Social Scientists: Managing Identity in Socio-Technical Networks

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Abstract

Since the advent of the world-wide web, academic researchers have constructed web pages to present a view of themselves, their work, their associations and their interests. This novel form of self-presentation has drawn a lot of attention over the past few years, prompting not only psychologists, but also social analysts, educators and software developers, to reflect on the ways in which technology pervades our self-presentations. Personal home pages are not, however, the only way in which scientists present themselves through technology construction and use—nor even the primary way. In this paper, we examine the technologies that oceanographers use to manage professional identity within their socio-technical networks.

1. Introduction

Early speculators heralded the Web as a watershed event in the coming of postmodern network society [28], [31], [7]. Through the web, we could morph, unconstrained by social institutions, into the multiplicity of selves that lived in our imagination (or in the imaginations of science fiction writers like Gibson [13]). In the professional domain, technology enthusiasts were more circumspect about how the Web might allow us to reshape our identities. An essay in Communications of the ACM written by Thomas Erickson reflects the view that the WWW home pages of organizational professionals could combine aspects of working and personal selves, and thus would become important sources of self-presentation. “Personal pages and the Web are not being used to 'publish information'; they are being used to construct identity—useful information is just a side effect. A personal page is a carefully constructed portrayal of a person” [10, p. 15]. Even more importantly, Erickson suggested, these presentations would enable new types of social knowledge networking, because web pages could be used to construct identity in a way that freed “interactors” from obligations of reciprocity: “An important difference is that on the Web I can find out about what people are doing and writing without becoming obligated to them” [10, p. 15]. In other words, personal web pages would enable asynchronous interactions that intimate closeness, but maintain more social distance than other communication technologies, like the telephone or even email.

Early projections such as Erickson’s were speculative, but preliminary studies provide some empirical backing for expectations about the effect of intermingling the personal and the professional on home pages [5]. Theoretical analyses have also pulled together disparate perspectives on web technologies and identity that seem to support these expectations. Wynn and Katz [35], for example, draw on Goffman’s observations and analyses to show that over time, people have used many resources, including technologies, to present multiple aspects of themselves to different audiences. Rather than allowing for the proliferation of multiple and separate selves, however, they posit that cyberspace provides yet another way of signaling our relatedness to the social contexts that are always already there shaping perceptions of self. Their discussion focuses primarily on the professional person, her extended self within an organizational context, and the degree of personal identity tolerated in corporately or institutionally maintained pages. However, Wynn and Katz conclude that the personal home page does allow for new ways to express identity, by adding context to the presentation of self through links to pages and sites others have developed for different presentation purposes. “This is postmodern in the sense that the browser has access to a much broader text and thus is in a position to construct an independent interpretation of the page creator” [35, p. 322]. The person viewing such a personal web page, in which links are meant to characterize the larger social context of the page creator, engage in identity construction by following links and making perquisite associations. Nonetheless, their actions do not involve reciprocity or co-construction of identity through the kinds of social interaction that Goffman [15] described, which we discuss shortly.

Given this earlier work, we expected to find that personal web pages have become an important forum for self-presentation for many professionals, particularly professionals like academic scientists who are generally allowed more freedom of self-expression than professionals in corporate organizations, such as those exemplified by Erickson and Wynn and Katz. However,
in our study of how oceanographers at the University of Hawaii use information and communication technologies (ICTs) in their collaborative research, we were surprised to find this does not seem to be the case. We are finding that academic scientists do use information technologies in ways that enact and present identity, but personal web pages do not play a key role in these processes. Instead, we are observing myriad uses of ICTs, many incorporating web based technologies, that represent a complex and multi-faceted interplay of identity management and information technology.

Our purpose in this paper is to explore the nature of these interactions and to reflect on the implications for understanding scientists’ identity management through ICT use. In the next sections, we outline our perspective on socio-technical networks in scientific research collaborations, which provides the theoretical foundations for our research. We then review key concepts of identity management, focusing on the involvement of information technologies in this process, and drawing examples from an on-going, multi-year study of ICT use among collaborating scientists. We outline our conceptual model of the social actor, which guides our investigation, and our research methodology. We then review preliminary findings that highlight key aspects of identity management through ICT use and conclude by considering implications of our work for further study.

2. Socio-technical networking scientists

Our interest in identity management and ICT use stems from our perspective, as socio-technical researchers, that individuals build and maintain social networks through which they negotiate their identities. Information and communication technologies are increasingly integral to these networks. A social network is a set of people, including organizations, connected by a set of social relationships [14]. A socio-technical network includes the technologies that sustain human interaction, and the technologies that people construct and use in collaboration. In socio-technical networks, the social and the technical are essentially inseparable and co-constitutive [6]. Our understanding of socio-technical networks draws from Berger and Luckman’s [3] theories on the social construction of reality, by focusing on related theoretical domains that explore the influence of technology in social spheres -- the social construction of technologies through human action [4] and the technological shaping of society [18].

