



Unidata Governance: A Quarter Century of Experience¹

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¹ This white paper draws mainly upon the experiences of Unidata, a community-driven data facility for the geosciences. Some of the material in this paper is based on previously published information.

1 Introduction

The overarching goals of EarthCube are to build a unified, adaptive, and scalable cyberinfrastructure framework for enabling transformative advances in geosciences research and education and realizing the vision articulated in the Geo Vision report. In the process, EarthCube aims to create a knowledge management system and infrastructure that integrates all Earth system and human dimensions data in an open, transparent, and inclusive manner.

The project of building a user-driven framework that addresses the computational, data, software, knowledge management, and user services needs of the diverse geoscience community is enormous. But the biggest challenges may be sociological rather than technical. Broad adoption and use of the resulting system will require users to adopt new methods in place of their current workflows. EarthCube's governance model must recognize and address the need to bridge cultural differences between disparate disciplines and developer as well as user communities, bringing all stakeholders together to create system-wide solutions to community problems.

Effective governance for EarthCube will:

- a) actively engage its diverse users
- b) provide strong leadership and oversight of the project to forge close cooperation, coordination, and collaboration among distributed development activities and the principal EC groups
- c) facilitate alignment of program plans and priorities with the needs of the community
- d) help the successful execution of the mission, meeting stakeholder obligations

This whitepaper describes Unidata's governance structure, process, and key elements, and illustrates how that governance has successfully stewarded the program and provided careful oversight for it as the community broadened. The paper concludes with a suggestion on how Unidata's experiences with community-driven governance, with appropriate changes, may also benefit the EarthCube project. At the same time, we recognize that there exist other models and implementations of governance within the scientific cyberinfrastructure arena, notably, the governance structures for Open Geospatial Consortium, TeraGrid, Open Grid Forum, and the Federation of Earth Science Partners.

2 Unidata Program and Governance History

The Unidata Program was formed in 1984, with funding from the National Science Foundation, to meet common needs for accessing and using atmospheric data in education and research. The meteorological community came together at a community workshop in Madison, Wisconsin in 1983; there, they articulated and agreed on their essential needs for data and software. Participants at the workshop committed themselves to helping one another fulfill those needs. Unidata has thus been a grassroots endeavor from the outset, while it has also received strong support from the NSF through the planning and implementation phases when few benefits were visible.

In an era of increasing data complexity, accessibility, and multidisciplinary integration, Unidata's current mission is to provide the data services, tools, and cyberinfrastructure leadership that advance Earth system science, enhance educational opportunities, and broaden participation. To fulfill that mission, the Unidata Program Center (UPC):

- Acquires and distributes real-time meteorological data for education and research
- Develops software for effectively working with geosciences data
- Provides comprehensive support to users of its products and services
- Conducts training workshops on its software packages
- Facilitates advancement of standards, conventions, and interoperability
- Provides leadership in geosciences cyberinfrastructure and fosters technological change
- Assesses and responds to community needs
- Advocates and negotiates agreements on behalf of the community on data issues
- Fosters community interaction to promote sharing of data, tools, and ideas
- Offers equipment grants to universities to enable and enhance participation in Unidata

As a result of the broadening enabled by the above activities, the Unidata community has grown from around 250 individual participants in the early years to now tens of thousands of users in over 150 countries. Today, Unidata's products and services are used on every continent and by every sector of the geoscience enterprise: universities, government agencies, private sector, and other non-governmental organizations. Over the years, Unidata has increasingly become a "virtual community" in which participants cooperate, collaborate, and share a variety of resources, including data. Given its grassroots origins, the program owes its success to and relies on extraordinarily high levels of community participation and contribution.

