

System Administrators as Broker Technicians

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ABSTRACT

This research investigates the work practices of system administrators. Using semi-structured interviews and an analysis of existing system administrator literature, we theorize that system administrators act as technical brokers who bridge two communities, the end users they support and their own technical community. We also show that system administrators, like other technical workers, rely on contextual knowledge. This knowledge is largely acquired through practice and less through formal education and certification. Through a discussion of common reactive and proactive system administrator duties, we present system administrators as broker technicians who must mediate between the end users they support and their technical community. We end with a discussion of the changing role of sysadmins as their tools and users get more sophisticated.

Categories and Subject Descriptors

K.6.4 [System Management]

General Terms

Management, Design, Human Factors, Theory

Keywords

System administrator, technician, work practice.

1. INTRODUCTION

"A programmer is much like a virtuoso musician. They know their instrument extremely well. They may know, and occasionally play other instruments, but tend to focus almost exclusively on one. A sysadmin is more like the conductor. They have to know about all the instruments, the characteristics of each, how they play and sound together and in contrast with others. Then [they] need to understand the timing, the sound characteristics of the hall, etc. and make everything work together."— System administrator

With the growing complexity of computing infrastructures, the

maintenance and management of these systems increasingly relies on the technical and professional occupation of system administrators [1-3]. Responsibilities of system administrators (sysadmins) include configuration, maintenance, troubleshooting, and data backup and replication. Their work requires knowledge of operating systems, hardware components, databases, networking, and the complex interrelationships among system components [2-7].

The financial implications of system administration are catching the attention of many companies [e.g., 8, 9]. While the costs of actual hardware components are falling, studies indicate the cost of administering these systems is increasing and surpassing component costs [6, 10, 11]. Furthermore, system administrators are in demand and commanding salaries that increase 5% - 10% each year [7, 8].

Even with this practical need and industry attention to system administrators, there is only a small group of researchers who are studying this unique and important group [see 3, 11, 12]. Moreover, only a few universities offer coursework in system administration [8, 9], and few research projects have explicitly focused on system administrators [notable exceptions include 3, 12, 13].

While the importance of studying system administrators has been noted [2] and more studies are being conducted [e.g., 1, 2, 3, 14-18], it is important to understand who these technicians are. Any investigation of organizational workers benefits from an understanding of the models of work they engage in [19, 20]. In other words, what do sysadmins do and what do they know? To answer these questions, we looked to the literature on technicians, and, more specifically, on the role of broker technicians, to provide a foundation for understanding the complex work of system administrators [19].

In this paper we claim that system administrators are broker technicians. Broker technicians are primarily "responsible for creating general conditions necessary for the work of others...[by overseeing] some aspect of the technical infrastructure on which the production of system rests" [19]. This technical support work requires communication and interaction with fellow sysadmins as well as users of the systems they manage. That is, system administrators, as broker technicians, must be simultaneously oriented toward the users of the technical infrastructure in the organization in which they work, and toward the developers of the technology in a wider and more diffuse technical community [21].

By examining the work practices of system administrators, the

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aim of this research is to show that the mediating position of “broker” complicates the sysadmins’ roles as traditional employees and “technicians.” Brokers act as the link between a larger system of work and the materials on which the system depends. The materials of relevance may be hardware, software, data, test results, images, diagnoses, or even theories [22]. Thus, technicians’ work, like that of sysadmins, requires expertise and knowledge that are a critical resource few outsiders possess. They are more likely to be strongly oriented to their community of practice than to organizational or occupational images of bureaucratic systems of control (e.g., graded pay scales, formal job classifications, and other HR practices) [19].

We first describe our methodology for conducting this research, followed by a brief description of how system administrators learn their technical skills, and the importance of the sysadmin technical community. Before we discuss the system administrator as broker technician, we first elaborate on their role as technical workers, including their skills. We then present work environment and work practices of system administrators, with a focus on their role as technical brokers. We provide descriptions of their daily activities to illustrate the role of sysadmins as broker technicians. We end with a discussion of the changing role of sysadmins as their tools and users get more sophisticated.

2. Research Methodology

Work practices of system administrators were examined utilizing a multi-method approach. The narrative of work contained in this study is based on the personal experiences of one author, both as a system administrator and as a consultant working closely with system administrators. This study utilized semi-structured interviews and an analysis of existing ethnographic and work practice studies of system administrators.

