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Integrating Organizational and Design Perspectives to Address Challenges of Renewal: A case study of NASA's post-shuttle workforce transition

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As organizations become increasingly complex and technology-dependent, likewise their challenges become increasingly complex and technology-driven. In the practice of organizational and design ethnography, the elements of organization and technology design overlap. However, a need remains for an explicit framework to deal with the complex challenges of innovation and change faced by contemporary organizations. This need is evident in a case study of NASA's workforce transition as a result of the space shuttle's retirement. NASA's challenge is both organizational and technological – the end of the Space Shuttle Program left the agency without a clear replacement vehicle and the risk of losing an experienced, expert workforce. An integrated organizational and design approach could foster an environment of renewal by involving stakeholders at all levels of the agency and adopting a future-oriented approach to anticipating change.

> "The shuttle is always going to be a reflection of what this nation can do when it dares to be bold and commits to follow through. We're not ending the journey today… we're completing a chapter of a journey that will never end."
> Shuttle Commander Chris Ferguson to Mission Control prior to the final launch of the Space Shuttle Atlantis on July 8, 2011(Rasco 2011:1)

INTRODUCTION

As organizations become increasingly complex and technology-dependent, likewise their challenges become increasingly complex and technology-driven. The organizational, or human, problems have become increasingly intertwined with design, or technological, problems. In practice, the elements of organization and technology design overlap. However, a unifying theory has failed to emerge which effectively addresses the complex organizational and technological challenges contemporary organizations face.

Anthropologists introduced ethnography to industry through work focused on organizational application, but now practitioners are being a pulled towards design applications. A brief look at the history of organizational and design anthropologies[1] reveals that workforce topics have been delegated to the organizational ethnographers and technology projects to the design ethnographers. Historically, both share a close engagement of the employee or consumer-user as a research participant. Design paradigms have shifted, however, towards a more user involved, active approach. Moreover, design ethnography is a future-oriented activity. In an ever-changing technology-driven world, academics and

[1] Although practitioners from many disciplines conduct ethnography, this brief history illustrates the separation in the organizational and design ethnographic approaches.

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practitioners have acknowledged the interrelatedness of technology and organization. Now is the time to develop a new approach to addressing the challenges contemporary organizations experience that incorporates participation, anticipation and innovation.

Building on Melissa Cefkin's introduction to *Ethnography and the Corporate Encounter* (2009), I undertook an exploratory research study investigating new applications of corporate ethnography. I was familiar with the National Aeronautics and Space Administration (NASA) as a highly complex, highly technological organization having worked within the agency for several years. The retirement of the Space Shuttle Program (SSP) affected many of my former colleagues and presented a unique opportunity to study organizational renewal from the beginning of the story. The pilot study I conducted exploring NASA's post-shuttle workforce transition revealed an interrelated organizational and technological challenge. I present my findings as an example of the need for an integrated approach to organizations which combines organizational and design ethnographic perspectives.

A BRIEF HISTORICAL LOOK AT ETHNOGRAPHIC PRAXIS IN INDUSTRY

Organizational Ethnography

Anthropology's involvement in industry began with an interest in the cultural aspects of work in the industrial organization. In 1931, W. Lloyd Warner began the first ethnographic study on social organization within the work setting in the Bank Wiring Observation Room at General Electric's Hawthorne Works (Baba 2005). The Hawthorne Studies established human relations as a topic of study and the field of industrial anthropology which later evolved into organizational anthropology. Warner's work brought to the forefront of organizational ethnography the concept of informal structure and unwritten protocols of behavior (A. Jordan 2003). Those that followed the industrial anthropological tradition in the 1940s focused on workplace studies including studies of assembly line workers, Chicago restaurant workers, incentive systems, and factory teamwork (A. Jordan 2003).

