Adaptive Management of Knowledge Ecosystems

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Abstract

The knowledge ecosystem concept and the related concept of information ecology are key foundations of participatory processes relating to sustainable development. Knowledge ecosystems can be defined as "the complex and many-faceted system of people, institutions, organizations, technologies and processes by which knowledge is created, interpreted, distributed, absorbed, and utilized."   The analogy of knowledge ecosystems to natural ecosystems is explored in relation to forest planning processes.

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Introduction

Many jurisdictions mandate stakeholder participation in forest planning processes, as encouraged by Agenda 21[1]. As the interaction of people and technology increases, we need to understand how individuals, organizations, cultures, and forms of knowledge relate in order to develop appropriate systems and processes. This need has led to the related concepts of Information Ecology and Knowledge Ecosystems (Davenport and Prusak 1997; Por 2000; Nardi and O'Day 1999). For the present study, a Knowledge Ecosystem is defined as "the complex and many-faceted system of people, institutions, organizations, technologies and processes by which knowledge is created, interpreted, distributed, absorbed, and utilized." The place where a participatory meeting is held thus becomes the environment.

"Adaptive Knowledge Management" (AKM) is a new system design philosophy specifically geared to participatory processes (Thomson 2005).   In AKM, hypotheses can be developed regarding the relative importance of costs (both time and money), roles, expertise, responsibilities, flow and transformation of information, products, and indicators of success. The present study extends the concept of AKM, developed in relation to customized reporting, to cover the more general issue of stakeholder meetings, their electronic analogues, and the role of KM systems in the process. The approach taken will be to explore a range of ecological analogies, highlighting the questions raised by the analogy with respect to design of forest planning processes.

Knowledge Ecosystems

There are many approaches to forest planning, but all have features in common: describe the process and identify participants for that plan; identify the temporal and spatial scope of plan along with needs, risks and information requirements; define land zones and set objectives and targets; develop strategies for managing resources as well as monitoring, communication, and opportunities for plan revision. Planning provides a future vision for land and resources, the steps to follow to achieve that vision, and the processes to determine the vision and steps. In forest planning there is a hierarchy of

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[1]http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm (Accessed October 2, 2003)

levels, from operational to strategic plans. Each level involves a different set of sectors, institutions and stakeholders. Stakeholders have a range of education, technological expertise and worldviews, with the worldview often being related to the institution or organization the stakeholder represents. Outputs of a planning process are, by definition, plans; i.e., a recommendation for a specific course of action, with plans at one level often being constrained by requirements of higher level plans, as well as constraining lower levels. Planning processes often mandate stakeholder involvement. Higher level planning in particular is often a lengthy process involving many meetings.

