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From encyclopedism to domain-based ontology for knowledge management: the evolution of the Sachs Classification (SC)

Abstract: A historic development from the mid-20th century has promise for utility in the global organization of knowledge in the 21st century and beyond. Essential concepts of knowledge organization such as the origin of domain- and ecology-specific ontologies are explored, and insight into classification warrant is offered. The Sachs Classification as it now exists and the *Worldmark Encyclopedia* from which it evolved are described. The continuing evolution of knowledge organizations based on the methodology of the Sachs Classification is demonstrated. Promise for enhanced knowledge management, and for management of electronic resources is demonstrated. The Sachs Classification can be viewed as a methodology for potentially powerful knowledge management through the development of domain- and ecology-specific ontologies, and its methodology is demonstrated as applicable to new and evolving knowledge domains.

1. Introduction

We describe a historic development from the mid-20th century that has promise for utility in the global organization of knowledge in the 21st century and beyond. *The Worldmark Encyclopedia of the Nations,* first published in 1960, was supranational in scope—its editorial policy relied upon a common heritage in knowledge that transcended the boundaries of nation-states. The point of supranationalism as an editorial policy was to liberate the reporting from artificial boundaries imposed by political concerns. The ontology that underlay *The Worldmark Encyclopedia,* here described as The Sachs Classification, is itself an initial stage in the development of a supranational system for knowledge organization.

Several authors have pointed to a need for classification research to turn to post-modern concepts of inter-disciplinarity, multi-disciplinarity, and reliance on domain-specific ontologies. For instance, Mai (1999) suggested that post-modern organizations of knowledge can no longer seek universality in their scope. He suggested that the attempts of the late 19th and early 20th centuries to concatenate universal orders of knowledge were inherently doomed to fail because the diversity of knowledge domains is such that there can be no universal order of knowledge. Rather, many orders are possible and all might be useful. Hjørland and Albrechtsen (1999) concurred, suggesting that increased inter-disciplinarity and multi-disciplinarity in classification design—a postmodern approach—could be anchored in discourse communities. They suggested knowledge organization should be shifted toward a semiotic approach, with a concomitant shift to historical and social understanding of knowledge. And Albrechtsen (2000) described "information ecologies"—socio-technical environments that involve a diversity of actors yielding self-organizing systems for knowledge organization. These systems are evolutionary, yet the resulting domain-specific

ontologies (or classification schemes based upon them) can be usefully distributed on a global scale.

The Sachs Classification (SC) is an example of a post-modern approach to ontology that embraces domain-specific input from the information ecologies of its component elements. Designed not to serve as a classification of documents, but rather as an ontology to undergird the construction of an encyclopedia, the SC presents a unique view of the potential for post-modern knowledge organization. Therefore, the SC also presents an opportunity within its methodology for the evolution of domain-specific ontologies for knowledge management.

2. The Sachs Classification

The SC was designed as the ontological basis for the *Worldmark Encyclopedia of the Nations*, the first edition of which was published in 1960. Envisioned as a supranational encyclopedia, editorial work began in 1953. From the beginning, the editorial policy was to establish a universal framework for the description of the world's nations and their inherent constituent characteristics. However, as the effort unfolded it was discovered that global diversity required a more rational construct to generate workable schema for the various nations. Thus, the eventual encyclopedia represented a very post-modern approach for its time, generating distinct schemata for the nations based on individual judgments by communities of local geographers.

The encyclopedia was conceived as a geographical enterprise, encompassing knowledge generated by a wide array of sciences, including geomorphology, geology, oceanography, and more than 20 other sciences. The challenge was to create a supranational schema that would serve as a framework for an expandable reservoir of facts about all countries. A hierarchical system was devised by consulting teams of local geographers, thus the schema represented a geographically-specific information ecology. Following the publication of the encyclopedia, editorial effort focused on attempts to expand the subdivisions of the ontology to generate a schema that would cross geographical boundaries. This effort resulted in the ontology represented by the Sachs Classification, which was first outlined in 1965.

