A Research Ensemble of Humans, Machines, and Algorithms: Future Designs of Research and Scholarly Communication

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Abstract

Bill Hart-Davidson's "Writing with Robots" [1] describes current practices of creating augmented research and writing teams that include robots, algorithms, and other machine partners with their human collaborators in designed space. In writing about emergent workplace practices in high technology environments, we (authors Michael and John) created a team of researchers, undergraduate research interns, and robot assistants to create the forthcoming book Artificial Infrastructures. In preparing the book, we used Otter.ai [2] to transcribe interviews with three working professionals. These rough transcriptions, produced by algorithmic assistants, saved the team important resources, namely time, money, and attention. Transcription tools like Otter.ai quickly create transliterated texts—word-for-word transcripts of spoken speech. In our ensemble, transcriptions were then edited by undergraduate researchers trained using Weiss's Learning From Strangers [3] as well as practice editing transcripts of other recordings of subject matter experts. The core finding was that we, as researchers, were able to concentrate on writing our analyses and organizing book contents while our undergraduate team members remained focused and more productive than previous teams working without advanced artificial intelligence (AI) tools. Overall, it was a productive and enjoyable research process with less frustration and tedious, repetitious work, leading to more productive engagement. Our initial findings suggest that as long as researchers retain their autonomy in establishing the study agenda, and SMEs are informed how AI tools are going to be used, research can be streamlined and made more productive. We are realizing the Human-Centered Artificial Intelligence (HCAI) outlined in Shneiderman [4] in which AI becomes a "superpower." This experience report describes how AI tools, such as Otter.ai's transcription service, played a role in our research ensemble for creating our forthcoming book Artificial Infrastructures. It outlines the research team structure, use of AI tools, and the interplay between human and algorithmic agents to create a research ensemble that gestures towards a future for the design of communication.

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CCS Concepts

• **Human-centered computing** → Human computer interaction (HCI); HCI theory, concepts and models; • **Computing methodologies** → Artificial intelligence; Planning and scheduling; Multi-agent planning.

Keywords

Artificial Intelligence, AI Agents, Infrastructure, Assemblage, Ensemble, HCAI

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1 Ensemble, Assemblage, Collaboration

Shneiderman's *Human-Centered Artificial Intelligence* [4], Weiss's *Learning From Strangers* [3], and Otter.ai's transcription technology are all important actors in the research collaborative at the center of this study. Human participants include a senior researcher (Michael), newer faculty researcher (John), and a team of six undergraduate students who, assisted by artificial intelligence (AI) technologies, produced a readable text in far less time than it would have without the support of AI technologies. One of these undergraduate research interns (Teah) distinguished herself by becoming a capable leader, and developed workflows for representing the visual content of video interviews (see section 2, **Exemplar node**, for more).

Artificial Infrastructures is a forthcoming book that articulates the emergent roles of AI specifically in high technology environments, with an eye towards the concerns of technical and professional writing experts and writing instructors, accessible to readers with a wide range of familiarity with AI technology. The book addresses the questions of *What now?* In an age when artificial agents draft text and respond to requests for unique prose. We are mindful that by the time this text is published, the capabilities and even the names of the technologies referenced will likely have changed, and may have cycled through more than one or two generations, leaving the technologies more capable and even more discomfortingly uncanny. Yet undeniably artificial. *Artificial Infrastructures* develops a durable argument about the nature of technology, ensuring it lasts longer than the current generation of AI tools.

A research ensemble is an assemblage. We tend to concentrate on the tools, the machines, the technologies, and even have a term to describe excessive emphasis on the technologies over the human participants in research networks: technological determinism.

Technological determinism tends to erase human agency while ascribing human characteristics to artifacts: an anthropomorphic transformation that erases human activity. But it's important to remember that the assemblage doesn't work without its people and we assert instead a human-centered description of a research network. The research ensemble is an assemblage, of humans, their technological tools, and the impacts of place, of context, on the functioning of the human and algorithmic nodes in the network.

Collaboration in a research ensemble transcends technological interaction, embodying a complex interplay among elements of human creativity, technological tools, and contextual influences. This ensemble approach emphasizes the symbiotic relationship between researchers and their tools, advocating for a human-centered framework that acknowledges the indispensable role of human agency within the network. Each participant, whether human or algorithmic, contributes uniquely to the research process, fostering an environment where innovation thrives. This collective endeavor mitigates the risks of technological determinism and enhances the richness and depth of scholarly inquiry. By integrating diverse perspectives and capabilities, the research ensemble cultivates a dynamic, adaptive, and resilient research ecosystem, capable of evolving alongside the very technologies it scrutinizes. Thus, the collaborative nature of a research ensemble ensures that human insight remains at the forefront of technological advancement, fostering a holistic understanding of networks containing human and artificial nodes.