Industrial anthropology receded to the sidelines during the 1960s and 1970s but reemerged in the 1980s as the work of anthropologists moved more and more outside academia (A. Jordan 2003). In academia, the revolutionary work of Marietta Baba (1989) and Patricia Sachs (1989) renewed interest in the anthropological study of organizations. In the business community, the ethnographic methods practiced by applied anthropologists appealed to the popular notion of organizational or *corporate culture* (A. Jordan 2003). An intrigued business community coupled with renewed academic interest paved the way for the seminal applied works of Ann Jordan (1990) and Elizabeth Briody (1991) in the early 1990s. Management consulting, organizational development, program evaluation, cross-cultural training, and workplace operations continue to characterize the ethnography practiced by organizational anthropologists.

Design Ethnography

Prior to the inclusion of ethnographic methods, social scientists employed in design were primarily cognitive psychologists focused on human factors or ergonomics research (Wasson 2000). Researchers and designers at the Palo Alto Research Center (PARC) in the Industrial Design Human Interface

department at Xerox were the first to actively pursue collaboration between ethnographers and designers, notably that of anthropologist Lucy Suchman (Wasson 2012). At Xerox, anthropologists were first introduced into the field of design through research in Computer-Supported Cooperative Work (CSCW). By 1997, every major design firm in the United States claimed to include ethnographic methods in their research and its popularity remains widespread in the design community today (Wasson 2000).

Increasingly, design projects have adopted ethnographic methods as design firms over time have discovered the benefits of qualitative approaches to user research (Kensing and Blomberg 1998). Anthropologists and other ethnographic practitioners provide a deeper understanding of consumer or user behavior. By situating user behavior within a larger contextual frame, contemporary applied ethnographers such as Charlotte Linde (2006) and Crysta Metcalf (2006) provide their respective organizations, NASA and Motorola Mobility, Inc., with practical knowledge of what users actually do versus what they say they do.

CASE STUDY: EXPLORING NASA'S WORKFORCE TRANSITION AS A RESULT OF SPACE SHUTTLE RETIREMENT

As a graduate student in applied anthropology, torn between the seemingly separate concentration areas of organization and design as illustrated above, I designed an exploratory study to investigate possible topics for my future thesis research regarding ethnographic applications in the space industry. The purpose of the pilot study I conducted was to explore the transition of NASA's workforce as a result of the space shuttle's retirement. The recent end of the SSP presented NASA with several challenges. After 133 missions the retirement of the nation's only operational manned space fleet created a period of uncertainty for the thousands of individuals who claim rocket science as their livelihood. As an agency, NASA was forced to address potential obstacles in successfully retaining an experienced workforce. Being a former NASA intern and contractor[2] for over five years, I was familiar with the complexities of what retirement could mean for the workforce. As a case study, I present my findings and research experience as an example of the need for an explicit framework integrating organizational and design ethnographic perspectives.

Shuttle Program Background

The birth of the space shuttle concept occurred shortly after the moon landing in 1969 when President Nixon put forth the task of creating a reusable, economic manned spacecraft. On April 12, 1981, Columbia lifted off from Cape Canaveral marking the first of 133 space shuttle missions. For 30 years, the space shuttle fleet served as the nation's icon for space exploration. Despite the catastrophic losses of Challenger and Columbia, the SSP continued to further other NASA missions including the

[2] As a student studying aerospace engineering, I completed two internship rotations with flight controller divisions. Post-graduation I supported flight controllers as a contractor and served on JSC's Culture Change Task Force of the Columbia Accident Investigation Board (CAIB).

launch and repair of the Hubble Space Telescope and the complete construction of the International Space Station (ISS).

In January 2004, President George W. Bush delivered to NASA the new Vision for Space Exploration which called for the retirement of the space shuttle. At the time, the SSP employed over 17,600 civil servants and contractors. NASA and its primary contractor United Space Alliance (USA) soon became concerned of the impacts the shuttle's retirement would have on the workforce. In 2005, the U.S. Government Accountability Office (GAO) reported that "both NASA and USA have acknowledged that sustaining their workforces will be difficult as the space shuttle nears retirement, particularly if a career path beyond the space shuttle's retirement is not apparent to their employees" (GAO 2005:2). The following year NASA began assessing the critical skills possessed by the shuttle workforce that would be vital to the success of future agency missions. The GAO testified to Congress in 2007 that the scheduled 5-year gap between the last shuttle mission and the planned launch of the new vehicle, Constellation, would "pose a unique set of challenges, and the agency is developing plans to mitigate the potential loss of critical skills and institutional knowledge" (GAO 2007:1). In 2008, NASA finalized their plans to manage the shuttle's retirement and published the NASA Transition Management Plan for Implementing the U.S. Space Exploration Policy.

