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Knowledge Sharing for Systems Engineering and Networks of Things and People

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CONTENTS OUTLINE

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- Knowledge
- Knowledge Reuse
- Knowledge Networks
- Systems Engineering
- Networks of Things and People
- Possibilities
- Challenges

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KNOWLEDGE

1. History of Knowledge

2. Theory of Knowledge

3. Knowledge in the Modern Age

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History of Knowledge

- Ancient History (Sanskrit वेद véda, "**knowledge**)
- The Greeks (Socrates, Aristotle, Plato,others)

http://en.wikipedia.org/wiki/Ancient_Greek_philosophy

- The Internet, and the Modern Age
- Knowledge Networks

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KNOWLEDGE IN MODERN TIMES

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Kant's central thesis —that the possibility of human knowledge presupposes the active participation of the human mind—is deceptively simple, but the details of its application are notoriously complex.

Bertrand Russell's *Theory of Knowledge* (1913) is an analysis of the differences which may occur between various cognitive relations (such as attention, sensation, memory, and imagination), and is an explanation of how cognitive data (such as perceptions and concepts) may become elements of knowledge.

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Ways of knowing
(sense
perception, reason, emotion and language/tone/symbols/nomenclature).
Areas of knowledge **(**mathematics, natural sciences, human sciences, history, the arts and ethics): their distinct natures and methods of gaining knowledge, the types of claim each makes and the issues to consider (e.g. "How do you know that the scientific method is a valid method of gaining knowledge?", "What is the reason for having historical knowledge, and how is it applied in life?").

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Declarative, Procedural, and Causal Knowledge

Declarative knowledge is knowing "that" (e.g., that Washington D.C. is the capital of America),
as opposed to *procedural knowledge* is knowing "how" (e.g., how to drive a car).

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Knowing **WHY**

http://www.psych.nyu.edu/rehder/

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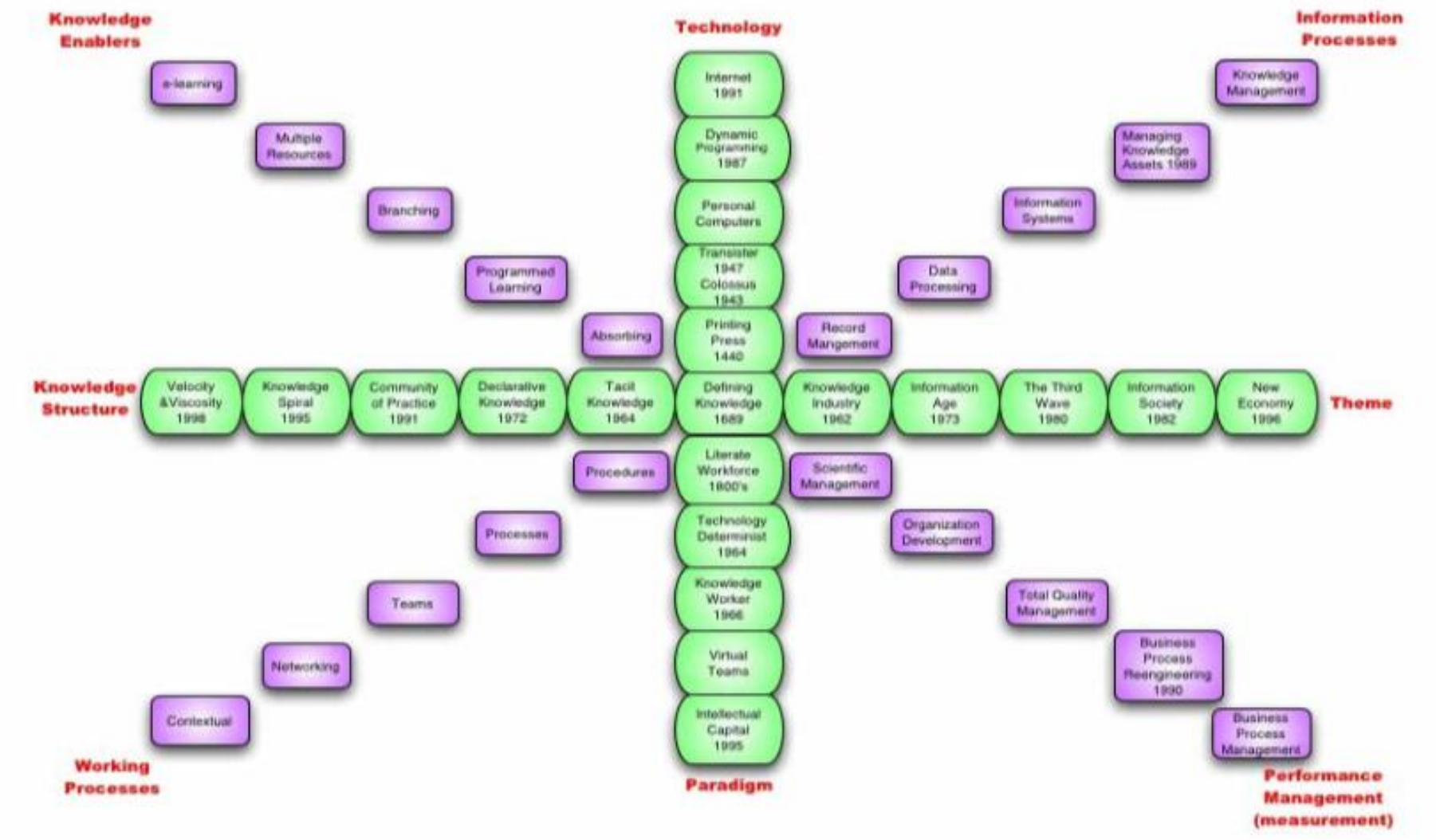
Factors that transcend individual ways of knowing and areas of knowledge