Semi-structured interviews were conducted to investigate system administrator work practices. Interview participants included both junior and senior system administrators whose work responsibilities included the administration of networks, storage, operating systems, web hosting, and computer security. Six interviews were conducted with system administrators at a location convenient to the sysadmin, with two conducted in person at the sysadmin’s place of work and four conducted over the phone. Three of the sysadmins interviewed worked for a Fortune 500 services computing company, while the other three worked in an academic setting, one for a large university and the other two for a college within the same university. The average length of time as a system administrator was 14 years (ranging from 8 years to 25 years) and the average age was 39 (ranging from 30 to 58 years old). Most of the study participants (83%) were male, which is consistent with demographic data reported by others [7]. The interviews addressed the work sysadmins did, how they did their work, and the tools they used. Due to security and privacy concerns, interviews were not audio taped and recorded, so responses were limited to copious notes. Interview notes were reviewed and expanded immediately following the interview to make sure all responses and relevant information were captured.

Existing papers detailing an ethnographic study of system administrators were also utilized. The largest number of sysadmin-centric research studies was conducted by IBM Almaden Research Center (ARC), and spanned four years and six

sites. In particular, six field studies were conducted with at least two researchers observing, taking notes, and videotaping. These researchers followed one sysadmin per day and collected artifacts throughout their site visits. Twelve interviews were conducted with sysadmins, managers, and team leads, focusing on work issues and concerns and were conducted in their offices. One system administrator logged his daily activities for ten months, identifying tasks such as meetings, problem solving, and planning, and details such as task collaborators. Finally, two surveys were conducted as part of the study, one pilot survey to better define the domain of system administration, and a more extensive survey to collect information on collaboration practices and tool use [1-5, 14-16, 23-28]. The research from this ethnography (referred to as the ARC ethnography) provided detailed, accurate, and contextual narratives of system administrator work practices and was used to augment the data collected for this study.

3. System Administrators

System administrators are the information technology professionals who execute the system administration tasks for their organization, even though their job titles may not designate them as such. System administration may be their sole responsibility or it may be just one of the line items in their job description. They can work alone or in teams and often have broad and overlapping responsibilities. The majority of system administrators report job duties that include working independently with general management guidance, planning for the future of the facility, managing the work of junior system administrators and engineers, establishing or recommending system use and service policies, managing computing infrastructures, providing end user and workstation support, and evaluating components for purchase [7].

Most system administrators are men (91.6%), though trends show this percentage gradually declining. A single system administrator can support anywhere from a single end user to over 16,000 end users, though most support approximately 80 [7]. The average workweek for a system administrator is 44.7 hours per week, but 22.5% of system administrators report working more than 50 hours per week [7]. To compensate for the long hours, many system administrators telecommute, with 40% working at least 8 hours from home every week [7].

3.1 Sysadmin Technical Communities

Much of what is known about system administrator demographics, job titles, responsibilities, and standards come from information collected and published by their two main professional associations, SAGE and LOPSA. The System Administrator’s Guild (SAGE) is a special interest group sponsored by USENIX, which is itself an association for professionals involved in advanced computing. The League of Professional System Administrators (LOPSA) is a nonprofit corporation with worldwide membership. These organizations collect membership dues and serve the system administrator community through conferences, training, technical information, and online communities. SAGE conducts a yearly survey about system administrator roles, job titles, responsibilities, ages, salaries, and work schedules (named the annual “Salary Survey”) and provides an analysis of the results to its members. SAGE sponsors various LISA (Large Installation System Administrators)

conferences each year and publishes white papers and a magazine called *:login:*. SAGE and LOPSA hold their own regional training sessions and host online forums. SAGE and LOPSA also collaborate on projects that benefit system administrators; for example, together, they composed the System Administrators' Code of Ethics [29]. Much of the demographic information about system administrators found in this study is gathered from SAGE and LOPSA websites and publications, such as the SAGE Annual Salary Survey [7].

3.2 Sysadmins as Technical Workers

Most system administrators have no formal education or formal training directly related to system administration. One third of sysadmins report having no certifications and 59% report having a college degree [7]. Of those that do have degrees, most are in technical fields, such as computer science. Many system administrators report starting to work in their field almost by accident: by stepping in and fulfilling a need when their organization asked for volunteers. As one system administrator said, "many of us are cases of programmers having to do some [system administration] work because they have the skills and someone needed to get the job done." Because of the lack of academic instruction directly related to system administration [8], the majority of learning happens informally. Over 85% of system administrators attribute their knowledge to on-the-job training or self-instruction [7]. Thus, for system administrators, as well as other technicians, formal educational skill is less important than contextual knowledge that is largely acquired through practice and difficult to verbalize, much less codify [21, 30, 31]. For example, one system administrator stated, "I can testify from personal experience that it is possible to pass a written test on system administration and not have the slightest clue about how to function as a system administrator" [32, p. 14].

