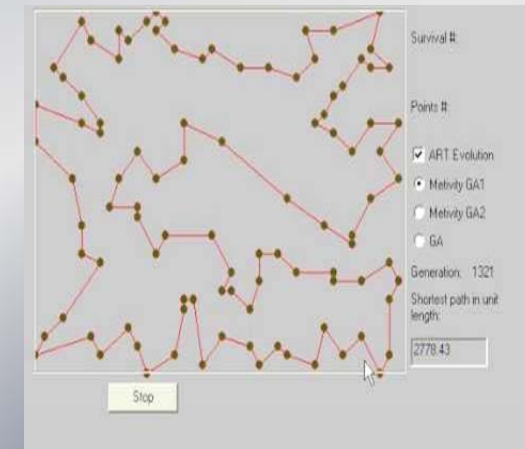
Decoding of chromosomes

Evaluation of chromosomes

This example illustrates an initial population of "chromosomes," each representing a different solution. The genetic algorithm uses an iterative process to refine the initial solutions so that the better ones, those with the higher fitness, are more likely to emerge as the best solution.

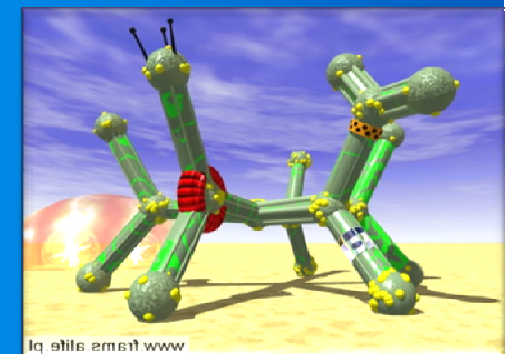
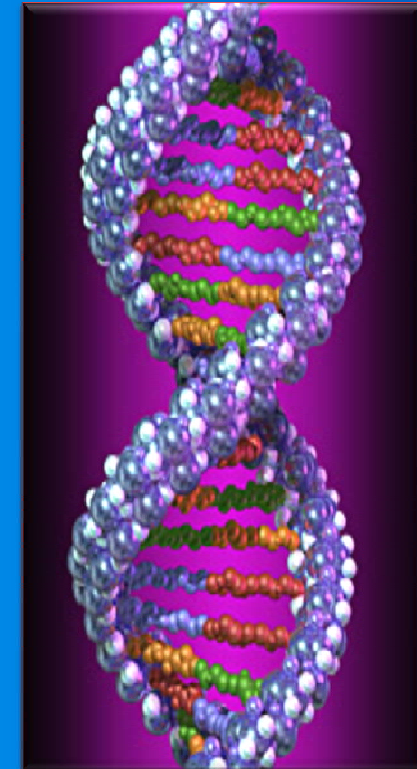
Benefits of Genetic Algorithms

- Concept is easy to understand
- Modular, separate from application
- Supports multi-objective optimization
- Good for “noisy” environments
- Always an answer; answer gets better with time
- Inherently parallel; easily distributed
- Many ways to speed up and improve a GA-based application as knowledge about problem domain is gained
- Easy to exploit previous or alternate solutions
- Flexible building blocks for hybrid applications
- Substantial history and range of use



Some GA Application Types

Domain	Application Types
Control	gas pipeline, pole balancing, missile evasion, pursuit
Design	semiconductor layout, aircraft design, keyboard configuration, communication networks
Scheduling	manufacturing, facility scheduling, resource allocation
Robotics	trajectory planning
Machine Learning	designing neural networks, improving classification algorithms, classifier systems
Signal Processing	filter design
Game Playing	poker, checkers, prisoner's dilemma
Combinatorial Optimization	set covering, travelling salesman, routing, bin packing, graph colouring and partitioning