NASA defined *transition* as the work which "encompasses the careful planning, utilization, and disposition of the SSP and ISS processes and resources, while leveraging existing assets for the safety and success of future Exploration missions" (NASA 2008:4). In recognition of the potentially negative impacts of shuttle retirement, the Management Plan stated, "the Agency's overarching goal is to preserve its critical skill base, ensure the viability of its core competencies, and execute its challenging, dynamic, and evolutionary Exploration mission" (NASA 2008:21).

Early on, one of the planned approaches to retaining critical skills and knowledge was to move shuttle workers to the Constellation Program aimed at returning to the moon. In 2010, this strategy proved futile when President Obama announced the 2011 NASA budget which cancelled the new program[3]. Therefore, the end of the SSP in 2011 marked the end of one manned spaceflight venture without a certain, foreseeable replacement vehicle for the first time in our nation's history. On July 21, 2011, the shuttle program ended as Atlantis safely returned her crew to the Kennedy Space Center and left many to question when America would return her own to space.

Research Design & Sample Selection

This study applied an ethnographic, qualitative approach to the exploration of the space shuttle's retirement and the resulting workforce transition. NASA's manned spaceflight missions are developed, managed, and operate out of the NASA Johnson Space Center (JSC) in Houston. I selected the center in Houston as the field site because it housed the highest percentage of civil servant SSP employees,

[3] The 2011 NASA budget preserved the Orion Crew Exploration Vehicle portion of the program. However, at the time of this study, adequate funding to develop the heavy-lift Space Launch System (SLS) needed to carry the reclassified Orion Multi-Purpose Crew Vehicle (Orion MPCV) into space did not exist. It is important to note that while budgetary resources exist in 2012 to support NASA's new SLS, engineers are pursuing the development of the Orion MPCV and heavy-lift SLS without a clear mission objective defining where the vehicle will go or what it will do.

and because the greatest threat of in-house critical skill loss resided with those employees. This decision was reinforced by findings of a 2007 survey conducted by NASA of civil servants at each space center concerning the end of the shuttle program. The JSC response was less positive than results from the other centers. The Marshall Space Flight Center results revealed 71 percent of civil servants planned to remain at NASA after the last shuttle flight, and 72 percent of civil servants in Florida said the same. In Houston, only 59 percent of the civil servants surveyed said they were likely to stay through the shuttle's retirement. Of the 41 percent of JSC civil servants planning to leave NASA either by choice or the anticipated layoffs, 53 percent of the respondents reported to likely seek a job elsewhere before the retirement of shuttle fleet (GAO 2007).

I limited the sample population of the case study to four participants[4], shown by their pseudonyms in Table 1, due to the constrained timeframe and resources of the study. In order to recruit initial participants, a criteria-based call for volunteers was posted on the closed NASA listserv of mission operations personnel. Additional participants were recruited through the use of a snowball sampling technique. I restricted participant selection to civil servants at JSC who previously worked in a Shuttle mission control position for at least five years. Pre-study communications with my former JSC colleagues along with a review of social networking sites maintained by mission operations personnel revealed an observable pattern to NASA's plan for reassigning shuttle flight controllers. The three apparent strategies were 1) temporary job rotations, 2) converting from shuttle to ISS flight controller positions, and 3) promotions to management. Subsequently, one study participant was chosen from each strategy category, and one study participant was selected from upper-level management within the Mission Operations Directorate. Further determinants in participant selection included flexibility of workday schedules and level of security clearance required to access personal workspaces.