The Sachs Classification (SC) targets direct access to details rather than to subject areas and titles. It is designed to trace the natural occurrence of thought as it evolves in academe. The hierarchical order and the domain-specific generation of genus-species relations is founded on a warrant styled "academic." Academic warrant can be distinguished from the literary warrant endemic in library classification schemes first and foremost because SC does not represent documentary content. Rather, it represents scientific order shaped in academe and refined by individual communities of scholarship, politics, and other cultural endeavor. SC is the product of an open ontological method, designed to yield domain-specific orders for the management of knowledge.

Basically, the natural growth of knowledge transcends, indeed ignores, preexisting limitations on thought. The SC, therefore, being based on "academic warrant," takes each discipline as a prime base. It follows the natural development of the body of knowledge of each discipline, adhering to developments and mutations of each division and subdivision. The ontology remains open to the evolution of not only disciplines, but domains and information ecologies.

The open methodology of the SC is related to the phenomenological method as described by Edmund Husserl ([1913] 1958). Phenomenology is an epistemological tool for analyzing isolates, which Husserl refers to as *eideia*, that are recognized as absolute and independent entities. However concrete they might be, intentional human perception of them is framed by experience and expressed through a filter of ego-acts such as volition and feeling—these he calls *noesis*. The corresponding objects are styled *noems*. Thus for every isolate (or *eideia*) the method must take into account both the intentional human perception as well as the object

perceived. *Noesis* and *noem* thus reside in a circular relationship that brackets each *eideia*.
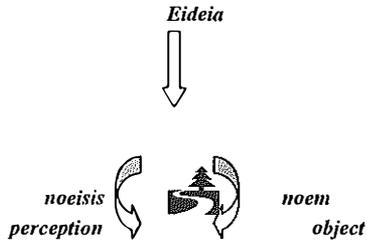

Figure 1. Phenomonological epistemology

Husserl's traditional example is a very real apple tree, which can be described in absolute terms, but can also be bracketed by its noetic value (for instance, pastoral) and its noema (the apples, the shade, etc.).

The SC aims at creating an open-ended schedule across its knowledge base. While providing an orderly access to each isolate, the schedule also provides orderly access to the evolving (or mutating) components of the classes. Because of the natural appearance of subjects in various classes (i.e., distributed relatives) the system automatically interrelates (or hyperlinks) across arrays.

The structure of the SC belies its flexibility. By following the extant organization of the sciences, SC in effect, utilizes a system of avenues that have been developed over the generations. These avenues have been challenged and defended, reassessed and revamped innumerable times. They have endured changes of basic concepts and formulations. They are, indeed, scientifically time tested. Yet, the SC at present is hardly complete—it is a beginning, a promising methodology for the development of ontologies for knowledge management across globally diverse cultures and ecologies.

3. SC's practical approach to knowledge organization

The SC is the result of an effort to create a practical approach to knowledge organization, developed from a direct approach to information gathering per se. The SC evolved naturally out of an endeavor to find a logical, orderly, and systematic approach to knowledge gathering and treatment (essential components of knowledge management). At present the SC exists as a special classification (see Satija 2000, 223), because only geography has been completely mapped. However, the potential exists for the SC to evolve into a general classification that can embrace a large repository of knowledge (such as a digital library) or that can be used for domain-specific knowledge management. In the SC as it now exists, the intricate network of specific subjects provides a naturally parceled ground that serves as a fertile receptacle for new knowledge. Innovations in thought, no matter how minute or esoteric they might be, can find their way to appropriate places within the schema.

For example, as noted above, the SC was used for the creation of a schema for a global encyclopedia of geography. Figure 2 demonstrates the 25 classes represented in the SC's "geographica" schedule.

