Knowledge, Collaboration and the Global Environmental Dialog

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Abstract

As we seek to create an international consensus to improve the ecological state of the planet, it is imperative that we map concepts, and reconcile definitions in to order share knowledge more effectively about the state of the environment, as well as the approach to solutions. An ecological civilization requires a consensus reality and a technological platform to host an interchange about that reality.

The world faces multiple barriers to clear communication and solution solving when it comes to the ecology and civilization, and although the diversity of core language plays an important role, other barriers will prove equally critical, including:

- a clear agreement on the uncertainties that will drive ecological change,
- the models used to forecast and anticipate ecological change, and
- the development of systems for collaborating and sharing information.

This presentation will focus on approaches to building consensus reality through scenario planning, and the use of technology to create a common platform for representation and communication.

In order to solve the communication and solution barriers, it will be necessary for the nations of the world to address deeply-seated semantic and conceptual issues, not those associated with science, but the political, social and economic representations of the impact of ecological change, and the possible approaches to solutions. Scenario planning offers a unique approach to creating a consensus reality because it forces individuals and organizations to agree upon not just that which is known, but that which is unknown or uncertain — and to put a name on both. Once something has a name and a character, it is much less likely to be ignored.

Language and concept, however, are just the first part of the equation. The world also needs a consensus platform for collaboration that can effectively manage the interchange of ideas and solutions through the common conceptual framework. To many, the Internet would appear a readymade solution to these difficulties, but whereas we operate the Internet with great interoperability and openness when it comes to network protocols, even commerce, methods for collaboration remain diverse and often proprietary. More importantly, we do not possess sufficient theory of cooperation to instantiate a robust, transparent, international approach to knowledge sharing. This paper will address the rudiments of such a system.

Going forward, those involved in the solution of common, cross-border ecological concerns must simultaneously develop a common collaborative platform, a vigorous representation of all aspects of the problem and solution spaces, all placed within the context of a consensus reality that proffers a shared view of the world.

Some would argue that the Internet has solved the problem of global collaboration. The Internet connects all who use it to and through a single network creating a global community. But that community is fractured. Hundreds of applications create silos, each with its selection of supported interfaces and protocols. Products like Facebook that purportedly connects one seventh of the human population remain but one portal into the Internet, and one with a purpose far different from the coordination of global knowledge exchange, or management of major events.

In the world of environmental science, many organizations have arisen that offer collaborative capabilities within regions or disciplines, even with aspirations for global cooperation. Even if these efforts succeed locally—even if they eventually support a global view—they are likely to remain narrow. And it is likely that any science-oriented effort will continue to focus on the needs of its research community, investing primarily in discovery and vetting, and only as a secondary effort translating findings into actionable input for policy makers, or applied solutions for environmental response teams.

The time has come for two complementary and simultaneous efforts. First, we must create a global qualitative framework that defines the uncertainties in science, technology, economics and politics related to the environment. That framework would then be used as an input for the design of a global collaboration platform aimed at the rapid assimilation of environmental and scientific data. This *Collaborative Environment for Environmental Research* could act as a single source platform for the collaborative collection and vetting of environmental research implications within the science community, and as the collaborative center for social and political agencies, as well as policy organizations.

The global environment offers a rare instance where a problem is truly global and truly apolitical. Even though the causes of environmental changes originate at the local level, the complex interactions of atmosphere and sea, land and human invention, create a situation in which no single government can address the issue singularly. Further, the effects already being felt around the globe require coordinated multinational efforts. Since most of these efforts reflect flawed designs, they generate high coordination costs, incomplete information and increased human suffering. The *Collaborative Environment for Environmental Research* must not stop at the collection and vetting of environmental data, but also include data related to relief efforts and other process-oriented investments.

In order to effectively respond to climate change and other environmental issues, nations and non-governmental organizations must work together. They must approach understanding and responding to global environmental phenomena as a design problem. Any approach must exist beyond politics and ideology—and any approach must lead to an environment that offers a common way to communicate, a common way to represent the central ideas and their implications.

Scenarios and Uncertainty

Many qualitative issues will, by their nature, reflect uncertainty. These uncertainties must be documented. Uncertainty should also be explored.

Scenarios could offer an important construct in the Collaborative Environment for Environmental Research.