Participant	Sex	Age	Education	Years @ NASA	Shuttle Position(s)	Current Position(s)
Annie	F	30	M.S.	7	Flight Controller	Job Rotation
Beth	F	43	B.S.	16	Flight Controller	ISS Flight Controller
Carol	F	36	B.S.	11	Flight Controller	Technical Manager
David	M	56	M.S.	35	Flight Controller/ Division Chief	Division Chief (ISS Operations)

Table 1. Participant Profile

The individuals selected participated in in-depth, semi-structured interviews and workplace observations that took place in November 2011 onsite at JSC. At the completion of the interview and a brief survey, each participant was asked to give a tour of their normal work environment. Depending

[4] Although three out of the four of the participants in the study are women this is not representative of the NASA civil servant population or the population of SSP flight controllers.

on each person's schedule, participants were observed while they went about their average workday duties including meetings and lunch breaks. During this time, notes were made documenting characteristics of their individual workspace including location with respect to key areas of JSC, proximity to former and current colleagues, floor plan layout, visual condition of office technology, agency-office decorations, and personal artifacts.

Research Findings

Defining Critical Skills - Flight controllers make up a significant portion of the shuttle workforce in transition, and the loss of technological skills developed and honed in the Mission Control Center (MCC) have been a concern to NASA administrators (GAO 2005). This concern does not appear to be shared among the four former flight controller participants. Each participant attributed greater significance to the non-technical skills of the flight controller. After explaining that the flight control software for the ISS is vastly different from the shuttle's software, which will also be the case for future vehicles, Carol expressed her thoughts on retaining critical flight controller skills:

> There are flight controller skills that are universal - so much of it is a basic way of approaching problems. I'm not worried about us forgetting how to do flight control, but after while if we were to lose all the key people I don't see a way we could train new people.

When asked if he was worried about the possibility of losing critical flight controller skills, David said that "If we suddenly lost all the [flight controllers] for some reason, even after being behind a desk for 19 years, I feel like if they called me up and said 'Fill in', that I would have no problem technically."

The Agency's Attempted Solution - In 2006, administrators in Houston created the JSC Transition Integration Panel (JTIP) as a forum for planning and coordinating the workforce transition (NASA 2008). The JTIP sponsored several activities and communication tools aimed at assisting those affected by the shuttle's retirement. Table 2 shows a list of communication tools presented by the JTIP to the Space Shuttle Transition Liaison Office at NASA Headquarters.

Communication Tools
• JSC Transition Management Integration Plan Document • JSC Transition Website • JSC Transition Graphic • JSC Quarterly Transition Newsletter • 2007 Transition Road Show • PM Challenge 2008 Transition Panel • Biweekly panel discussions with JSC departments • Brown Bag Luncheons • Town Hall forums

Table 2. JTIP Communication Tools (Dornell 2008)

The JSC Transition Graphic advertising the Transition Website and the JSC Transition Update Newsletter were the most visible artifacts created by the JTIP. I noted numerous full color, 11x17

posters of the Graphic-Website advertisement in the buildings and cafeteria utilized by JSC administration, astronauts and former shuttle trainers. Several copies of the Newsletter were also observed in these areas. However, I did not observe any of the JTIP products on the opposite side of the JSC campus where the MCC, majority of flight controller offices, and their main cafeteria are located.

Despite the apparent efforts of the JTIP, all four participants stated they did not utilize any of the tools because they were either unaware of their existence or believed the aids did not apply to their situation. Although all participants were aware of JSC's official transition program, the JSC Transition Website was the only NASA-designed tool that was mentioned when interviewees were asked to list available transition aids. Annie and Beth reported that several resume workshops were offered to help those affected by agency-wide layoffs, and all four participants reported numerous job fairs were held onsite - transition tools that were initiated by NASA contractors and not the agency.

The Employees' Perceived Solution: The Need for Meaningful Work - When asked what type of work they consider important, each former shuttle flight controller said that it must directly relate to a future manned mission and that it should involve something "hard-wired," "technical," or "worthy of an engineering background." Activities relating to the ISS, robotics, and management duties while important to NASA's overall mission were considered less desirable roles by the former shuttle flight controllers.