1. General
2. Geomorphology
3. Geology
4. Oceanography
5. Inland Water

6. Meteorology and Climatology
7. Soil Classification
8. Biogeography
9. Human Geography
10. Economic Geography – Geographic Distribution
11. Economic Geography – Natural Resources
12. Forest and Naturally Occurring Vegetation Resources
13. Resources from Naturally Occurring Animal Life
14. Fish and Other Marine Life Resources
15. Agriculture
16. Animal Husbandry
17. Industrial Production
18. Transportation
19. Communications Media
20. Commerce
21. Labor
22. Cartography
23. Geographical Research
24. Sources of Geographical Information
25. Bibliography

Figure 2. The SC's 25 'Geographica' classes

SC incorporates a practical, workable tool for treating all countries in an all-inclusive method, using a comprehensive checklist of details that cover the subject in its entirety. Not all details are applicable to all countries. Thus, for example, land erosion caused by ice does not apply to the section on Cuba, and cultivation of sugarcane does not apply to the section on Iceland. Resulting ontologies are thus domain-specific. Within the schema for global geography, all disciplines are viewed from a geographical viewpoint. Thus, for instance, "transportation" might be dealt with under the headings of mechanical engineering, economics, sociology, etc. In the schema, "transportation" is viewed from the geographic viewpoints such as passenger land transportation, freight land transportation, waterborne transportation, urban transportation, coastal transportation, and so forth, as related to specific geographic areas.

The numerical order given to entries is not meant to be indicative of a system. In fact, the reason we refer to the SC as an ontology is that no notation has yet been devised. The numerical identifiers instead are pointers to locations within the geographical encyclopedia. Figure 3 demonstrates a single hierarchy for geomorphology.

Geomorphology (chapter)	2
Physiographic Regions	2-2
Volcanic Activities	2-3
Volcanoes (table)	2-3.1
Cinder Cones	2-3.1.1
Composite Cones	2-3.1.2
etc.	

Figure 3. Numerical pointers to the Geographical Encyclopedia

SC, by coupling the principle of hierarchical classification with the principle of hyperlinkage, offers the user delivery of reference to specific knowledge components. Thus, for example, materials generated by the United Nations on the question of the Law of the Sea might traditionally be classified under Law and its subdivision Admiralty Law. When classified by SC it will be intra- and interdisciplinary and appear under Law, Admiralty Law, Nutrition, Plankton, Fish, Mining, Metallurgy, Military Uses, Common

<table>
<tr><td>•</td><td>Marine (GEOMORPHOLOGY) -- Sedimentation, 2-5.2</td></tr>
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- Marine (GEOMORPHOLOGY) -- Sedimentation, 2-5.2

- Marine [forecasting] (METEOROLOGY AND CLIMATOLOGY) -- Meteorological Services -- Weather Forecasting, 6-6.1.2

- Marine Causes -- Shore Drifts (GEOMORPHOLOGY) -- Sedimentation, 2-6.2.1

- Marine Causes -- Spits (GEOMORPHOLOGY) -- Sedimentation, 2-6.2.2

- Marine Causes -- Wave Effects (GEOMORPHOLOGY) -- Erosion2-7.2.1

- Marine Causes (GEOMORPHOLOGY) -- Erosion, 2-7.2

- Marine Causes (GEOMORPHOLOGY) -- Sedimentation, 2-6.2

- Marine Erosion (OCEANOGRAPHY) -- Shore Line, 4-5.3

- Marine Sedimentation (OCEANOGRAPHY) -- Shore Line, 4-5.2

- Marine Vegetation (BIOGEOGRAPHY) -- Vegetation, 8-1.13

Figure 4. "Marine" in the SC chain index

Heritage, Sovereignty, and other specific items discussed during the meeting of the UN Law of the Sea Commission. Essentially, SC uses a system of domain-specific facet formulas generated from the appropriate information ecologies.

Recently, as a means of demonstrating the potential flexibility of the SC a chain index was developed. Figure 4 contains a section of the chain index found under the concept "marine." This example was chosen because of its brevity. Nevertheless it demonstrates the richness of the distribution of relatives across the schema. The combination of side-by-side schedules and chain index provides a powerful tool for information retrieval and knowledge management.