Rather than simply examining data in a single context, models, actions and information can value from exploration through various scenarios that look at a range of ways important uncertainties play out under differing social, economic, technological and political situations.

Unlike collaboration systems that have generic features, the *Collaborative Environment for Environmental Research* should be designed with contexts that stipulate scenario logics as underlying assumptions associated with particular models or discussions. Rather than carrying out speculative discussions of social or policy actions in a generic, undefined future, the scenario framework provides a context for a robust and systematic exploration of potential outcomes.

Scenarios need not be limited to a set initiated for the purpose of a collaborative framework. Ideally the system would include a scenario modeling framework, and would permit users to assign scenario-related metadata to datasets, data values and conversations that reflects the contingent values of those elements.

The fragmented nature of global environmental research investments currently lead to duplication, often reflect narrow future contexts and use a variety of frameworks for assessment. The environment is an interconnected system with local effects and global controls. We should consider this, not as a design template, but as a critical realization that any system that oversimplifies fragments or disregards any aspect of the environment may work in limited application, but certainly cannot scale. Models of uncertainty, driving forces and other qualitative aspects of the environmental question will prove equally important to the analysis of hard scientific data.

We do not know what the future will hold, and therefore, must design a system that can adapt to an uncertain future, but more importantly, actively anticipate the future so plans and actions clearly reflect current knowledge, recognize uncertainty and include adaptability as a key element of their design.

Learning from Science: Designing for Coordinated Policy

In *Reinventing Discovery: The New Era of Networked Science*, Michael Nielsen, describes the struggle between the old formula of peer reviewed journal publication, and the rapid rise of competitive outlets on the Internet that allow research that might be otherwise obscured or lost, to contribute to the global growth of knowledge. Peer-reviewed journals cannot keep up with the overwhelming amount of discovery and insight being produced by the world's

researchers. And the world cannot benefit from information and knowledge that cannot be discovered.

Environmental science, like all sciences, is evolving past constraints toward a new, more open investigative model, a model of thought and engagement and challenge, delivered not through the scrutiny of pre-selected juries, but from the scrutiny and insight of the entire community of thinkers, regardless of their discipline or affiliation.

As we seek solutions to Beijing's smog and the spread of the Sarah Desert, remedies for thinning of ice sheets in the North Atlantic and flooding in the coastal planes of Florida and Louisiana, the results of environmental shifts exist beyond the purview of any one nation, or any one region.

As Nielsen so eloquently documents, scientists easily share data, even complex models, by choosing new channels of communications that put their data and methodologies, source code and algorithms, into the hands and minds of fellow researchers.

But even with the willingness to share, and with a global Internet that permits the free flow of information, technology becomes its own enemy. Marshall McLuhan once stated, "We become what we behold. We shape our tools and thereafter our tools shape us.[i]" We are at the point in the development of collaboration technology where rampant innovation and enormous assortment reflect the variety of human collaboration approaches. We are shaping our tools.

Part of that shaping involves making choices. Political and social leaders in national, provincial and municipal governments and other agencies need to coordinate their efforts as much as scientists, perhaps more so. Applying design means that we not only accept and use our technology, but that we do so effectively. Design in the context of collaboration requires people to select relevant tools for the work they wish to accomplish, and that they use those tools with policies and practices that create a positive experience. For a global community focused on the environment, paying attention may be one of the most important aspects of such an experience.

Attention is the scarcest of 21st Century resources. Nielsen suggests that "the purpose of the online tools is to help people figure out where they should direct their attention. The better the tools can direct people's attention, the more successful the collaboration will be. Put another way, the online tools create an architecture of attention whose purpose is to help participants find tasks where they have the greatest comparative advantage."[ii]

It is such a design that this paper proposes. As scientists grapple with how new technology enables discovery and facilitates knowledge sharing, so too must the policy community seek to employ technology to respond to research, and use that research to anticipate and respond to real world events.

Design Considerations for a Collaborative Environment for Environmental Research

Management By Design (Rasmus, 2010) documents a methodology for the design of work experiences[iii]. Creating a Collaborative Environment for Environmental Research is not just a platform for collaboration. It is but a single component within a very complex experience. The ***Management By Design Methodology***, outlined in Figure 1, forces organizations to develop work experiences that take into account strategic and tactical elements, while using the core elements of policy and practice, technology and space to shape the experience.

