Articulation Work Supporting Information Infrastructure Design: Coordination, Categorization, and Assessment in Practice

Karen S. Baker
Scripps Institution of Oceanography
University of California at San Diego
kbaker@ucsd.edu

Florence Millerand
Dépt. de Communication Sociale et Publique
Université du Québec à Montréal (UQAM)
millerand.florence@uqam.ca

Abstract

Articulation work is a critical factor in information infrastructure building projects that involve multiple and diverse communities. It brings awareness of language differences, ramifications of definition and use of categories, as well as other coordination mechanisms. Articulation work is of particular relevance to scientific endeavors that have broadened in the past decade to encompass global scale research and now require collaborative arrangements to handle complex interdependent elements. Our interdisciplinary research team joined with the Long Term Ecological Research (LTER) community of information managers recently to develop articulation work in selected activities. Through this partnership, initial activities and approaches in the articulation process are considered along with language and category uses pertinent to four main concepts (infrastructure, representation, design and mediation). Coordination mechanisms developed and employed over the last year as means for articulation work include dialogue mediation, co-design activities, and category elaboration in addition to traditional and emergent forms of assessment.

1. Introduction

Articulation work is a concept important to community-building and to long-term information infrastructure building. Articulation work is characterized as the interrelating of parts or the alignment of work elements, often involving a range of planning, coordinating, and negotiating efforts. Articulation work has been described as work that enables other work within a task, within a project, or across organizational entities.

This study focuses on work that is of a long-term type and a collaborative form. Although work is sometimes classified as routine or non-routine types and frequently expressed in information infrastructure building as self-paced or interrupt-driven, we draw on empirical fieldwork and the literatures of interactionist sociology, computer-supported cooperative work, and science & technology studies to consider another work classification scheme with two categories: production (tasks) and articulation (relations). These categories are sometimes designated in a more hierarchical fashion as primary work and articulation work – bringing out the supportive nature of articulation work (Bratteteig, 2003). We suggest, however, that care be exercised here for the designation of support as 'secondary' (interpretable as meaning less important or not primary) appears a source of difficulties in complex, interdependent work arenas.

We understand information infrastructure building processes as 'articulation processes' between diverse and distributed communities across space, time, and disciplines. With social and technical components identified as mutually interdependent (Star and Ruhleder, 1996; Kling, 2000; Star and Bowker, 2002), we view large-scale scientific collaborative efforts as inherently sociotechnical (Figure 1). Here, the technical dimension of infrastructure, frequently

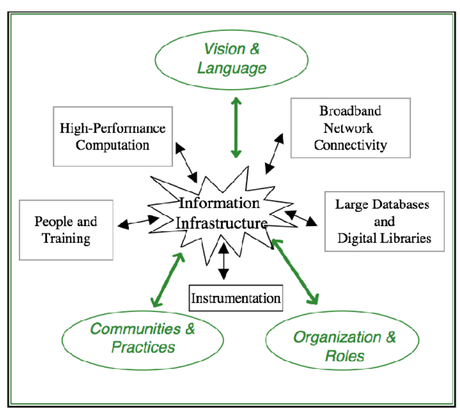

Figure 1. Envisioning sociotechnical information infrastructures. The boxes represent traditional 'technical' elements while the ovals bring forward 'social' elements.

presented in terms of hardware, applications, networks and training, is explicitly recognized as intertwined with social dimensions such as language, practices, and community that often remain tacit and sometimes represented as one category such as 'people' or 'users'.

Strauss (1988, 1993) devised the terms 'articulation work' and 'articulation process' in understanding how to describe the work within projects or, in other words, to understand how a project's participants get their work done. Articulation work is one constituent part of an overall articulation process. It refers to "the specifics of putting together tasks, task sequences, task clusters - even aligning larger units such as lines of work and subprojects - in the service of work flow" (Strauss, 1988). Articulation process represents a more inclusive set of actions; it refers to "the overall process of putting ***all*** the work elements together ***and*** keeping them together" (ibid). The term 'alignment' is sometimes used to refer to one aspect of articulation work and the articulation process.