When asked about their personal experiences in the transition, each participant directed the conversation towards the topic of work satisfaction. Beth, Carol and David voiced this theme through their observations of colleagues and refrained from giving testament to their personal level of work satisfaction. Annie, on a temporary job rotation outside mission operations, expressed extreme satisfaction with her new job role. She viewed her day-to-day activities as "meaningful work" preparing for NASA's eventual return to flight. The phrase *meaningful work* has been used in the media, academic literature and in official NASA documents to describe motivation in NASA's work environment (Vaughan 1997, Dornell 2008, Rasco 2011). The phrase was echoed by each participant when discussing their opinions on why civil servants may voluntarily seek employment outside NASA:

> "… there is a lack of meaningful work now…" (Annie)
>
> "We need to find more work that is meaningful to folks… work that serves a real purpose." (Beth)
>
> "There are those who are die-hard flight controllers who feel they will never find meaningful work here again in their lifetime – for those it doesn't matter where they work now." (Carol)
>
> "[He] loved the new environment and the pay was not a factor – there was simply no meaningful work knowing that the [system] would never be used." (David)

INTEGRATING ORGANIZATIONAL AND DESIGN PERSPECTIVES

As I developed my research plan, I struggled with how to approach the study of NASA's transition. My perceived need to choose between an organizational perspective and a design

perspective perplexed me - a crisis of personal identity I also experienced in my first semester of graduate school. A clear, explicit framework for describing the challenges faced by the agency and the shuttle workforce was not apparent. However, I could see how the two seemingly separate styles of ethnography could apply. This thought was reinforced as I concluded my research and discovered the complexities of NASA's challenge in retiring the space shuttle - NASA's challenge is both organizational and technological.

In the rhetoric of business ethnography, workforce topics have been delegated to the organizational practitioners and technology projects to the design researchers preserving their historical disconnectedness. In reality, much overlap exists between the two apparently separate groups. Organizational knowledge has influenced design projects aimed at creating environments of collaboration and change. Similarly, the focus on participant involvement characterizing many design traditions has impacted the view of the worker inside organizational ethnography. However, there remains a need for a fully integrated framework to deal with the complex concerns of innovation and change faced by contemporary organizations.

Creating an integrated framework built on both design and organizational ethnography perspectives goes further than methodology. More than a cross-application of methods, an integrated approach to addressing the challenges of contemporary organizations calls for an exhaustively holistic look at both the organizational and technological. Even though my framework is still in development, three elements emerged from this case study, and each bear further consideration in constructing an integrated approach to organizations. First, the new integrated framework should place a premium on the voice of organization members and provide them with the opportunity to participate throughout the ethnographic process. Second, an integrated framework should be oriented towards the future when considering the contemporary issues of organizations. Third, a continual awareness and acknowledgement of the interconnectedness of technology and organization should be present when contextualizing current and future challenges. By integrating these elements, as shown through a theoretical discuss of the NASA case study, ethnographers can provide organizations with the ability to foster innovation and renewal.

People-driven

Plans for implementing change will be better suited to the needs of the organization if they empower members at all levels. Although they served as an important introduction between industry and ethnography, the Hawthorne Studies, and the functionalist framework on which they relied, eventually received criticism within the field of organizational anthropology for failing to take into account influences of power. Design ethnography, however, allows for a research process which provides participants a stronger voice. The North American tradition of Participatory Design (PD) emerged from the roots of Scandinavian PD which is characterized by a focus on active user involvement throughout the entire development process (Kensing and Blomberg 1998). User-centered and user-directed design paradigms[5] are those most often discussed within anthropological circles of

[5] Other design paradigms exist which place the user in a central role which I will not discuss within the scope and length of this paper.

praxis and academia, and allow for similar yet distinct approaches to design projects which continue to evolve and co-exist simultaneously in contemporary practice.