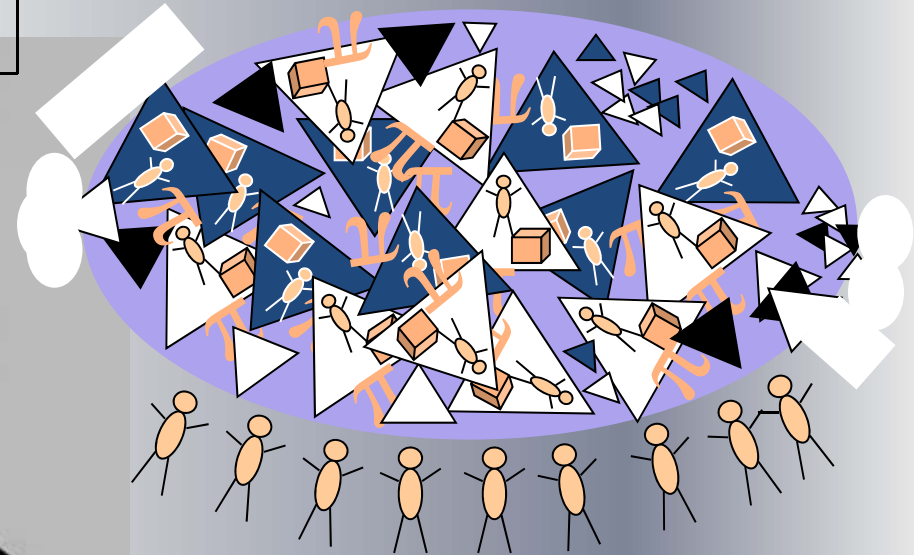
ORGANIZATIONAL LEARNING

Genetic algorithm

Applied as a collective intelligence tool

Ecologies of Ideas

Human populations



community intelligence: citizens
not as clients but as assets

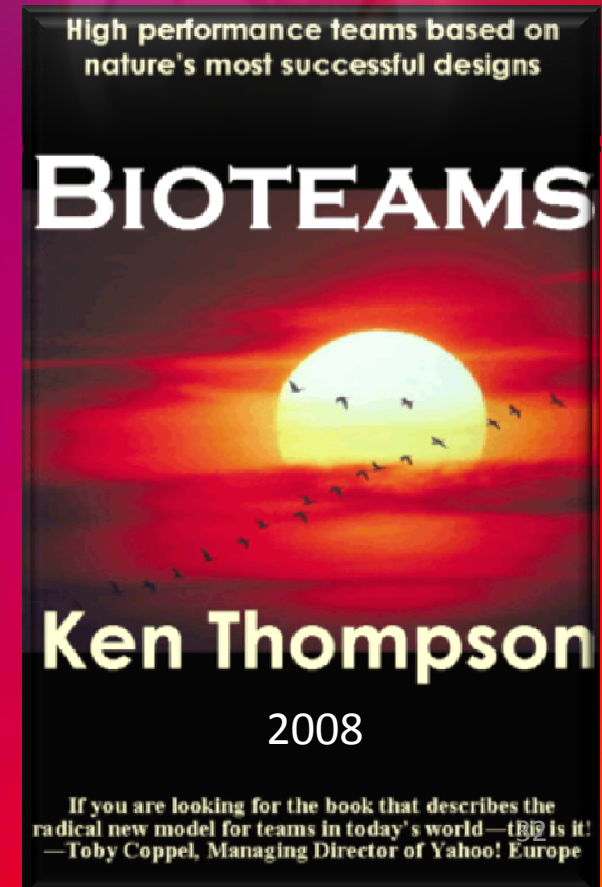
BIOTEAMING



The term was established by Ken Thompson

The major components of bioteaming are summarized into:

- Team beliefs
- The action zones
- Bioteam techniques

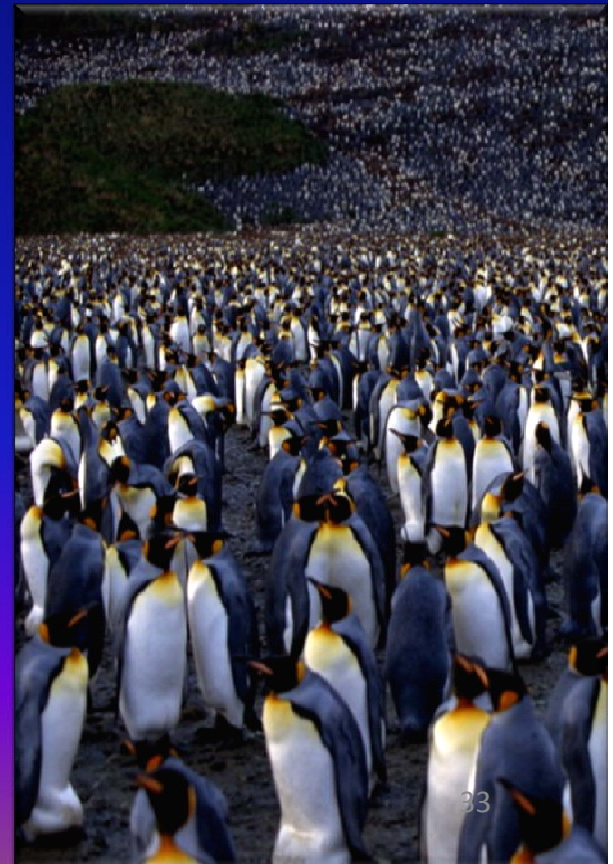




BIOTEAMING

essential features of “bioteaming”, extracted by analyzing most successful groups of living organisms in nature yet often absent in organizations:

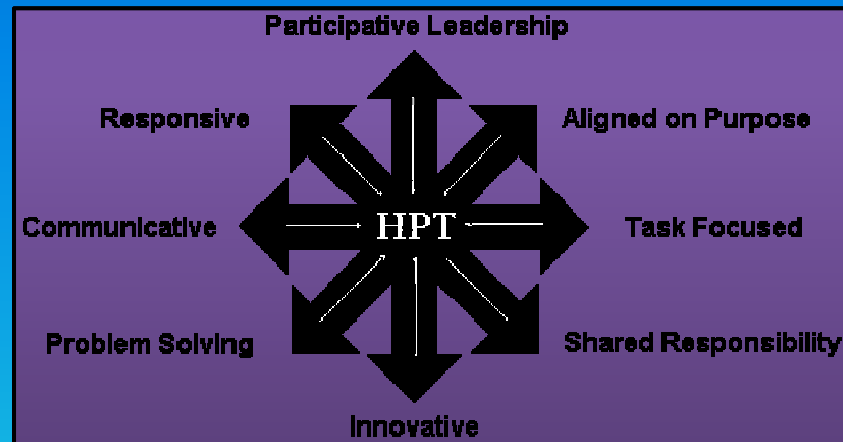
- a- collective or distributed leadership based on redundancy and contingency
- b- instant or pheromone like information communication, leading to concurrent decision making as opposed to sequential; the swarming effect
- c- ecosystem responsiveness and size adaptation
- d- clustering using connectors



BIOTEAMING

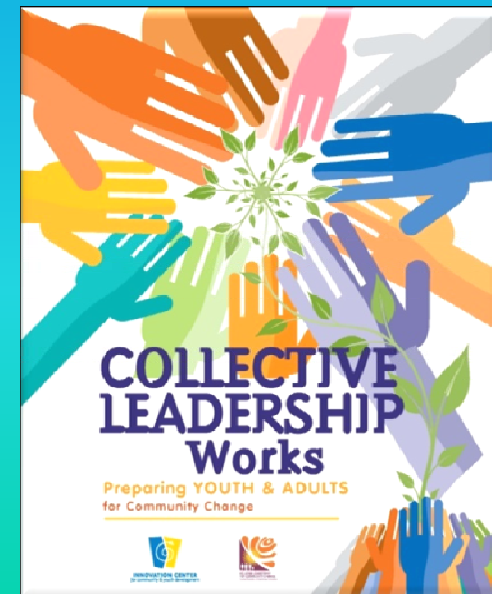
action zones of bioteaming

- a- Leadership zone
- b- Connectivity zone
- c- Execution zone
- d- Organization zone



a- **Leadership zone:** fostering collective and distributed leadership by adhering to the rules of communicating information not orders, mobilizing collective intelligence, and propagating a permissive environment.

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BIOTEAMING

- **b- Connectivity zone:** fostering synergistic interactions between team members, partners and the network by adhering to the rules of instant and continuous availability, granting trust transparency, and nurturing the internal and external network structure and connections.



