A Model of Corporate Knowledge Management

Executive Summary

Knowledge and knowledge creation are becoming prime assets, like natural resources, of every competitive company in the knowledge-age. These knowledge assets originate in the creative minds of employees and managers within the organization. To tap into this rich resource, companies are investing considerable amounts of money and time into developing knowledge management systems to capture, store, and retrieve knowledge. Information stored in computer systems or documents is only useful if employees know how to access it.

Concept maps are effective visualization tools for representing knowledge of any domain. In addition, concept maps are a learning tool and access point for the domain of knowledge represented. In simplistic form, they provide a graphic interface into the structure and relationships of knowledge. At the next level of sophistication, the software used to make concept maps becomes the knowledgebase storage system. Research findings support the effectiveness of concept maps as a thinking and visualization tool that empowers the user (learner) to more effectively use knowledge.

This project is comprised of three concept maps, *Knowledge Management, Concept Mapping,* and *Concept Maps as Knowledge Management Tools* along with the corresponding narrative that explains the relationship of elements in the concept map. The purpose of this project is to present a basic model and demonstrate the feasibility of using a concept map as a knowledge management tool.

The project is presented in paper and electronic form. In electronic form, there are more related concept maps to view than the three presented in this paper presentation. The Inspiration (Mac) files on the attached Zip disk add a deeper level of relationship allowing the user to hyperlink from one concept map to another. Instructions are included in Appendix A.

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A Model of Corporate Knowledge Management
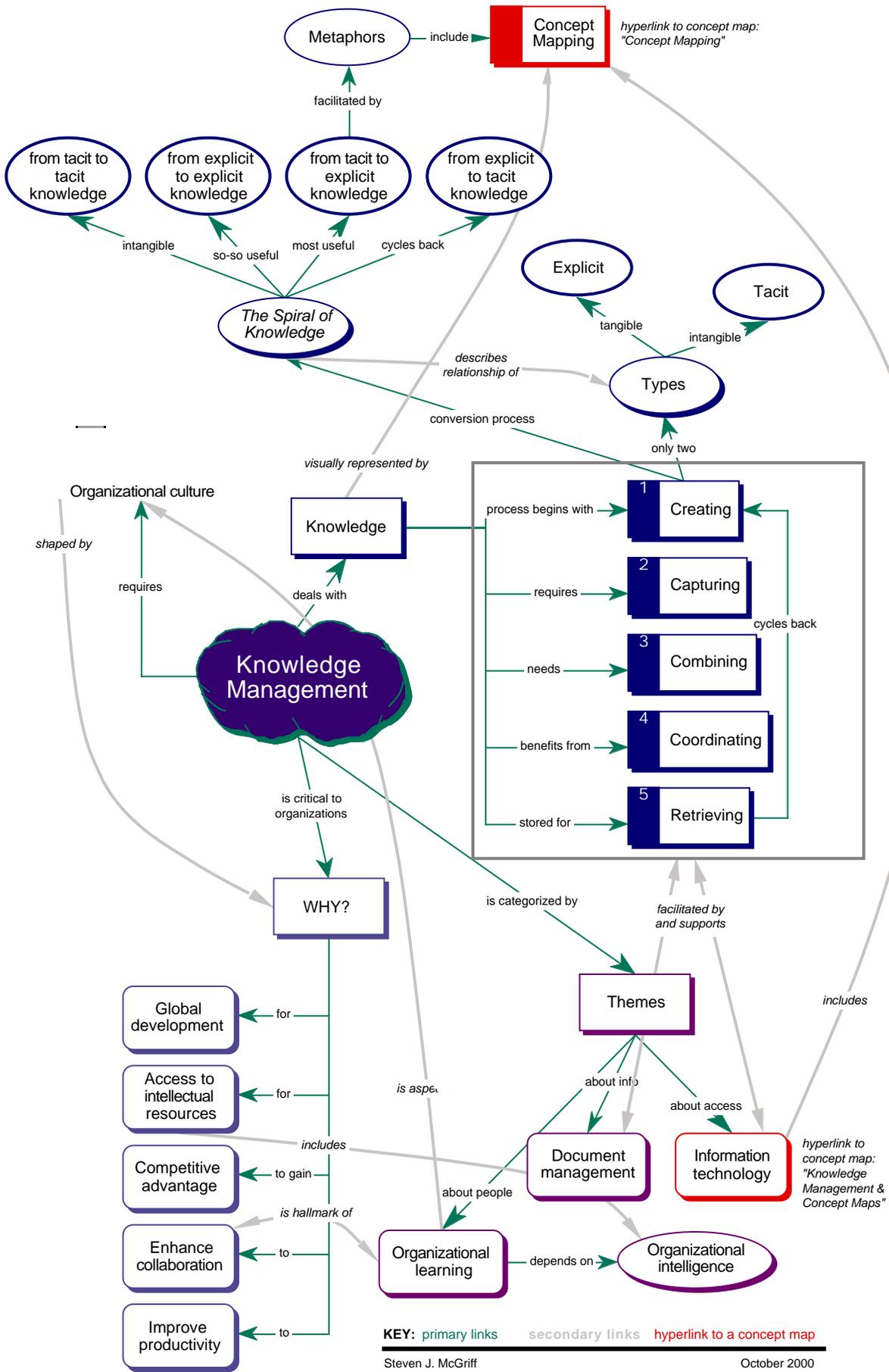
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Concept map: *Knowledge Management*

Narrative

Concept map: *Concept Mapping*

Narrative

Concept map: *Concept Maps as Knowledge Management Tools*

Narrative

Appendix A

Metaphors —include→ **Concept Mapping** *hyperlink to concept map: "Concept Mapping"*

Metaphors ←facilitated by—

from tacit to tacit knowledge — from explicit to explicit knowledge — from tacit to explicit knowledge — from explicit to tacit knowledge

intangible — so-so useful — most useful — cycles back

The Spiral of Knowledge

Explicit — tangible — intangible — Tacit

describes relationship of — Types

conversion process

only two

visually represented by

Organizational culture

shaped by

requires

Knowledge —process begins with→ **1 Creating**

deals with

Knowledge Management

2 Capturing — requires

3 Combining — needs — cycles back

4 Coordinating — benefits from

5 Retrieving — stored for

is critical to organizations

WHY?

is categorized by

Themes — *facilitated by and supports*

includes

Global development — for

Access to intellectual resources — for

includes

Competitive advantage — to gain

is aspect

Themes — about info

about access

Enhance collaboration — to

is hallmark of

about people

Document management

Information technology — *hyperlink to concept map: "Knowledge Management & Concept Maps"*

Improve productivity — to

Organizational learning —depends on→ Organizational intelligence

KEY: primary links   secondary links   hyperlink to a concept map

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Knowledge Management

— Introduction
Kim Cameron wrote in 1989 that increases in knowledge, complexity, and turbulence in postindustrial environments will place enormous strain on managers. To underscore that premonition, Cameron quotes H.A. Simon, who wrote in 1973:
"Organizational decision making in the organizations of the postindustrial world shows every sign of becoming a great deal more complex than the decision making of the past. As a consequence of this fact, the decision-making process...will [become] the central activity in which the organization is engaged...the central problem is...how to organize to make decisions—that is, to process information. [Simon, H.A. (1973). Applying information technology to organization design. *Public Administration Review,* 1973, 34; 268-78.]