So much of the concern around AI is about the replacement of people with automated machines. Advocating for a participatory approach to integrating robots into industrial process, Tom Sorell argued in his *Ethics and Information Technology* article that "To the extent that work contributes to human well-being (Arneson, 1990), the replacement of human beings in industrial processes may be recognised by managers as something to be avoided" [5]. There are unethical ways to use technologies, including displacement of human labor, but as Shneiderman [4] reminds us, effective user-centered deployment of AI gives people what amounts to, in his powerful phrase, *superpowers*. It doesn't take the necessity of work away but multiplies human effort and refocuses human attention on novel and challenging work, with the potential to reduce repetition and drudgery. AI tools change labor, and Sorell acknowledges that participatory approaches cannot always prevent worker replacement. But changes in labor are not technologically determined. Used ethically, artificial agents become powerful assistants, improving potential enjoyment. Artificially intelligent tools do not displace humans nor make us unemployed on their own. Unethical labor practices do.

We do not aim to dismiss concerns regarding replacement of human labor, but rather emphasize that it is not an inevitable or "natural" outcome of automation. Administrators choose how they involve employees in decision-making about AI's impact. This decision-making process is crucial for ensuring ethical integration of AI technologies in the workplace, much like in the classroom. Towards that end, Alan M. Knowles, in "Machine-in-the-loop writing," discusses the concept of *load sharing theory* [6]. He explains that "the goal of most HRI [human-robot interaction] research into load sharing is to evaluate 'the quality of human-robot interaction and collaboration by examining the acceptability of the framework by human volunteers."' This framing emphasizes the impact on humans rather than solely focusing on productivity. Extending this further, Knowles provides a framework for evaluating the ethicality of "machine-in-the-loop" writing processes that students use when collaborating with LLMs within writing classrooms. Technical communication instructors expect students to make ethically responsible decisions about how they integrate AI into their writing workflows. We share that expectation for administrators.

We must remember that we are assembling a functional working collective, facilitated by people, with technologies serving as the glue. These technologies don't deliver content; rather, communication designers rely on their ensemble's effectiveness. Obscuring technology's human origins occludes issues of power—making it difficult to unravel the dynamics that make people feel subjected to technology—instead of recognizing oppression as humans subjugating other humans, it becomes easier to ascribe motives to technological artifacts.

Our ensemble consists of researchers, one Senior, one Junior, and six undergraduate students connected together in the desire to create a book that records the experiences of three working professionals, who have integrated AI technologies into their work to different degrees over long spans of time. What these professionals are concerned about is efficiency and time saving *and* creating opportunities for people to do fulfilling work that meets both economic and workflow needs. In Knowles' terminology, our aim was to create a machine-in-the-loop ensemble in order to effectively describe innovative workplaces. These tools enabled working groups to meet the requirements of their organizations as well as the people working in these groups. Perhaps this has to do with our selection of participants and their institutional roles, but none of them expressed concerns about what so many of our colleagues seem to be worried about: replacement by technology or displacement by work speedup.

Our research ensemble functions well because we share common goals: making the words of experienced professionals accessible, durable, and meaningful to readers. We knew that three hour-long interviews—three hours of transcripts—would be prohibitively expensive to have transcribed professionally. We understood from the start that we would not be able to create high quality transcripts through a professional service. Otter.ai was one tool that could easily be incorporated within the assemblage that made the transcription process not only timely, but affordable. For a nominal annual subscription, we quickly obtained reasonable preliminary transcriptions.

Important to the ensemble is the growing expertise of the six undergraduate research interns. Their work was intrinsic in turning literal transcriptions of speech into readable prose. One other technology in our assemblage is Weiss's 1995 book *Learning From Strangers* [3]. Weiss's is the best source we know for turning oral transcripts into readable transcriptions of interviews. Weiss's work humanely massages spoken words of research participants into prose that is true to the spirit of what people meant. Weiss acted as our guide for translating spoken word to formal written English, a remediation of spoken speech into electronic text, and eventually into formal printed text.

When we write about creating a research ensemble, we are creating an assemblage, a community, a group of people dedicated to a

goal. Hunter [7] recently revisited Assemblage theory, placing it in the category of post-human rhetoric for UX literature. Hunter links assemblage to Latour's Actor-Network theory, indicating the interrelationship of network metaphors in descriptions of human and artificial collaborators as normalized elements of symbolic-analytic work.