I easily recognized the benefit of a participatory research process through the participants' discussions regarding NASA's transition programs. Although the shuttle's retirement ultimately affected both civil servant and contractor flight controllers, the civil servants interviewed did not utilize the aids because they did not feel the tools were relevant to their situation. The services most noticeable to the participants were the aids aimed at supporting workers transitioning out of the NASA organization rather than helping those staying behind. In addition to the unsuitable support programs, JSC's strategies aimed at retaining their expert flight controllers did not reflect the desires or voice of the workforce. The flight controllers interviewed felt powerless in their ability to choose what their new roles might be in the agency. Regardless of JSC's attempt to offer relevant, new opportunities to all members of their shuttle community, the options were limited and were often times undesirable by a workforce accustomed to real-time operations[6]. Perhaps a more participatory approach would have resulted in transition programs and strategies better suited to the needs of flight controllers.

Future-oriented

The concept of change is intertwined with notions of future. Change implies that a certain amount of time is required for transformation to occur. This viewpoint, of change and future, is well-known by organizational ethnographers. Organizational ethnographers are often called upon to offer insight into organizational change, as evident in the early works of Ann Jordan (1990). Design ethnography could contribute to the insights of organizational ethnography through its emphasis on the future and needs that are not yet known or perceived. Johan Redström coined the phrase of designing for "use before use" (Redström 2008:421). Ehn (2008) argues that PD provides a framework and methods to meet the design challenge of fully anticipating, or envisioning, use before actual use takes place. PD requires the identification of future users while meta-design, another strand, allows for future stakeholders to remain unknown (Ehn 2008). Even though these perspectives are mostly applied to the design of material artifacts, the benefits of a future-oriented perspective still apply towards the issues faced by changing organizations, as seen in the NASA case study.

Findings from the study revealed a shared concern among management and workers for retaining an experienced mission operations workforce to ensure the success of future missions. However, NASA and the former shuttle flight controllers maintained an inconsistent definition of *critical skills*. The agency administration framed their concern with retaining experienced in-house flight controllers as the possibility of losing those skilled in the technological expertise deemed necessary for future missions. The flight controllers interviewed assigned greater importance to non-technical knowledge. Both the agency administration and the flight controllers shared a concern that was future-oriented. As an example of the need for a future-oriented approach, NASA's challenge will not become measurable for some time. The stakeholders in this example will be the next manned NASA program and the

[6] NASA engineers often align themselves in one of two camps - systems or operations. *Systems* characterizes engineers involved in hardware applications while *operations* refers to those involved in real-time mission activities.

future members of their workforce yet to come. Will they lose critical skills? With a future-oriented approach to this problem, and by giving the flight controllers a stronger voice in the transition planning, a clearer definition of the critical skills more likely to be lost could have been made years before the last shuttle flight.

Org+Tech- interconnected

The idea that technology and organization are interwoven is well accepted in academia and praxis. Activity theory (Holt 1993, Nardi 1996) and sociotechnical systems (STS) theory (Baba and Mejabi 1997) acknowledge the influence of artifacts on behavior, and these theories regularly ground the praxis of design and organizational ethnographers. More explicitly than activity theory, STS attempts to connect the two worlds of organization and technology through a framework concerned with people and their interactions with technical or designed products and processes at work. In a world increasingly sustained by technology, organizations will be better equipped in decision-making if they view their problems not as separate organizational and technical issues but as a single, interrelated challenge. As revealed in the case study interviews, the key to retaining a motivated workforce rested in the agency's acknowledgement of the flight controllers' definition of *meaningful work*.

NASA Headquarters as well as JSC leaders developed solutions to the problem of workforce retention by developing new roles within the agency for those impacted by the shuttle's retirement. However, those roles failed to provide widespread opportunities for *meaningful work* as defined by the flight controller participants. Each participant gave their definition of significant and worthwhile work as that which is directly involved with the technologies of manned spaceflight. As engineers in mission operations, they shared the belief that working in roles directly relating to the development of new spaceflight capabilities (i.e. technology) was crucial to preventing the loss of in-house experts. In short, NASA's organizational problem of retaining flight controller experts was directly related to the space agency's lack of new operational technologies[7].