***Nature of knowing*:** what are the differences between information, data, belief, faith, opinion, knowledge and wisdom**?**
***Knowledge communities*:** what is taken for granted in a community? How can we decide which beliefs we ought to check further**?**
***Knowers' sources and applications of knowledge*:** how do age, education, culture and experience influence selection of sources and formation of knowledge claims? If you know something, or how to do something, do you have a responsibility to use your knowledge?
***Justifications of knowledge claims*:** why should claims be assessed critically? Are logic, sensory,
perception, revelation, faith, memory, consensus, authority, intuition, and self-awareness equally reliable justifications? Use of
coherence, correspondence, pragmatism, and consensus as criteria of truth.
http://en.wikipedia.org/wiki/Theory_of_knowledge_(IB_course)

Knowledge today



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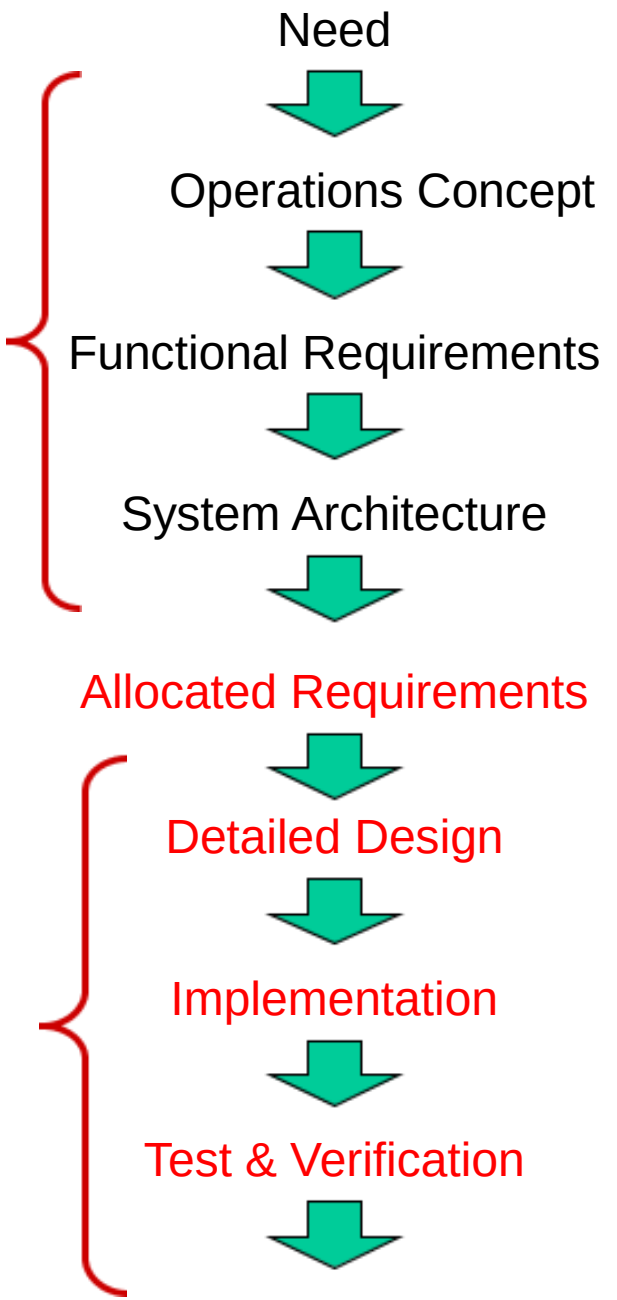
Focus of Systems Engineering

From Original Need
To Final Product
The Whole System
The Full System Life Cycle

- Focus of Component Engineering
  - On Detailed Design
  - And Implement ation



What needs are we trying to fill?
What is wrong with the current situation?
Is the need clearly articulated?

Who are the intended users?
How will they use our products?
How is this different from the present?

What specific capability will we provide?
To what level of detail?
Are element interfaces well defined?

What is the overall plan of attack?
What elements make up the overall approach?
Are these complete, logical, and consistent?

Which elements address which requirements?
Is the allocation appropriate?
Are there any unnecessary requirements?

Are the details correct?
Do they meet the requirements?
Are the interfaces satisfied?

Will the solution be satisfactory in terms of cost and schedule?
Can we reuse existing pieces?

What is our evidence of success?
Will the customer be happy?
Will the users' needs be met?

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SYSTEMS ENGINEERING

"The **value added by the system as a whole**, beyond that contributed independently by the parts, is **primarily created by the relationship among the parts; that is, how they are interconnected**. It is a way of looking at the "big picture" when making technical decisions. It is a way of achieving stakeholder functional, physical, and operational performance requirements in the intended use environment over the planned life of the systems". NASA SE Handbook, p 4