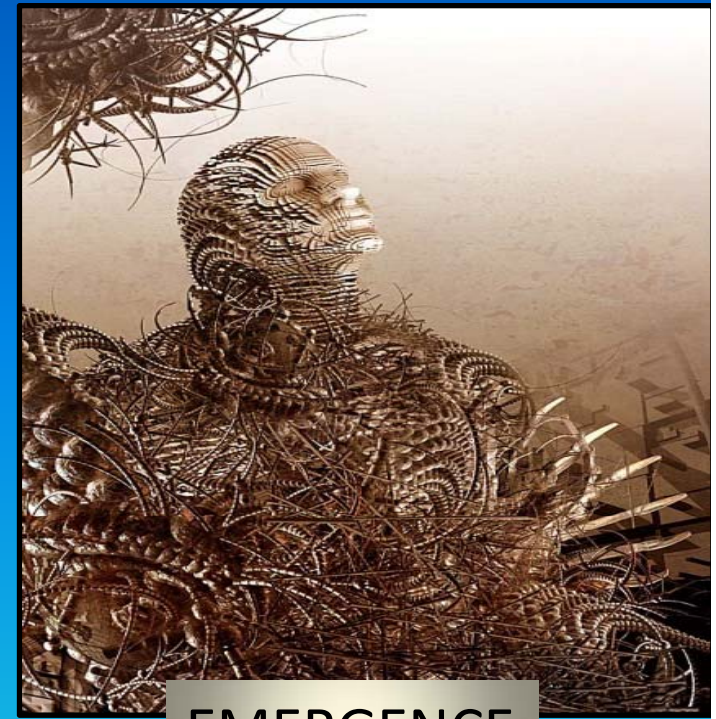
BIOTEAMING

- c- **Execution zone** fostering experimentation, cooperation and learning by adhering to the development of consistent autonomous team member behaviors, learning effective biological and interpersonal cooperative strategies, and learning through experimentation mutation and team review.

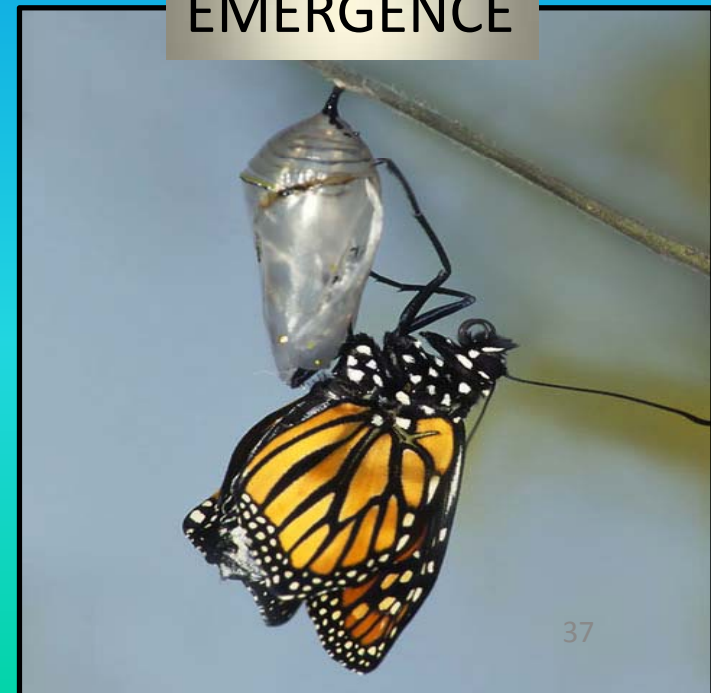


BIOTEAMING

d- **Organization zone** fostering sustainable self organization by defining teams as network transformations not outputs, developing boundaries that are open to energy and closed to waste, and relying on growth and scale that trail natural impulses.