The socio-technical perspective has formed the basis for milestone studies by Latour [23], Traweek [30], and Knorr-Cetina [20] that poignantly demonstrate the ways in which scientists participate in socio-technical networks, and how such participation affects identity and the presentation of self among research scientists. These empirical studies show how the concept of “science” is constructed through the interactions of scientists, laboratories, funding agencies and technologies. They demonstrate how scientists imbue high profile technologies, like the Super Collider, with human-like identities; and also how scientific processes objectify some people, like cancer patients, stripping them of human identifications [20].

These researchers solidly link science, scientists, identity, technology and socio-technical networks. More importantly, their collective work highlights an aspect of technology use that has not been systematically examined – the co-constructive aspects of socio-technical interaction. That is, scientists socially shape the technologies they use to carry out their work, but at the same time, they are shaped, as scientists, by the technologies they employ. We believe that this concept of co-construction is missing from discussions of web-supported presentation of the self. It helps explains why, at least for many academic scientists in our study, personal home pages languish unattended and out of date. For oceanographers, it’s the technologies they co-construct with close collaborators that shape their identities, and the technologies that allow them to reciprocally interact that most effectively convey their self presentations. To pursue this argument, we consider the theoretical underpinnings of concepts of identity, self presentation, and interaction.

3. Presenting the self in theory and technology

People construct identity from a wide array of interdependent social resources. Ethnic background, nationality, gender, friends, workplace, education, hobbies, and possessions all shape our identity and convey a sense of who we are. Erikson [11] described identity formation as one of the eight stages of social development, commonly occurring during the teenage years. However, identity concepts span many inter-related disciplines and sub-fields, like developmental psychology, social psychology, sociology, philosophy, post-modernism and post-structuralism, and these ideas help us understand how people construct and present multiple identities throughout life.

In this study, we are particularly interested in what shapes the professional identities of scientists. Sociologists like Whyte [34] have described the ways in which people identify themselves with the kind of work they do and the organization where they work. His portrayal of the “organization man” shows that the workplace strongly influences our identities and self-presentations. Our educational background and membership in professional associations also shapes our sense of who we are, how we should conduct our professional activities, and how others should regard us. Although doctors, lawyers and scientists have held special titles and degrees for many centuries, the rise of professionalism in modern society has increased and standardized the ways in which people identify themselves and signal their occupational competencies (e.g. the MBA degree for managers, the CRS certification for realtors), and has also provided codes of conduct for interactions among these professionals and those they
serve [22]. Professional and personal identities can become multiple and overlapping. For example, I may be a lawyer, but more specifically an African-American tax attorney. I may be a doctor, but more specifically a woman pediatrician at Massachusetts General Hospital, where I work with cutting-edge technology for early detection and treatment of infant immuno-deficiencies.

Identity is both avowed and ascribed. When we tell people something about ourselves, when we present ourselves in a particular way, that is our avowed identity. It may differ from the identity which others interpret from our self-presentation, and which they then ascribe to us. Goffman [15] differentiates between these types of identity as expressions of the self that are intentionally "given" and those that are unintentionally "given off." Here, we're interested in avowed identity -- how the individual presents her identity to the world, particularly through ICT use. According to Taylor [29], what we say about ourselves reflects our basic moral sense about what is "good" or what is "good to be." For example, "I am a good oceanographer" might be demonstrated by meticulous application of the scientific method in collecting seafloor data samples. We may present different facets of our identity to different audiences, and we may also present ourselves in a way that differs from our self-image, either through exaggeration or deception.1

The things we own, use and display to others also make statements about who we are [2]. Thus, our technological possessions and competencies are very much a part of identity. We have all seen people making this kind of statement: "I am cool because I have the latest technology" by talking loudly on tiny cell phones in public places. Fischer [12] reminds us that information and communication technologies (ICTs) have been resources for identity construction and self-presentation since the early diffusion of telephone technology, when few people had access to telephones, and many people considered it a status symbol to own one. Professional identity often has a technical component (e.g. "I'm an ROV [remotely operated vehicle] deep ocean researcher"). And, reciprocally, our self-images or the images we wish to portray may influence how we decide to use technology in our work (e.g. "I'm not a technician, so I don't use sonar devices"). These avowals, audience reactions to them, and our reactions to those reactions help shape our identities. As Taylor has observed, "a self exists only within what I call 'webs of interlocution'" [29, p. 36]. In fact, for Goffman [15], the self and presentation of the self can only be understood through a person's interaction with others. That interaction is defined as "the reciprocal influence of individuals upon one another's actions when in one another's immediate physical presence" [15, p. 15]. That is, identity is co-constructed by interactors, and reciprocity is a fundamental ingredient in identity construction.

