Object Lessons: Workplace Artifacts as Representations of Occupational Jurisdiction[1]

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While the development and control of professional jurisdictions has been well studied, less is known about the way in which occupational jurisdictions are enacted within organizations. This article suggests that one can gain insight about such dynamics through analyzing occupational communities' use of organizational artifacts. This article describes the ways in which two artifacts—engineering drawings and machines—mediate the relations of engineers, technicians, and assemblers in a manufacturing firm. These artifacts are useful in problem solving across boundaries. At the same time, authority over these objects can reinforce or redistribute task area boundaries, and by symbolizing the work of occupational groups, the objects also represent and strengthen beliefs about the legitimacy of a group's work.

The interdependence of occupations is a reality of organizational life, resulting from specialization within a division of labor (Durkheim 1984). Because occupations vary in status, tasks, and goals, this interdependence may lead to discord, and it certainly results in negotiation and accommodation between occupational groups. Such occupational conflict has an extensive tradition of study, primarily among analysts of the professions (Friedson 1970; Abbott 1981; Larson 1977). Recent work on jurisdiction—the link between a profession and its work—presents a dynamic view of

the competition between professions for dominance over areas of work. Jurisdiction is contested through public, legal, and workplace claims for control over task areas (Abbott 1988). These jurisdictional claims act to shift both relations between professional groups and the boundaries of their core work domains. As Abbott (1988, p. 109) points out, "The strength of task area boundaries is a central and problematic property of systems of professions." Because the task domain is the means of continued livelihood, occupations fiercely guard their core task domains from potential incursions by competitors.

Competition for control of task areas has been well documented in the arena of legal and social institutions, but investigations of workplace occupational boundaries are rare. This is regrettable because it is through workplace interaction that many of the status dynamics between occupations are negotiated (Abbott 1988), as the workplace is where claims are enacted and made real for particular occupation members. Studies suggest that occupational interrelations at the workplace can shift task areas, revise occupational scripts, and shake up organizational structures (Barley 1986; Allen 2000; Crozier 1964). As occupational groups act to claim task areas in the legal or public realm, the consequences of such actions are enacted through workplace relations. Jurisdictional change also emerges through interactions initiated within organizations while members of occupations accomplish their daily work. We need to further investigate workplace interaction in order to fully specify and explain the process by which occupational boundaries move and are shaped.

In this article, I adopt such an approach to occupational competition by exploring the work of engineers, technicians, and assemblers at a manufacturer of semiconductor equipment. By examining their workplace interactions, I can describe how task boundaries are maintained and challenged in an organizational setting where specialization creates significant interdependence and where the hierarchy generates differentials in status and power. Considering the interactions around two artifacts—engineering drawings and machines—provides an opportunity to see how claims of occupational status and challenges for control over the work process play out within an organizational hierarchy.

INTEROCCUPATIONAL JURISDICTION IN THE LITERATURE

Most analyses of interoccupational competition approach the negotiation of task areas from a macrosociological perspective, looking at political boundaries rather than interactional ones. These studies provide a basis for our understanding of the channels for interoccupational conflict at the level of the professional field, but they fall short of explaining how such

processes take place within organizations, the setting for most occupational life. Studies in the tradition of the professional power approach to occupational conflict, for instance, locate the arena of negotiation between occupations in institutional structures (Friedson 1970). These studies have shown that professions vary in their ability to control membership and practice through means such as certification, accreditation, or legislation (Kronus 1976; Halpern 1992; Begun and Lippincott 1987).

Other examinations of occupational control derive from the professionalization approach (Etzioni 1969; Ritzer 1977) and point out that the composition of an occupation has a strong influence on its success in gaining jurisdiction. From this perspective, power results from the race, gender, or class composition of the occupation, which enables or restricts access to opportunity. Occupations composed primarily of women, for example, such as teaching and nursing, have lower status and, as a result, cannot access the educational, political, and bureaucratic systems needed to defend or expand their turf (Manley 1995; Preston 1995; Glazer 1991; Kanter 1977). Finally, research has also demonstrated that cognitive and representational strategies are influential in garnering and maintaining occupational jurisdiction. The framing of knowledge and expertise can shift public opinion in favor of a particular occupation (Power 1997), and therefore occupations compete for jurisdiction "by claims argued through abstract knowledge" (Abbott 1989, p. 278) in attempts to make their control over a domain seem valid.

These studies demonstrate important institutional and cognitive dynamics in interoccupational conflict and are the backdrop for our understanding of jurisdiction at the workplace. They suggest that access to resources, occupational composition and status, and representations of expertise can influence occupational boundaries. However, these theories of interoccupational conflict are incomplete; while macrosociological processes influence jurisdictional outcomes, the task boundary is further specified through occupational interactions at the point at which the work takes place.