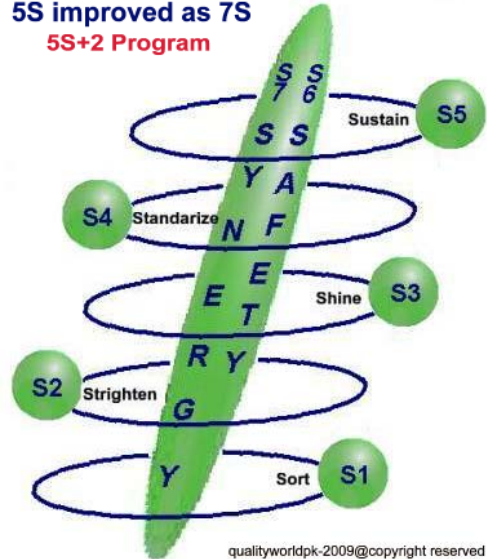
EMERGENCE



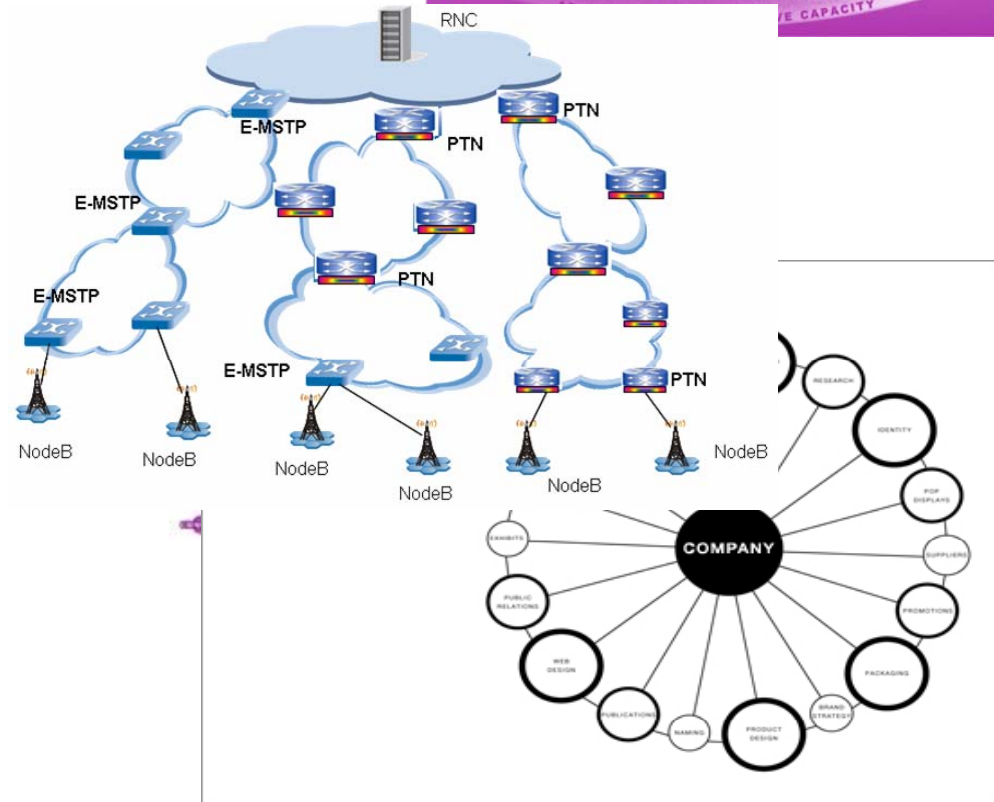
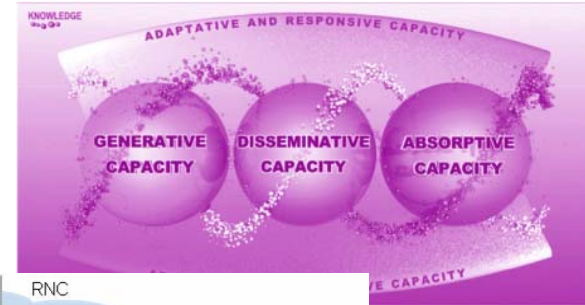
LEARNING



5S improved as 7S
5S+2 Program



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BIOTEAMING

Bioteaming applied techniques

can be assembled into two categories:

- foundational**
- operational**

Foundational: dedicated to team mobilization stages:
symbiosis: disclosing potential synergies between members,
predator – parasite: establishing fair ground rules,
Metabolism: determining members intentions and readiness, and



symbiosis



intentions and readiness



Members of USA-2



predator – parasite

BIOTEAMING

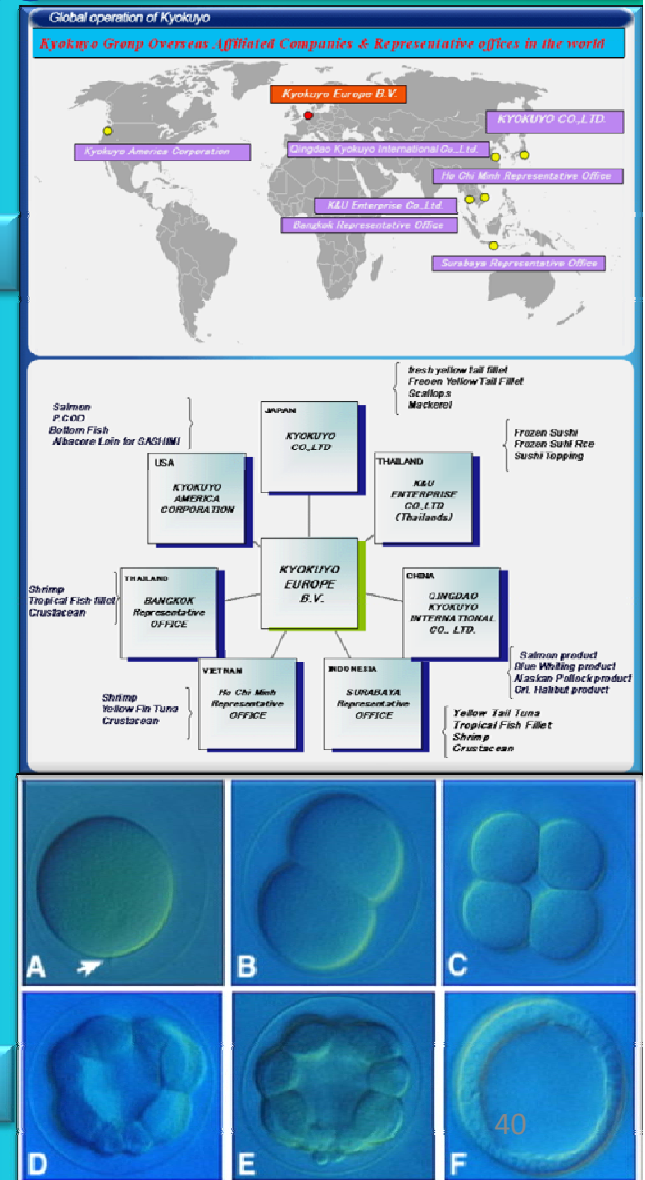
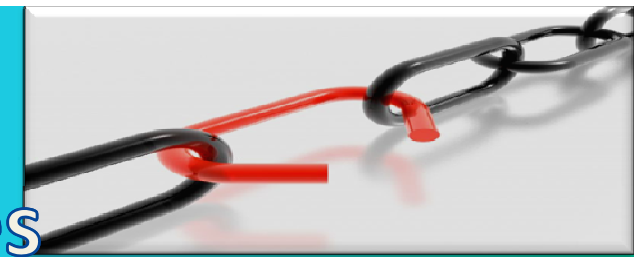
Bioteaming applied techniques