The notion of articulation work applies to technical and organizational arrangements but also to coordination of cooperative work involving interdependencies. Schmidt and Bannon (1992) consider the concept of articulation work as a core concern for the field of computer supported cooperative work, arguing for an understanding of the protocols, formal structures, plans, procedures, and schemes as mechanisms of interaction in the sense that they reduce the complexity of articulating cooperative work. Simone et al (1995) focus on articulation as "the orderly accomplishment of cooperative work" highlighting two of its characteristics (Schmidt and Simone, 1996): malleable or openness to modification and interoperable or linkable coordination mechanisms. The work is fundamentally related to communication and coordination mechanisms (Schmidt and Simon, 1996; Fjuk and Smordal, 1997; Simone et al, 1999).

Fujimura (1987) defines "articulation is the work of pulling together everything that is needed to carry out production tasks: planning, organizing, monitoring, evaluating, adjusting, coordinating and integrating activities" and emphasizes the need to plan and coordinate across three levels: experiment, laboratory, and social. Studying the use of software configuration management systems, Grinter (1996) presents three aspects of articulation work: the challenges of representing the work, the need to support both individuals and groups working together, and the assumptions about the work built into the tools. She specifies crossing not levels but layers of functionality: configuration control, process management, and problem reporting. More recently articulation is presented as a socio-technical concept of "work that supports other work", making use of categories of articulation work categories such as fitting or adjusting regular work patterns to accommodate contingencies; augmenting or taking on additional work in order to facilitate the arrangement, and working around or the use of alternative, even non-approved methods to facilitate work (Sawyer and Tapia, forthcoming). Gerson and Star (1986) emphasize a common thread found throughout articulation work - making visible activities that are not conceived as work but that still require skill and knowledge to perform. Eschenfelder (2003) summarizes the articulation work required to accomplish production work as having three characteristics: 1) invisible within rational models of work, 2) involved with coordination of tasks, beliefs, goals or standards, and 3) undertaken in support of a high level end goal.

Our work addresses and extends the concept of articulation work in addition to illustrating articulation work in practice. Information infrastructure projects today, sometimes called Cyberinfrastructure or e-Science, frequently involve a number of heterogeneous communities. The concept of articulation work may represent a critical factor in coordinating such projects.

Our interdisciplinary research team joined with participants of a scientific research community in ecology to develop and reflect upon articulation work in selected activities. Through this partnership, articulation processes are considered along with language and category uses related to four key concepts: infrastructure, representation, design and mediation. Examples of coordination mechanisms co developed and employed over the last year of fieldwork as means for articulation work are presented. They include dialogue mediation, co design activity and category elaboration in addition to traditional and emergent forms of assessment.

2. Case Study and Approach

The Long Term Ecological Research (LTER) community is a federated network of environmental researchers working to improve understanding of ecological systems and knowledge of environmental change through interdisciplinary collaboration and long term research projects building long baselines of ecological data (Hobbie et al. 2003).

Highly distributed and heterogeneous, the LTER community is organized with a designated local information manager at each of its twenty-six centers representing 1800 participants. The information management community works together through the whole network on standardization processes for its data management practices to facilitate data sharing across its multiple technical frameworks, organizational arenas and disciplinary environments. The LTER information managers agreed upon a metadata standard, the Ecological Metadata Language (EML; Jones et al., 2001), deciding to endorse it in 2001. After a number of years of design, development, and deployment with EML, the information managers are in the midst of enacting this standard locally – that is, of incorporating the standard into local infrastructures and practices (Millerand and Bowker, forthcoming). The long-term and collaborative nature of the LTER community provides a unique venue for considering the work of developing community standards as particular sub processes within the process of building information infrastructure in general, and offers an unprecedented opportunity to consider the articulation work associated.