2.1 Guiding Principles

Successful organizations are guided by a set of principles that define their character and culture. The following enduring credos and shared convictions have helped to shape Unidata's efforts through the years and served as the program's underpinnings:

- Strong community-based governance for direction and priority setting
- Support for small colleges as well as large universities
- Priorities that balance user support with new development
- Distributed rather than centralized resources for scalability and autonomy
- Centralized functions only when the benefits for doing so are clear
- Platform independent tools and interoperable frameworks
- Free and open sharing of data and software
- Strength through partnerships and utilization of systems developed by others
- Strong advocacy for community needs
- Adaptability to rapid changes in technology, data availability, and user needs
- Continued commitment to the core program while undertaking new efforts
- Performing no function that can be performed equally well by universities
- Searching for and applying best ideas regardless of source
- Adopting, adapting, and only as a last resort developing new technologies
- Leveraging the strength of strategic alliances and partnerships

Community ownership is central to Unidata's success and involvement is critical to the program's overall effectiveness.

3 Governance Mechanisms

Unidata is governed by two standing committees whose members are drawn from the academic community. In their guiding role, the Unidata Policy Committee and the Unidata Users Committee sustain the program's community-oriented character, facilitating consensus-building for future directions, and establishing standards of involvement for community members. As noted by the current chair of the Unidata Policy Committee, Prof. Steven Businger:

"The governing committees have provided important guidance in setting goals, accomplishing objectives, and helping to set future directions for the program."

The remainder of this section describes Unidata's governance structure, committee activities, and the role of the Unidata Program Center in making it all work.

3.1 Policy Committee

The Unidata Policy Committee holds the primary responsibility for guiding the Unidata Program, advising on the program's overall direction and program priorities. The committee's most important responsibility is to ensure that the needs of the university community are met and that Unidata is responsive to those needs. To that end, the Policy Committee helps in the development of strategic and implementation plans, core-funding proposals, and reviews status reports on ongoing projects and activities to monitor the overall health and orientation of the program. The eight voting members of the committee are drawn from universities and appointed by the president of UCAR. In making the appointments, the UCAR President balances the membership to represent a range of institutions and to reflect the concerns of both instructors and researchers in the Unidata community. The committee also includes representatives from NASA, NOAA, and NSF, as well as from UCAR and NCAR, who are important sources of information and advice about events and environments that can profoundly affect the program.

The Policy Committee meets twice a year, and its members serve three-year terms. The committee's official charge is as follows:

The Policy Committee recommends to the UCAR President on Unidata policies, activities, and objectives. This includes, but is not necessarily limited to, usage, development, services, licensing, financial status, sponsorship, and relations with the private sector. The committee's most important responsibility is to ensure that the needs of the university community are met and that Unidata is responsive to those needs.

3.2 Users Committee

The Unidata Users Committee, composed of university representatives and appointed by the Policy Committee chair for three-year terms, is the primary mechanism for seeking user input and gaining feedback on the effectiveness of the Unidata Program. Similar to the Policy Committee, appointments reflect the range of large and small colleges and universities with undergraduate and graduate emphases where Unidata systems are in use.

The committee is explicitly charged with three tasks:

- *Determining the attitudes of the user community toward the Unidata program;*
- *Soliciting suggestions for additions to the data streams and software products; and*
- *Facilitating the exchange of ideas among users on the Unidata Program and its systems.*

The Users Committee meets a minimum of twice yearly and reports to the Policy Committee; As one of its principal activities, the Users Committee organizes workshops every three years on wide-ranging topics of interest to faculty, researchers, and educators. The workshops provide a venue for sharing ideas and materials, engaging in in-depth discussion on curricular matters, and devising ways to enhance teaching and learning in the geosciences. For example, the workshops provide participants with information on new datasets or on how Unidata tools may be used in the classroom.

To enhance communication and coordination between the two standing committees, cross-committee liaisons attend and provide representation at the other committee's meetings. The above committees have helped build community-wide agreement on the UPC's role while defining the expectations placed upon the member institutions. The committees are also instrumental in setting priorities and altering the course of the program when warranted.

In addition, and throughout Unidata's history, other interim working groups (e.g., Implementation Working Group and Advanced Technical Advisory Committee) and task forces have been constituted on an as-needed basis for providing technical expertise, to review technical designs and plans, and to help set technical directions consistent with industry and community standards and trends. For example, one such committee was convened to guide the development of Unidata's Integrated Data Viewer (IDV) tool, a software application for analysis and three-dimensional visualization of data. The IDV steering committee, and its predecessor, the MetApps Task Force, worked closely with UPC staff to define the functionality needed in the new tool. The results of these efforts are embodied in the IDV reference application and the IDV framework; the user input gained from the task force made the IDV a more useful tool, and facilitated its broad adoption. Furthermore, even when there is no standing or interim committee appointed, the developers have solicited input on technical and usability issues, design, and functionalities in tools.