- **operational** for the execution stage: swarming: creating controlled self-management, tit for tat: adopting nature's most effective collaboration strategy, linkage: establishing key external relationships, cell division: establishing minimal functional key subgroups.

linkage

cell division

Rahmo



APPLICATIONS

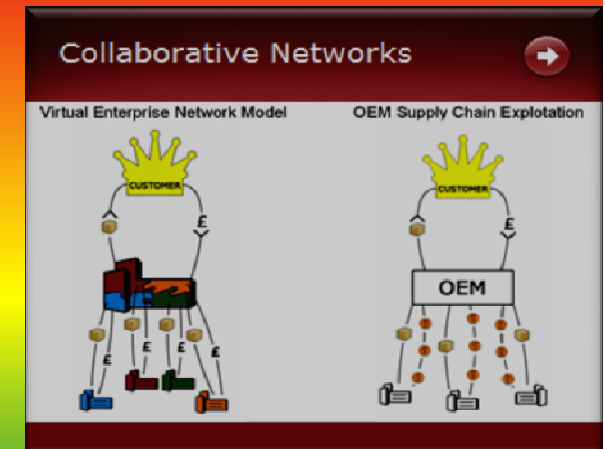
Organizations that **implicitly** applied some aspects of **the bioteaming approach** include large enterprises like *Capital one Bank, Schlumberger, General Electric, Southwest Airlines*, as well as, important organizations like the *Humberside training and enterprise council (UK)*, industry giants like *Boeing*, and sport teams like the *Boston Red Sox*..



APPLICATIONS

Case studies that **explicitly** used the bioteaming approach include:

- a) Virtual enterprise Network: Representing 15 core member companies operating in Environmental technologies sector (Ireland).
- b) A hospital intermediate care team unit (daisy hospital, Ireland).
- c) Telecoms industry working party representing key players from telecom and software industry (Ireland).
- d) Conference organization: *Dynamic knowledge* a leading performance and learning consulting company (England).
- e) Virtual language school: *lancelot* a training center and job portal for live online language trainers.



CONCLUSION

- The human aspect related to free will and choice presents a challenge for adopting the sociomimetic model. Tacit knowledge or “hidden beliefs” that factors in as emotional intelligence are essential attributes of success and failure in high performance teams. Challenging hidden beliefs are: Absence of accountability, perceived incompetency, upset in rewards and contributions, opacity, non-shared glory, absence of meaningful mission value and outcome pessimism.
- The establishment of such a Meta structure faces some obstacles related to incumbent norms of behaviors, cultural divide persistent in scientific disciplines and a pervasive paradigm based on mechanical and hierarchical social and organizational model, that permeates through almost all forms of collective and individual decision making.

CONCLUSION

- The observation of very successful groups in nature demonstrate that there is little or modest pre-requirements set on the members of the team, in terms of individual intelligence or knowledge; however, certain simple techniques must be adhered to by the members of the group. Due to its simplicity, such teaming, or networking fabric, could be of exceptional value to developing countries and emerging economies output and development.

