"Designing and Using FastLane: History and Cyberinfrastructures"

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FastLane is the central nervous system and key information conduit connecting NSF to the distributed community of researchers and institutions. We are researching FastLane's design, implementation, and use as an instance in computerization and of cyber-infrastructure. Unexpected findings to date include the dearth of NSF documentation on FastLane as well as the crucial role that FastLane played in the early WWW era, with its early use of Mosaic and PDF. In piecing together FastLane's history, we are forced to confront many salient aspects of NSF's development in the past two decades: the implementation of computing technology, the relations to other federal agencies pursuing electronic document systems, and the agency's relation to the research enterprise.

FastLane is well known to NSF's senior staff and to those who participated in its creation in the 1990s and launch in the fall of 2000. Curiously, however, it seems to be suffering the fate of many similar infrastructures (in Paul Edwards' terms) in that just as they become necessary to daily life and indispensable to common routines they appear to vanish from our conscious awareness.[1] These days, we pay attention to water, electricity, and the Internet chiefly when these systems periodically are not working with their accustomed regularity.[2] Many of our interview respondents seem to think that FastLane has "always" been there: the days of paper proposals, not that many years ago, are something like a bygone century. Even on the NSF.gov website, the material

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[1] Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems." Pp. 185-225 in Thomas Misa, et al. eds. *Modernity and Technology* (MIT Press 2003).

[2] David E. Nye, *When the Lights Went Out: A History of Blackouts in America* (MIT Press 2010)

devoted to FastLane's genesis and history has dramatically shrunk over the past two decades.

We conceived this historical assessment and appraisal of FastLane with several goals in mind. First, we suspected that much of the early documentation on and insight into the system was, like that for many computer systems, in significant danger of being lost or forgotten. A concerted effort to collect documents, interview key participants, and pull together a history of FastLane would be timely and valuable. Second, we wanted to integrate views from both the designers of FaneLane (around two dozen individuals played some identifiable role) alongside the varied users of FastLane. The users are a diverse lot: PI's at universities and research institutes, Sponsored Projects staff at those institutions, and the numerous "legacy staff" at NSF who use FastLane and eJacket in their daily work. Third, we were inspired by a comment by a rotator colleague of mine, who observed (around 2001) "FastLane is changing NSF, but NSF has only the faintest idea of how." FastLane would be a good instance of implementing e-government, what once was termed "computerization."[3] And, finally, we hoped to learn something about how and why FastLane became an early, successful instance of cyber-infrastructures that might help the design, implementation and use of present and future cyber-infrastructures.

We had some of the needed research tools for this project readily at hand. The Charles Babbage Institute specializes in the history of computing, and ever since our founding in 1980 we have conducted a number of studies of large-scale computing efforts, both in the government as well as in private companies.[4] **Document analysis** is the traditional core of historical research. In the computing field, identifying and collecting documents from the individuals or agencies that created them is often the first order of business. **Oral histories** are a key resource in many contemporary history

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[3] Thomas J. Misa, "Understanding 'How Computing Has Changed the World'," *IEEE Annals of the History of Computing* 29 no. 4 (Oct.-Dec. 2007): 52-63.

[4] See (e.g.) the published studies Arthur L. Norberg and Jeffrey R. Yost, *IBM Rochester: A Half Century of Innovation* (IBM 2006); Arthur L. Norberg, *Computers and Commerce: A Study of Technology and Management at Eckert-Mauchly Computer Company, Engineering Research Associates, and Remington Rand, 1946-1957* (MIT Press 2005); Arthur L. Norberg and Judy E. O'Neill, *Transforming Computer Technology: Information Processing for the Pentagon, 1962-1986* (Johns Hopkins University Press 1996).

fields, and the history of computing is no exception. My predecessor as CBI director, Arthur Norberg, was one of the figures who helped develop "research grade" oral histories. These are not journalistic interviews but a systematic method requiring extensive preparation on the part of the interviewer and a careful attention to the transcribing of the interview, editing, revising, and finally making the results publicly accessible.[5] We knew that we could conceivably interview the two dozen or so "core designers" (including people who helped manage the development process, contractors, and trainers). We also knew that it was practically impossible to interview more than a tiny portion of the thousand or so NSF staff, let alone the innumerable PIs and SPA staff whose experiences we wished to capture, record, and preserve.