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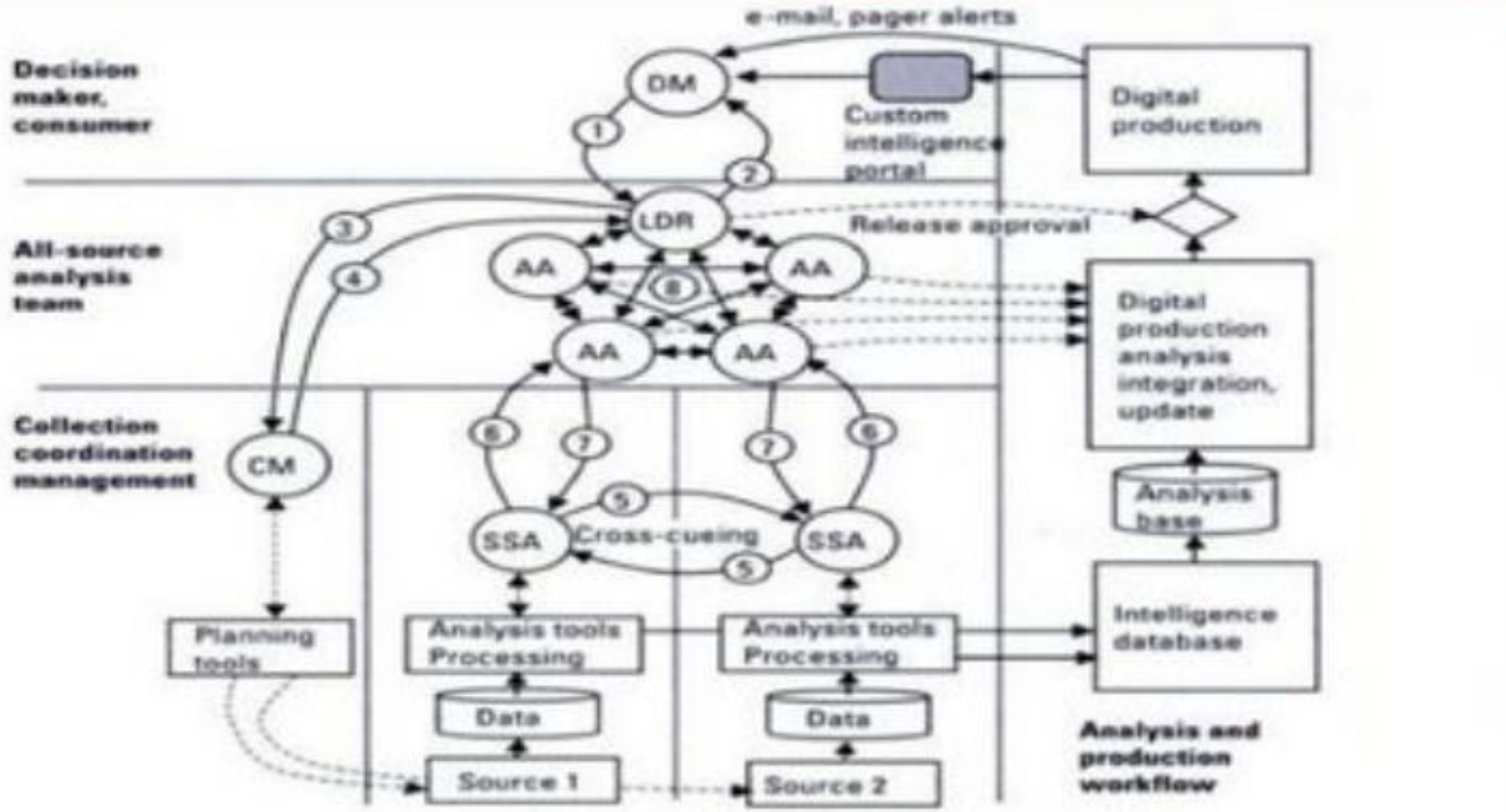
Background: All Source Knowledge Systems



Knowledge Management in the Intelligence Enterprise, Edward Waltz, 2003 Artech House Page 347

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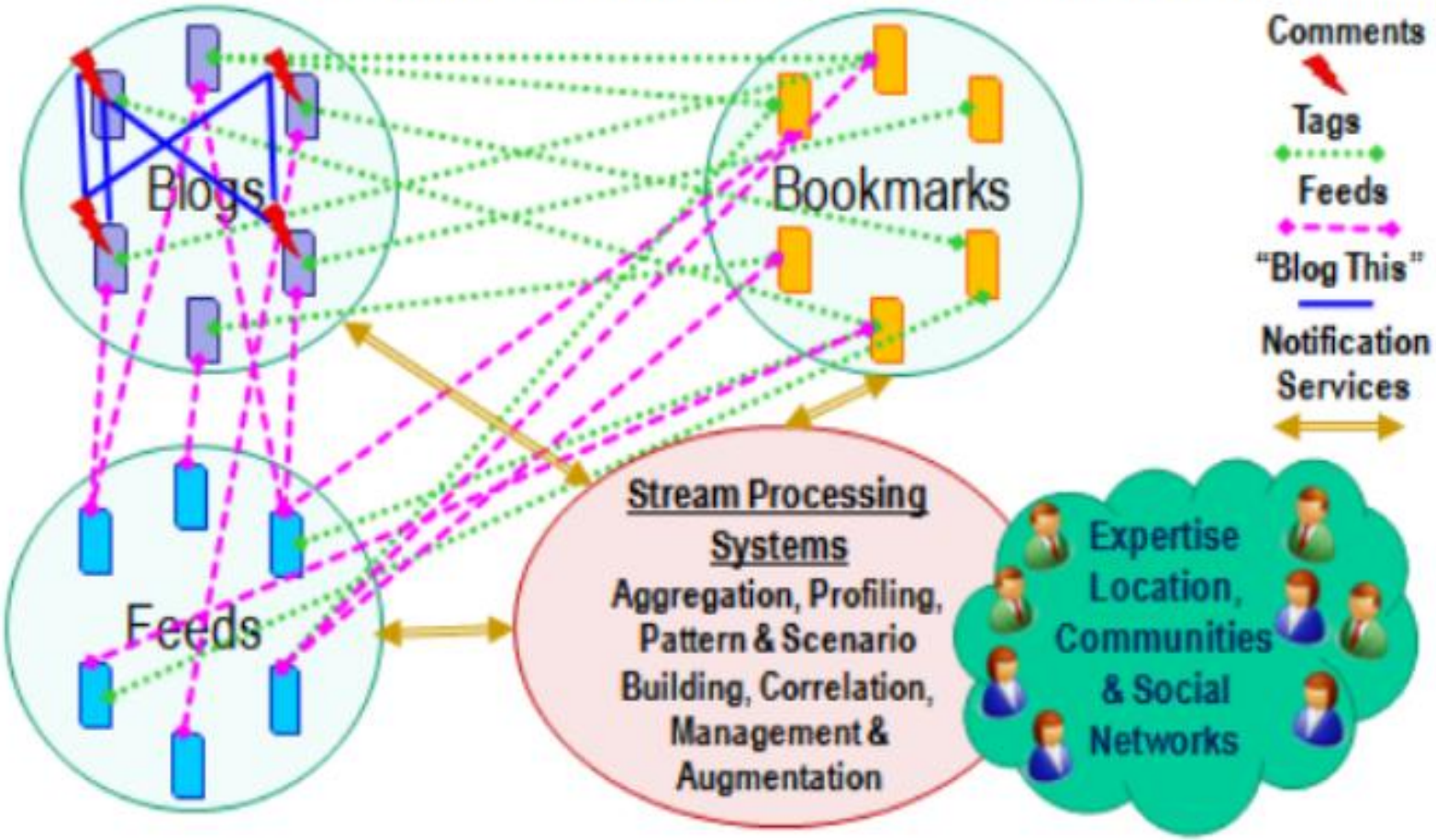
Social Systems Promote Collective Intelligence