Our study draws from grounded theory building making use of ethnographic methods such as interviews, document analysis, and participant observation (Strauss, 1987; Strauss and Corbin, 1994). Gathering rich ethnographic detail within a qualitative framework, we seek to hear the diversity of community voices and to invite dialogue on project findings and participant engagement (Ribes and Baker, 2006). For this approach, our research team is interdisciplinary, consisting of participants from Communication, Sociology, and Science Studies as well as Social, Ecological, and Ocean Informatics working in close relations with scientific community participants over time (Figure 2).

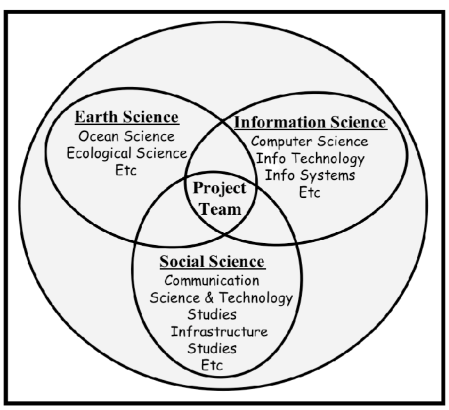

Figure 2. Interdisciplinarity in practice.

In seeking to augment, in the near-term, community access to conceptual, rhetorical and organizational tools that can facilitate ongoing work (Baker et al., 2005a), our approach extends the participant-observer approach (Spradley, 1980; Jorgensen, 1989) to one of collaborative design (Baker et al., 2005b)

3. Key Information Infrastructure Design Concepts: in Theory and in Practice

The setting for this work is local information management environments, operationally enmeshed with the work of long-term environmental scientific research teams. The role of the information manager frequently serves to interface among science, data, and technology (Karasti and Baker, 2004), taking on the role of mediator and/or catalyst. It is interesting to note that Sawyer and Tapia (forthcoming) suggest such roles are alternatives to spiraling articulation costs. In this particular case, the long-term perspective brings to the forefront a number of under-explored issues such as planning for processes of alignment and change. This, together with the contemporary rapid change in information technologies, creates a period of active development in information management in terms of concepts, language, and opportunities with respect to information management approaches. Focusing on key concepts and understanding their scope may enrich design discussions and inform practices; they include ‘information infrastructure’, ‘representation’, ‘design’, and ‘mediation’. These terms are presented below briefly as background.

3.1 Information Infrastructure

An understanding of data work and workflow in information management rests upon the concept of *infrastructure*. The term “infrastructure” typically is used to refer to the pervasive physical support systems of pipes, wires, and pathways. As a broad functional category, though, it also includes an array of services and support (Star and Ruhleder, 1996; Star and Bowker, 2002). Examples of infrastructure in the community arena include schools and fire departments while in the digital realm include computational services, user groups, help desks, and data archives. Stretching into the network realm, the term “cyberinfrastructure” alludes to alignments of interacting computational and technological resources. The Atkins report (2003) on contemporary infrastructure summarizes: “If infrastructure is needed for an industrial economy, cyberinfrastructure is required for a knowledge economy”; between the base technology and its use are intertwined arrangements of “enabling hardware, algorithms, software, communications, institutions, and personnel”.

Focusing on the topics of data, information management, and workflow brings forward the notion of an *information* infrastructure. The components of infrastructure that support data capture, preservation, and use must function in conjunction with physical infrastructure, such as digital connectivity, computational power, and storage capacity. In addition, issues of varying scales are relevant to the design of an effective information infrastructure. For instance, consider how many information infrastructure elements are called upon in two very different but typical scenarios at an LTER site: a) accessing satellite data from a national archive for download and use in a local visualization application for the conduct of a global research question or b) converting an online audio file from ogg to wav to ipod format for download to a pda in order to keep abreast of a colleague's work via an audio cast. Though representing different scales of coverage and sampling, the answer in both situations to the question of how many elements are involved is "a few" when all is familiar and functional but frequently the answer is "a host" - of arrangements of systems, standards, and people including experts who are able to mediate framing the information management *questions* as well as the answers when some slight misalignment(s) occurs within the system.