Knowledge (intellectual capital) is the most critical asset of an organization (organizational intelligence) for obtaining the competitive edge; knowledge is the capability to act, according to Hubert St. Onge of the Mutual Group in Canada. How do you judge knowledge from information (patterned data) or data (dispersed elements)?

Management = extracting, packaging and distribution

Knowledge managment is the process of creating value from an organization's intangible assets (Liebowitz, 2000).

Knowlege management is what an organization does to take its intellectual resources, both obvious and subtle, and make them fresh, meaningful and accessible (Rossett & Marshall, 1999).

Gartner Group: A discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing alll of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously uncaptured expertise and experience in individual workers (Srikantaiah, 2000).

Srikantaiah, T. Kanti, Knowledge Management for the Information Professional: Chp 2. KM has become a new way of capturing an institution's full expertise addressing factors such as: databases, Web site interfaces and documents; knowledge infrastructure for just-in-time knowledge and global access; enhancing the visibility of knowledge in an institution; sharing knowledge not only within an institution but also with external clients; an institution's knowledge culture; capturing tacit knowledge and experince of staff; and information collected in libraries, record centers, administrative units, operational units, and with individual staff.

Knowledge management deals with the conceptualization, review, consolidation, and action phases of — creating, securing, combining, coordinating, and retrieving knowledge. The process are difficult for an organization to master unless they first create a knowledge sharing environment inwhich everyone from the CEO on down actively promotes and utilizes the knowledge management system.

A. Knowledge

"a fluid mix of framed experience, values, contextual information, and expert insight" (Davenport & Prusak, 1998, p. 5 in Rossett & Marshall, 1999)

Eisner (1988) in Wilson (1991) writes "knowledge is rooted in experience and requries a form for its representation. Since all forms of representation constrain what can be represented, they can only partially represent what we know." [Wilson, B.G. (1991). Constructivism and instructional design: some personal reflections. In: Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology Sponsored by the Research and Theory Division (15th, New Orleans, Louisiana, January 13-17, 1993).] [Eisner, E.W. (1988). The primary of experience and the politics of method. *Educational Researcher, 17* (5), 15-20.

1. Creating

The Japanese companies are highly effective at creating new knowledge partly because executives at these companies are managing/nurturing quality innovation. The key to Japanese approach is that creating new knowledge is not just a simple matter of processing objective information. Instead, it depends on accessing the tacit and often highly subjective insights, intuitions, and hunches of individual employees. This method works because of personal commitment and the employees' sens of identity with the enterprise and its mission. (Nonaka, 1991)

New knowledge always begins with the individual regardless of position in a company. (Nonaka, 1991)

a. Types

(1) Tacit

intellectual capital and social capital: people are the embodiment of tacit knowledge; face-to-face conversations; telephone conversations; knowledge possessed in an individual's head, desk drawer, or filing cabinet; e-mail; customer knowledge; Tacit knowledge is not easily expressed, it is hard to formalize and

ocmmunicate to others. Tacit knowledge is intertwined with action and with an individual's commitment to a craft or profession, a particular technology or product, or the activities of a workgroup or team. It consists partly of technical skills, often referred to as, "know-how," and akin to the expertise of a master craftsman with years of experience. Tacit knowledge also has a cognitive dimension; mental models, beliefs, and perspectives that are so ingrained that they are taken for granted and cannot be easily described.

Sharing tacit knowledge can only occur through networking among those people in possession of the tacit knowledge, referred to as communities of practice.

(2) Explicit
Knowledge that is contained in artifact form: commercial publications; organizational business records; email; Web; GroupWare; Intranets; databases; self-study material

b. The Spiral of Knowledge
Nonaka (1991) writes that in the knowledge-creating company, four patterns for creating knowledge exist in dynamic interaction, as a kind of spiral of knowledge.

(1) from tacit to tacit knowledge
When one individual shares knowledge directly with another, such as a master-apprentice relationship. This knowledge is not easily leveraged by the organization because it has not become explicit.

(2) from explicit to explicit knowledge
An individual can also combine discrete pieces of explicit knowledge into a new whole, such as when data is synthesized into a report. This knowledge does not extend the company's existing knowledge base.

(3) from tacit to explicit knowledge
When tacit knowledge, such as that learned by an apprentice, is articulated, it is converted to explicit knowledge and therefore can be shared with the organization.

(a) Metaphors

Nonaka (1991) writes, to convert tacit knowledge into explicit knowledge means finding a way to express the inexpressable. An often overlooked management tool can assist the process: the store of figurative language and symbolism that managers can draw from to articulate their intutions and insights. One form of figurative language that is especially helpful is the metaphor. Moving beyond the standard definition of allegorical expression, it refers to a distinctive method of perception. It is a common way for individuals grounded in different contexts and with different experiences to understand something intuitiively throught the use of imagination and symbols without the need for analysis or generalization. Metaphors allow people to put together what they know in new ways and begin to express what they know but cannot yet say. Metaphor is a highly effective catalyst in fostering and focusing on the creative process in the early stages of knowledge creation. Metaphor can either associate similar concepts or meld disparate ideas into discrepancy or conflict. In the latter, metaphor merges two different and distant areas of experience into a single, inclusive image or symbol that seem only distantly related. Often, metaphoric images have multiple meanings. Concept maps are a metaphor for the domain knowledge stored in an individual's mind or the corporate knowledge stored in the organizations knowledge base.

See the "Concept Mapping" concept map.

(4) from explicit to tacit knowledge

As new explicit knowledge is shared throughout an organization, other employees begin to internalize it. In other words, they use it to broaden, extend, and reframe their own tacit knowledge.

2. Capturing

Techniques for capturing knowledge: interviewing, protocol analysis, questionnaires/surveys, observation/simulation, learning by doing.

Once captured, knowledge must be stored in a repository for later distribution, retrieval, and access. Four approaches include: 1) knowledge attic, 2) knowledge sponge, 3) knowledge publisher, 4) knowledge pump

3. Combining

Once knowledge is captured its useful increases when combined with other knowledge, either stored in the knowledge repository or from outside users, to form new knowledge. Think of this a synthesis. Refer to the cognitive information processing model for an analogous process.

4. Coordinating

Knowledge transfer and distribution involves sending knowledge internally and externall to those who could benefit from the use and application of the knowledge. Usually there is an infrastructure within the organization whose responsibility is to handle this task.

5. Retrieving

B. Themes

Srikantaiaha

1. Document management

Emphasizes collection and policies and determines effectiveness of the information systems in terms of throughput, quality of informaiton, accuracy of informatin, completeness of information and relevancy of information.

2. Information technology

Information technology provides tools to support managment of explicit knowledge, and also to support communities of practice. IT is a powerful and necessary enabler for effective knowledge management, but require is not solely capable of supporting the entire KM system. All the other factors included in this concept map are required.

KM is seen as systems analysis, design, and implementation which emphasizes knowledge storage and access; "push" and "pull" approaches; networks; customer satisfaction; institutional culture; telecommunications; application software packages; and cost recovery. General technology tools include all the internet technologies (websites, WWW search engines, telecommunication links) and intranet technologies (LAN, WAN, servers, telecommunication links).

[Editor: Link to concept map "Knowledge Management + Concept Mapping" by double-clicking the top right corner of the symbol box.]

a. Concept Mapping

[Editor: This is the hyperlink to the concept mapping concept map. In diagram view, double click on the top right corner of the symbol to

access that concept map.]