These findings suggest that for system administrators, technical skill acquired through contextual knowledge is valued above any formal training or certifications. Skill is a component of technical work [33] and is more than just knowledge; it is the ability to do something well [34, 35]. Skills that are highly context dependent rely on tacit knowledge acquired in the practice of doing work [33, 36, 37]. Surprisingly, technical skill is often not the focus of an organization's specialized job training for its technicians [30].

3.2.1 Sysadmin Skills

But what skills are needed? Although the answer may depend on the situation and computing environment, some skills are fairly universal. For example, a "Unix shop" (slang for an organization whose infrastructure is supported using primarily servers running a Unix operating system) will recruit system administrators with a Unix background, while sysadmins reported that same Unix background would offer little operating system knowledge in a "Windows shop." Beyond these vendor- or operating systems-specific requirements, the sysadmins we interviewed identified a common set of skills: a technical background, the desire to learn, some programming ability, creativity, and a good "sense" of the system and any problems that may arise. When probed further about acquiring the intuition needed, the answer was always very similar to, "I don't know; you can't learn it. Some people just have it and you pick it up along the way."

3.2.2 Learning Sysadmin Skills

Indeed, most system administrator skills are learned on the job or by personal investigation and experimentation. This is apparent in the response of a sysadmin when asked about having a particular skill: "No, but only because I haven't ever needed to use it yet. The first time I do, I'll learn it." All of the system administrators that were interviewed started their careers under the guidance and direction of a mentor, much like an apprenticeship. This on-the-job training imparts practical knowledge under the guidance and direction of an experienced mentor [38]. Much like the advancement within occupational communities, system administrators move through stages of skill proficiency [39]. However, unlike traditional apprenticeship models, the technically diverse and dynamic work environment of system administration does not cultivate professionals who are experts in the entire field of system administration. Instead, a junior sysadmin will often continue to gain knowledge and eventually specialize in one particular aspect of system administration, such as operating system administration or web server administration, more closely resembling the guru¹ model of workplace learning [40].

For example, the work of system administration requires knowledge and skills that are local and dynamic. Emerging technologies result in frequent system changes and upgrades, which dictate the learning required of the organization's system administrators. In the case of an addition or upgrade of a server made by a familiar vendor, the system administrator most familiar with that vendor's products would most likely assume – or be assigned – responsibility for this new component and remain the local expert. In the case of the installation of a new system component that no one on the team has experience with, one sysadmin will likely be sent to a class to learn about it, becoming the new guru for that component through local responsibility with that component. Additionally, a recent college graduate may be familiar with the latest version of a database system and therefore be regarded as a colleague and the guru of that particular database system. The rapid pace of technological change requires knowledge and skill updates that work against traditional models of apprenticeship and result in the dynamic allocation of guru status among team or community members [40]. This also explains the collaborative nature of the work of system administration: By assigning the responsibility of a skill set to a particular team member, the cognitive load is reduced for the rest of the team.

4. Work Practices of System Administrators

Work practices are about the ways in which people organize and perform their work [20, 41], not just the tasks they perform. These include work routines, modes of cooperation, gestures, and rituals [42]. Work practices are not always visible to outsiders [43], often because of the proficiency with which it is done [44]. That is, "the better the work is done, the less visible it is to those who benefit from it" [43, p. 58]. Thus, the work practice of system administration is revealed in the situated context of the work.

¹ In fact, a yearly technical conference hosted by SAGE, a professional system administrator association, hosts "Guru Is In" sessions where system administration experts impart knowledge on topics of interest to the professional community.

For example, if a system error is detected following the upgrade of a software program, there are many possible causes. These can include a failed or incomplete upgrade, incompatibility between the upgraded software and another infrastructure component, or even an unrelated error elsewhere in the system that was coincidentally discovered following the software upgrade. A system administrator must not only perceive the error, but also identify and attempt to correct it by process of elimination – checking each possible cause and solution. This is an involved process of researching possible causes and solutions and trying each until the system is restored. In this way, the work practice of system administration requires a deep understanding of the situated context.