A series of recent committees and groups have provided reports on infrastructure (White, 2003) and cyberinfrastructure (Atkins, 2003, Pfirman, 2003, Futrell, 2003, David, 2005; Berman and Brady, 2005), on long-term data collection and curation (Hedstrom et al, 2002; Lord and Macdonald, 2003; NSB 2005; Karasti et al, forthcoming), on collaboratories (Finholt 2003, 2004) and e-Science (Hey and Trefethen, 2003). These literatures, touching on the issues of interdisciplinarity and long-term sustainability, frame and prompt the work of information infrastructure building. Yet, conceptual understandings of information infrastructure as well as methodological and theoretical frameworks are still developing.

An information infrastructure consists of configurations of technical, human, and conceptual components, including the individuals and communities who are designing, building, using, maintaining and redesigning the infrastructure elements associated with the interface of human and information systems. A multidimensional information infrastructure is required to support data processes.

To open up the work of information management, our approach involves developing understandings of and sensitivities to vocabularies for community data tasks within and constituting an information infrastructure. Information infrastructure, a shifting blend of configurations and capacities of technology, organization, and community, is portrayed in Figure 3a (Baker et al, 2005a). The interdependent, persistent presence of all three of these mutually informing elements is inherent to working with data involving design and development as well as deployment and enactment. These intertwined elements call for an ongoing process of balancing and arranging. A reminder of the need to be constantly aligning or (re)constructing is wrapped into the term "infrastructuring" (Star and Bowker, 2002). This active form of information infrastructure serves as a reminder that infrastructure is not just a thing but also rather a set of dynamic arrangements, negotiations, and alignments that is "always already" undergoing maintenance and update (Star and Bowker, 2002; Star 2002; Karasti and Baker, 2004).

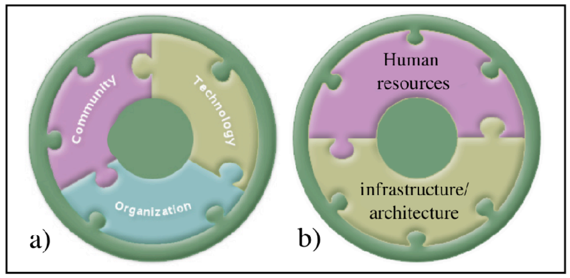

Figure 3. Envisioning categories of information infrastructure: a) 3 category and b) 2 category examples.

3.2 Representation

There are significant issues in the field of scientific research pertinent to the work of data and information management that benefit from ongoing reflection. These are not esoteric matters removed from everyday work. Two dimensions of representation issues are 1) data representation as involving strategic choices that introduce constraints into the data. The importance of articulation work is frequently through mediation work that makes evident assumptions and choices among involved participants; 2) human representation also involving strategic choices in terms of organizational structures or professional status for instance that may impact some individual or group's visibility, recognition, etc. The importance of articulation work often may focus on categorization work.

Scientific work with environmental data may be categorized as data collecting, data preserving, and data delivering (Figure 4). Representation involves strategic choices in each of these areas regarding the data of observational science. For instance, a field scientist chooses data to be collected as part of a field sampling strategy seeking to portray a selected portion of an environmental system.

Data and information managers deal with preserving data. They organize and curate data through data practices and description. Consider the subsequent community needs to manage categories of data through naming conventions so that the entities 'oxygen' and O2 are discoverable as related. The existence of distinct attribute names or of data type categories within different research groups and projects inhibits data flows; data types such as 'streamed data' and 'cruise data' involve differing foci, in this case an emphasis on real-time automated homogeneous data acquisition versus heterogeneous data collection federation at the end of a study (gathering several datasets from a cruise at sea for instance) for local data use or optimal automated query. Larger scale data delivery endeavors incorporating information systems have technology techniques and data organization formalized in data schema that document particular relations and enable queries of selected types.