C. Organizational culture

The corporate culture is transforming. Business in the late 1800s had knowledge concentrated at the top of the hierarchy. The rest of the employees were hired hands. In an information-based organization, the knowledge is primarily at the bottom, in the minds of the specialists who do different work and direct themselves (Drucker). Building a sharing culture is *the key* element for developing an organizational culture that nurtures organizational learning and organizational intelligence. Good organizational culture can be best understood by looking at the obstacles that hinder its development (Liebowitz).
• Organziational structures that promote isolated thinking, in which subgroups within the organization focus on maximizing their own accomplishments and rewards, hoarding information.
• A culture that values personal technical expertise and knowledge creation over knowledge sharing
• The lack of contact, relationships, and common perspectives among people who don't work in close proximity to one another
• An over-reliance on transmitting explicit rather than tacit knowledge
• Not allowing or rewarding pople for taking the time to learn and share and help each other outside of their own small corporate village.

Liebowitz (2000) states that creating and fostering a climate that promotes learning will ultimately give a sustainable strategic advantage to the organziation. Cultures that are most supportive of knowledge management have these common factors:
• exemplary leadership at every level
• celebrate successes of the organization
• provide the resources necessary for people to find the information and knowledge they need themselves
• clarify the business case and value proposition in concrete terms

1. WHY?

In 1988, Peter F. Drucker wrote that the typical large business in 20 years will not resemble the manufacturing giants of the 1950s at all, rather they will be structured like hospitals, universities, and the symphony orchestra. Like them, the typical business will be a knowledge-based organization ("knowledge organization") comprised of specialists who direct and discipline their own performance through organized feedback from colleagues, customers, and headquarters. This new entity will be classified as an information-based organization. (Harvard Business Review). Drucker continues his vision of the future:

• knowledge workers are evolving from manual and clerical workers
• economics and information technology dictate change; for large businesses to innovate and be entrepreneurs.
• organizations must engage in analysis and diagnosis of information or risk drowning in all the data generated

a. Global development

The World Bank identifies knowledge management as an "urgent necessity" for global development. Andersen Consulting has leveraged the knowledge of the worldwide workforce through its Knowledge Xchange system, a Lotus Notes-based system that allows storage of information objects. Andersen employees can access people, examples, data and presentations at a moment's need from anywhere. (Rossett & Marshall, 1999).

b. Access to intellectual resources

Companies are realizing that their competitve edge is mostly the brainpower of intellectual capital of their employees and management.

(1) Organizational intelligence

Organizational learning is the key component of organizational intelligence, which is described by Leibowitz as:
• the problem of gathering, processing, interpreting, and commmunicating the technical and political information needed in the decision-making process.
• information processing fuctions that permit adaptation to environmental demands and are related to innovation initiation and implementation
• understanding organizations as learning systems and creative systems

The ability of an organization to learn is an essential component of organizational intelligence. To accomplish this, employees and management must be able to "learn how to learn" as well as be adaptable to changes in the marketplace. The learning culture of an organization is made up of shared values, norms of behavior, symbols, and symbolic actions. The dimensions of the required values and beliefs include: truth, courage, self-mangement, conflict resolution, coopration, diversityh, decision making, participation, compensation, motivation, sponsorship, mistake-toerance, authority, creativity, rituals (symbols, myths), consistency, fairness, risk-taking, teams, empowerment, collaboration, power, sharing, partnering, information access, commitement, risk-tolerance,

competence, innovation, acceptable behaviors, change, focus, attention (Liebowitz, 2000).

c. Competitive advantage

to make the organization more productive, more effective, and more successful

According to Japanese organizational theorist Ikujiro Nonaka, "In an economy where the only certainty is uncertainty, the one source of lasting competitive advantage is knowledge" (Nonaka, 1991). Further, successful companies consistently create new knowledge, disseminate it widely throughout the organization, and quickly infuse it in new technologies and products. These are "knowledge-creating" companies whose purpose is continuous innovation. The competitive edge stays sharp when companies replenish their intellectual capital and knowledge assets, thus becoming a "knowledge organization."

d. Enhance collaboration

How can an organization increase its intelligence and rise up to the level of a "knowledge organization"? These strategies for enhancing collaboration should help.
• Develop knowledge repositories for perserving, sharing, and distributing knowledge
• Provide an appropriate motivation system to encourage employees and management to contribute to the organization's knowledge repository and use this knowledge
•Consider annual reviews of each member of the firm on the quality and quantity of knowledge contributed to the firm's knowledge bases, as well as the organizational knowledge used and value-added results obtained by that firm member
• Consider hlolding knowledge fairs/exchanges to encourage informal communication sharing amoung communities of practice

(1) Organizational learning

Transfer information and knowledge and make them available to the institution. OL emphasizes that the efficiency and effectiveness of knowledge workers depends mostly on how workers communicate and collaborate in ther efforts. The Japanese perspective presented by Nonaka (1991) is that knowledge should be seen holistically existing within a living organism; the company. Much like individuals, companies can have a collective sense of identity and fundamental purpose —self-knowledge—a shared understanding of what the company

stands for, where it is going, and what kind of world it wants to live in, and how to make that world a reality.

A few important ideas about organizational learning emerged from the 1998 Conference on Knowledge Management and Organizational Learning:
• The only way to sustain competitive advantage is to ensure that your organization is learning faster than the competition.
• Whereas knowledge should be seen as a resource and asset, learning should bes een as the process whcih really drives us. Learning shoud be our focus and the main strategic requirement.
• Knowledge is socially constructed within collaborative activity.
• Access does not equal success.

A key concept from Larry Prusak of IBM Global Services is paraphrased by Liebowitz (2000) is that knowledge originates in people and becomes "embodied" in networks and communities, "embedded" in work routines, practices, and norms, and "represented" in artifacts. In order to build knowledge capital (and organizational intelligence), social capital is likely the most critical element. Social capital involves: trust, cognitive space, time to reflect, coherence, shared vocabulary, symbols and signals.

See topic *Organizational culture.*

e. Improve productivity
How can a an organization improve its productivity and rise up to the leve of a "knowledge organization"?
• Enable and encourage innovation if the firm's human capital
• Invest in education and training of the firm's human capital
• Develop methodologies for managing and structuring the knowledge in the knowledge repositories
• Adapt to the changing competitive enviornment by forming project teams based on the employee knowledge profiles
• Integrate knowledge management within the strategic goals of the organization