4.1 Sysadmins as Broker Technicians

System administrators bridge two communities, the end users they support and their own technical community (see Figure 1). System administrators provide support for a variety of organizations, including those in finance, academia, research, government, and non-profit agencies [7]. In maintaining computing infrastructures, system administrators create artifacts that are meaningless to the users they support, but which are important to their understanding of the system and meaningful to other system administrators in their technical community [22]. The users are supported by system administrators and rely on the computing infrastructures that are maintained by them, but as users, they do not understand the physical or symbolic components of system administrator work, often viewing the technician's work as a black box.

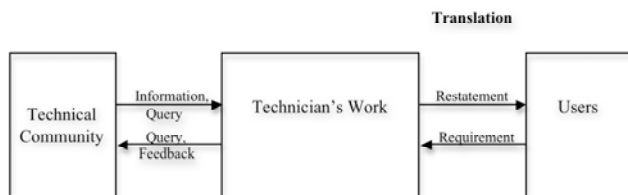


Figure 1. Broker technicians (adapted from Barley 1996)

Although sysadmins did not describe themselves as brokers, when they discussed their work activities, they did articulate an understanding that their responsibilities demanded a dual focus. On the one hand, they were involved in maintaining a computing infrastructure for the organization. In a sense, they were on call to repair equipment, upgrade software, keep the network running efficiently, and diagnose and solve problems as necessary. This is what Zabusky [21] calls reactive work. In contrast, proactive work involves purchasing and testing new equipment and software to keep the infrastructure up to date, providing posts and technical help to various sysadmin bulletin boards, as well as learning what others have to say, reading a wide variety of trade magazines, attending trade shows and conferences, communicating with other people working on similar projects, and conducting on-the-job training (either online or by reading books and documentation).

Of course, what makes this dual focus difficult is that neither occurs in isolation. In fact, the activities listed above often involve interactions with both communities (i.e., supported users and fellow sysadmins) simultaneously. Even though Figure 1 looks as if the system administrator has to do two separate kinds of work,

in reality, the two worlds are not isolated. System administrators have to do both reactive and proactive work concurrently.

Recently, Haber and Bailey [22], reported that system administrators spent almost a quarter of the day in meetings, echoing reports from Dijker [45]. The rest of the workday was spent on planning (21%), system maintenance (19%), troubleshooting (11%) and installation (8%) [3]. These activities reveal the dual nature of system administrators, as broker technicians. In some activities, they must translate their activities to the users they support; in other activities, they interact with their technical community about technical subjects, such as technical solutions or best practices. Descriptions of these daily activities will be used to illustrate the role of sysadmins as broker technicians.

4.1.1 Meetings

Meetings were referred to as a “necessary evil” by our interviewees; they expressed annoyance at having to leave their work duties to attend meetings, but agreed they were necessary for communication with the users they support, and for communication within the team. The translation aspect of system administrator work is apparent in meetings with users, where future computing needs of the organization and system status are discussed. In these meetings, both supported users and sysadmins discussed future computing needs that were to be translated into technical specifications, and these specifications would later become work items for the system administrator and his or her team. These meetings were also used to communicate system status back to the users, representing a translation of technical details. For example, sysadmins would detail the work they completed in terms that could be understood by the users, such as the installation of software patches and firmware updates, as “servers have been updated to support our growing database needs.” Meetings were also held with sysadmin co-workers as part of their technical work to communicate business requirements, coordinate work activities, and disseminate technical knowledge.

4.1.2 System Planning

System planning is a proactive component of system administration that spans all aspects of broker technician work and includes system forecasting, component planning, system design, and implementation. As an example, system administrators are often responsible for the upgrade and maintenance of network hardware. High-level business needs are gathered from management and translated into technical specifications, generally understood only by the system administrator technical community. Up-to-date information about current hardware and software releases and issues is gleaned from the Internet and discussed with the technical community through messageboards and online forums. This knowledge is then applied to the context of their computing environment and new components are purchased, installed, and configured. At the conclusion of the upgrade work, the system administrator must then communicate the work that was done and its relative contribution to the organization's computing goals back to their end users in language and terminology the supported users understand.

4.1.3 System Maintenance

System maintenance is a continual process that includes monitoring system state and troubleshooting any problems that arise. An example of this requirement as communicated to a system administrator might be to “maintain servers and systems to support the organization’s day-to-day operations.” The sysadmin then translates this requirement into tasks and activities needed to maintain current system state. These tasks and activities include network maintenance, and both server and individual workstation maintenance. For example, server maintenance may involve performance tuning and data backup tasks. Individual workstation maintenance may involve end user technical support. When questions arise or problems occur that sysadmins cannot solve alone, they often consult others in their technical community and use this feedback in their work. Again, status and information of the sysadmin’s completed work, such as overall system state, is collected and translated to users with terms and language they can understand.