If we accept Goffman's perspective, to understand identity we must move from asking "what is identity?" to "how is identity enacted?" This shifts our discussion to presentation and interaction, where the roles for technologies in identity enactment can be brought into sharper focus. For Goffman, identity co-construction was a face-to-face affair, but his concepts remain insightful when used to examine self-presentation within environments mediated by interactive technologies, like the telephone and email. In a postmodern sense, these technologies have become essential extensions of ourselves, without which it is difficult to interact effectively. Goffman described how interactions are shaped or framed by social institutions enacted by the presenter and her audience [16]. Now, ICTs are fundamentally a part of that framing, and identities are shaped by technologically enhanced interactions. These identity-shaping processes occur not only through personal encounters (face-to-face and ICT-mediated), but also through institutional interpellations, like the databases of police records that profile individuals through a compilation of selected actions and documentations [24], [26], and subtly through product marketing initiatives, like those that combine hype with aggressive research and sophisticated use of media technologies, encouraging American youth to construct their identities through the use of consumer products [25].

Self-presentation always involves some expectations about who the audience will be, and some anticipation of their reactions. In a recent study of self-presentation on Internet homepages, Walker [32] found that pages fall into two main categories: those intended for viewing by the entire Internet audience, and those intended to support interaction with a special "already known" community. She concluded that the former were more effective in self-presentation than the later, because the pages that focused only on a special audience ignored the rest of the Internet community. However, Bly et. al. [5] argue that in organizational use, personal web pages that combine personal and professional information aimed at a directed audience do effectively present elements of the self. The theoretical concepts reviewed above further suggest that ICTs that mediate expected and actual interactions will have a more substantial influence on identity enactment and self-presentation. In fact, data from the study we are now conducting suggests that all ICTs that allow for interaction, reciprocity and co-construction are highly influential in shaping identity.

Thus far, we have considered how professional identities are socially and contextually situated, how identity is co-constructed through interaction, and how identity can be avowed in multiple ways that entail ICT use and expertise. Because interaction and co-construction are fundamental to the concept of identity, we have posited that ICTs that engage actors in reciprocal interactions are likely to be highly influential in computer-mediated self-presentation. What is lacking is a

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1 See Goffman [15] for a thorough description of the ways in which people present themselves fictitiously. See Turkle [31] for examples of how multiple pretended identities are manipulated in cyberspace. In this study, we are not dealing with malicious deceit or playful virtual pretense, but perhaps an intentional exaggeration of "good" professional qualities in identity avowal.
4. Social actors, ICTs and identity

In prior analysis, we have begun to relate identities with interactions and ICTs by developing a socially-rich view of the ICT “user” as a multi-dimensional social actor [21]. Four dimensions comprise our social actor view: affiliations, environments, interactions and identities. The first two dimensions relate individuals to their organizations, and to the industries and environments of those organizations. Thus, they situate the individual actor in the social and organizational contexts that underpin professional identity. The second two dimensions relate organizational individuals to others and to the ICTs they use to interact with and present themselves to others. Although we consider all dimensions of social actors in our larger study, for brevity, we have detailed only these last two dimensions which are the focus of this paper in Table 1.

This conceptualization of social actors is consistent with our perspective on socio-technical scientific networks outlined earlier. It entails several related theoretical propositions: i) social actors form affiliations that are networked, exchange-related, multiple and changing; ii) their environments are technical, institutional, ICT-enhanced, and expansive; iii) social actor interactions are legitimate, action enabling, constructed, and role-based; and, iv) social actors continually reconfigure their roles to reconstruct and represent themselves as competent, ICT-savvy social actors. The social actor view acknowledges that the world is changing, and that globalizing phenomena strongly influence organizational relationships. It also acknowledges that ICTs play a fundamental role in identity management among organizational individuals.

The social actor concept has been useful in earlier work [21], but we found in this study that it does not reflect the nature of reciprocity and co-construction of identities and technologies. Interestingly, these aspects are also missing from other theoretical analyses of ICT use and identity [32], [35]. Our unanticipated finding that personal home pages apparently do not play an important role in self presentation, at least for the oceanographers we are studying, suggested that we need consider more carefully these aspects of ICT use. For example, lack of reciprocity between page creator and page reader may decrease the “benefits” of page construction and maintenance and raise the relative costs in time and effort to unacceptable levels on the creator’s side. On the other hand, we observed that co-construction of different technologies in the oceanographers realm, like sample collection instruments, does allow for this kind of exchange, and at the same time builds the reputations and identities of these scientists.