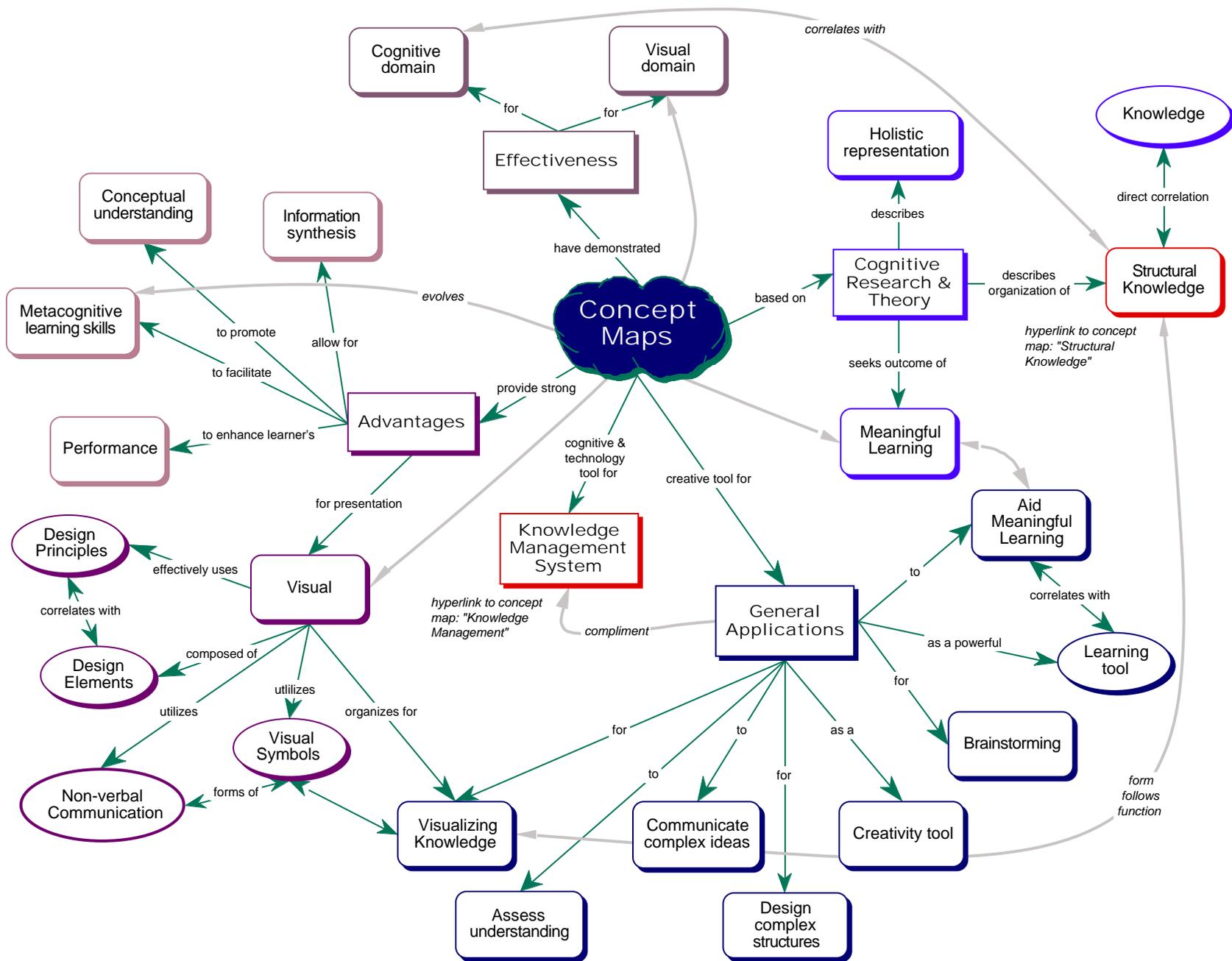## D. Miscellaneous Thoughts

1. Conclusion
Conclusion
This is the postindustrial age and even the information age is quickly fading into history as the knowledge age emerges. Knowledge is the synthesis of information and today information is a chaotic explosion of data that has

no meaning until captured and organized into meaningful patterns. Knowledge management is about an organization's systematic process of creating, capturing, storing, coordinating, and retrieving information that is known by the people associated with the organization and converting it into knowledge that would benefit others in the organziation. Why do ompanies bother with all the effort of knowledge management and becoming a "knowledge organization? It is for the purpose of maintaining a competitive edge by encouraging and nurturing innovation. The competitive edge is further defined by cost effective policies that create return-on-investment and the measure of success in a given market or domain. Knowledge is becoming a commodity on par with natural resources, such as oil, natural gas, and forests. The most successful organizations in the knowledge age will be the ones that know how to learn, especially from effective and innovative uses of their own storehouses of knowledge.

2. References

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Concept Maps

Concept Maps

- **Effectiveness** — have demonstrated — Concept Maps
  - for — Cognitive domain
  - for — Visual domain
- correlates with — Concept Maps
- Concept Maps — based on — **Cognitive Research & Theory**
  - describes — Holistic representation
  - describes organization of — Structural Knowledge
  - seeks outcome of — Meaningful Learning
- Knowledge — direct correlation — Structural Knowledge

hyperlink to concept map: "Structural Knowledge"

- Concept Maps — evolves — Metacognitive learning skills
- **Advantages** — provide strong — Concept Maps
  - to promote — Conceptual understanding
  - allow for — Information synthesis
  - to facilitate — Metacognitive learning skills
  - to enhance learner's — Performance
  - for presentation — Visual
- Concept Maps — cognitive & technology tool for — **Knowledge Management System**

hyperlink to concept map: "Knowledge Management"

- Concept Maps — creative tool for — General Applications

- **Visual**
  - effectively uses — Design Principles
    - correlates with — Design Elements
  - composed of — Visual Symbols
  - utilizes — Non-verbal Communication
  - utilizes — Visual Symbols
  - organizes for — Visualizing Knowledge
- Visual Symbols — forms of — Non-verbal Communication

- **General Applications**
  - to — Aid Meaningful Learning
    - correlates with — Learning tool
  - as a powerful — Learning tool
  - for — Brainstorming
  - for — Visualizing Knowledge
  - to — Communicate complex ideas
  - as a — Creativity tool
  - to — Assess understanding
  - for — Design complex structures
- compliment — Knowledge Management System
- Meaningful Learning — Aid Meaningful Learning
- *form follows function* — Structural Knowledge

- Visualizing Knowledge — Assess understanding
- Communicate complex ideas — Visualizing Knowledge
- Creativity tool — Communicate complex ideas
- Design complex structures

KEY: primary links   secondary links   hyperlink to a concept map

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Concept Maps

— Introduction

Also known internationally as Mind Map (Buzan) or locally called a 'mind tool' (Jonassen, et. al., 1998), a concept map is a representation tool that may be used as an adjunct to thinking. It is a way to organize knowledge. As you can see in the concept maps presented in this project, they are comprised of symbols (geometric shapes, graphics) called nodes, lines that connect the nodes (links), and propositions (words on the links) that make the connection between nodes meaningful. Holistically, the concept (main idea) presented is a representaton of the creator's knowledge of that domain. Concept maps may be drawn by hand or with computer software (Inspiration), as illustrated in this project.

Research on cognitive theory points to the use of concept maps as a useful tool for the representation of a knowledge structure, whether individual or corporate. The key point is that concept maps aid in meaningful learning and that can improve performance and achievement in school or the workplace. The broad application of concept maps is best seen in its application to creative thinking and visualization. In both cases, the goal is to communicate ideas (convert tacit knowledge into explicit knowledge) so that others can interact with and use it. The implications for education are enormous—improved learning and teaching. In a corporate setting, knowledge representation is a fundamental ingredient of an organization's success.

This concept map about concept mapping begins the process of building a case for the use of concept maps as a corporate knowledge management tool for the capture, storage, retrieval, and display of knowledge. The next concept map in this project is about knowledge management, which elaborates on these principles.

A. Cognitive Research & Theory

Tolman refers to *cognitive maps* and Bartlett & Piaget use *schemata* and Lewin's concepts of *differentiation* and *hierarchical organization*

"Common to all theory and research on cognitive style is an emphasis on the structure rather than the content of thought. Structure refers to *how* cognition is organized; content refers to *what* knowledge is available." [Goldstein, K.M. and Blackman, S. (1978). Cognitive style: Five approaches and relevant research. New York: John Wiley & Sons.]