4.1.4 Troubleshooting

Troubleshooting is an on-demand, reactive aspect of system administrator work seen in both system maintenance and system planning that can involve all aspects of sysadmin work. This work is initiated by system errors and often discovered by monitoring tools. In one case, an organization’s database was no longer accessible and users told the system administrator that the database “wasn’t working.” This was interpreted by the sysadmin as a problem with a certain database application residing on a specific server. The system administrator and his coworkers began their technical work by collecting information such as error messages, network connections to the database server, and system logs and dumps² to generate a list of possible causes. The system administrator then searched for information and possible solutions on a sysadmin messageboard and posted a question in an online forum, using messageboard information and forum feedback to identify and rank probable solutions. Each potential solution was executed in a trial-and-error fashion, with the sysadmin issuing Command Line Interface (CLI) commands to check the current system state and see if the last action corrected the error. Once the error was solved, the system administrator updated his online forum post to communicate his findings back to the technical community and an email was sent to users telling them that the database was “up and working.”

4.1.5 Installation

Installation activities typically involve sysadmin technical work and interactions with the technical community. Installations include hardware or software additions to the network and may be done proactively as part of a planned system upgrade or reactively as a fix to a current network issue. An example of a software installation involves performing work, communicating with a coworker, and engaging the technical community. Interactions may occur with sysadmins in the same organization and queries may be made to the technical community, but detailed, technical

communication with supported users is rare and usually limited to status reports.

4.2 Sysadmins as an Occupational Community

System administrators, as broker technicians, are often organizational outsiders [19, 22]. A sentiment shared by the sysadmins we interviewed was that they regarded their careers as a profession in an occupation rather than as a player in an organization [21]. This may be because system administrators, like other technicians, typically work in organizations that are dominated by members of another occupation [22]. Similarly, system administrators support a computing infrastructure used by many end users of different professions, such as finance, manufacturing, and government. As occupational outsiders, system administrators are often physically separated from others in their organization; anecdotal evidence and past experience shows that sysadmins are often housed “out of the way,” in corners or basements and host their own business functions and parties.

Finally, as members of an occupational rather than organizational community, technicians belong to and frequently participate with members of their technical community [19, 22]. Similarly, system administrators participate in a community that extends beyond the bounds of a single organization or a single project. System administrators utilize discussion listservs, online forums, online support groups, and IRC chat to share stories, describe problems and discuss solutions. System administrators have developed their own professional organizations (e.g., SAGE and LOPSA, described earlier), which define the profession and create foundational documents. For example, to alleviate confusion associated with ambiguous job titles – one organization’s system architect might be another’s senior administrator – SAGE has defined job levels and responsibilities that system administrators can then use in communications with fellow sysadmins [7]. Professional conferences, such as LISA and the USENIX Annual Technical Meeting, give members the opportunity to gather in person and strengthen social ties while gaining technical knowledge. For example, many sysadmins attend the LISA conference every year and make sure to attend both technical sessions and the “hallway track,” or the informal discussions that occur in the hallway.

Clearly, the role of a system administrator is complex and difficult. The mediating position of “broker” complicates the sysadmins’ roles as traditional employees and “technicians.” It requires a great deal of knowledge that is often acquired in the local context of the work, or with the help of others. What will become of system administrators as their work shifts to more automated computing environment, as tools become easier to use, and as users become more sophisticated in their understanding of technical work?

5. Discussion

In this paper, we provided evidence showing that system administrators are technical brokers. Their work includes activities traditionally classified as both reactive and proactive, and they broker information between the many end users they support and their technical community. Their work is complicated by this dual role they play because the world of users

² A system log contains a historical list of previous events and status messages for a given hardware or software component. This list can include system actions and error messages. A system dump is a more detailed and inclusive (often called “verbose”) list of system events and messages that generally must be requested by a user.

and other system administrators is not really separate, but exist simultaneously.

The dual world of system administrators is dynamic and constantly evolving because (1) their tools are becoming easier to use, smarter, and facilitating communication and collaboration, (2) the users sysadmins support are becoming more sophisticated with the use of these tools, particularly for those who work in a high tech work contexts, and (3) the reactive and proactive work activities of the sysadmin may be shifting due to changes in the work, rapid changes in the technology, and the need to monitor the training budget. We elaborate on each of these points below.