The analogy of trophic levels and food webs reflects the hierarchy of meetings in the planning process. Ecological pyramids show decreases in numbers, biomass or energy towards the top of the pyramid. On average, about 10% of the energy available in one trophic level will be passed on to the next. Death of organisms returns material to the base of the pyramid, giving flow in the opposite direction (Fig. 1).   The ecosystem approach applied to the knowledge pyramid focuses attention on issues for participants as their knowledge amalgamates with other sources and filtered during the synthesis process. Issues include: Who draws the inferences from the material presented? Do participants have an opportunity to see how their information is used and provide feedback before the summary is transmitted to the next level? Where does the summary go - to what individual or group and what are their roles and responsibilities?
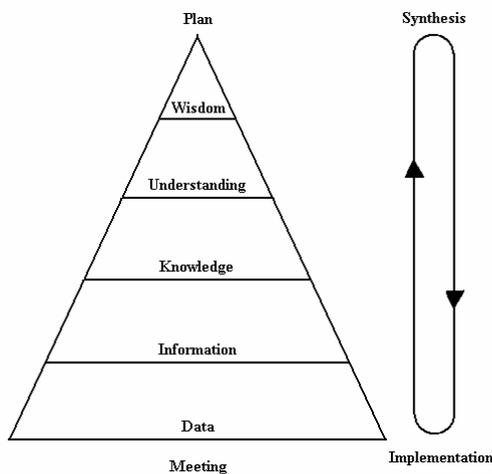
Figure1. Stages of synthesis between initial meetings and the actual plan are illustrated in a knowledge pyramid.
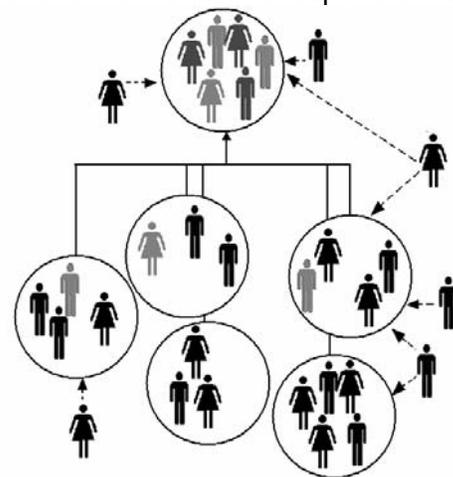
Figure 2. Metapopulations: Shadings indicate participation at different levels. Dashed lines indicate extraneous influences.

At a particular position in the planning hierarchy, there may be many meetings at different locations involving different groups of people and organizations; this is captured by the analogy of metapopulations (Figure 2).   A metapopulation is a group of subpopulations, each isolated in a patch of habitat. The different populations are able to exchange individuals by migration and to recolonize sites where the species has recently become extinct.   The metapopulation concept highlights issues related to multiple groups in a hierarchical process. How uniform are the conditions under which each group operates? How are the outputs of the different groups synthesized? How is representation at higher levels determined and to what extent is the representative bound by group decisions? Do all meetings at one level have the same agenda, and if not, what are the consequences? How do individuals' roles vary with venue and stage of the process? How are extraneous sources of information included?
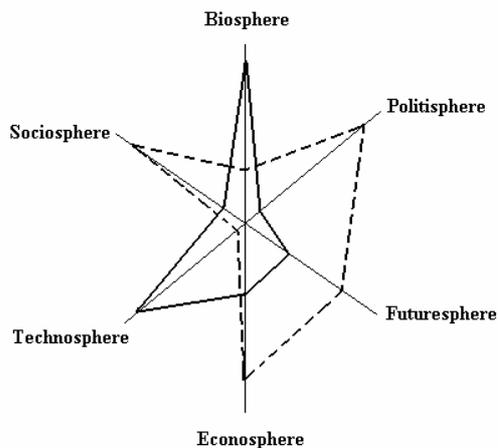
Figure 3. Star diagrams can be used to characterize meetings. A science meeting (heavy solid line) and a forest employment policy design meeting (dashed line) are illustrated.
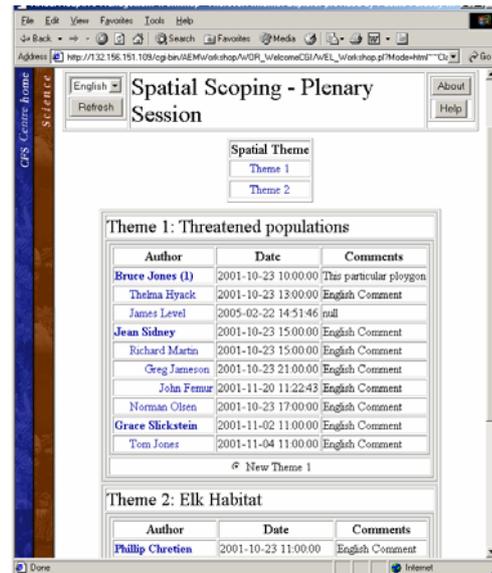

Figure 4. Tracking debate in the spatial scoping tool by an indentation hierarchy.