Finally, there is the analysis and packaging of the data. Studies are beginning to demonstrate how project and community data arrangements regarding information objects (e.g. the work of forming standards; Millerand et al, forthcoming) serve as mechanisms for data delivery but also, particularly in explicative settings, represent opportunities for cumulative, integrative, and synthetic work.

3.3 Design

Effective information infrastructure often hinges upon sociotechnical design work. In large-scale scientific projects with associated sociotechnical considerations, the design process is a critical aspect of infrastructuring. Design work today may explicitly address the interfaces of human and technical systems. Design capacity is central to work processes and information management. Design involves the ability to create data processes, information systems and infrastructures as well as community standards and human-to-computer interfaces based on interpretations of data needs. For both individual and collaborative efforts, design involves the theory and practice of identifying a purpose, planning a strategy, and analyzing results while arranging parts and developing end products such as a database schema or a web interface for data collections. As such, design involves articulation work with articulation work potential for increased effectiveness when considered as both requisite for and integral to the design process.

The literature provides growing evidence of the importance of design as both an approach and a tool, and above all, as an on-going research area. Design itself is indeed under discussion, as researchers consider classification distinctions such as engineering and creative design (Wolf et al, 2006), collaborative and ecological design (Karasti et al, forthcoming; Baker et al, 2005) in addition to incorporating use of analytic and descriptive ethnography. An emphasis on the design process occurs in the fields of information systems and action research (Greenbaum and Kyng, 1991; Whyte 1991). Participatory Design (Schuler and Namioka, 1993; Dittrich et al, 2002), Computer Supported Cooperative Work (Kaplan and Seebeck, 2001; Schmidt and Simone, 1996), and Meta-Design (Fischer, 2003). All these are contemporary approaches that inform regarding how we do our work as we work

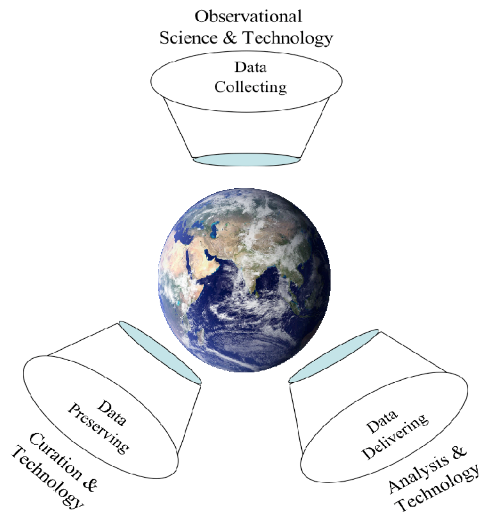

Figure 4. Representations in the work of science: a) science together with technology represent the natural world through selected data collecting; b) curation and technology facilitate science representation through selected data preserving; c) analysis and technology represent the natural world through selected data delivering.

although there is no 'ready' toolbox for every situation. That is, sometimes the design approach that would fit the situation requires modification of an existing procedure or doesn't exist and needs to be developed.

3.4 Mediation

Current data responsibilities of domain scientists and information managers involve mediation. Mediation is most often highlighted by its absence. Misunderstandings occur frequently due to lack of mediation and due to disciplinary differences regarding what constitutes mediation work. Mediation work is required to interface and to create new combinations of datasets, systems, or communities of differing type scales. Mediation involves articulation and translation work in order to negotiate, interface, and align requirements in the design of information flows among data system layers of data collecting, preserving, and reuse, among data types and structures by data handlers of all types.