1. Structural Knowledge

SK is most often depicted in terms of some sort of concept map that visually describes the relationships between the ideas in a knowledge

domain.

SK was also defined as conceptual knowledge, which is the the "integrated storage of meaningful dimensions...in a given domain of knowledge" (Tennyson & Cocciarella, 1986). It is the "understanding of a concept's operational structure within itself and between associated concepts." Conceptual knowledge is considered to be the facts, concepts, principles, and their interrelationships that apply to a specific content domain. See topic: 'Knowledge'.

Conceptual knowledge is used to develop procedural knowledge for solving domain problems. SK involves the integration of declarative knowledge into useful knowledge structures.

SK describes an individual's organization of ideas (knowledge structure) about different content domains. This knowledge is essential to understanding the content and the ability to apply it.

SK describes and facilitates the application of prior knowledge. SK is the knowledge of how ideas within a domain are interrelated (Diekhoff, 1983). Explicit awareness of of those interrelationships and the ability to personally describe those relationships is a fundamental component in prior knowledge and an essential component of higher order thinking. It is not enough to *know that* (measured by recall tests). To *know how* (application of prior knowledge), you must *know why*. SK provides the conceptual basis for *why*. It describes how prior knowledge is interconnected. SK enables learners to develop the understanding of connections that is required to describe and use prior knowledge.

(Jonassen & Grabowski, 1993)

    a. Knowledge
        Concept maps visually represent knowledge, which is comprised of facts, concepts, propositions, and principles. [Editor: See concept map, "Knowledge Management" for further details on knowledge.]

2. Holistic representation
        Gestalt psychology is the study of how people see and understand the relation of the whole to the parts that make up that whole. While appropriate recognition is given to component parts, Gestalt theory focuses on how the whole entity functions given its components and the interrelationships between them. A concept map is a holistic representation of component parts of a larger concept.

3. Meaningful Learning
> Ausubel: Assimilation Theory
> Joseph Novak (1960s)

B. General Applications
> The most common uses for concept maps or ideation software, like Inspiration, include:

1. Brainstorming

2. Creativity tool
> Freeform style of concept maps (they are whatever the creator *thinks* they should be) allows endless usage as a tool to facilitate the creative process for any type of project.

3. Design complex structures
> Hypertext design tool and modeling tool for hypermedia or web site design. Serves two possible functions: 1) as design tool it creates "blueprints" and plans or 2) as a hypermedia environment, it becomes the idea container system itself.

4. Communicate complex ideas
> Communication tool; create visual presentations, graphics, charts, etc. for the purpose of communicating concepts and ideas.

5. Aid Meaningful Learning
> Novak (1998) writes meaningful learning results when the learner chooses to relate new information to ideas the learner already knows (prior knowledge). The quality of meaningful learning is dependent on the conceptual richness of the new material to be learned. New material or knowledge to be learned, must be relevant to other knowledge and must have significant concepts and propositions (multiple concepts linked together). Meaningful learning is also enriched when the new knowledge can be strongly linked to relevant prior knowledge. The greater the interrelatedness of the learner's prior knowledge, the more likely new knowledge can be tightly bound to it. In addition, and perhaps most importantly, the learner must choose to learn meaningfully. There must be a high motivation to empower the learner to make a conscious choice to deliberately relate new knowledge to prior knowledge in a nontrivial manner.
>
> Romance and Vitale (1998) write that many cognitive science researchers

consider the goal of meaningful learning to be the continued, organizational development of conceptual understanding to move learners from a novice state toward that of expertise.

a. Learning tool

Concept maps represent knowledge acquired from any source, such as lectures, books, movies, audio sources, interviews, conversations, dreams, etc.
Refer to *Learning How to Learn* (Novak & Gowin, 1984). In this concept map, see "Effectiveness - Cognitive domain".

6. Assess understanding

Assessment tool used by teachers to determine the breadth, depth, and variety of linkages within a learner's cognitive understanding of a particular domain of knowledge.

7. Visualizing Knowledge

At a visual level visualizing knowledge as a concept map is organizing data in a recognizable visual pattern. At a cognitive level, it is showing an individual's structural knowledge. See topic: *Structural Knowledge.*

8. Knowledge Management System

As evidenced by the plethora of knowledge management books, a major problem faced by organizations is how to cope with volumes of information, particularly information acquired by staff over their years of experience in the organization. This issue is critical in corporate settings where knowledge is now recognized as more important that the traditional resources of land, labor, and capital. According to Nonaka and Takeuchi (1995, in Novak, 1998, p.34):

Knowledge is created by individuals. An organization cannot create knowledge on its own without individuals. It is, therefore, very important for the organization to support and stimulate the knowledge-crating activities of individuals or to provide the appropriate contexts for them.

The purpose and application of concept maps in the business environment includes all the reasons associated with the node "Purpose & Application." Visuals are an important, necessary aspect of business communication because good communication is profitable. The most common visual media are overhead transparencies, flip charts, 2X2 slides, electronic (computer) visuals, and document visuals. The visuals frequently used with these media include diagrams, graphs,maps, words,

multimedia, and hypermedia. Concept maps are a flexible, adaptable form of visual that can be comprised of each visual type. As a hypermedia or multimedia tool, concept maps can be adapted for use as a knowledge management system or be used as only a component. Concept maps are usually described in the literature as a representation of an individual's knowledge, unique to that person's semantic network. It is conceivable that concept maps can be a representation of corporate knowledge, unique for that entities organization of knowledge. A concept map can also be used to show the structure of an organization (i.e., organization chart), thus indicating its holistic purpose and showing the interrelationship of offices, departments, functions, and people.

[Editor: Link to concept map "Knowledge Management" by double-clicking the top right corner of the symbol in diagram view.]

C. Advantages

1. Visual

In order to create a concept map that effectively communicates, the designer must be familiar with the language of visuals and design considerations. Design considerations comprise two areas: design elements and design principles. In this concept map, see "Effectiveness - Visual domain".

a. Design Elements

Design elements are the building blocks or basic units of construction of the visual piece. For a concept map, the design elements include nodes, links, shapes, text, white space, and other graphics. The elements have form and attributes. Form is the primary identifying characteristics of the space it occupies. Each element and its form have attributes, (i.e., color, shape, proportions, dimension, and direction) that can be manipulated.

When creating a visual like a concept map, it is important to begin with consideration of the target audience and the characteristics and purpose (objectives) of the communication medium.

b. Design Principles

To facilitate reading, comprehension, and retention, the concept map design should include:
• restructure the text using verbal and visual cues, chunking, and page layout
• build internal connections among different concepts

• place visuals next to relevant text so novices can go back and forth between text and pictures
• Provide executive summaries and overviews with the concept maps
• use pointers to identify critical attributes to facilitate subsequesnt identification

To best communicate the intended message, Merton Thompson in his chapter in Dwyer's Visual Literacy (1994), presents eleven general design principles as guidelines for effective visual communication:
• simplicity
• clarity
• balance
• harmony
• organization
• emphasis
• legibility
• unity
• perspective
• point of view
• framing

C.R.A.P. = Robin Williams, noted author of graphic design books for non-designers, espouses the virtues of CRAP for proper design guidelines. The four letter acronym is easier to remember than Thompson's eleven principles and produces very satisfactory results.
• Contrast (size, color, placement, balance)
• Repetition (consistent use of same or similar elements; elements that are consistently organized in a pattern)
• Alignment (justification, spacial relationship of elements to one another on the page)
• Proximity (related elements are located near, next to, or in obvious visual relationship with one another)

c. Visual Symbols

A symbol is a visual representation or expression of some abstract or concrete event or idea. It signifies something. Symbols are the basis for all significant communication. It begins as some arbitrary construction that is given meaning. After communication, is the concept of using symbols as knowledge. The degree of knowledge required to interpret the meaning of a symbol varies from basic knowledge to complex and obscure knowledge. As a communication tool symbols identify action, individual, organization, direction, concept, philosophy,

a notion, or a thing.

d. Non-verbal Communication

Object language - objects can by their arrangement, location, convey information and instruction. The ability of people to "read" object codes is very important.