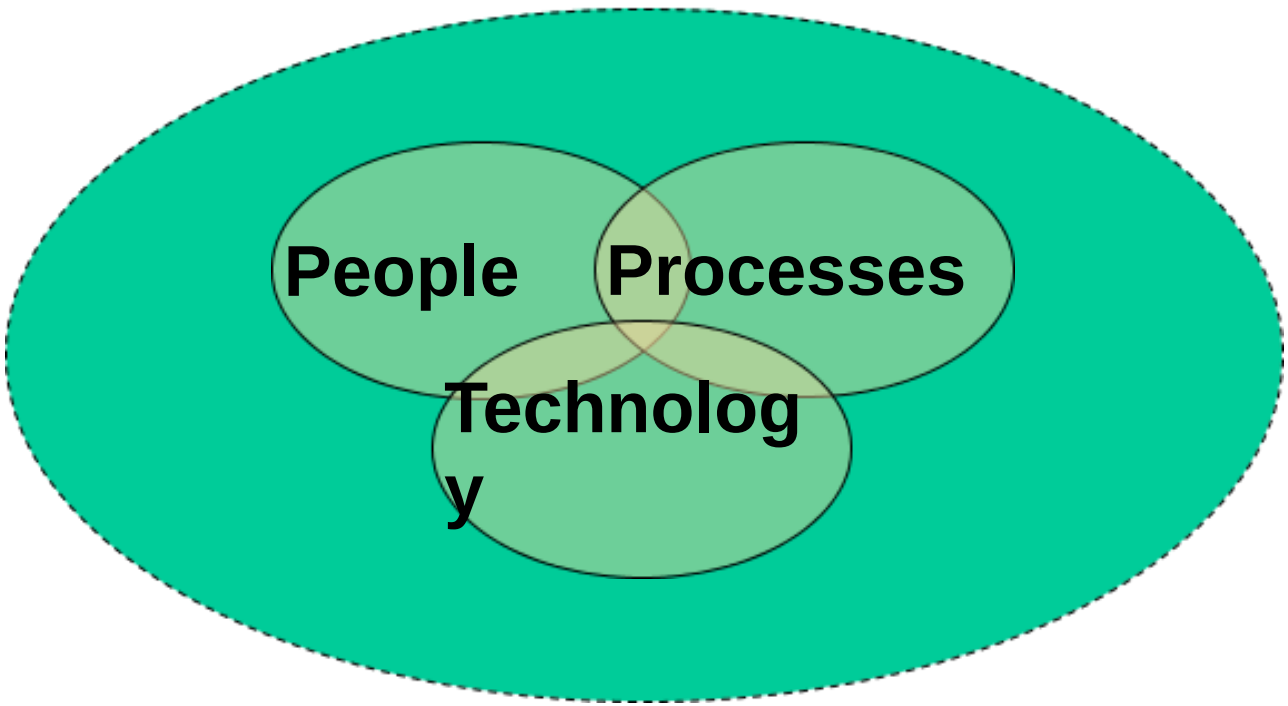
burton GROUP

Broadcast-post communication models help inter-connect people with similar attention areas, enabling shared awareness



SOCIO TECHNICAL COMPLEX SYSTEMS

SICSA Scottish Socio-technical Systems Network, Launch Event
14th December Informatics Forum



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KR-L DRIVERS

Knowledge Reuse and Learning is part of a Knowledge Exchange/Knowledge transfer activities