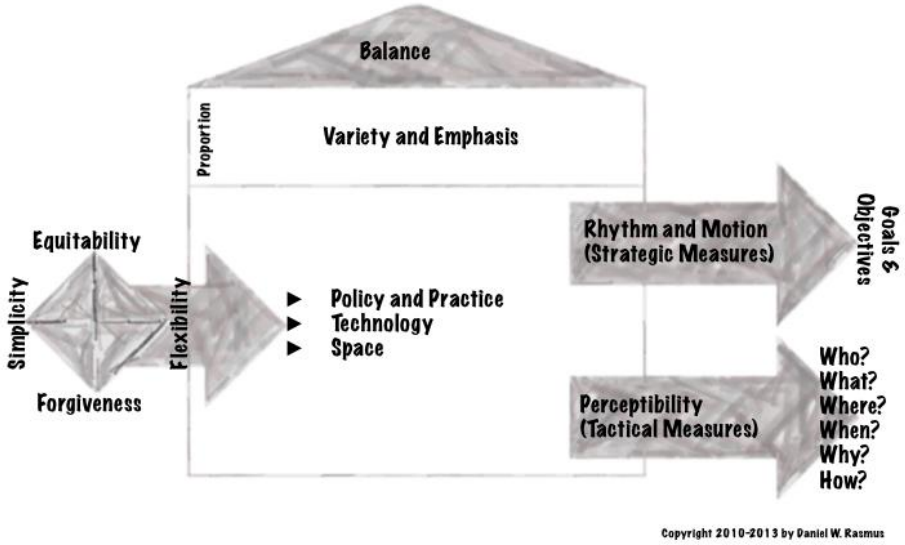


Figure 1: The Management by Design Methodology.

Design is of particular importance to large, multinational, interdisciplinary efforts because there are so many conflicting frameworks and cultural elements that must be taken into account. Simply putting a common collaboration platform, either commercial or open-sourced, into place and asking people to "collaborate" is doomed to failure at large scales. Some groups may use such a system to great effect, and they may even document and share those successes, but in a strategic sense, the system will likely not achieve its goal, in this case, of coordinating global environmental research. Only when strategy (rhythm and motion) is used to drive the work, and the work experience itself has been considered with design in mind (balance, proportion, variety and emphasis,) can it be measured by, and reflect, strategic value, rather than tactical success.

The following paragraphs outline the basic ideas behind the *Management by Design* work experience methodology, and provide brief examples for how they related to the design of a *Collaborative Environment for Environmental Research*.

Balance Balance asks work experience designers to determine what work experience elements designers should consider. The balance step presumes that any of these elements, if out of balance, would cause the system to fail. In the case of the *Collaborative Environment for Environmental Research*, accuracy, thoroughness, engagement, uncertainty, discoverability and transparency can be considered the highest order elements, though they may not be exhaustive.

Proportion Balance does not come from sheer force of will, but must be designed into the system. Proportion asserts ways to counterbalance competing work experience elements through **emphasis**, or prioritization and variety.

Variety Variety provides the much needed reminder to avoid work experiences that are repetitive, singularly dull, or marginally inviting. Consider discoverability in this instance. Although people using the *Collaborative Environment for Environmental Research* might well offer insights proactively along with links or ideas related to something being discussed in the database, if designers include engaging activities like brainstorming exercises and embedded gamification, they will likely see improve results. They might realize increased participation and engagement leading to a higher number of solicited ideas, or a higher conversion rate of ideas into practical solutions. In any system like this, where the primary collaborator is likely to be a volunteer, the system must effectively compete for attention with other systems in which its members are also affiliated. Variety helps achieve that goal.

Emphasis Emphasis also plays a critical role in nurturing attention. Emphasis helps bring items into focus that are important at a given point in time, or to a given task. Emphasis helps eliminate information overload, thereby reducing the imbalance caused by people inundated with irrelevant or untimely information. Emphasis is also important as the source of alerts that shift contexts based on actual or perceived events.

Rhythm and Motion. Using the *Management by Design* methodology, work experience designers think about strategic context and measures as long duration activities. All work within the experience should be able to be tied back to some strategic effort that drives the day-to-day work. As strategic imperatives shift, all activities tied to a particular imperative should be flagged for reflection and reconsideration. Think of rhythm and motion as a way of keeping a work experience aligned with strategic goals.

