Ecological Design: An Interdisciplinary, Interactive Participation Process in an Information Environment

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ABSTRACT
In this paper, an ethnographically informed approach to information system design is described. Ecological design is explored through two collaborative research community case studies: the Long-Term Ecological Research Network and an Ocean Informatics Community. The similarities and differences of the two related but independent case studies spur developing understandings as we learn from past studies to articulate ongoing experiences. New vocabularies and methods help with the emergent work of infrastructuring, explicitly taking into account characteristics of interdisciplinarity and collaboration.

Categories and Subject Descriptors
K.4.0 [**Computers and Society**]: General

General Terms
Design, Human Factors

Keywords
Information Studies, Information Management, Sociotechnical, Ecological Design, Participatory Design

1. INTRODUCTION
As scientific themes broaden, integrative efforts arise that prompt collaborative teams of increasing diversity, information systems with more complex requirements, and infrastructures of thicker sociotechnical composition. Such work brings an increasing need for new approaches to both collaborative science and interactive

systems design. Developing understandings of everyday practices and boundary objects present a rich tradition from which to build both in theory and in practice [24], [25], [5], and [7]. As experience with collaborative science matures, shifts are evident in the design landscape itself as well as changes in the kinds of questions being asked with respect to information and knowledge management [18], [9], and [21]. Looking to future scenarios with grids and portals ([11]; http://www.grids-center.org/), will the growing understanding of sociotechnical dynamics and infrastructure transform the questions from consideration of access points to creation of active processes? In addition to asking 'how to build a useful grid', we may also ask 'how to grid' or 'how to portal' over time.

2. INFORMATION SYSTEM DESIGN
Ethnography provides an approach for developing understandings of the everyday activities of communities of people [23], [15], [26]. It is both a field practice and a discursive practice; it focuses on processes as well as on products. It is of particular interest in the process of designing effective information systems because it allows for multiple voices to be heard. Participatory Design (PD) is a particular approach to the design and development of technological and organizational systems. User involvement in PD is respected and trusted to bring the skill and expertise of practitioners into design and decision-making processes [4]. These powerful approaches are central to an interdisciplinary study carried out with the LTER community of information managers and scientists in 2002 [1]. A developing initiative, informed by this study, continues the LTER study basic philosophical approach but with a shift in perspective. A participatory design continuum could be considered that stretches from 'knowledgeable observer' to 'user-centered designer' to 'ethnographer participant' [10]. Moving along the continuum reflects a change in the ethnographer role. Moving from left to right, from knowledgeable observer to ethnographer participant, arrives a point where there is not the loss of an interested, dispassionate observer but rather the addition of a project partner who by way of designing a study in collaboration with domain scientists designing their own

studies, provides meaningful interventions both to domain scientists' work as well as to ethnographer's work. Distinctions between 'observer-participants' and 'participant-observers' fade as joint projects that co inform are co constructed. We are exploring whether small teams may participate before, during and after a design project and/or ethnographic study within an information environment. This holds the potential to transform design processes into active learning processes. This distinguishing characteristic of an ethnographic participant is a feature of 'ecological design', an interactive design approach.

## 3.0 CASE STUDIES

3.1 LTER: Information Management

The 'ecological design' concept emerges from a one year study with the Long-Term Ecological Research (LTER) network community [12], [2]. Our goal was to bring everyday practices and lived experiences into an ongoing LTER metadata discussion, seeking new ways of grounding environmental data in its organizational context so it can be used more flexibly today and retains its value longer. Our interdisciplinary team explored the articulation between 'scientific' and 'organizational' data with a three-component conceptual model focusing on the intersections of the domains of environmental science, social sciences/humanities, and information sciences [1], [16], [8]. Such a model makes visible the information sciences and makes explicit the overlapping regions or interfaces where the work of participatory design and information management is emerging. Our work makes available an expanded vocabulary (e.g. articulation, invisible work, tacit knowledge, tensions and balances) to the LTER information managers. The LTER IMers are a community-of-practice embedded within a federated set of 24 scientific research teams with each research team focused on a particular ecological biome. This study focuses on liaison work such as that of the LTER information manager, a role that is emerging to meet today's collaborative science needs today.