It is necessary to :
solve problems
generate innovation
advance knowledge

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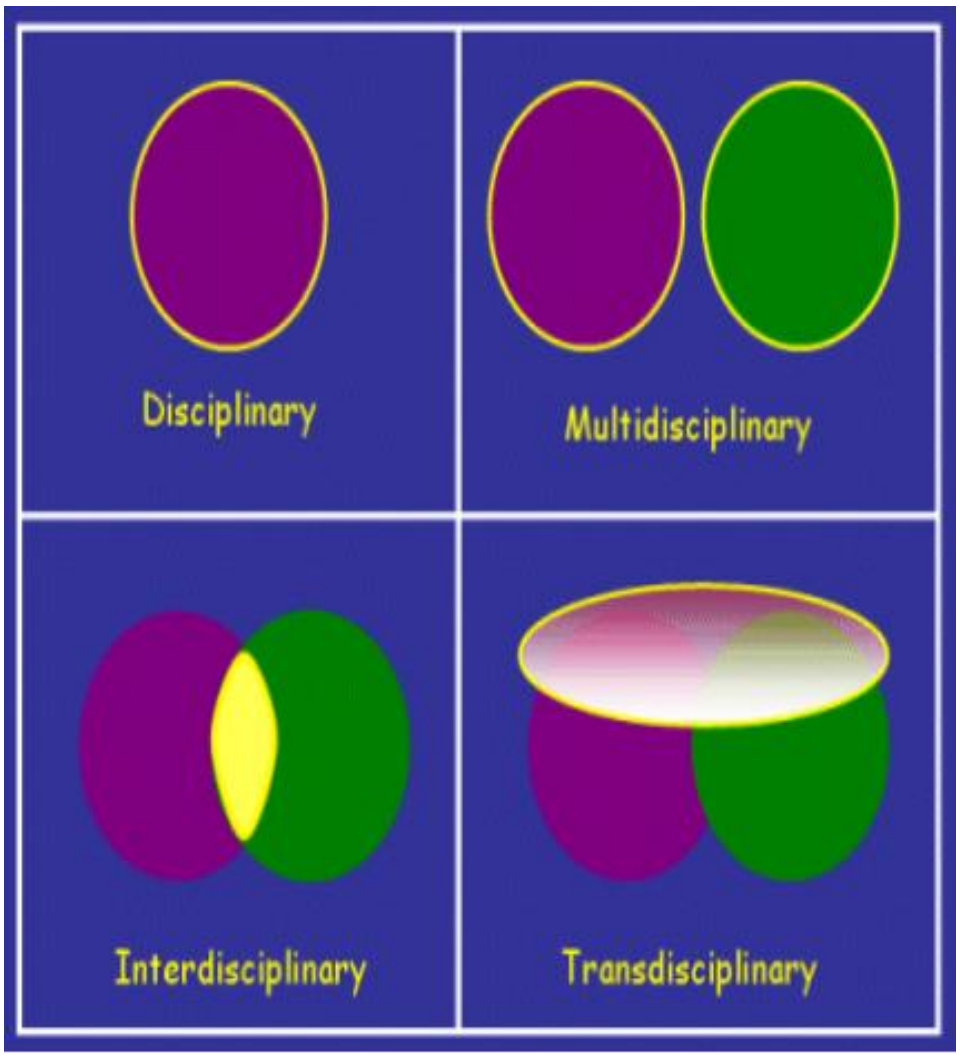
INTER- MULTI- TRANS- DISCIPLINARITY (CROSS-?)



Disciplinary: Epistemologies, assumptions, knowledge, skills, methods within the boundary of a discipline.
g. Physics; History; Psychology
Multidisciplinary: Using the knowledge/understanding of more than one discipline. eg Physics **and** History; Biology **and** Architecture
Interdisciplinary: Using the epistemologies/methods of one discipline within another. g. Biochemistry; Ecophilosophy; Astrophysics
Transdisciplinary: Focus on an issue such as pollution or hunger both within and beyond discipline boundaries with the possibility of new perspectives

www.hent.org/transdisciplinary.htm

KR/L IN THE CONTEXT OF OTHER DISCIPLINES

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Neighbouring disciplines

Neuroscience
Brain Informatics
Digital Ecosystems
Knowledge Hubs and Knowledge Clusters
Social Network Analysis
Ambient Intelligence
Interaction Design
More…