Consider an effort looking at fresh water reclamation using membrane processes like microfiltration, ultrafiltration, and nanofiltration for water and wastewater treatment, along with reverse osmosis for desalination. If a new technology arises, any strategic effort focused on these technologies would need to be restated to include the new technology, or perhaps even reshaped completely, eliminating an existing strategy in favor of the newer strategy. The new strategy might also include a faster time to realization. By tying projects to a strategic context, any shift in strategy forces a re-evaluation of underlying projects and activities.

Rhythm and Motion also act as the hub for strategic measures. An individual project may be completed on time and within budget, but if it does not positively impact the organization's goals, then it is likely a wasted investment. Rhythm and Motion ask that designers consider not just the relationship between work and a strategy, but how the outcome of the work should be measured strategically.

Perceptibility. *Management by Design* uses the idea of "perceptibility" as a proxy for tactical reporting. Where rhythm and motion seek to align to strategic goals, perceptibility seeks to keep peers, colleagues, other teams and other networked organizational structures informed about accomplishments, dependencies and the status of other tasks or activities that require tactical coordination. Perceptibility uses a very simple: *who, what, where, when, why* and *how* formula to make sure that anyone who wants to look at a task or activity can acquaint themselves not just with status, but with history and approach as well.

At the core of the methodology are the elements that can be manipulated in order to create the work environment: **policy and practice**, **technology** and **space**. Although these are widely divergent at first glance, each of them reflects a tangible and malleable aspect of an organization's culture. Rather than look at culture as an abstract, using these elements, the culture can be affected by changing behaviors, tools and physical/virtual spaces. In a highly distributed, virtual, emergent environment, these elements become the primary building blocks of a new environment.

Each of these design elements is further scrutinized by the application of the following four modifiers:

- Simplicity
- Equitability
- Forgiveness
- Flexibility

Each modifier acts as a design lens for policy and practice, technology and space, leading designers to a deeper examination of their proposed experiences.

Here is a brief overview of how those terms might apply to the technology of collaboration within a *Collaborative Environment for Environmental Research*.

> **Simplicity** The system should be easily used by people with basic computing skills. It should eliminate end users actions where possible, and also take actions on their behalf where intent is clear.
>
> **Equitability** The system should recognize cultural, physical, social, technological, and other characteristics of those who use it, and wherever possible, adapt to the special needs or unique capabilities of those users.
>
> **Forgiveness** Any system should allow for the graceful recovery from errors, including errors of omission or errors of fact. In a system like this, the community of researchers should decide on methods of arbitration and remedy for factual errors or other indiscretions.

Flexibility Although a system is often built for a particular purpose within a set of current technological capabilities, such a system should be developed in a way that allows for the expansion of the data it can contain, the communications channels it can connect to, and types of problems it facilitates.

Collaboration technology is inherently horizontal and generic, meaning that it cuts across a wide range of functions and processes. At its core, collaboration technology is ambivalent to any problem being discussed within the system. That being said, after the implementation of any system, parts of it begin to adhere to the structural necessities and biases of the teams using it, which often threatens the flexibility and simplicity of such a system. Flexibility suffers as teams constrain the use of a system to a particular set, or subset, of problems. Simplicity erodes as the cult of knowledge asserts itself and those familiar with the problem space and the tool become more prone to cryptic abbreviations and technological shortcuts. It is not that productivity should suffer at the hands of design, but that the design should recognize these future points of failure and put in place design elements, either technological or practice-based, to ensure that new users, and users from other disciplines or collaborative experiences, can still quickly and efficiently engage.

This last paragraph may seem convoluted, and perhaps a bit over cautious, but it reflects a fundamental issue in collaborative systems: horizontal technology often evolves to suit functionally specific needs. To some degree, that is the purpose of a horizontal technology, like collaboration, but activities like commenting, seeking people and searching for information, remain horizontal, generic information tasks, independent of the content or the context. The application of design to the collaborative experience should help moderate the propensity of systems to take on unwanted characteristics.

The Semantics and Knowledge of Environmental Management

A *Collaborative Environment for Environmental Research* requires a solution to semantic representation of the environmental problem space. This representation must capture the social and political aspects of environmental dialog in the same way that physical scientists represent their data.