As mediation roles evolve, they may be perceived quite differently. Figure 5 provides one example of two perspectives on the work of information management and information technology mediators. An earth

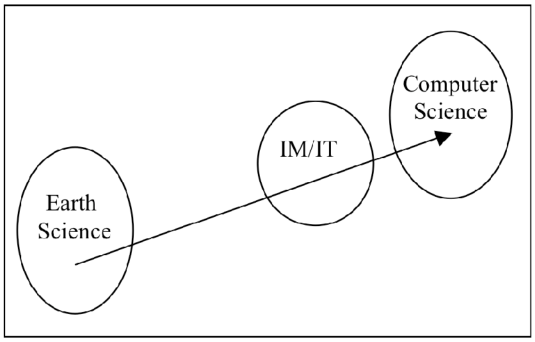

Figure 5a. **Domain Science Perspective**. An earth science point of view where information technology is considered close to information system and computer science.

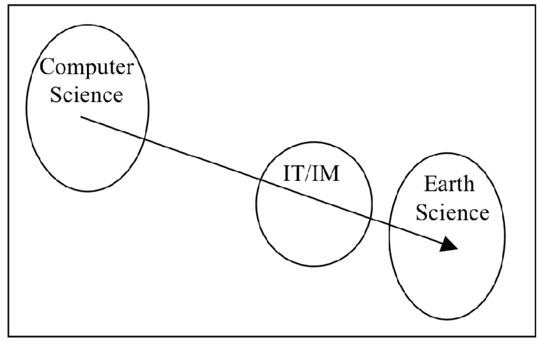

Figure 5b. **Computer science perspective**. A computer science point of view where information management is considered closer to domain science.

scientist may see that data can be handled by technology where technology is the province of both information managers and technologists, closer to the realm of information systems and computer science (Figure 5a). On the other hand, from a computer scientist's view, the work of the information technologist represents a field endeavor closer to the applied needs of domain science (Figure 5b). These two views may be brought together as in Figure 5c to make evident that the practices of one influence the practices of the others. This portrays interdisciplinarity with all its attendant mediation.

4. Examples of Articulation Processes

Through selected examples of articulation processes experienced in the LTER community, we present three communication and coordination mechanisms and then consider both traditional and emergent forms of assessment. The mechanisms employed include dialogue mediation, co-design activity and category elaboration. The examples present opportunities for community discussion, dialogue, and joint work as part of the process of articulation. The following activities fit within the category of a conceptual framework where the focus is not on cost-saving technological automations but rather on opening up discussions and long-term perspective. Each activity is facilitated organizationally by the LTER traditions of collaborative work such as periodically scheduled meetings and working group sessions, thus making use of existing organizational structures rather than augmenting or changing them.

4.1 Dialogue mediation

A Community Process Working Group (CPWG), organized jointly by LTER participants and our research team, was held at the LTER Information Manager's annual meeting in Montreal in August 2005. The working group looked back on the metadata standard's implementation that took place over a multi year time period as a model of community processes. The goal of the CPWG was to share information managers' and developers' experiences in working with the Ecological Metadata Language standard and to distill insights and recommendations on how to improve the standards formation process. Our participation as mediators in this effort consisted in prompting and facilitating a dialogue about the standard between participants - developers and enactors.

One topic of discussion that arose was that of an

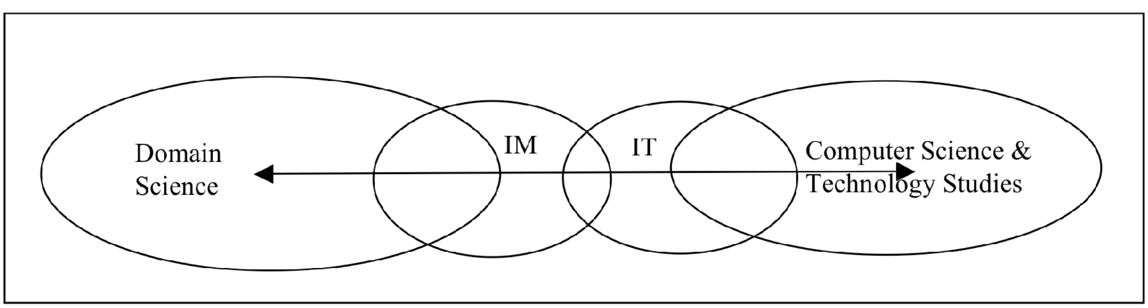

Figure 5c. **Mediation Perspective.** A bidirectional perspective of information management and information technology as mediating roles.