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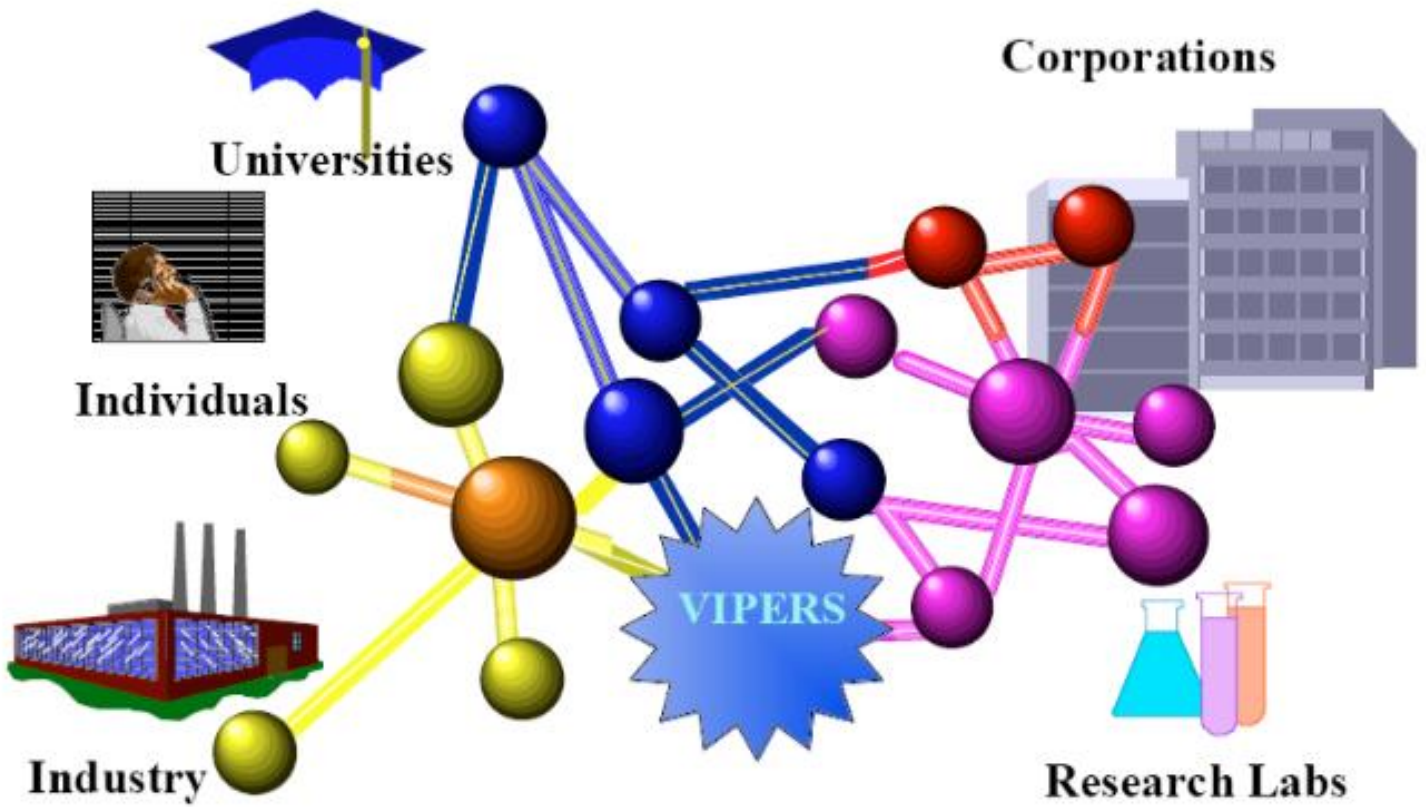
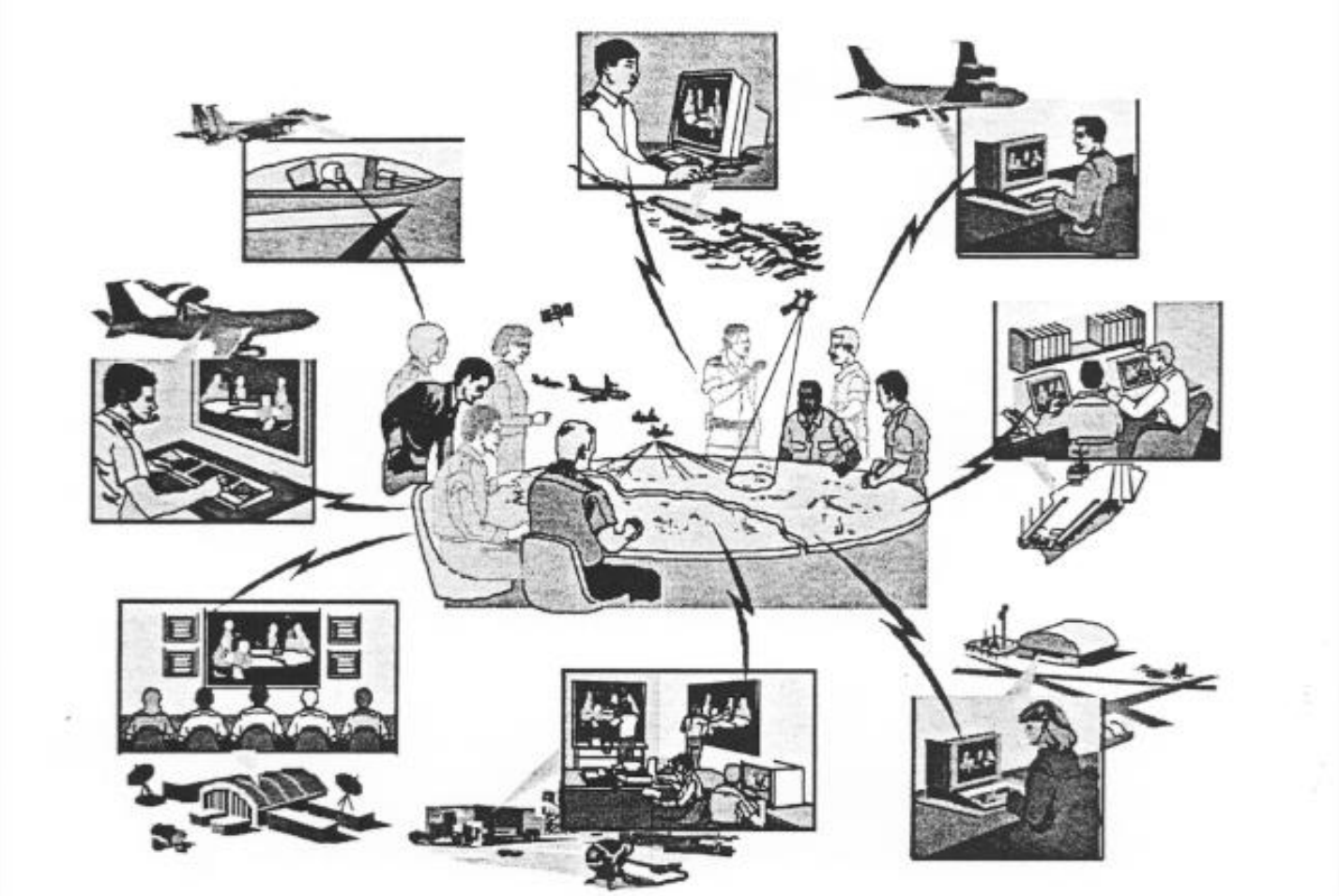
SCENARIO 1 – 2025 (Vipers)