As Tahir and Banares-Alcantara point out: "a comprehensive formulation of an electricity generation mix must include aspects associated with the triple bottom line sustainability (social, environmental and economic criteria), an evaluation of which requires the consideration of a significant amount of diverse non-numerical information.[iv]"

The best numerical models are simply incomplete without recognizing the value of qualitative data. The *Collaborative Environment for Environmental Research* must accurately represent the non-quantitative aspects for environmental issues, which means that it must permit the accumulation of unstructured, textual and media material, as well as the analysis of that material.

Although research continues in both the statistical and cognitive analysis, early implementations of a *Collaborative Environment for Environmental Research* may benefit more from human classification than from machine learning or other approaches to automated classification. If the semantic infrastructure is designed into the solution, the process by which the content is classified can be amended as technology and techniques mature.

Moving Toward Cooperation in Florida

Management by Design makes the observation that most people, and most organizations, just let work experiences happen to them. In other words, whatever already exists, and what emerges, becomes the default experience. In contrast, *Management by Design* suggests that people and organizations actively co-create work experiences to meet organizational and individual needs.

Multi-dimensional, multidisciplinary efforts, such as environmental research often come together from serendipitous events. Florida has already been affected by climate change, and the Florida Keys are one of the most threatened places on earth: from delicate ecosystems that support rare species, to hurricanes that reshape landscapes, to rising waters that change the chemistry of the environment and may ultimately submerge it altogether. Florida cannot afford to wait, and must act now.

But collaboration and cooperation are not easy. In 2009, Florida Atlantic University (FAU) recognized that they were conducting good research, but that each discipline did so within the confines of its programs, and very little synergy or synthesis was being realized. To create a more open and cooperative environment, FAU created the Integrative Collaboration on Climate and Energy (ICCE)[v]. They brought together engineers and architects, meteorologists and geoscientists, to focus not just on basic research, but to move together toward applied science and solutions.

But scientists in one university, no matter how coordinated their efforts, cannot affect policy change or implement solutions. Practitioners and policy makers must also be involved.

So the next level of cooperation was established, with counties, municipalities and water districts coming together to form The Southeast Florida Regional Climate Change Compact[vi]. This Compact was created by Broward, Miami-Dade, Monroe, and Palm Beach Counties in January 2010 to coordinate mitigation and adaptation activities across county lines. Their charter quoted from their website reads: “The Compact represents a new form of regional climate governance designed to allow local governments to set the agenda for adaptation while providing an efficient means for state and federal agencies to engage with technical assistance and support.”

This compact now brings county officials and scientists working for the county, together with university researchers.

ICCE continues its charter, but is now part of a larger network called the Florida Climate Change Task Force, which coordinates across multiple universities as well federal, state and country programs.

In all of this work, traditional methods of collaboration dominate: conference calls, workshops, summits and e-mail, all used to explore issues and to work on joint proposals and whitepapers.

Florida's efforts likely represent the most comprehensive environmental collaboration taking place in the United States, yet they have allowed work happen to them. They use the most widely known tools, like e-mail, despite its shortcomings in managing massive undertakings, at the core of their collaborative endeavors. As is true in many collaborative efforts, the design of the experience reigns secondarily to the initial problem, and that is how it should be. But second does not imply how people work together remains unaddressed.

Florida's leadership in integrated science and policy developed still has work do to at the communication and process level. Like many investments in collaboration, the design of processes and use of related technology come as an postscript, often after much work has already been done, and many conversations opaquely documented in e-mail or other systems that make them hard to share with a larger audience.

Organizations, especially academic organizations, should seek out additional internal collaborators from the business school, from the psychology department and from computer science to conduct collaborative meta-research, and to suggest tools and platforms that can be used effectively to manage the information that arises from these cooperative efforts, the types of relationships that form and the categories of information created.

It is imperative that all environmental initiatives recognize that they are collaborative in nature, and that as much as they may understand their disciplines or functions, they are likely not experts in collaboration. In order to be effective, they need to invest in technology and practice that can support their goals, along with the work related to those goals.

The Problem of Collaboration and Collective Action

Although it is feasible and desirable to create a *Collaborative Environment for Environmental Research*, the effectiveness of the collaboration must be separated from efficacy of the action suggested by the information collected. As Strauss-Titus pointed out in 1985[vii], collective problem solving often results in decisions that are worse than clear best decisions. In *From Cooperative to Motivated Information Sharing in Groups: Moving Beyond the Hidden Profile Paradigm*[viii], the authors explore the problems of collective decision-making. They present a model for motivated information sharing decision-making groups.