We accordingly designed and built a **web-based interview platform** that permits larger numbers of respondents than we could interview in person. We designed the site to augment, not to replace, our traditional in-person interviews. We hoped that by gathering perspectives from a much wider profile of users that we might also make a fundamental advance in the craft of studying contemporary science and engineering, where (typically) only the leading or elite figures are ever interviewed and the perspectives and experiences of the rank-and-file participants are simply unknown and undocumented. We decided that we would set up a self-paced interview that would closely approximate the questions we are asking in our in-person interviews. We also were able to add the capability of uploading binary files (of many types). In addition, we created a **project wiki** with the initial idea of presenting a "core narrative" of NSF's FastLane that participants might comment on, revise, and extend. The wiki is an alternate for participants to view our collected historical materials on FastLane, to comment on these materials, as well as to upload further documents (paper documents that might be scanned as well as WORD.doc, pdf's, PowerPoints, and so on) that might otherwise never be preserved. (These sites are now "live" and ready for use: start with <fastlanehistoryproject.org>.) The Human-Centered Computing program helped launch

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[5] Thomas J. Misa, "Organizing the History of Computing: Lessons Learned at the Charles Babbage Institute," in John Impagliazzo, Timo Järvi, and Petri Paju, eds., *History of Nordic Computing 2*. Second IFIP WG 9.7 Conference, HiNC2, Turku, Finland, August 21-23, 2007. (Boston: Springer, 2009), 1-12. [DOI: 10.1007/978-3-642-03757-3]

the project with a SGER in 2007 and a full award in 2008. Our research team has been physically located at CBI, including the PI, co-PI, and three graduate student assistants.

We have been systematically collecting material not merely to document the historical evolution of the FastLane project but also with two broad questions in mind. First, in an attempt to "pin down" some lessons for contemporary cyber-infrastructure, we are seeking information on the interactions (and feedback mechanisms) between designers and users. Early interviews with Fred Wendling alerted us to the fact that FastLane was conceived and developed to fit with the needs of NSF's audience in the research community: the six early modules of FastLane that were chosen to be developed were selected because they had immediate relevance and connections to one or another of these constituents. Financial transactions would connect with university administrators and finance officers; paperless proposal submission might appeal to PIs and SPA offices buried under mounds of paper, to say nothing of the mounds of paper at NSF itself. NSF staff trainers who traveled to regional meetings and met with many PIs and SPA staff were another mechanism of interaction and education. We have "heard of" the existence of some thousands of "user response" forms but have not been able to confirm their existence, let alone examine them ourselves. This is an on-going research topic for us.

Another important question involves the possible effects of FastLane on PIs and SPA staff at different types of universities. Our interviews make very clear that faculty and staff at the elite research universities had minimal difficulties in adapting to FastLane. Many of these PIs had NSF grants already or had the institutional means to acquire all needed computer resources: desktop PCs, robust Internet service, and the proprietary Adobe software that was once needed to create PDFs.[6] Generally, faculty and staff at elite universities positively welcomed the move to electronic proposal submission, project reporting, and proposal reviewing and panel functions. At the top-tier universities, faculty often enjoyed support staff members in their laboratory or

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[6] FastLane initially required the use of Adobe Distiller, which in a two-step process "distilled" PDF files from post-script output. FastLane rejected files created by the readily available PDF Writer.

department that handled many of the detailed interactions with FastLane itself (and we have been able to interview some of these staff).

Further, we have paid close attention to the experiences of PI's and SPA staff at non-elite universities where institutional resources were less plentiful. Two well defined populations of pre-existing NSF interest and concern are the 100 or so Historically Black Colleges and Universities (HBCU)[7] as well as the colleges and universities in the federal government's Experimental Program to Stimulate Competitive Research (EPSCoR),[8] which includes NSF and other agencies and now involves more than half of the U.S. states as well as Puerto Rico and the U.S. Virgin Islands.[9] In both these cases, NSF recognizes a special responsibility to broaden individual and institutional participation in the research enterprise. If FastLane has had any perceptible effect on broadening participation in the national research enterprise, this would be an important finding. We are investigating two alternative hypotheses. Conceivably, institutions with fewer resources may have experienced greater difficulties in making the transition to successfully using FastLane for submitting proposals. Alternately, institutions with fewer resources may have experienced a "leveling upward" as their submitted proposals would appear identical in readability to those of better-resourced colleagues. (Recall that in the 1990s, high-resolution laser printers were not on everyone's desktop.)