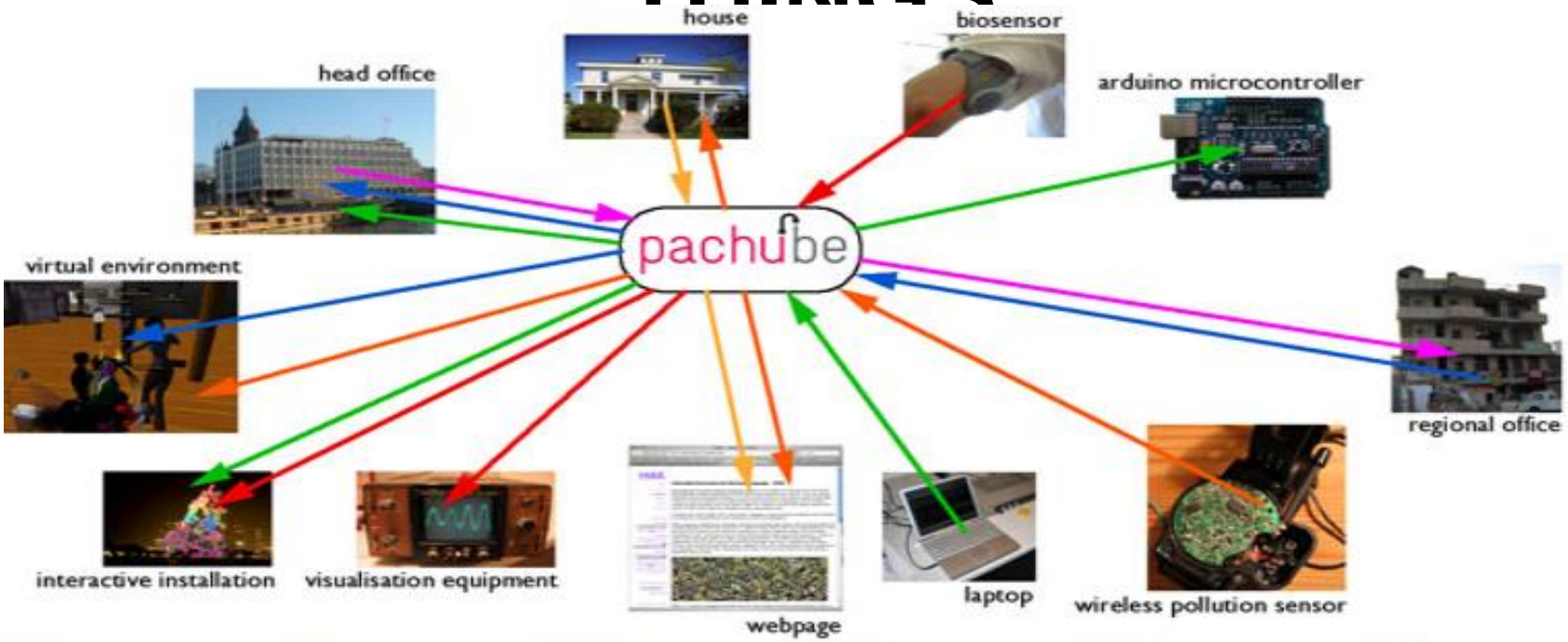
Virtual Integrated Planning Execution Resource Systems



SCENARIO 2- REAL TIME DECISIONS



SCENARIO 3 – INTERNET OF THINGS



one-to-one
webpage responds to house

one-to-many
laptop ambient light level and accelerometer sensor readings shared with public

one-to-one
head and regional office share sensor data

many-to-one
virtual environment responds to regional office and wireless pollution sensor

one-to-many
wireless biosensor connects to interactive installation and visualisation equipment

one-to-many
webpage, house and virtual environment respond to wireless pollution sensor

KNOWLEDGE NETWORKS

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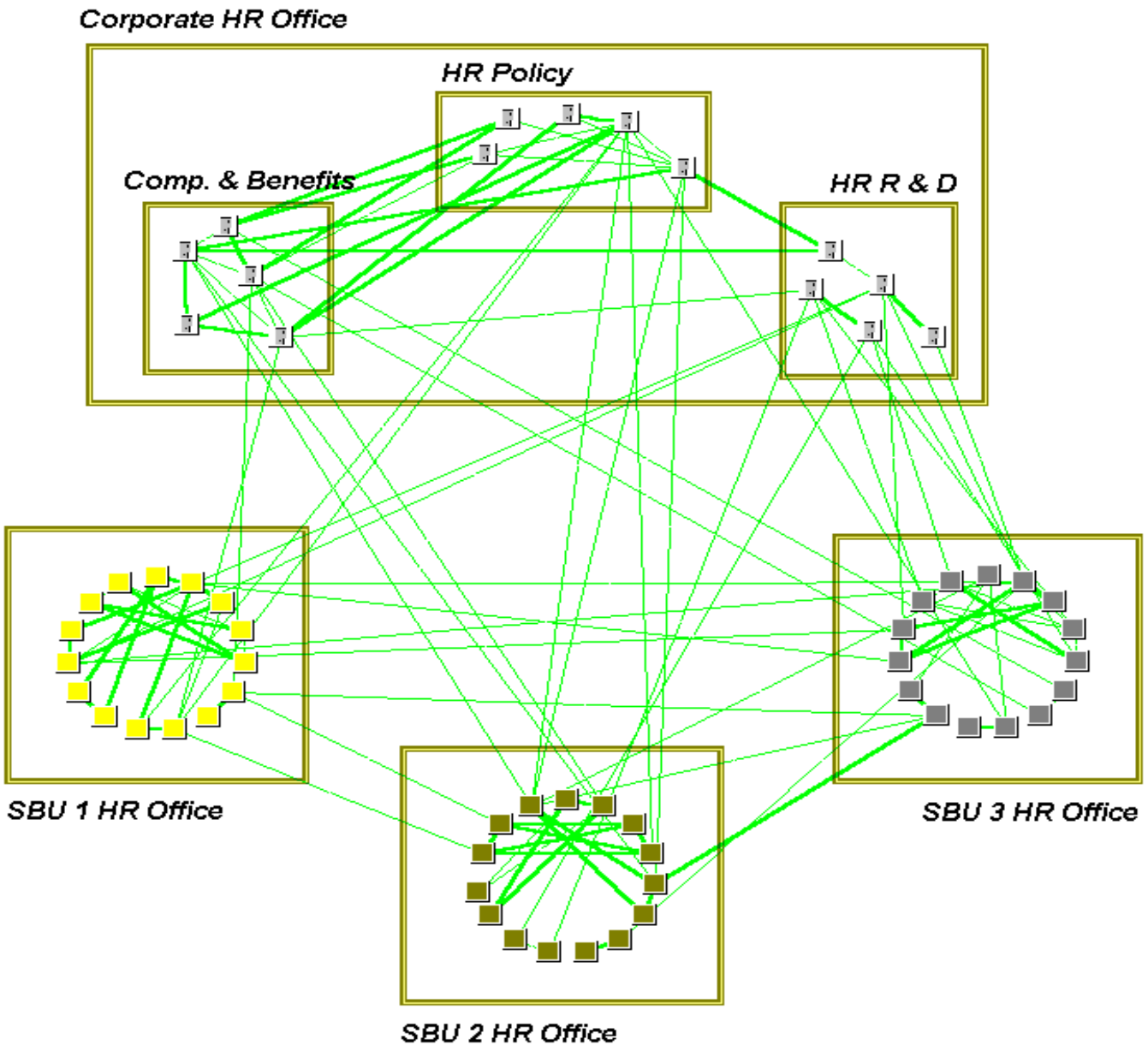
Valdis Krebs