3.2 Ocean Informatics: Infrastructure Process

'Ocean informatics' is an unfolding case study that brings together another interdisciplinary design team with similar approach and new members exercising and exploring the principles and features of 'ecological design'. The Ocean Informatics environment that is envisioned represents an information ecology with four interdependent elements, a federated community-of-practice coming together to share tools and approaches in a working forum that facilitates joint learning and knowledge making. Here the community-of-practice involves members within oceanographic institutions and design partners include those working in information and science studies. Interventions in practice are bi-directional: environmental scientists intervene in the work of ethnography and science studies while social scientists intervene in the work of environmental scientists. Participants are collaborating in that all are fully engaged in their own work and all

participants are dispassionately scientific in their use of scientific methods.

This project represents a first step in a long-term process for building infrastructure for an information ecology to be used by a wide range of scientific and support personnel from a broad spectrum of oceanographic disciplines. The environment will afford a "community commons" or an "intellectual village square" where oceanographers and information managers can explore research questions and information techniques informed by concepts and methods from environmental, computer, information, and science studies. Such work will provide the long-term scaffolding required for diverse ongoing interdisciplinary efforts, from heterogeneous environmental datasets to global earth observing systems, from ocean policies to education opportunities. Process oriented design approaches present viable options to address some of the problems encountered with the use of large data systems that uses more traditional (short-term, non recursive, non participatory) product focused design techniques (e.g. [13], [14], [20]). Yet process oriented work is frequently invisible and rarely supported so it is frequently left undone. In foregrounding the design process through participatory strategies as well as tending to articulation and assessment, invisible work is made visible.
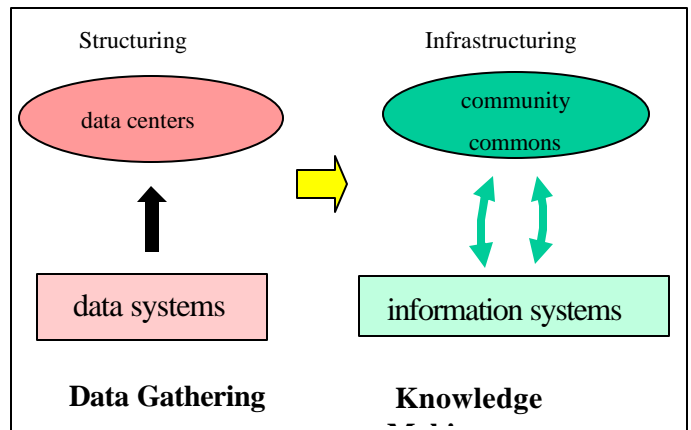
Figure 1. Data Center Transformation

This particular project is organizing to meet the design challenge of transforming a data center to a contemporary community commons (Figure 1). That is, rather than design solely for a work flow that handles diverse streams of ecological data and funnels data to specialized repositories and centers, the team recognizes the need to establish self sustaining elements of an information environment in close proximity to the data. The goal is to initiate design for a community commons with an emergent, evolving infrastructure capable of change through attention to the sociotechnical dynamics. That is, we work to create a participatory environment [22], [17]. This view shifts from the data, data system, and/or organization to the learning environment

as the unit of study. The ocean informatics case study is particularly apropos to developments today as we work on a shared data system node and its future interoperability along with assessment strategies and community building activities, including the meaning of portals. We look to interfaces with the education, library, and grid communities and centers to inform our future work and to provide important input to ongoing efforts [6], [19], [3].

4.0 EMERGENT WORK

Efforts such as those illustrated by these recent case studies are leveraging from the experience of those actively engaged in collaborative research with theoretical and practice components. Sensitivity to elements of change is required prior to leaping boldly into new partnerships. New vocabularies and methods are needed to ensure an engaged collaboration beyond the rhetoric of partnership. Perhaps this emerging work is a natural approach for interdisciplinary fields such as ecology and oceanography that work with fundamental ecological principles of emergent systems. Within the matrix of recognized professions and organizational domains, there are benefits to new strategies and emergent needs. Just as technology may be seen as a change agent, so can collaborative partnerships and liaison roles. Rather than invisible infrastructure to a single disintermediated digital world, these elements provide some visible scaffolding to mediated digital worlds.

3. ACKNOWLEDGMENTS

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