Graphics are simply the means through which people communicate. They are a one-way form of communication, in that generally, they do not allow for feedback from their audience in a similar form. Graphics, when used properly, can be a valuable tool in enhancing communication. The forms of graphics is varied: symbols, maps, graphs, diagrams, illustrations, photos, 3D models, graphic devices and elements, composite graphics. Graphics, according to the American Institute of Graphic Arts, can be described as serving the following positive functions: informing, directing, exciting, inviting, explaining, entertaining, simplifying, identifying, educating, demonstrating, motivating, organizing, inspiring, selling, promoting, and warning. Graphics communicate, sometimes correctly or sometimes poorly, nevertheless, if it is seen, it will be interpreted consciously or unconsciously. It is important to know that without knowledge of how graphics function (visual literacy), the viewer is left out of an important, powerful level of discourse. The viewer is subjected to a one-way communication process without understanding the full meaning or intent. Every non-verbal form of communication will be affected by the communication process (sender -> filter -> receiver) psychological constructs of the viewer, such as cultural bias and semiotics (theories of sign). (Saunders in Dwyer)

2. Information synthesis

Learners can use concept map software to record and organize information from multiple sources in preparation for writing, research, or project development. The concept map serves as a vehicle for organizing the information around key ideas, as well as a fluid medium for reorganizing the information as the learners' knowledge about a topic expands and perceives new patterns (Anderson-Inman, L. & Horney, M., 1996)

3. Conceptual understanding

Concept maps promote conceptual understanding through identifying cause-effect relationships, prioritizing and organizing concepts, and displaying other meaningful patterns of ideas (Romance and Vitale, 1998).

4. Performance

5. Metacognitive learning skills

Concept maps can facilitate metacognitive learning skills, such as note taking, textbook comprehension, organization for papers, project planning, preparing for exams.

D. Effectiveness

Researchers investigating the use of concept maps in science reported:

1) consistent correlations existed between quality of concept maps and other measures of student achievement.

2) students using concept maps displayed greater achievement on three conceptually based measures: a multiple-choice measure of misconceptions, a fill-in-the-blank concept map instrument, and a general measure of concept relatedness.

3) use of concept maps in combination with lecture in college biology class resulted in significantly better student learning and retention.

4) concept mapping skills to be powerful learning tools for enhancing students' performance.

(Romance & Vitale, 1998)

1. Visual domain

As a visual form of communication, concept maps are highly effective for conveying complex or highly interrelated knowledge in an holistic, easier-to-understand manner.

2. Cognitive domain

In the book, *Handbook of Individual Differences, Learning, and Instruction*, Jonassen and Grabowski (1993) present research that strongly indicates high levels of structural knowledge enhances learning. Specifically:
• problem solving and transfer of learning
• comprehension or understanding of material to be learned
• retention and memory of material

They deduced from the research that those who possess more SK will be more effective at acquiring these learning strategies:

* evaluating current information
* analyzing of key ideas
* generating metaphors and analogies
* predicting outcomes, inferring causes, and explaining implications

Given that concept maps are a visual form of structured knowledge, these findings indicate that concept maps would enhance learning and assist the learner in acquiring learning strategies (Novak, 1998). Further, for the individual user, concept maps acquire the essential purposes and enabling properties of structural knowledge.

E. Miscellaneous Thoughts

1. Conclusion
Concept maps are an excellent way to help learners organize knowledge, to empower themselves to better comprehend the key concepts, and principles in lectures, readings, or other instructional materials. Students using concept maps discovered they were learning how to learn and becoming better at meaningful learner. In the corporate setting, concept maps serve much the same role for employees. Specific application includes organziational charts, communication pieces, visual aids, hypermedia design tools, hypermedia interface design, creativity, knowledge capture.

Born from cognitive research, concept maps can serve as the visual representation of one's structural knowledge about a given domain. In a holistic manner, as supported by Gestalt theory, an individual's domain of knowledge can be presented in a concept map that can be viewed all at once. The component parts are visible and clearly articulated on the concept map with nodes, symbols, and links (propositions) that shows an individual's conception of a particular knowledge domain. This visual representation of knowledge is a creative, powerful communication tool. The many other applications of concept maps listed in this project are applicable to both education and corporate settings.

The main point of this concept map about concept mapping is to build a case for the use of concept maps as a knowledge management system (albeit a simple one) or as the interface for a more sophisticated KM system. The applications for concept maps presented here, along with the research on meaningful learning and the research on effectiveness of concept maps as visual and cognitive tools, strongly support the possibility for integration with knowledge management systems.

2. References

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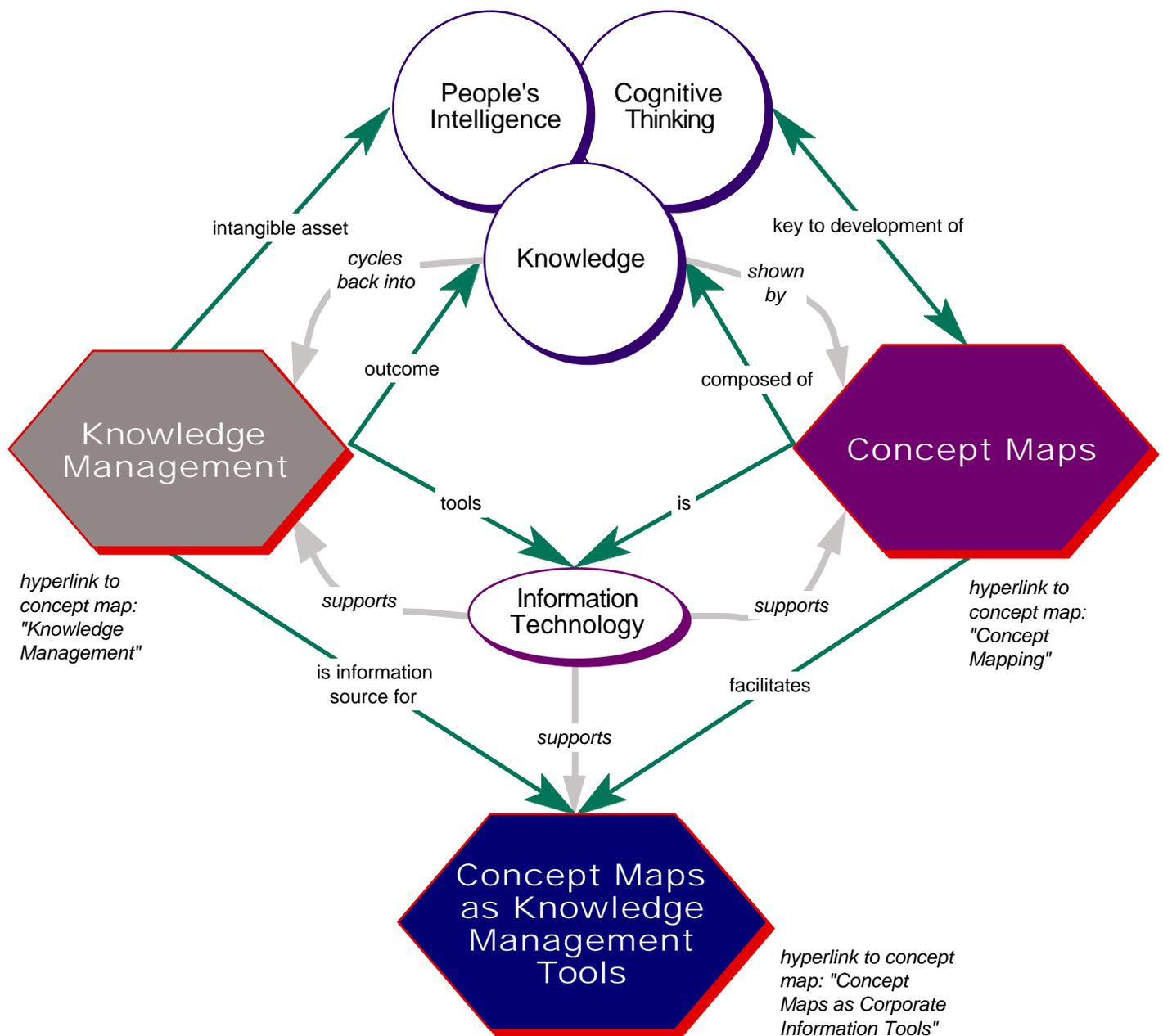
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People's Intelligence