EML Best Practices Manual. Several information manager's expressed satisfaction with having developed a useful community manual while some developers pointed out the value of a broader domain-wide approach. With this classic local-generic dichotomy identified, existing options could be discussed and alternatives introduced in order to enable cross-perspective thinking. Here, one alternative suggestion was to have developers guide development of multiple local manuals for different communities considering the manual as an engagement/enactment mechanism, an opportunity to negotiate standards 'bottom up', and a potential proposal for funding.

Collaboration was continued among workshop coordinators after the meeting through joint work on a summary text. Publication of this document as a community newsletter article then brought the dialogue back to include the community (Millerand et al., 2005).

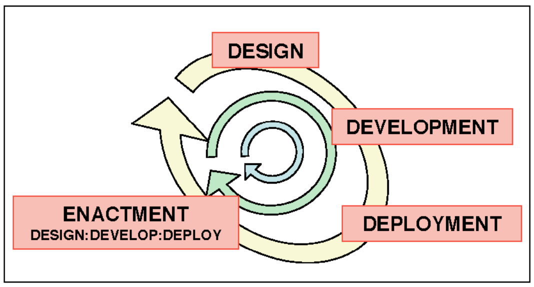

Figure 6. Envisioning information infrastructure Implementation cycle.

4.2 Co-design activities

A diagram (Figure 6) was constructed jointly by the CPWG working group organizers to serve as a shared visual for the working group meeting, to capture a fuller life cycle of standards implementation and to draw attention to the need for attention to vocabulary and expanded views when working to negotiate between local and generic requirements in the complex arena of community standards. As a result of such co-design activity between the developers of the standard and its enactors (the information managers), a diagram that initially focused exclusively on the design-development-deployment activities from the developer's perspective, opened up to include local enactment and the information managers' organizational settings and views.

4.3 Category elaboration

Within the LTER community, information infrastructure development was recently considered in planning discussions using the two distinct categories of 'human resources' and 'infrastructure architecture' (Figure 3b). This is a remarkable shift from the more usual exclusive focus on the technical where categories typically might be named 'technical requirements' and 'usability'. Yet the dual category schema contrasts with a three-category information infrastructure framing: the simultaneous mobilization of community, technical and organizational resources (Figure 3a). With three components tied together, complex *configurations* of communities, technologies and organizations are emphasized rather than a distinct split between human and technical categories.

At a joint meeting on Cyberinfrastructure in 2005 between LTER participants and members of our team, the two category split structured the LTER breakout working groups into two teams: technical and human resources, thus reinforcing a common lack of interface between the two. The ramifications of such category choices were considered. After discussion and in recognition of the dichotomy, some members from each working group changed groups half way through the sessions in an effort to share across the division.

There are many cases where classification schemes serve as a prompt for articulation (Bowker and Star, 1999; Simone et al, 1999). Early attention to category-making and category-naming stimulates important discussions. Lack of sensitivity to classification schemes reinforces the status quo of existing conceptualizations, thus preventing consideration of alternatives.

5.0 Discussion

We view language, joint activities, and category formation as integral to information infrastructure design and may also serve as community mechanisms for formative assessment. Traditionally the survey is an assessment tool (in this case a self-assessment or design tool) measuring a frequently unclear mix of perception, usefulness, and effectiveness. The Community Process Working Group meeting described above began with a survey for participants – asking their role and experiences with the standard, and ended with another survey – asking for recommendations and thoughts regarding standard development and enactment. The first survey was useful to collect participants' input while the second helped both to capture participant learning and to serve as a learning prompt.