5. Research design and methods

Our findings about identity and ICT use among academic researchers are drawn from an ongoing research study of socio-technical networks in academic/industry collaborations [9]. The study examines multiple aspects of the collaborative associations of academic and industry scientists in oceanography, marine biology and astronomy, using the social actor concept to guide data collection and analysis of collaborators, their socio-technical networks and their organizational environments. We are focusing primarily on understanding the roles ICTs play in enabling or constraining interactions and collaborations that cross institutional boundaries, as well as the technical and institutional environments that influence the use and development of ICTs. We believe that the social actor approach can guide our investigations in ways that will allow us to link micro-level, ICT-enabled collaborations with macro-level phenomena and globalization. In particular, it helps focus our analysis of identity enactment and self presentation through ICT use.

During the first phase of this multi-year project, we are conducting interviews with academic oceanographers at the University of Hawaii, Manoa. We have taped and
transcribed interviews with 20 full-time research or teaching faculty members. Each interview lasts from 45 to 75 minutes and follows a semi-structured protocol in which scientists are asked to review their background, to describe in depth a recent collaborative research project and their use of ICTs in that project, and to discuss their general perceptions of how ICT use influences research activities. We also ask interviewees about the importance they ascribe to using various ICTs and how their use of various technologies may vary among groups with whom they interact. We supplement interview data by examining each researcher's homepage and any related web sites that describe their research programs. We then read and review data to identify themes related to identity and ICT use that are shared among subjects or that differ between subjects. This paper presents our preliminary findings and analysis from this population of researchers.

Our approach has been to cast our net widely in terms of the technologies of interest. Over the past year, we have seen a number of different technologies used to collect or create scientific data, to share findings, to disseminate data, and to enhance research collaborations (e.g. internet sites, data collection devices, towed instrument arrays, satellite positioning software, email, CD-ROM presentations). Moreover, it appears that the roles that ICTs play may vary within disciplines, within industries, and across industry/academic collaborations. In other words, scientists work with many different technologies in many different ways.

To facilitate our analysis, we have considered how these technologies might be categorized. Existing categorizations of information technologies are drawn primarily from business practices and thus provide only limited insights about the kinds of technologies used in scientific research activities. For example, business information systems are often categorized according to the level of the organization they serve: operational transaction processing systems (TPS), tactical management information system (MIS) or decision support systems (DSS), and strategic management (executive) support systems (MSS/EIS). They have also been characterized according to the extent to which a technology or application is shared among users, i.e., personal, workgroup, or enterprise-wide systems. These categorizations work well for traditional business information systems, such as an order entry system (i.e., a workgroup TPS) or a data warehouse (i.e., an enterprise-wide MIS/DSS). They work less well for communication or infrastructure technologies. For example, depending how e-mail is utilized, it might be part of a TPS, a workgroup DSS, an enterprise-wide MSS/EIS, and so on. There are even fewer correspondences between these business-focused categorizations and the applications of ICTs we are observing among oceanographers engaged in scientific research endeavors. We may encounter these business-type ICT applications as we investigate project management aspects of scientific collaborations. However, our current focus is on the conduct of scientific research, and our interest is concentrated on understanding how scientists manage identity through ICTs. Therefore, we are developing a classification scheme that is grounded in the data we collect. Thus far, we have identified a variety of ICTs used by oceanographers, such as:

- Towed arrays of sea floor mapping devices that collect signals from the physical environment; software that interprets data for electronic display. These ICTs are used by the teams who construct and deploy them.
- Web-enabled databanks such as FTP sites that package observational data and make them available to others. Scientific teams construct and deploy the sites, which are open for use throughout the scientific community. Funding agencies such as NSF encourage or even require data sharing of this type.
- Communication technologies such as e-mail, teleconferencing and (unadvertised) public web sites that coordinate work among scientific teams.
- Communication technologies like listservs that are used to communicate with the broader scientific community.
- Information web sites reporting information about scientific projects that K-12 educators, the general public, and other scientists can use. NSF and other funders are encouraging creation of such sites.

We can loosely classify these ICTs along two key dimensions: functional affordances like empirical data collection, data interpretation, process modeling, and data sharing; and, collaborative reach, including use by individuals, scientific teams, scientific communities, and global communities. Using these dimensions and our social actor view, we developed themes from our interview data that relate scientific collaboration, ICT use and identity management. In the next section, we discuss our findings.