5.1 Sysadmin Tools

The importance of usability is beginning to be recognized in organizations that develop tools for system administrators [e.g., 46]. For example, the User Centered Design group at Cisco Systems recognized a lack of usability and consistency in product design and promoted usability as a key component of all offerings, resulting in maximally usable products [46]. These initiatives, and similar efforts by other companies, are improving the usability of sysadmin tools. Indeed, although many sysadmins we interviewed reported that the tools they use are far from perfect, most claimed that in general, many of their tools were getting more usable with each release.

In addition to usability enhancements, several tools used in system administration are getting smarter and assuming more work. The rising cost of system administration [6] has prompted companies to develop tools that increase the efficiency of system administrators. A clear example can be seen in autonomic computing (AC), which seeks to transform system administration from low-level system commands to high-level business policies [10]. Tools that utilize AC may fundamentally change the way a system administrator does his or her job. If automation is introduced at every level of detail, it should relieve them of basic sysadmin responsibilities [23].

Finally, tools are also changing the way sysadmins communicate and collaborate. All of the sysadmins we interviewed used instant messaging (IM) to communicate with both the end users they supported and their system administrator cohorts. One sysadmin's shop used Bugzilla to communicate and track errors in the system, a tool used for communication only within the sysadmin team.. Our interview respondents also reported that the use of wikis and specialized knowledge bases [e.g., 47] is also common among system administrators.

5.2 Technical Sophistication of the End User

In addition to changing tools among system administrators, end users are changing their tool use as well. As technology and computing become more pervasive, the users that sysadmins support are becoming much more technologically savvy. Familiarity with personal computers, social networks, web-based software, and sophisticated cell phones is introducing traditional end users to basic troubleshooting and maintenance concepts, such as the installation of operating system updates. This familiarity may relieve sysadmins of some of their end user technical support responsibilities, particularly when the end users are in high-tech or scientific fields.

Possibly contributing to the technical sophistication of end users is the availability and prevalence of technical documentation. Many of the technical documents used by system administrators,

such as vendor documentation, support forums, knowledge bases, and wikis, are posted and available online. This information, once available only to system administrators and other technical professionals, can be easily located with online search engines by anyone with Internet access. This access to technical information by end users may serve to redefine the work responsibilities of sysadmins.

5.3 Shifting Reactive and Proactive Work

Reactive work involves maintaining a computing infrastructure for the organization. This involves debugging and upgrading software, keeping the network running efficiently, supporting server and individual workstations, troubleshooting problems, and installing new hardware and software. Some of these reactive work activities may fall to others to do, creating a shift in the type of work sysadmins conduct. For example many sysadmin tasks (e.g., workstation support) are needed less frequently. In fact, some companies are outsourcing some advanced sysadmin duties, which in turn may require that some users become more proficient at, say, workstation support. In contrast, senior system administrators with complex network experience will probably continue to be in demand as networks become more complex [23].

Proactive work, such as system planning and technical training, may be shifting as well. As technologies rapidly change, it becomes imperative that system administrators stay current on state-of-the art technologies and tools that will help them perform their work better. Here, they often rely on others in the community to become informed of better techniques, as well as attend conferences. However, due to budget concerns, many sysadmins will participate in on-the-job training, often with online tutorials and demonstrations, or may post and read comments on the SAGE listserv.

6. CONCLUSION

In this paper, we investigated the work activities, skills, and contextual knowledge of system administrators. Our investigation was conducted with data based on previous experience, interviews with sysadmins, and data from other authors who also conducted in-depth research on system administrators, including survey data from SAGE members [7]. Based on the literature on technicians, this research contributes to our existing knowledge of system administrators by analyzing their work practices, and identifying their dual role with users and others in their technical community. In doing so, we found that system administrators are broker technicians.

Evidence of sysadmins as broker technicians came from a variety of sources. These include the reactive and proactive work activities that sysadmins conduct, and the dual world they inhabit as both maintaining systems infrastructure for the users they supporting and maintaining their ties with the technical community to keep up with new technical developments and share technical knowledge. We learned from the narratives of common system administrator activities – meetings, system planning, system maintenance, troubleshooting and installation – that communication with users requires translation, both to convey the work that the sysadmin has done, as well as to take back to the technical community work that needs to be done.

This dual role of the system administrator as technical broker may exist among other types of technical occupations. These include certain types of engineers, fire-fighters and emergency response

teams, computer vendors, software support teams, web designers, nurses, and other healthcare professionals, to name a few. Our aim in this paper was to focus on system administrators, and the changing role of technical brokers has implications for an increasing number of people in our technical workforce today.

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