

## Email as Telescope in Distributed Scientific Collaborations

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Matthew A. Willis, Doctoral Candidate, School of Information Studies, Syracuse University, Syracuse NY, USA

Sarika Sharma, Doctoral Student, School of Information Studies, Syracuse University, Syracuse NY, USA

Jaime Snyder, PhD, Information School, University of Washington, Seattle WA, USA

Carsten Østerlund, PhD, School of Information Studies, Syracuse University, Syracuse NY, USA

Steve Sawyer, DBA, School of Information Studies, Syracuse University, Syracuse NY, USA

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We report on a study of email and related digital technology uses among scientific collaborators as a view (from a telescope, at a distance) into understanding distributed scientific collaborations. As might be expected, findings make clear that email is a – if not *the* – primary mechanism for interaction, communication and information sharing mechanism among distributed scientific collaborators. The more pertinent insight, and the primary contribution of this work, is insight into the ways in which email are embedded into scientific practices and serve as record and structure of the work being done.

This analysis comes from an exploratory study of distributed collaborative scientific practice. As a formative part of a larger study, we focus on the ways in which scientists share and manage documents, we pursued field research in order to bring together what is known in the research literatures on scientific practice, distributed collaboration, documenting practice, and e-science/uses of cyberinfrastructure with contemporary practice. We used both purposive and snow-ball sampling to identify 22 active scholars from the intellectual communities of science and technology studies, information science, information systems, computer-supported cooperative work (CSCW) or human-computer interaction (HCI). While collaborators come from a range of disciplines, the projects described were each grounded in social science practices around similar research interests, providing a basis for comparison. Reports of collaborative practices provided to us by our primary informants gave us insights into the work practices of over 170 researchers and project staff.

Data collected for this study are drawn from a comprehensive inventory of software and tools the participant uses in their collaboration and semi-structured face-to-face or phone interviews. Interviews were transcribed and then coded. One of the collaborations allowed us to follow project emails for more than a year and we analyzed the metadata to categorize the purpose of the email in relation to project research activity. The participants have evidence through publication, funding, and other visible products of their work that they were part of an ongoing, successful, distributed scientific collaboration. Participants also have experience with digital tools and computer-mediated collaborations because of these projects. The highest number of collaborators on a single project was over 30 and the lowest was two, most had four to six. These participants used a variety of digital tools, platforms and other online technologies. While there were patterns, a distinctive similarity across all distributed scientific collaborations is the intense use of email as the most common means of communication.

Analysis highlights three distinct roles email plays in supporting distributed scientific collaboration: (1) articulation, delegation and coordination work; (2) document management and archiving; and (3) shared cognition. First, and as expected, much of the email among scientific collaborators focuses on either articulation work – work done in order to do goal-oriented work (e.g., following the right template in order to submit a paper) – or on project goals, meeting times, detailing tasks and to-dos, and coordinating schedules.

Second, while document management and file sharing software/platforms are widely available, we find file sharing through email is a common practice in these distributed collaborations. Email appears to serve as a redundant file of record. Team members often put a file in a shared repository such as Dropbox, but also attach the same file to an email to edit and review. Third, we find email serving as social cognition. It is a script or record for what has happened previously for the project, and helps plan the future goals and tasks of the project. It is also visible, arriving to each participant's email inbox to be seen by each member but each member can work with the email separate from the rest of the collaboration

These findings make clear that email practices are deeply integrated with the lives of the scientists we studied. Email messages often contain personal or non-project related information, come in waves of light or heavier email use, and email practices and etiquette shift over time in a single group. Specifically, one shifting practice is that

email subjects do not always relate to or represent the content of the email body. This presents a challenge for similar studies which only collect email metadata and rely on subject lines to derive context of the email.

Mundane and often complex, emails' pervasive, ubiquitous and multi-faceted roles in distributed scientific collaboration practice suggest that it is deeply embedded in practice. This suggests that opportunities to shift project management techniques into email (imagine if the task and to-do email were posted to a team wiki for editing and updating), instead of the reverse, will likely lead to more fruitful uses of these techniques. Likewise, developing documenting systems and practices that work off of (instead of in parallel or even as opposed to) email sharing (imagine document platforms that monitored and curated email attachments) will improve document tracking. Finally, we imagine that, increasingly, project emails are the distributed digital equivalents of physical laboratory notebooks and systems should be harnessing these as part of the team's digital interactions.