6. Managing identity through ICTs in scientific research

When we ask oceanographers to talk about their collaborative research projects, they typically first describe themselves in terms of their organizational affiliation (e.g. "I'm in the physical oceanography department") or their university role (e.g. "I'm a professor," "I'm a full-time researcher"). Later, their comments revolve mostly around research interests and specialties (e.g., "I'm classified as a phyto-plankton ecologist," "My research program is in atmospheric chemistry"). Some additionally delineate themselves as "observationalists" who collect and interpret empirical data, or as "modelers" who create simulations of oceanographic-related phenomena. A few described themselves as "eclectic" or "a hybrid" of various research domains. These statements indicate aspects of the social environment in which professional identity is negotiated and enacted, but they also demonstrate that "what I do" to a large extent determines "who I am" as a scientist.
We are finding that ICT use is deeply embedded in what oceanographers do, and thus, ICTs help define who they are as scientists. Three themes have emerged from our data that illustrate the interplay of professional identity, ICT use, and socio-technical networks. First, oceanographers actualize their identity as researchers through the ICTs they create or use to conduct research. Second, ICTs that have broad reach beyond the group of collaborators actively involved in their creation or use, can create identity management problems for scientists. Third, self-presentation through ICTs such as web pages takes on different form, meaning and importance to scientists, depending on the intended reach of the ICT.

6.1 Actualizing scientific identity through ICTs

Oceanographers who collect and maintain empirical data sources often need to construct special devices to take measurements, or to create software to interpret digital signals from these devices. These technologies are typically conceived of and created through collaborative efforts with close associates (i.e. researchers at other institutions or in other departments, research staff members, and graduate students), in which individual scientists may contribute specific instruments or aspects of an instrument array to a joint effort. If they are unique and valuable scientifically, the devices and related software can become closely identified with the scientists who create them. For example, scientists in the Hawaii Mapping Research Group, an ocean floor mapping group, (http://www.soest.hawaii.edu/HMRG/), have created towed arrays of sonar devices and interpretation software to display sonar data, which are unique among groups doing this type of mapping work. The group is known for this technology internationally, and the professional identities of the group’s lead researchers are closely associated with these technologies. Commercial firms and other researchers who need sea floor mapping services come to them, based on their reputation and referral. Without the technologies, the group itself would not exist. In fact, several years ago, the towed array device was lost at sea during a voyage, and the group, lacking the means to do their science, nearly disbanded during the year it took to get a replacement device.

Even if oceanographers do not create leading edge ICTs, ICT use may still be integral to their identity when the data collected through ICTs are unique and interesting scientifically. These oceanographers don’t associate their identities with ICTs per se. However, the data collection and interpretation enabled by the ICTs can become a critical source of professional identity and scholarly reputation. For these scientists, being “cutting edge” in the types of data collected is highly valued. They look for opportunities to collect data never before collected or never collected from a particular ocean region, or by gathering and consolidating region-wide or global data sources. For example, a data collecting ICT may allow scientists to examine chemical interactions in seawater that have not been previously understood. Or, an ICT may be deployed in remote Antarctic regions, where empirical data has not been collected before.

Co-construction of professional identity and technology is evident in these scientists’ social construction of devices to do what they, as scientists, do. At the same time, their identity as scientists is shaped by the capabilities and limitations of the ICTs they create or utilize. This duality is evident among a group of researchers who maintain an ocean monitoring buoy anchored off the Hawaiian coast (Hawaiian Ocean Time Series (HOTS), http://hahana.soest.hawaii.edu/hot/hot_jgosf.html). HOTS scientists collect and maintain ocean readings that are unique, particularly since the group has accumulated years of data. However, the buoy, once perceived as “cutting edge,” is becoming technologically out-of-date. Now, the field is moving toward use of satellite data collection and transmission integrated with programmable ocean sampling devices. Lead HOTS scientists, responding to the diminishing reputational value attributed to their more traditional buoy-based technology among fellow researchers and funding agencies, are moving on to projects that are more technologically cutting-edge.

An oceanographer in a similar situation explained his decision to create an FTP site to post and distribute satellite data, then to discontinue its support after years of operation when it was no longer cutting-edge:

“I think it’s more important to be a pioneer, and do it first. Why keep competing with other people who can provide more of the same service? So in 1990, I was the first and the only one. So, a lot of people used my services ... Something which may be a hot topic today, and useful, down the road may be so routine that it’s not worth doing anymore.”