Integrating perspectives to foster innovation and renewal

Both organizational ethnography and design ethnography offer the insight and means to anticipate change and address innovation. However, by integrating the three proposed elements, organizations will be better equipped to foster renewal and innovation. Strengthening the voice of members throughout the organization not only solidifies the best-made plans of the establishment's leaders but also allows for a stronger creative process. A people-driven and future-oriented approach puts members' needs in a central position when planning for the organization's future while at the same time allowing the organization to tap into unused human resources for innovation. However, innovation involves more than producing a new technological invention or strategizing organizational effectiveness. As Allen Batteau (2010) points out, innovation is more often a restructuring or

[7] The absence of an operational American spacecraft posed another problem for NASA. With the retirement of the shuttle fleet, America became totally dependent on Russia to transport astronauts to the ISS. Russia responded to the situation by tripling the cost to ride on the Soyuz capsule from $20 million per seat to roughly $63 million (Atwood 2011).

redesigning activity than it is about creating something new. In light of this observation, concepts of innovation and change involve routine activities of adaptation and renewal. Organizations foster renewal by incorporating practices of anticipatory behavior into their milieu. In terms of sustainability and industry innovativeness, organizations remain profitable if they can effectively anticipate and adapt to internal changes and external influences, as seen in Jeanette Blomberg's (2011) recent work investigating enterprise transformation. An organization's attitude of innovation and an orientation towards continual renewal is more likely achieved when a focus on the future is just as prevalent as an understanding of the past and present.

Ethnographers integrating organizational and design perspectives, in this manner, create an awareness that renewal and innovation is an on-going process. For NASA, a futuristic outlook is second nature; their ability to anticipate change is crucial. Aside from science-fiction-esque plans to inhabit Mars, NASA provides a noble example of an organization oriented towards the future through their routine re-purposing of technology. Driven by the political climate of the nation, NASA is familiar with ever-changing mission objectives and works through budget constraints to retain its technological assets. However, the retirement of the shuttle fleet has presented NASA with a challenge of renewal on a grand scale. Whether or not NASA will recapture its place as the leader in manned spaceflight is a question only time can answer.

CONCLUSION

Although the research findings are not generalizable to all members of NASA's workforce, this study has laid the groundwork for future studies. In addition to establishing access to the field site, additional research questions have emerged from this study that once explored may gain better insight into the impacts the shuttle's retirement will have on NASA's expert workforce. One such question that bears attention is how the concept of *meaningful work*, as understood by the participants in this study, impacts critical skill retention. More significant to the scope of this paper and the EPIC community, the case study provides an example of the need for an integrated ethnographic framework in addressing challenges of organization renewal and innovation.

An integrated organizational and design approach could foster an environment of innovation by involving stakeholders at all levels of the agency in a co-creative, future-oriented renewal process addressing interrelated issues of technology and organization. Approaching industry from a mixed perspective allows for dynamic, solution-making decisions which would allow for organizational and technological solutions to be considered simultaneously. With stakeholder buy-in a major obstacle for practitioners to overcome, diversifying the range of deliverables offered by ethnographers on any given project should be a welcome innovation to any discipline. Discussion among scholars and practitioners suggests that jobs outside academia are on the decline for purely organizational anthropologists. Organizational projects today are often undertaken by ethnographers who work in a variety of applications such as technology design, program evaluation, and teaching. Combining these applications under one integrated paradigm would strengthen our ethnographic praxis and allow us to better serve our clients in an ever-more technology dependent world.

NASA is but one example of the need for an integrated framework. Approaching industry from a mixture of organizational and technology design perspectives would allow ethnographers to apply a

complete, or exhaustively holistic, view of modern organizations both large and small. As the business world becomes increasingly dependent on technologies of globalization and innovation, an integrated organizational and design perspective has the potential to provide a theoretical foundation and methodological practices applicable to organizations of any size in any industry. In keeping with the elements I have proposed, I invite the ethnographic community to become co-creators of this new paradigm. Take a future-oriented look at the nature of our discipline and consider the interrelated nature of challenges you have observed in contemporary industries. With such a great need apparent, our ability to renew ethnographic practice by anticipating change and planning for times of needed innovation makes this study and subsequent studies urgent, meaningful work.

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