Cognitive Thinking

Knowledge

intangible asset

key to development of

cycles back into

shown by

outcome

composed of

Knowledge Management

Concept Maps

tools

is

supports

Information Technology

supports

is information source for

facilitates

hyperlink to concept map: "Knowledge Management"

hyperlink to concept map: "Concept Mapping"

supports

Concept Maps as Knowledge Management Tools

hyperlink to concept map: "Concept Maps as Corporate Information Tools"

KEY: **primary links** **secondary links** hyperlink to a concept map

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October 2000

Concept Maps as Knowledge Management Tools

Joseph D. Novak is credited with coining the phrase 'concept map' and is widely recognized for his work on the development of a comprehensive theory of education. In his book, *Learning, Creating, and Using Knowledge,* (1998) he addresses the central problem of 'creating knowledge' with theoretical explanations, insight, and a set of practical tools for implementing a knowledge creation process. The focus is on making formal and informal learning more meaningful and empowering people by helping them to take charge of their own meaning. He argues for the use of concept maps and related metacognitive tools to advance and consolidate learning. The context for learning is education and corporate.

Novak addresses the corporate need for creating a learning environment since the future economic well-being of an organization rests on its effectiveness to empower its workforce to be more effective learners, knowledge creators, and problem solvers. Problem solving has become critical in the highly competitive corporate environment. Knowledge and knowledge creation also become principle resources for increasing profitability in the current society.

Concept maps play a valuable role in helping an organization gain competitive advantage by capturing and utilizing the collective knowledge of its employees and managers. Managing the knowledge (cognitive and psychomotor) of employees is called knowledge management. See the concept map "Knowledge Management" for explanations of the knowledge management domain.

This concept map shows the important intersecting points and relationships of concept maps and knowledge management.

See the concept map, "Concept Maps as Corporate Information Tools" for a sketchy overview of the topic. Double-click the top right corner of the symbol.

Cognitive Thinking

In part, the defintion of cognitive thinking is the mental work of processing information, forming concepts, and creating knowledge. For creating concept maps, cognitive thinking is critical for determining which concepts and relationships to show for a given knowledge domain. Closely related to knowledge and intelligence.

Knowledge Management

For a more complete explanation of the domain of knowledge management, see the concept map, "Knowledge Management". Double-click the top right corner of the symbol in diagram view. In this representation, only the most important factors

of knowledge management shared with concept maps are shown.

Concept Maps

As described in the concept map, "Concept Mapping", the definition is a hierarchical diagram used to represent a set of concepts beginning with the most general or most important, and then working down to more specific detail. Key concepts are connected by links that have descriptive words on them explaining the relationship between the concepts.

People's Intelligence

New knowledge always begins with the individual regardless of position in a company. (Nonaka, 1991)

People are at the core of knowledge management. It is their brainpower that is the resource that fuels the process. Intelligence connotes a capacity to evaluate and synthesize information, forming concepts and relationships. That process of cognitive thinking which overlaps intelligence, is the essence of concept maps. Both intelligence and cognition are the characteristics of people, therefore they overlap in the diagram. The outcome of the cognitive process is the creation of new knowledge. Knowledge, cognitive thinking, and intelligence are related and form a common triad between knowledge management and concept maps.

Knowledge

Nonaka writes, "In an economy where the only certainty is uncertainty, the one source of lasting competitive advantage is knowledge" (Nonaka, 1991). Further, successful companies consistently create new knowledge, disseminate it widely throughout the organization, and quickly infuse it in new technologies and products. These are "knowledge-creating" companies whose purpose is continuous innovation. The competitive edge stays sharp when companies replenish their intellectual capital and knowledge assets, thus becoming a "knowledge organization."

In this fusion of knowledge management and concept maps, knowledge is the key ingredient shared by both concepts. The concept map visually presents the knowledge in a manner meaningful to the person who created it.

See the concept map, "Knowledge Management" for a more complete description of knowledge. See the concept map, "Concept Mapping/Structural Knowledge" for a related topic.

Information Technology

Information technology provides the means to develop a Concept-Map based Electronic Knowledge Capture, Storage, and Retrieval system, or Knowledge Management system. Novak (1998) writes: A major project is underway with the Navy and NASA to capture the knowledge held by experts using interviews and concept maps. Concpet maps will also provide the basis for easy access to this knowledge. One of the major difficulties faced in using and retrieving information stored electronically is that traditional search strategies can provide thousands or een millions of references if one or several pertinent keywords are used to generate the search. Most of these references have little or no relevance to the searcher's needs, but adding more explicit keyword combinations can eliminate desired information as well as irrelevant information.

The advantage of using computer search engines based on information stored in concept maps is that knowledge is highly organized in a concept map, and each proposition in the map is set in a context, thus aiding the searcher by providing relatively easy selection of the most pertinent infformation. Maps can be stacked hierarchically, where selecting and clicking on a concept on a global map can bring up on the screen a subordinate or more explicit concept map with greater detail. Any number of map hierarchies can be programmed into concept maps for a given domain of knowledge. Furthermore, a searcher can easily scroll across and up and down a concept map to see other related concepts and propositions, somem of which might never have been known or considered if only keywords were used to guide the search. Thus, information stored as concept maps is contextualized, not random bits, and locating knowledge is a much more orderly process. Such search process have already been build into AI programs to train physicians with astonishingly good success (Canas & Ford, 1992; Canas, Ford, & deBessonet, 1993; Ford, Stahl, et al., 1991, in Novak, pp.217-218)

The hardware and software tools, resources, processes, and network infrastructure currently utilized by the global society are the necessary components to enable a dynamic knowledge management system. One of those tools is the concept map and the software tools that help create them.

Conclusion

Novak (1998, p 219): I expect an extraordinary growth in the development of computer tools and strategies for using concept maps to create, acquire, store, and utilize knowledge. He also anticipates a revolution in the way we think about knowledge, teaching, and learning.