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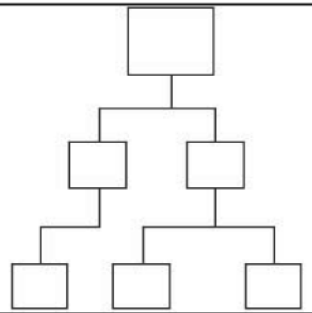
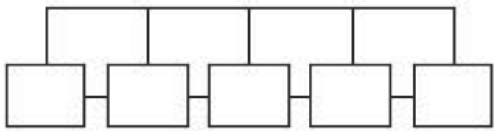
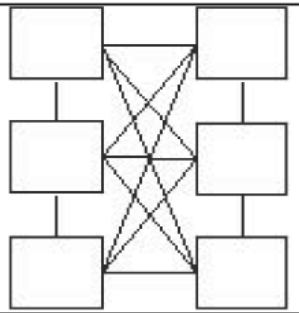
	Production Network	Development network	Innovation Network
Illustration			
Nature of the system	Mechanical	Organic	Dynamic
Aim	Effective production of a pre-designed product for the focal company	Sharing knowledge between actors. Shared knowledge benefits the actors individually	Constant creation of innovations and new knowledge
Structure	Vertical	Horizontal	Diagonal
Relationships	Determined by hierarchy	Reciprocal, seeking consensus	Spontaneous, abundant
Social connections in the network type	Not many. Interaction is restricted to production-related matters	Every organization (actor) is represented by a person. These representatives keep up personal relations with each other	There are a lot of connections between the firms' personnel
Duration of co-operation	Long-term. Dyadic relations are important investments	Can be either long-term or short term	Co-operation sustained until innovation is complete
Knowledge and competence	Defined, explicit	Experiental, hidden, tacit	Intuitive, potential
Information flow	One-way, top-down	Multi-way, horizontal	Chaotic, sporadic
The role of communication in the network	Clear rules and regulations. Possibly a shared ERP system	Casual interaction between people in a specific region	A lot of entropy, i.e. excess communication and information
Importance of location	Subcontractors can be located geographically anywhere as long as logistics and information flows are functioning	Requires face-to-face communication	Regionality is pronounced in the development of innovations, but some actors can still be located geographically elsewhere
Management and leadership method	Orders, direct use of power	Dialogue, empowerment	Personal networking skills, relinquishing power

AMBIENT KNOWLEDGE

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Using palm for dialing a phone number

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SIXTH SENSE

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SOME DEFINITIONS

Knowledge Davenport and Prusak (1998, p. 5) define knowledge as, "a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information." Also: The product of learning

Learning: The process and activities of acquiring knowledge

System. An interacting combination of elements to accomplish a defined objective. These include hardware, software, firmware, people, information, techniques, facilities, services, and other support elements. (INCOSE)

Complex System; 1) A a system composed of interconnected parts that as a whole exhibit one or more properties (behavior among the possible properties) not obvious from the properties of the individual parts. en.wikipedia.org/wiki/Complex_system 2) A collection of many simple nonlinear units that operate in parallel and interact locally with each other so as to produce emergent behavior. mitpress.mit.edu/books/FLAOH/cbnhtml/glossary-C.html

SoS A system-of-systems is an assemblage of components that individually may be regarded as systems and that possess two additional properties: www.capdem.forces.gc.ca/html/definitions_e.html

Emergence the process by which patterns or global-level structures arise from interactive local-level processes. This "structure" or "pattern" cannot be understood or predicted from the behavior or properties of the component units alone. *(Mihata 1997:31)*

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Title:Assessing intellectual capital creation in regional clusters

Author(s)Aino Poyhonen, Anssi Smedlund

ournal:

Journal of Intellectual Capital