Here, we see that ICT use and scientific competency are closely linked to the researcher's identity. As scientists, they are what they collect, measure, analyze and synthesize. It is notable that these devices are created, deployed, and utilized by closely collaborating, interacting teams of scientists, and that their value is negotiated within a scientific community of peers and colleagues. To serve as an effective medium for enhancing scientific identity, technologies must be unique and "cutting-edge" in ways valued within the socio-technical network.

6.2 ICTs and identity management issues

Sharing scientific data, once the researchers who originally collected the data have published their findings in journals, is normatively sanctioned and sometimes institutionally dictated by funders such as National Science Foundation. Making research data widely available is part of what it means to be a “good scientist” and hence is a way that scientists enact their identity as researchers. ICTs now play a key role in distribution of research data, findings, and related information to the
wider scientific community or to the community at large. These ICTs include FTP sites that make data files available to other researchers for download, e-mail for distributing data files to specific requesters and CD-ROMs for recording and sharing data sets to colleagues who may not have good Internet access. However, using ICTs to share data with the broader scientific community can introduce identity management problems for scientists whose reputation and identity is intertwined with their data.

Oceanographers become very familiar with the data they collect. Through their expertise in creating, deploying, and managing data retrieval from their sampling devices, they understand all the contextual nuances of the data collected. As one oceanographer said:

“I’ve been doing this for so long... after a while I can take a spectrum and tell you whether this is realistic or not, whether something is wrong, whether something is a little bit funny with it.”

An identity management problem arises from using ICTs such as FTP sites for data sharing, because the raw data posted on a site may be used in ways that are beyond the control of the researchers who originated the data files, and, if used or interpreted incorrectly, could negatively impact their professional reputation. They fear, as this scientist does, that other scientists, who lack contextual understanding, may make erroneous interpretations:

"I have no problem giving the data to anyone who wants it. But I do have a problem in letting anyone just grab it. Because part of this investigation is about using unusual technology to study the ocean. And if you don’t know what you’ve got, you don’t know how to interpret the raw data and what it means, you can make a mess of it."

“Making a mess of it” would reflect poorly not only on the researcher who downloads the data and publishes articles using it, but also on the data creators. This identity management problem can be mitigated in two ways: by cleansing the data of segments that could be misinterpreted before it is posted to the FTP site, and by encouraging site users to interact with project researchers while making their analyses. To do this, data site sponsors must know who is downloading from the site, and may add a login/password filter to their site for this purpose. Some do not post their data to an FTP site at all, and instead force the requester to send an e-mail asking for the file. This ensures that data creators know who the data users are, and provides an opportunity to discuss data peculiarities, or to simply monitor who is using the site and document its uses in ways that can support the site’s claims of usefulness to research funding agencies. This oceanographer explained:

“I set up the registration screen to try and remind my colleagues that there is an obligation and ethical issues concerned with using data ... I’ve been extremely disappointed in this kind of idea that unless you are one of the people that originated an idea for a paper then you shouldn’t be co-authored.”

The flip side of the flawed interpretation of their data that damages their reputations, is the scientifically important interpretation of their data that is not attributed to them. Several oceanographers noted that a “good scientist” should at least acknowledge their data source in publications, and possibly offer co-authorship to the data set creator. However, when ICTs facilitate anonymous downloading of data, this is less likely to happen. One researcher explained:

“On the one hand you want to put all the data you have out there on the web, so that everyone can use it. And it could be exciting, and you can collaborate and so forth. But on the other hand, again, you want to get credit for having that data...It's a lot easier to not think about where you got your information. Its on the web -- its like this amorphous thing, as if someone didn’t do a lot of work to put it out there”

From these examples, we see that using ICTs to share data with scientists outside of the immediate group of collaborators, provides opportunities to showcase and share a researcher's unique scientific contributions -- to enact his or her scientific identity. But some ICT-enabled sharing, like anonymous FTP sites, can introduce identity management problems when data are disengaged from creators and managers. It is the lack of social obligation and reciprocity which Erickson [10] speculated about, that forms the basis of these identity management difficulties. These problems are worth dealing with only as long as the site serves as a stimulus to identity-enhancing interactions with colleagues or as a positive reflection on their work among funders.

