

# NSFNET to Cyberinfrastructure: Polity, Path Dependence, and Scientific Practice

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## ABSTRACT

The current efforts in “building cyberinfrastructure” are being met with varied success in different disciplines. With respect to the social sciences, cyberinfrastructure (CI) is a tool of significant potential for advancing research, both in terms of connecting social scientists, as well as making accessible vast stores of research data. The current focus of CI, however, is apposite for only a small segment of social scientific efforts. This research approaches CI from a historiographic and STS perspective, examining the development of CI from the early days of NSFNET and Advanced Systems and Networks (ANS). The consequences of particular decisions motivated by political, social, and economic factors created path dependencies gave rise to the current configuration of CI, and consequently define the types of science that most benefit from the CI environment.

## 1. INTRODUCTION

The cyberinfrastructure movement, largely defined by the initiatives organized by the NSF Office of Cyberinfrastructure and the newly launched CDI program (Cyber-enabled Discovery and Innovation), is posed to become a dominant framework through which formal scientific inquiry and collaboration is conducted in the foreseeable future [2][3]. As working cyberinfrastructure is realized, or as is commonly claimed, “built”, disciplines are attempting to find their way in this new, distributed, and technologically mediated framework of practice. The unfortunate reality is that not all disciplines are as well-suited to the cyberinfrastructure environment. Some research traditions, usually high-paradigm and quantitative sciences, find a welcome home in the services offered by CI - sharing and availability of databases and datasets, high-performance processing of numerical data, negotiating and scheduling of shared laboratory resources, visualization tools for complex information. Still, other research areas, namely the “softer” disciplines – qualitative social sciences and the humanities – struggle to find their relevance within the CI environment. A 2006 report from the ACLS entitled “Our Cultural Commonwealth” outlines

the ways in which the social sciences and humanities can gain relevance and advancement through advanced cyberinfrastructure [1]. The report, however, belies a tension and sense of urgency that the humanities will have difficulty remediating itself in this new framework. If the humanities, as well as other fields cannot step into line with the new scientific CI-based world order, what are the unintended consequences for these types of scholarship on the horizon?

As has been discussed at length in the information science and STS literature, technological systems represent not unbiased and objective realities; rather, they are externalized encodings of political, social, and economic values [6][5]. The decisions made in the past - design, temporal and spatial positioning, granting of access - were the seeds of these encodings and created path dependencies which led to the current state and configuration of scientific research infrastructure [4].

The underlying sensibility is that this shift in research environment holds the potential to consequently shift the boundaries of science-as-practiced, not only for the social science, but for the view of academic scholarship writ large. The loose sense of logic here (to be refined and articulated through the dissertation research) is that CI privileges particular types of sciences, projects, proposals, and activities. Of course, the calculable reward for successful projects is the frequency and level of funding received by various agencies. Savvy scientists position research projects to draw funding and continue a track of successful grant streams. Another tier of scientists follows the lead of the winning scientists and shifts research projects to be similar in composition, and on down the line. Eventually, the types of science practiced, the construction of what is “legitimate science” to practice, shifts according to the attributes and constraints established by the CI environment. Those disciplines that are already struggling face the threat that the current challenges of securing funding will become more extreme. and in this same vein, the shifting boundaries of legitimated science have the potential to push them completely across the boundary to the “outside.”

## 2. RESEARCH QUESTIONS

The questions (roughly articulated here) I am contemplating through the dissertation research are:

- How have political, social, and economic agendas been encoded into, and created path dependencies leading

to the current incarnation of cyberinfrastructure?

- How does the configuration of cyberinfrastructure enable and exclude various disciplines and distribute resources, reinscribing the boundaries of “legitimate science?”
- How can we further understand infrastructure and cyberinfrastructure in terms of construction/deconstruction, modernism/postmodernism, present-at-hand/ready-to-hand, and epistemic/ontic concerns and objects of study?

### 3. WORK IN PROGRESS

The most likely form of this dissertation will be the “multiple article” format. The proposed lineup (as it stands) is as follows.

#### 3.1 NSFNET as Path Determinant Precursor to Cyberinfrastructure

While a number of accounts of the birth and growth of the Internet have been told, most focus on the opening of network technologies to the public and commercial sectors. To date, only one internal report has been written on the history of NSFNET that focuses on the continuation of the research arm of the network. Information scientists and STS scholars claim that technology encodes social and political values, which in turn constrain their uses through path dependencies. This article aims to examine such dependencies in shaping the technological topology of scientific research networks by conducting oral history interviews of key figures involved in the creation and maintenance of the NSFNET project.

#### 3.2 The Constructed/Contested Object Called Cyberinfrastructure

When we speak of infrastructure, we have taken the product of historical forces, path dependencies, and heterogeneous processes that have sunk below the level of individual and sociocultural cognition, and resurrected it as a bounded object for our deconstruction. This is not without its own consequences or problems. What makes examination difficult is managing the complex choreography of the OEP (Ontological, Epistemological, Phenomenological) views. Several philosophical traditions (ranging from Aristotle to Heidegger to Bowker), in my interpretation, are related to managing the OEP choreography and acknowledge the underlying problematic of describing objects of complexity. How do we draw upon or integrate these previous interpretive frameworks to develop a new understanding of infrastructure/cyberinfrastructure?

#### 3.3 When is Cyberinfrastructure? For Whom?

Following in the tradition of Susan Leigh Star, who asked “When is Infrastructure?”, considering cyberinfrastructure merely as supercomputers and physical networks misses the point. Without activity and users, cyberinfrastructure serves no purpose. Instead, if we additionally consider cyberinfrastructure as the building of relational capacities and services between and among organizations, institutions, and providers, we can develop a more robust sense of cyberinfrastructure in its operating and contributory modes – its functional state.

### 4. EXPECTED CONTRIBUTION

This research aims to contribute new knowledge on several fronts. First, the history of NSFNET and ANS as told from the perspective of the system builders is largely untold. In the recent past, a number of these central figures have passed away. Recording an oral history of the process is an important contribution in creating an archive of a critical period in Internet history. As is clear from the mentioned passing, the opportunity to capture primary source material in this case is fleeting, and the window period to create a record has an uncertain duration.

Second, cyberinfrastructure is positioned to be the dominant framework for scientific research in the 21st century and beyond. If it is a possibility that the social, political, and economic structure of cyberinfrastructure prioritizes some disciplines or research traditions over others, it is important to explicitly address these issues when forming future research policy. To allow fields to fall by the wayside simply because they were not ready for cyberinfrastructure could be damaging to the stability of the academy, and a frank discussion of this potential will be invaluable to policy formation in the science and technology arena.

Finally, this research aims to add cyberinfrastructure to the general STS dialogue as a complex and constructed object, pointing out the often transparent assumptions and processes required to examine infrastructures and engage a contemporary process of “building cyberinfrastructure”. The ways in which infrastructure building is being pursued are potentially problematic, and this dissertation research aspires to articulate epistemological and ontological issues in infrastructure studies.

### 5. REFERENCES

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