The three concept maps presented in this project, "Knowledge Management," "Concept Mapping," and "Concept Maps as Knowledge Management Tools" show the theoretical basis and practicality of using the concept map metaphor as either an interface for a sophisticated knowledge management system or as a

complete, simple knowledge management system. Ideally, the sophisticated system would give a user access to a knowledgebase by allowing them to dynamically construct a concept map interface of their own representation of the content and the linking relationships.

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APPENDIX A

Viewing concept maps in electronic form with Inspiration software

Inspiration software (Macintosh and Windows) allows the user to 'interact' with the content of a concept map. Viewing concept maps in electronic form allow for a more dynamic viewing experience and underscores the relationships established from a single node to a whole concept map.
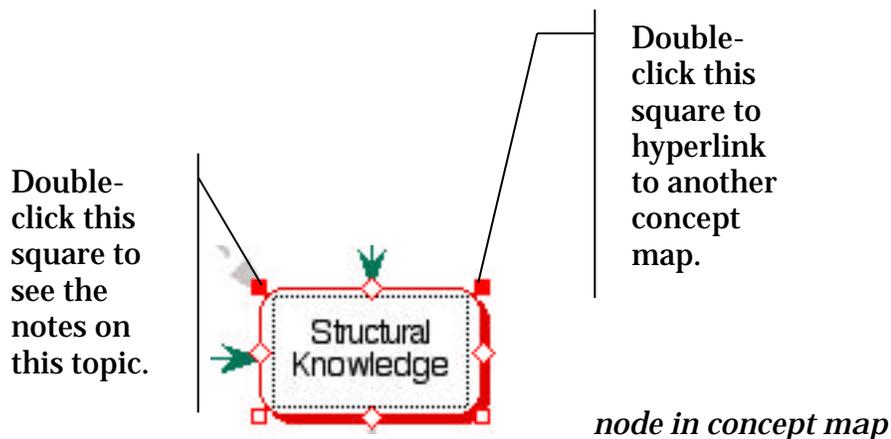
Opening the concept maps

Insert the attached Zip disk (Mac only format) into the Zip Drive. You may start with any concept map by double clicking on its icon, *however,* the recommended order of viewing is listed below:

1) Knowledge Mgmnt   2) Concept Mapping   3) KM + CM
(Knowledge Management)   (Knowledge Management and
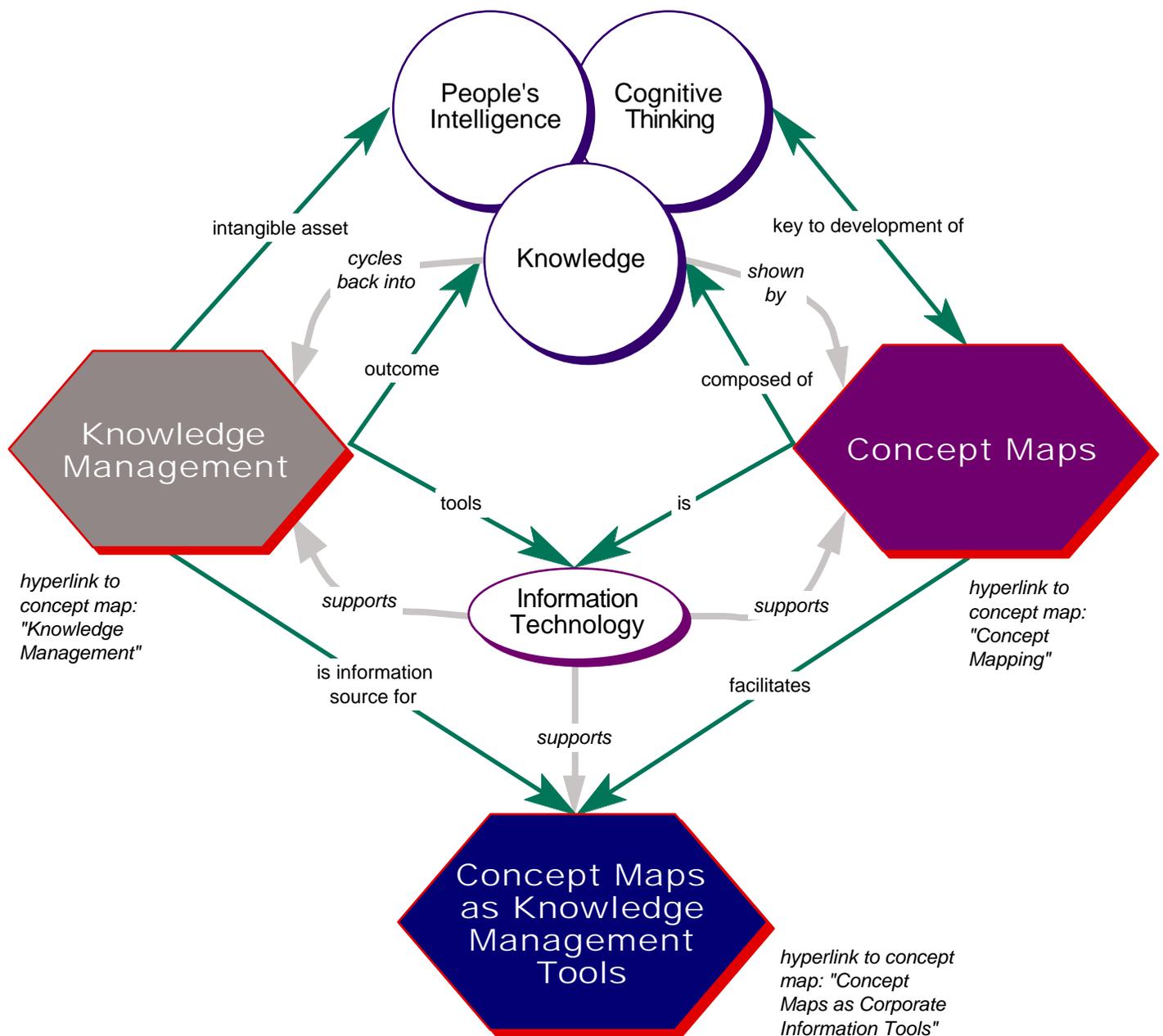   Concept Maps)

Opening an associated concept map in diagram mode

For the concept maps in this project, any nodes colored red in a diagram indicate a link to another concept map. To access the other concept map, double-click the red square in the top right corner (see below). The requested concept map will open in a new Inspiration window with the title of the node you just clicked.

Double-click this square to see the notes on this topic.

Double-click this square to hyperlink to another concept map.

Structural Knowledge

node in concept map

Viewing notes while in diagram mode

To view the notes on related to a topic (node), double click the red square in the top left corner. The node color varies and is not an indicator that a note is associated with it.

People's
Intelligence

Cognitive
Thinking

Knowledge

intangible asset

*cycles
back into*

*shown
by*

key to development of

outcome

composed of

**Knowledge
Management**

tools

is

Concept Maps

*hyperlink to
concept map:
"Knowledge
Management"*

supports

Information
Technology

supports

*hyperlink to
concept map:
"Concept
Mapping"*

is information
source for

facilitates

supports

**Concept Maps
as Knowledge
Management
Tools**

*hyperlink to concept
map: "Concept
Maps as Corporate
Information Tools"*

KEY: **primary links** **secondary links** hyperlink to a concept map

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