4. Knowledge management and the Sachs Classification

The term "knowledge management" has arisen in the past decade to describe the systematic accumulation, ordering, manipulation and retrieval of specific knowledge in an information ecology. Arising primarily in the business world, knowledge management as a tool for the management of intellectual capital has been extended to all sectors of today's information society, and has even found a home in academe (albeit in diverse disciplinary quarters ranging from information studies to business). Ponzi's recent dissertation (2002) describes an evolution that embraces both parts of a dichotomous conception of knowledge management. That is, knowledge management involves both the management of tacit knowledge and the development of tools for explicit knowledge.

We suggest the SC's open methodology has promise for both the management of tacit and explicit knowledge. Our concept of "academic warrant" can be extended epistemologically to the concept of information ecology. Tacit knowledge within a domain, as it emerges, can be nurtured by affiliation with an environment in which a tool such as the SC is available for perusal. Concepts can be recorded in the index and hyperlinked to the appropriate points within the hierarchical array. Phenomenological analysis of any given phenomenon encourages the gathering of tacit perception as well as the concretizing of eidetic isolates. As a given segment of knowledge grows and gains credibility within the domain a facet formula will emerge to describe the placement of the distributed relatives within the

schema. Actors within a given information ecology equipped with an SC-based knowledge management tool can become the interactive managers of an ever evolving knowledge base.

5. Conclusion

We also believe the Sachs Classification has promise as an ontology for the ordering of digital libraries. Its utility as the basis of the supranational *Worldmark Encyclopedia* demonstrated its capacity for utilization in the global information ecology. Other potential uses for an expanded SC include curriculum development, the generation of a new encyclopedia, research for international investment and development, and the ordering of a global search engine for international trade. Regardless, the parallel development of the *Worldmark Encyclopedia* and the Sachs Classification represent a demonstrable turning point in the history of the development of 20th century classification.

6. Acknowledgments

We would like to acknowledge the contributions of two students from the Palmer School. Kenichi Tsuda developed the chain index for the SC, and Alon Friedman is currently working to make the SC Web accessible. We are grateful to both for their assistance.

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External Knowledge Management, on the other hand, is typically customer-facing. It involves documenting information and sharing information with customers in order to address important issues and provide outstanding customer support. Most businesses need both types of Knowledge Management in order to both increase internal efficiency and provide the best experience for their customers. Primary Components. Now, it's time to break down the primary components of Knowledge Management and how they work to optimize the storage and sharing of information in your business. An effective Knowledge Management strategy involves several layers in order to fix the information bottlenecks in your business. Classification schemes and thesauri could be used beneficially to develop organisational taxonomies. This is demonstrated by Wang et al. (2008), who developed taxonomy in the information studies domain for the Division of Information Studies at the Nanyang Technology University, Singapore. An enumerative classification scheme attempts to enumerate, or list, all subjects. There are obvious problems associated with this. Apart from the difficulty of listing everything and the resulting size of the publication, in a strictly enumerative scheme the schedule (listing of subjects) will be very long. Another problem is that subjects change and new subjects emerge that could not have been anticipated when the scheme was devised. Ontology, Knowledge Management, Knowledge. Engineering and the ACM Classification Scheme. John Kingston. AIAI, School Of Inform atics, University of Edinburgh. Deciding where to classify knowledge man agement is difficult because there is. considerable disagreement about th e best approach to knowl edge managem ent. KNOWLEDGE MANAGEMENT, CAREERS INOnce upon a time an article about careers might well have described a "career ladder." The concept was a useful one when organizations were hierarchical in nature and one might progress step by step ever higher in the management hierarchy. Many research studies of such diverse careers as college presidents, career army officers, directors of academic libraries, and chief executive officers concluded that successive positions followed a predictable upward pattern (i.e., a career ladder). Source for information on Knowledge Management, Careers in: Encyclopedia of Communication and Information dictionary.