Overall, we are in the middle of our active research. To date, we have conducted 121 interviews at eleven universities, with a cross section of research,[10] HCBU,[11] and EPSCoR,[12] as well as at NSF. Interviews range from 20 minutes to 5 hours. Of the FastLane "core designers" we have interviewed Frederic Wendling (early FastLane design team leader), Craig Robinson (FastLane project leader), Beverly Sherman

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[7] See the White House list at <www2.ed.gov/about/inits/list/whhbcu/edlite-list.html>.

[8] See the NSF document <www.nsf.gov/od/oia/programs/epscor/about.jsp>.

[9] For the EPSCoR states, see <www.nsf.gov/od/oia/programs/epscor/statewebsites.jsp>.

[10] Purdue University, Santa Clara University, University of California--Berkeley, University of North Carolina--Greensboro, Stanford University, University of Texas--Austin.

[11] Jackson State University, North Carolina A&T University (two visits)

[12] North Dakota State University, South Dakota State University, University of South Dakota.

(education and training), George Strawn (former NSF CIO), Rich Schneider (programmer for Compuware, the primary external contractor on FastLane in its early days), and Constance McLindon (Director, Office of Information and Resource Management, and early inside NSF advocate for FastLane). In addition we have interviewed a dozen NSF "legacy users."

All interviews, where permitted, will be added to CBI's public oral history database <www.cbi.umn.edu/oh>. The "core designer" interviews will join our interviews with some of the most notable figures in computing; we presently record 20-30 thousand downloads of interview transcripts each month.[13] CBI oral histories are a frequently cited source in education and research on computing, and are cited in numerous Wikipedia articles on computing topics. The varied sample of "user" interviews will be a unique resource documenting the use of computing by rank-and-file figures. We have secured permission from 80% or more of our interviewees to make their transcripts publicly available.

We do have some "unsolved problems." There is a massive and not-easily-corrected bias inherent in our PI sample and, to a lesser extent, in the SPA sample. The NSF database we use to identify and to contact PIs represents, obviously, researchers who have been successful in winning NSF support. We have no easy way of identifying a faculty member who submitted one or more grant proposals to NSF, but never received NSF support, and then simply stopped submitting NSF proposals. (Personally, I know of several such individuals but creating any sort of representative sample is difficult.) It is also difficult to form a "representative" sample of the HBCU institutions. Many are two-year or four-year colleges without NSF-funded research activity. The research-active HBCU sample is surprisingly small. Four or five institutions, including the leader Howard University, constitute the vast majority of HBCU PIs in the NSF database. At most HBCU's the number of NSF-funded PI's is very small, and the practical difficulty in finding enough PIs able and willing to do an in-person interview is daunting. It is possible that the on-line interview platform will allow us to gain

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[13] See also Thomas J. Misa, ed., "An Interview With Edsger W. Dijkstra," *Communications of the ACM* 53 no. 8 (August 2010): 41-47. [DOI: 10.1145/1787234.1787249]

information from even a single researcher, at any type of college or university, that we would otherwise miss.

In our "home discipline" of science and technology studies, the main consequence of this project will be a new method for conducting large-scale, user-centered research. While scholars in science and technology studies, history of technology, and computer history have lauded this research aim, without explaining how it is to be done, we are providing a practical and exemplary model. Preliminary results have been reported in sessions organized by the PI at annual meetings for the Society for the History of Technology (Lisbon October 2008) and (Pittsburgh October 2009) as well as workshops, conferences, and/or summer schools in Sweden, Finland, Portugal, and Bulgaria.[14] CBI has high visibility in computer history and the history of technology, and we are continually in consultation with colleagues about research methods and historical approaches, including the FastLane study.

Our research on computer development and implementation in the federal government will have relevance to managers and executives of NSF; interdisciplinary scholars of computers and organizations; and historians of the federal government, including those seeking to understand the impact of computers in their agencies. Further, we are interested in identifying the lessons that present-day designers, developers and users of cyberinfrastructures can learn from carefully worked-out historical analysis. We also hope to foster interdisciplinary interaction since HCC and STS scholars are each interested in the interplay of social and technical factors in the design, development, implementation, and use of computer systems. Finally, interviews with FastLane designers/developers and legacy users at NSF, and subsequent analysis, can contribute greater understanding of NSF as an organization (communication, work processes, work practices, culture and structures) and the dynamics of organizational change/development with the introduction of a pervasive new technology.

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[14] Our Lisbon paper contains screenshots of the early web-based interview platform; see <www.tc.umn.edu/~tmisa/papers/2008_SHOT-FastLane.pdf>. Or—for the real thing—you can visit the site proper, sign in, and complete an interview yourself: <fastlanehistoryproject.org>.