- **What Information.** Group members selectively share information, rather than sharing everything they know.
- **How information is shared.** What method is used to share information, what channels and what technologies act as part of the constrained delivery selection.
- **To Whom Information is Mentioned.** Group members intentionally select who they share information with, including selective sharing of new knowledge that may remain unshared across the larger group.

Goals moderate these three elements. Goals vary from an adherence or acceptance of a group's goals, to members acting on their own behalf or on behalf of conflicting or competing goals.

In the Wittenbaum model, "information exchange in decision-making groups is a deliberate process in the interest of members' goal attainment." It is pointed out that little work has been done to understand group decision making where external factors are explicitly described within the motivational structure. With an emphasis on the environment, information sharing may prove more open as the nature of the environment creates a less political context. But we cannot be sure.

This view of information sharing is particularly pertinent to a global collective focused on the sharing of information and decisions about the accuracy, efficacy and applicability of that information, offering an opportunity for a meta-level view of information sharing. Any effort must include research and assessment to understand how decisions are being made, how information is being shared, and how relationships develop over time.

A Course of Action

Creating a global collaboration environment for anything is a daunting task, even for organizations that have a common mission and a unified management structure. The goal before the global community should be the development and deployment of a *Collaborative Environment for Environmental Research* aimed at facilitating the collection, representation, correlation and discussion of global qualitative and environmental data, and related supportive quantitative data. It should not be seen as a repository for science, but an environment for reflecting on the implications of science.

The first step requires deciding what organizations and/or agencies will sponsor such an endeavor. Open source and commercial software is readily available to meet most check marks on a features list, but the need for customization will be inevitable, as this document suggests a number of areas beyond the capabilities of most of those systems. Incremental design and deployment is possible, but certain fundamental features, like the scenario frameworks, should be in place in order to capture metadata with the earliest instances of data capture.

It is unclear if any existing non-governmental agency has sufficient jurisdiction to undertake the sponsorship of a *Collaborative Environment for Environmental Research*, nor the budget to develop and deploy it. As with the Florida example, it may well be that less ambitious projects can incrementally be brought together over time from regional efforts. The collaboration about collaboration, however, should begin today so that the representation of knowledge contained in distributed, standalone systems, can be migrated and integrated as systems consolidate.

The next step requires initiation of limited pilots in order to ascertain the educational and engagement requirements, along with improvements in initial features, if any, to accomplish pilot tasks.

In parallel, the sponsoring organizations/agencies should define, refine and deploy policies that set expectations about usage models. This is important, as the design of the system also requires the design of policies and practices that reinforce the principles applied in the software design. As with any design effort, an imbalance between software design and practice can lead to the failure of the system. The design should also include ample feedback loops to understand when its data is used, and ways to determine the value and fit of that data.

Over time, decisions can be made about which information is most pertinent to a particular situation, and which information overall provides the best insight. Whereas the basic protocols of collaboration can be designed, the actual use, and the situations of use, will emerge over time and nothing in the system should constrain it from hosting discussion and research related to any environmental topic.

Conclusion

Collaborative Environment for Environmental Research offers a design exercise to highlight what can and should be done to enable global environmental research and collaborative reflection, enhancement and use of that research.