The geochemical model of the earth is based on the concept of four spheres: atmosphere, lithosphere, hydrosphere and ecosphere or biosphere, whereas knowledge can be partitioned into six spheres: Biosphere, Sociosphere, Technosphere, Econosphere, Politisphere, and Futuresphere. Star diagrams based on this concept can be used to characterize the nature of a meeting (Fig. 3). Distance along an axis may reflect the range of expertise included for each domain to provide a guide to the required range of participants balanced against optimal numbers: How can one ensure that a single expert will bring the required breadth to the deliberations? To what extent can other meetings at the same level be relied on to provide breadth? Stars can also be used to ensure an appropriate mix over a set of meetings, or to evaluate the extent to which actual participation met a desired level.

Other concepts contributing to an expanded view of knowledge ecosystems include "sustainability", "resilience", "ecosystem restoration", "information pollution" and "semantic drift". The concept of resilience also pertains to recovery. The related concept of "panarchy" (Gunderson and Holling 2002) involves cycles of destruction and reorganization providing opportunities for reorganization of the structure and processes of a system. A hierarchy of cycles within a process can lead to a disruption at one level cascading through other levels. Ecosystem restoration, the process of reestablishing, the structure, function, and composition of ecosystems, implies returning to an original format rather than taking advantage of new opportunities. Questions include: Should change be encouraged (panarchy) or discouraged (restoration)? Does the process provide any mechanism to increase resilience? If a group falls apart, are there any contingency plans for its restoration? Is restoration possible (or desirable)?

Information pollution includes wrong (or outdated) data, ambiguity, incompatibility of systems and languages, under-use of hardware, hacking, viruses (Capurro 1990). As knowledge flows through a hierarchy of meetings (Fig.1, 2), it is filtered and transformed; however, "information pollution" can result in inaccuracies in that process. Genetic drift refers to the constant tendency of genes to evolve even in the absence of selective forces. Similarly, semantic drift (Davenport and Cronin 2000) suggests that in an extended process, the meaning of terms can change. Semantic drift may contribute to information pollution.

Knowledge management for the meeting space environment

The knowledge ecosystem concepts and the questions raised above can be applied to any participatory process, without any technological components. However, meetings can be virtual, as in a virtual Adaptive Management workshop. In ecosystems, organisms interact through processes such as predation and herbivory; in knowledge ecosystems, individuals interact through processes such as debate. The system developed by Thomson (2000) brought together a diverse set of knowledge management tools developed as java applets. However, experience with these tools indicated that they did not easily track required attributes of debate. Since that time, the system has therefore been redesigned using a consistent approach based on XML. While the opening page of the new system is similar in appearance to the former applet based system, the underlying structure and construction method is very different, and subsequent pages for the range of tools have been redesigned in a manner that facilitates tracking debate (Fig. 4).

Whether it will be possible for a process to evolve with experience is a key decision made at the start of the process. The concept of "fitness landscapes"[2] is key to process evolution. A fitness landscape can be considered as representing how likely a set of conditions is to lead to a successful process. Experience may indicate the optimal set of conditions. However, the existing process, although not the best possible, may be working satisfactorily. The fitness landscape can then be used to indicate whether an attempt to switch to the optimal process might first require passing through transition stages with low likelihood of success, indicating maintenance of the *status quo*.

Discussion

Real world ecosystems provide a powerful analogy for Knowledge Ecosystems, explored in relation to forest planning processes. The exploration extended the existing view of the concept by introducing analogies: trophic levels to information synthesis in hierarchical processes; competition in food webs to competition in relationship webs; metapopulations, and succession and cycles to the life cycle of parallel meetings at one level of a hierarchical process. These analogies permit the Knowledge Ecosystem approach to provide a number of concepts to guide creation of successful future participatory processes, and also to guide participants in existing processes.

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[2] http://en.wikipedia.org/wiki/Fitness_landscape

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