6.3 Self-presentation through ICTs

For oceanographers, “who I am” as a researcher is negotiated through research-related interactions with colleagues, close collaborators and funding organizations, and is enacted primarily through the technologies that enable them to do their research as oceanographers. Although Internet and WWW technologies offer useful channels for self-presentation and identity management, as the previous FTP site discussion shows, personal web pages may not be among the most useful channels. The scientists we talked with report that they become “known” in oceanographic circles for their expertise and interests through conventional, legitimate academic channels, notably, journal publications and conferences, as this scientist noted:

"I become known by people reading my papers. When I attend a conference to give a paper, people can see that this is the guy who is associated with that paper, and they recognize the name."
They use ICTs for communication, including e-mail, videoconference, teleconferencing, and collaborative web sites, to communicate and coordinate with members of their community between face-to-face meetings. Interactive ICTs such as the telephone and e-mail once conveyed a certain status, but they have achieved such wide-spread usage that they no longer play a special role in self-presentation among close collaborators [12], [27]. WWW-based ICTs, including personal home pages, project pages, and collaborative work sites are valued differently among the oceanographers we interviewed.

Personal web pages, for example, do not appear to be an important or valued venue for self-presentation among senior researchers. Among the oceanographers we interviewed, many of their personal web pages are presented in the department’s standard format with a little personalization (e.g., a picture), and are months or years out of date. When we asked them about the importance of the personal web page, these researchers professed that it was “important” for presenting themselves to potential students, but not to peer colleagues. Therefore, they put little effort into page maintenance. Several commented about the time, effort and skills required compared to the benefit they expected to accrue:

"I think there is a tremendous value to [the home page]. The problem is with maintaining it. I don’t have anybody to do that."

"I've been really slow in getting my web pages up to date. Some people are a lot more into self-promotion than I am."

"I think it’s fine if you have the time to do that kind of stuff…it can be very informative. I guess I'm a little bit old fashioned. I don’t think it’s necessary”

There are only a few junior faculty members in the UH oceanography department. We noted that their web pages appeared to be more personalized, more detailed, and more up-to-date. When asked about the importance of the personal web page, they reported that, in addition to traditional channels, their personal pages offered opportunities to present themselves and their work as scientists. A junior oceanographer noted:

"I want to show who I am and where I’m at. This is what I’m doing, and isn’t that interesting. If you've got something that’s very similar or you want to do something that’s very similar, email me."

She finds value in other oceanographers' home pages, and expends some energy keeping hers up-to-date, particularly since her reputation is not well established:

"It really is helpful for me to look at a web page for what is their latest project, what are some interesting papers, what are some interesting things that they've done. So I try to update my website every year. I go in every year, and I just spend a day, and I do it. For me, I get a lot more student contacts because they look at my website, and they can understand what I’m doing. I try and make an effort so that it’s understandable."

Notably, this junior researcher finds her personal web site helpful for attracting potential graduate students (as did more senior oceanographers), but she also perceives it as helpful for making herself known in the research community (which senior oceanographers did not). She did not, however, provide us with any instances of scientific reputation enhancement resulting from the web page to substantiate that belief. Based on our conversations with senior oceanographers, we doubt they are reading her home page to evaluate her scientific reputation. However, younger scientists, like herself, may do so, and as they mature, this practice and the interactions it generates, may become an important part of oceanographers’ identity and self-presentation.

Despite the condition of their personal homepages, nearly all oceanographers have extensive, up-to-date project web sites. We found that scientists used project websites for special purposes and targeted audiences. Oceanographers often create web sites to coordinate planning during grant preparation, to post and present data used in decision-making during experiments, to collect and preserve metadata about conditions under which the data collection took place, and to share raw data results among collaborators. Although they may be deployed as public sites without password protection or security measures, their intended audience is a specific group of collaborating scientists, not the broad scientific community nor the public. These sites are closely intertwined with the day-to-day conduct of the research project. They serve as a medium for scientific communication and coordination as well as for building a reputation as a "good scientist."

After several years, the project site may change to address a new audience. More polished project web sites are aimed at the broad scientific community and the general public. Funding agencies such as NSF, for example, are stressing the need to demonstrate the value of science to the public that provides tax funding, and to reach K-12 students. These web sites may contain scientific plans, video clips, many pictures of scientists at work, scientific explanations (with animated graphics) aimed at nonscientists, and so on. Such sites may be maintained by the researcher’s staff or by government support services.

A project that demonstrates these various applications of project web sites is a large-scale, multinational project to measure aerosol particles in the atmosphere in Asia (ACE-Asia). The U.S. Joint Office of Science Support (JOSS) created ACE Asia’s operational command center on the Internet, linking scientists in the field in various locations in Asia and throughout the world. Construction of the web site was included in project funding and developed by JOSS personnel, thereby reducing demands on scientists to maintain the site. Scientists have used the project site to run predictive
models that determined where data would be collected on certain days, to archive satellite and other data that described atmospheric conditions when sampling took place, and to record contextual meta-data, such as equipment conditions, which might affect current and future data collection. In addition to this real-time coordination function, the project site provides evidence that researchers are doing “good scientific work”. For example, the ACE-Asia field catalog (http://www.joss.ucar.edu/ace-asia/catalog/) documents actions researchers take when carrying out the scientific method, visibly presenting them as “good scientists.” In addition to this highly interactive, collaborative Internet site, the ACE-Asia project has a professionally developed companion web site (http://saga.pmel.noaa.gov/aceasia/).