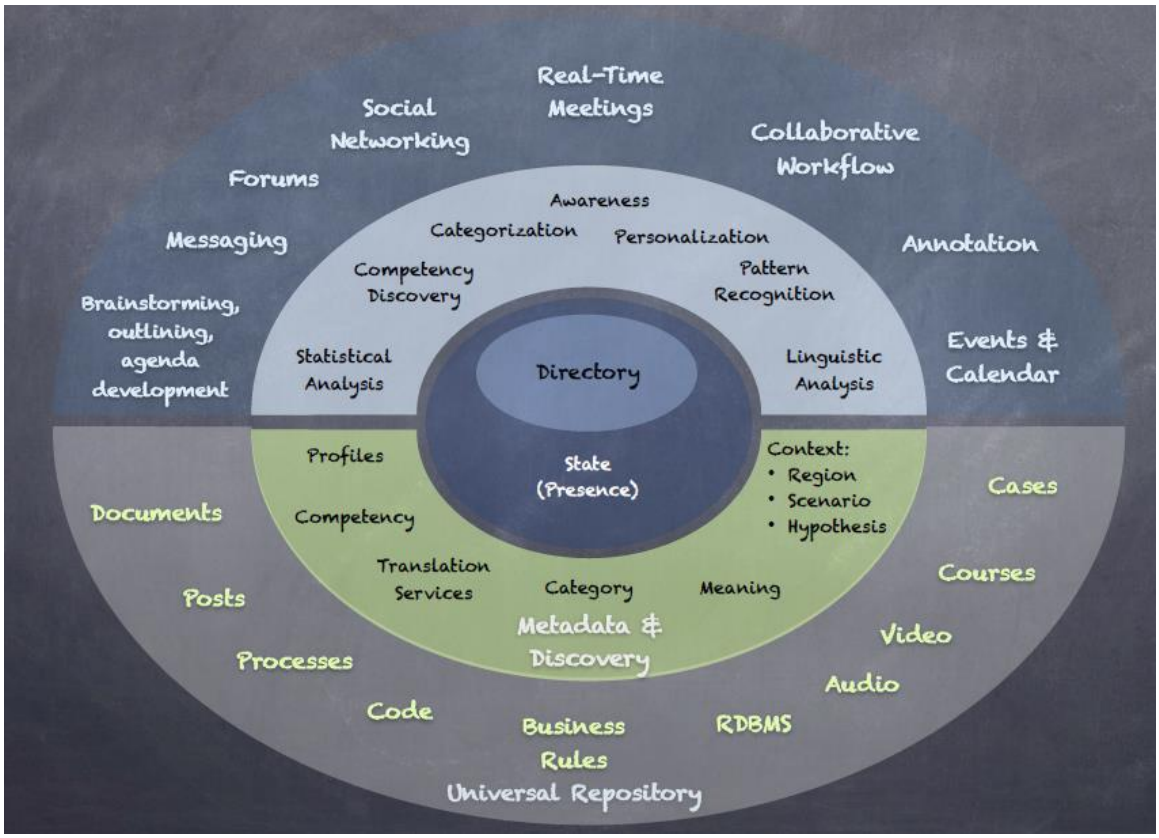
Such an effort elevates environmental research from observation and modeling, into the realm of social, economic and political systems. The *Collaborative Environment for Environmental Research* would help policy makers understand what is done, and through the documentation of uncertainties and the scenario framework, what is not known — and it would offer a robust and systematic way to examine data through various alternatives.

It is unlikely that anything like the *Collaborative Environment for Environmental Research* will ever be deployed, but it is important that we recognize that anything less limits our perspectives, leaves information hidden, creates silos where incompleteness reigns and forces researchers and policy makers to regularly retrace old ground, walk over the paths others have already treaded upon, reinvent solutions and rediscover insights. If we can but move a little forward, we will benefit from that movement. If this paper helps achieve that movement, it will have been well worth the investment.

Appendix

Suggested technical features for a *Collaborative Environment for Environmental Research*.

- Directory
  - Profiles
  - Competency/Skills
  - Online presence state
- Common Logical Repository
  - Documents
  - Posts
  - Processes
  - Media
  - Ontology and taxonomy
  - Rules and triggers
- Metadata Constructs
  - Contexts (defaults listed)
    - Region
    - Scenario
    - Hypothesis
- Collaboration Features
  - Messaging
  - Social
  - Discussions
  - Real-time Collaboration
    - Video
    - Audio
    - Shared Experience
  - Process and workflow
  - Calendar/schedule
- Search
  - Indexing
  - Awareness
- Meeting Support
  - Brainstorming and idea mapping
  - Agenda management
  - Outlining
- Discovery and Analytics
  - Semantic and linguistic analysis
  - Translation
  - Social network analysis
  - Summarization
  - Knowledge mapping



A collaboration architecture

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iv Chee Tahir, A., Banares-Alcantara, R., A Semantic Representation of Policy Goals in the Modeling of Electricity Generation and Water Treatment Systems, 29 October, 2012, 12AIChE, session 127c, Pittsburgh, PA

v http://www.ces.fau.edu/climate_change/icce

vi http://southeastfloridaclimatecompact.org

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