For the time that we, humans and machines, work together, our ensemble concentrates on the same goal of producing a meaningful transcript of expert interviews. The language the team used to describe its work—*concentration*, *goal*, *meaningful*, *collaboration*—reflect human valuations that are incomprehensible to the artificial agents. However much they multiply our productivity when engaged, algorithms are inert when humans are not directing action in the network. Even autonomous agents, engaging in programmed action, are only capable of functions determined by initial human instruction. Even those agents enabled with machine-learning are limited by the vision of their human creators.

The tools and the connections that we make in building our community of researchers becomes an important means of understanding the contributions of AI and how these programmed agents support processes we already know and use well. These assemblages, these groups, experience frustration and face problems precisely at those moments where communication vacillates. And that communication can falter for any number of reasons.

2 Exemplar Node: Teah

Assemblage is the collection of people and technologies in particular places; we emphasize the importance of the *people* in the assemblage. Teah (one of the undergraduate researchers) emerged as a leader. Quickly, Michael and John were able to give Teah complex tasks. An AI tool cannot achieve leadership. But as Teah was scheduling group meetings, planning meeting agendas, and breaking down complex tasks into smaller duties and assigning them to the appropriate interns, she was also working with AI-enhanced image tools. John and Michael asked her to create camera-ready screen captures—still images—from three minute selections of video (see Figure 1). Our interview subject shared live video of AI-enhanced working processes with detailed live screen captures. In an hour-long interview, we aimed to capture the essence of 5 or 6 moments. We were translating complex thoughts into meaningful procedures—standard technical communication tasks—for example, translating minutes 13 through 16 into a single screen shot to include as a camera-ready illustration. The challenge required complex technorhetorical work: trying to translate video and voice into a meaningful still image presented a visual rhetorical challenge. As part of the process, Teah asked AI-enhanced image creation tools to generate numerous versions of elements of the image she wanted. None met our exact needs, but having multiple images allowed her to focus on one or two stronger versions to further alter and manipulate in illustration software. Teah leveraged the affordance of generative AI: automatically generating varied possibilities faster than a human could render 10 distinct draft images. The AI did not replace the human labor of structuring an interview, delivering a screencast, or refining an idea, but offset the labor of searching for sample images and templates or crowdsourcing mock-up designs.

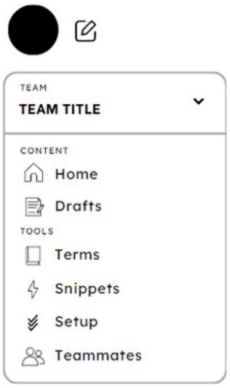

Figure 1: Example of Teah's mock-up image illustrating 3 minutes' worth of video from interview.

Using Knowles' spectrum of human-in-the-loop and machine-in-the-loop writing, we situate Teah's work as machine-in-the-loop. She leveraged automated tools to summarize human-authored information and generate condensed output, selectively integrating that output into deliverables as she decided was rhetorically appropriate. Revising the AI-generated output into a usable form required rhetorical knowledge and technical skills.

Teah did not merely proofread what the AI produced, she developed a visual language for representing the video content in still images. Teah did not use the AI output as the printed image here, but the AI assisted her by generating multiple options. Teah quickly sorted through alternatives to settle on a visual language without significant time or resource expenditure. One of our interview subjects described how their team used AI to generate 12 or 20 different mock-ups for projects. They could never afford to have a professional illustrator create that many brainstormed samples to work with, most of which would be immediately eliminated. And none of the samples would become the working draft—all played a role in prompting visual conversations and moving the project forward. By using the AI tool, her team and ours generated numerous different "good enough" images that served the purpose of the team—inspiring further communication and design. The AI tools did not replace the work of collaborative brainstorming or development. Teah, as the human in this loop, "retain[ed] majority of the rhetorical load," and used AI tools as important assistants (p. 8) [6].

For the purpose of our assemblage, AI was an assistant in different forms. It was a time and money saver. As mentioned, transcription services would be prohibitively expensive for three one-hour interviews, ranging from $0.25 to $0.90 per minute. Otter cost $0.01 per minute, or $0.42 per *hour* (at the $8.33/month tier). Many transcription services now use AI for initial transcriptions and add a nominal fee (e.g., $0.10 per minute) for human proofreading, an ethically fraught example of human-in-the-loop writing. Using Otter, transcribing an hour-long interview became an afternoon task of editing, rather than an all-day project. In comparison, purchasing Express Scribe Pro and a transcription foot pedal costs about $144.