A principal investigator for the project described how this set of sites evolved:

“It began as a very informal thing but was directed totally at those who were getting the experiment organized. And so it was not pretty to look at, it didn’t include a lot of web background information ... However, as it got closer and closer to the time of the experiment we began to realize, partly as the result of prompting from our program managers, the importance of outreach in making the results of the experiment available to more than just the scientific community, to help in educating kids and making them excited about this kind of enterprise. And so this website was cleaned up a little bit to give a little bit more background, to direct people to the prospectus.”

His explanation demonstrates how interactions with collaborators (including program managers or funders) can shape professional presentations of the self to other audiences (in this case, grade school and high school students). It highlights the difference between web sites that direct an official image toward the public, and collaborative web sites that are intended for use within a close-knit scientific community where they influence professional identities among peers.

7. Closing thoughts

In this paper, we argue that ICT use is a fundamental part of research scientists’ identity construction, both as a forum for self-presentation and as a component of project-based collaborative interaction. For oceanographers, it’s the ICTs they co-construct with close collaborators that help to shape their identities and the ICTs through which they reciprocally interact that serve as the more valued forums for self-presentation.

With respect to web pages, our data does not support Walker’s (2000) conclusion that sites directed toward the anonymous web audience are more effective for identity enactment, while those directed toward an already-known community are less effective. We have found that for research scientists, web sites and other ICTs used in close interaction with colleagues are more effective for shaping and presenting professional identity. Even low-profile FTP data sites do this with greater effect than the public presentations of homepages. As others have noted, scientists enact their identity primarily with peers, even when using the WWW for “private” exchanges in the public forum [1]. Communications within these institutional circuits support the invisible colleges that Cran [8] and others have described.

The kind of ICT-related identity construction evident in our findings is more interactive than the opportunities for “intertextuality” between authors and readers discussed by Wynn and Katz [35]. We can see clear opportunities for such postmodern constructions when scientists link their homepages (even belatedly) to their project pages, and these are later “cleaned up” for public consumption. However, this sort of ascribed identity is not likely to reflect back on the professional identity avowals of the oceanographers in our study, unless these public interpretations are held up as important by others within their socio-technical networks, such as NASA program managers.

At this point, our data does not reveal much about the multiple identities that modern individuals construct and project. This partly reflects our focus on professional identity. Also, we have, to date, interviewed a rather homogeneous group of oceanographers. Nearly all these scientists are middle-aged males with senior positions in their specialty areas. Hesse et al [17] found that researchers who are peripheral to the field due to ethnicity, age, gender, or years of experience, use ICTs differently from more established colleagues. The junior oceanographers we interviewed did consider personal web pages somewhat more useful for self-presentation than did senior scientists. We can only speculate about whether junior faculty will find personal web pages less valuable as they become well-known through conventional venues, or if there is a “generational shift” occurring, such that junior scientists will carry forward current uses of these ICTs and legitimize this venue for self-presentation in the future. We do note that strong institutional pressures remain to publish through established journal outlets, and that “web-publishing” on home pages may preclude more traditional publishing opportunities. Recent studies of ICT use for publication among academic disciplines suggest that the norms of a discipline strongly influence how its members use ICTs [19] [33]. Thus, we anticipate finding differences in this regard among marine biologists and astronomers as we continue our study.

Although we are still at an early stage in our research, our findings underscore the value of a social actor approach for studying ICT development and use. When focusing on social actor identities, we see that awareness of the audience, framed interactions, expected and realized reciprocity, and identity co-construction are fundamental to identity shaping whether ICTs are involved (as they increasingly are) or not. This understanding helps explain why, among oceanographers, particular ICTs are more effective in co-constructing technologies and professional identities than others.
We believe that this co-constructive aspect of both technologies and identities is a basic part of what it means to be a social actor in the information age. Latour [23] has demonstrated the ways in which "science" and its technologies are co-constructed, and Knorr-Cetina [20] has provided valuable insights into the nature of scientific technologies and scientific identities; but their work does not directly address the role of ICTs in these processes. Today, as one researcher reminded us, nearly all scientific instruments and devices have an information processing component. Accordingly, the construction of ICTs, identities and science itself may have become inseparable.

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Bibliography