To reflect the broadening community that Unidata serves, the composition of its governing and advisory committees are regularly augmented with representatives from other geoscience disciplines such as oceanography and hydrology. Such additions bring diversity in data needs and opportunities to the program, as well as help establish new priorities and activities for advancing the infrastructure needed for the broader geoscience education and research community.

3.3 Governance Principles

The following principles have provided the framework for Unidata's governance through the years while enabling its governing committees to fulfill their responsibilities and helping the program to remain focused and operate in a manner that has maintained its community-centric character.

- Community-led and autonomous governance, but with accountability and responsiveness to stakeholder and community needs
- Open, transparent, and inclusive approach to communication and deliberations

- Active, independent, and informed oversight and stewardship on behalf of the community
- Consensus-oriented and pragmatic approach to decision making
- Balanced representation from the full range of participating institutions
- Shared responsibility between the governing committees and the program, but with a clear delineation of the roles
- Direct lines of communication between governing committees and staff
- Focus on long-term strategic direction, but with nimbleness to respond to rapid changes

4 Lessons Learned

The Unidata governance model has provided a wealth of practical experience that has shaped the program's character and offered valuable insights for continually improving the execution of its mission. That experience suggests that building such a sense of community may be an important goal in its own right. The synergy arising from Unidata as a community effort has created a whole greater than the sum of its parts and a program whose culture is as important as its technologies. Unidata has helped transform, on a national scale, how universities acquire, share, manage, analyze, and visualize atmospheric and other data. In relying on participant interactions, the Unidata story demonstrates that virtual communities can share not just mutual interest, but also social network capital, knowledge capital, and communion. These attributes are present in the Unidata community and have been critical to the program's success.

That is, Unidata realizes the concept of a collaboratory, as defined in the 1993 National Research Council report "*National Collaboratories: Applying Information Technology for Scientific Research*," with a positive feedback loop for participation and resource contributions. Such feedback appears essential to maintaining a program's effectiveness, and achieving it represents as great a challenge as employing the technologies. We think this lesson is important if the Unidata model is to be applied in other disciplines.

Unidata operates in a world of rapidly advancing technologies and paradigm shifts. Such an evolving environment creates difficult choices; the evolution of proprietary and open-source operating systems and changes in communication technologies have required Unidata to be flexible and take calculated risks. Weighing risks against potential gains has been a key aspect of program governance, and community participation has been critical because those most affected by the risks are in fact the community members. Through the years, Unidata's governance has played a crucial role in helping the program to maintain the pulse of the community, stay nimble and make much needed course corrections through development efforts and projects. Community governance has helped Unidata make important decisions affecting the program on software, data, and user support, facilitated community relations, and helped diffuse the occasional tensions that arise from time to time. The governing committees have provided greater transparency for UPC activities and shaped the culture of ownership and active engagement by the community.

Unidata's reliance on community participation and contribution is not without drawbacks. Decision making can be slow when it depends on committee deliberations. This may seem risky in the rapidly changing environment of computing and communication, but we believe the process is vital and has helped to avoid developing tools that are technically elegant but, in practice, not so useful to users.

5 Applicability to the Earth Cube Project

Unidata's success has been possible only because of its strong, community-driven governance and the commitment of individuals at the UPC, NSF, universities, UCAR, and other partnering agencies to the principle that a community-oriented program could and would prove beneficial. The knowledge gained from Unidata's quarter-century of experiences with community governance can inform and give shape to the EarthCube effort, should the EarthCube community elect to build a Unidata-like collaboratory.

We submit that the Unidata model for governance and community interaction can be readily extended to the EarthCube context. In particular, the governance and guiding principles articulated in this paper and certain key characteristics — centralization only of selected functions and overall leadership, a high degree of community engagement, and strategic partnerships between agencies and universities — are necessary in similar collaborative efforts such as EarthCube.