For the $8.33 cost of a one-month Otter.ai subscription, one would need to manually transcribe 12 hours daily for a month to justify the cost of transcription software and equipment.

Though the economic affordances and impact of AI in this instance are remarkable, automated transcription has considerable limitations. Before integrating Otter into our research workflow, we carefully considered our use cases. Each interview involved only three simultaneous speakers. All participants spoke English as their first language, with Midwestern accents—privileged defaults embedded in training data. The IRB determined that our interviews posed minimal risk. We interviewed industry experts about information that was neither proprietary nor confidential, and in many cases already publically documented. We disclosed to participants that interviews would be recorded and transcribed via Otter.ai and that we would invite participant feedback on drafts. Ultimately, Otter was viable because our interviews fit the use cases Otter's programmers envisioned, and were not highly confidential (though alternatives such as Whisper AI, designed to minimize privacy risks, exist). Otter's output was useful, but still required considerable human editing to textually represent spoken conversations.

Otter performed the initial transliteration, and then the undergraduate students learned to transform that raw transcript into readable prose. It was an important skill for the students to learn and focused their attention on the rhetorical elements of what would otherwise be a routine task. Students finished their internship expressing great satisfaction with their participation in the group. These activities allowed Teah to emerge as a leader and to fulfill the requirements of her credit-bearing internship. Teah, as a member of the ensemble, translated an interview subject's show and tell from live screencast to simplified still images appropriate for book presentation over just a few weeks.

Over a year's internship, Teah took the initiative at different moments, bringing us samples and describing her AI-assisted workflow. Teah explained that the AI-assisted workflow helped her quickly and easily translate complex procedural information into sample images while removing any identifying corporate information, a process she termed "genericizing." The assemblage focused on the people in communication, supported at different points by AI tools. These tools enabled us to focus on keeping our research assemblage functional, efficient, and effective.

3 Conclusion: AI Assemblages

This research report emphasizes the impact of integrating AI tools within research teams. By detailing the collaborative process involved in producing the forthcoming book *Artificial Infrastructures*, this report showcases how AI can streamline and enhance research efforts. Using Otter.ai for transcription, coupled with the growing human expertise of undergraduate researchers, exemplifies a productive synergy between human and machine intelligence. This collaboration facilitated a more efficient research workflow while maintaining researchers' autonomy. The article illustrates the implementation of AI technologies like Otter.ai in supporting Shneiderman's vision of Human-Centered Artificial Intelligence (HCAI), where AI amplifies rather than replacing human capabilities. By embracing these advancements, research ensembles can concentrate on higher-order tasks, fostering innovation and alleviating the burden of repetitive activities. Furthermore, integrating network theory underscores the interconnectedness of human and algorithmic agents in the research process.

Latour's Actor-Network Theory (ANT) and Knowles' Machine-in-the-loop (MITL) highlights the various nodes in this network: senior researchers, newer faculty, undergraduate students, AI tools, and contextual influences. Each node plays a crucial role, emphasizing the distributed agency and collaborative nature essential for advancing research. This report serves as an example of emerging practices for technologically-enhanced research communication, advocating for a future where human intellect and AI collaborate to advance knowledge and discovery.

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References

[1] W. Hart-Davidson, "Writing with Robots and other Curiosities of the Age of Machine Rhetorics," in *The Routledge Handbook of Digital Writing and Rhetoric*, Routledge, 2018.

[2] "Otter.ai - AI Meeting Note Taker & Real-time AI Transcription." Accessed: May 23, 2024. [Online]. Available: https://otter.ai/

[3] R. S. Weiss, *Learning From Strangers: The Art and Method of Qualitative Interview Studies*. New York: Free Press, 1995.

[4] B. Shneiderman, *Human-Centered AI*. Oxford, New York: Oxford University Press, 2022.

[5] T. Sorell, "Cobots, 'co-operation' and the replacement of human skill," *Ethics Inf Technol*, vol. 24, no. 4, p. 44, Oct. 2022, doi: 10.1007/s10676-022-09667-6.

[6] A. M. Knowles, "Machine-in-the-loop writing: Optimizing the rhetorical load," *Computers and Composition*, vol. 71, p. 102826, Mar. 2024, doi: 10.1016/j.compcom.2024.102826.

[7] P. T. Hunter, "Toward TPC-UX: UX Topics in TPC Journals 2013–2022," *Journal of Technical Writing and Communication*, p. 00472816231191998, Aug. 2023, doi: 10.1177/00472816231191998.