The construction of a diagram was a critical element of CPWG preparations. This task, performed jointly, initiated bridging between the information manager and developer co-leaders. In order to capture the context of the work, concepts and language were considered and sorted collectively prior to the workshop - ensuring a representation or integration of multiple views as well as an initial alignment of language. From this sorting out process emerged the term 'enactment' and an opening up of operational notions of implementation (Fountain, 2001). The implementation process - initially seen as a set of design-development-deployment tasks delivered as a product - was augmented to include an additional category - enactment. To increase access to the enactment diagram so it could serve as a discussion prompt both for the immediate meeting and for future dialogues between information managers and technologists, a hardcopy handout was prepared. Further, to ensure the diagram would be available over longer time periods as a contextual guide, it was refined and included in a community newsletter article (Millerand et al., 2005).

In the articulation examples above, the term enactment provides a mechanism for augmenting understanding of the implementation cycle while surveys provided a mechanism to elicit information about and prompt for lessons learned. These are lessons learned over the long-term when reported in the scientific literature; these are learning moments or change opportunities when viewed as part of an ongoing articulation process within a community. As communities look forward to future infrastructure building efforts (from standards formation and information systems to dictionary and ontology building, for example), it is critical that the lessons learned in constructing information infrastructure be articulated and drawn upon for planning of future community processes.

In considering articulation work and articulation processes as an inherent part of infrastructure building, we turn to the eight salient features of infrastructures (Star and Ruhlder, 1996). We find that five of them - embeddedness, scope, learned as part of membership, links with conventions of practice, built on installed base - describe the articulation processes presented here. The other three features of infrastructure form a different type relationship to the notion of articulation; here articulation work contributes to discussion and an overall coherence that is associated with increasing transparency, avoiding breakdown, or forming of standards. In addition to the feature of maintenance and its relationship to renewal, there is also a heterochronic nature to infrastructure to consider. Perhaps these represent additional features: 1) sustainability - including maintenance, update, and change and 2) temporal dimensions - gathering together the always-already present, past, and future through the lens of the long-term (Karasti et al, forthcoming).

Deployment delivery, ease of enactment, and conceptual development all represent criteria in considering infrastructure development. Another criteria from the perspective of iterative design would be some measure of organizational support for feed back activity between enactors and developers. In collaborative settings we are finding it of interest as an alternative assessment to consider the extent to which an entity - a diagram or set of categories - travels, that is, appears elsewhere over time used by different participants in diverse venues. For instance, in the case of LTER, the term 'enactment' appeared in subsequent venues including several LTER cyberinfrastructure proposals [personal communications]. Elements such as the interdisciplinary team diagram, the implementation diagram, and the categories of information infrastructure have appeared subsequently on posters as well as in discussions and presentations. In essence, this represents a trace of communication success as well as a mechanism to indicate the impact as an effectiveness indicator to aid the design of articulation work within communities.

Conceptualizing articulation may be seen as the use of an articulation approach for exploring the unplanned or non-rational aspects of work frequently left out of rational work models (Star and Strauss, 1999; Sawyer and Tapia, forthcoming). In our work, we interpret broadly the definition of articulation as an alignment of tasks and resources including explicitly financial, physical, human, and conceptual resources and tasks. With such an understanding, the notions of alignment referring to task meshing, unit-worker meshing, and task-worker meshing (Bratteteig, 2003) are extended to include framing, bridging, and preparing. Framing may involve focus on classifications (Bowker and Star, 1999) and on explicating or representing the work (Grinter, 1996). Bridging includes joining theory with practice and understanding with use. Planning includes preparations for articulation work to occur within the larger articulation process. Such preparations include design activities that may result in emergent understandings and mutual learning with the potential of creating new types of alignment arrangements.

Articulation work is work – often invisible or unnoticed work in everyday activities – referring to the interrelation of parts or alignment of elements. It involves a range of categorizing, planning, coordinating, and/or negotiating efforts. Articulation work represents an element critical to designing and arranging for long-term community information infrastructures. In ongoing and future work we continue to seek to identify articulation work moments and mechanisms as well as additional emergent assessment approaches to collaborative work as a guide to articulation work.

6. Acknowledgements

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