Organizations are a social world in which task areas are susceptible to continual renegotiation as groups are faced with solving workplace problems when they arise. For instance, in manufacturing plants, specific engineers and technicians negotiate whether to allocate head count to develop a wire harness or to have the assembly wired point-to-point on the production line. Similarly, the decision about how much medication is administered to a patient is enacted by particular doctors and nurses in the patient's room. It is by examining such workplace interactions that we more completely specify the processes of occupational competition.

Thus far, there has been little study of the interactional process by which these struggles happen within organizations. While many research-

ers note that workplace task boundaries differ from institutional strictures on task areas (Kronus 1976; Abbott 1988; Manley 1995), they do not examine the work processes themselves to determine the consequences of the enactment of workplace task boundaries. However, a body of ethnographic literature about the professions, particularly in the medical field, suggests that the workplace is a consequential setting for jurisdictional struggles. In hospitals, workplaces with frequent cross-professional interaction, the informal practices and rhetorical strategies of professionals have been shown to blur and alter task boundaries (Mesler 1991; Chambliss 1997; Hughes 1980). Allen (2000), for instance, has demonstrated that the everyday "boundary work" of nurses is key to understanding how the division of labor in hospitals is accomplished.

One study that illustrates the unique insights provided by examinations of workplace interaction is Barley's (1986) examination of the changing interaction order of occupational groups within radiology departments. Barley found that the introduction of CT scanners into radiology departments changed the task area of radiologists and technologists; however, the roles ultimately adopted by the technologists differed in the two hospitals he studied. Macrosociological approaches to occupational boundaries might predict the radiologists would maintain their status and task area in both settings as a result of their training, occupational composition, or framing of knowledge. Instead, Barley found that the mechanism that changed task area boundaries was the manner in which the occupations enacted their expertise in daily interaction: in one hospital, it was the technologists who exercised their knowledge through specific interactional scripts; in the other hospital, it was the radiologists. More work of this type is needed to extend our understanding of how the dynamics of occupational competition are created and enacted in the workplace and how these dynamics relate to professional interaction in legal and public realms.

Investigating workplace boundaries is particularly important in light of the changing nature of the economy. Service work and white-collar work have become the mainstay of the economy; one of the largest American occupational segments is professional and technical workers (Barley 1996a). With the development of progressively complex workplace technologies, technical knowledge has become an imperative of organizations (Barley 1996b; Vallas 1999; Zetka 2001). If, as several analysts suggest, this leads to more organizing on the basis of occupation (Vallas and Beck 1996; Barley 1996a), occupational negotiations at the workplace will increasingly determine jurisdiction.

Investigating occupational jurisdiction at the workplace level requires gaining analytical purchase on the moments in organizations when such claims take place. We need to document the relations that emerge when

occupational groups intersect within an organizational structure. One such point is the creation, interpretation, and handoff of organizational artifacts. These artifacts cross occupational boundaries in the service of production, communication, and representation of every task area within an organization, and thus they are a vital element of the work process. Because occupations use physical objects not only for technical purposes, but also as a means of representing and instigating difference and conflict, an analysis of organizational artifacts provides a lever for understanding interoccupational dynamics in the workplace.

ARTIFACTS IN ORGANIZATIONAL LIFE

The display and use of objects is a key social mechanism for signaling and representation, particularly in the construction and maintenance of communities (Mauss 1976; Douglas and Isherwood 1979). Studies of commodity exchange, taste, and consumption point to the function of artifacts and people's stance toward them for signaling membership in a particular class and expressing cultural categories and ideals (Veblen 1979; Bourdieu 1984; McCracken 1988). People not only use objects as a means for presenting themselves as members of a culture, but also to invoke a particular definition of a situation (Goffman 1959). These studies suggest that artifacts can symbolize an individual's membership in a particular social milieu, such as an occupational community.

Social dynamics also inhere in material objects, as several decades of study of science laboratories, sociotechnical structures, and everyday life have demonstrated (Winner 1980; Foucault 1979; Knorr Cetina 1999). For example, Latour demonstrates the social agency of artifacts as diverse as laboratory assays, automatic door closers, and transportation systems (1988, 1996; Latour and Woolgar 1979). Artifacts embed the knowledge of their creators and can serve as boundary objects, conveying information between groups and mobilizing action (Star and Griesemer 1989; Carlile 2002; Henderson 1999). Their function, therefore, is not only technical but social.

These previous studies suggest that artifacts are an important aspect of organizational life: they symbolize social categories and influence and constrain social action. As such, they have the potential to influence social relations between occupational communities, and they offer a means to fruitfully approach jurisdictional issues at the workplace. Examining artifacts provides a window into the social dynamics of occupational groups, because as artifacts cross occupational boundaries, they highlight the social interaction coalescing around them: people cooperating to solve problems, fighting to maintain status, and struggling to gain control of the

work process. Below, I describe the ways in which two artifacts mediate the social relations of engineers, technicians, and assemblers in a manufacturing firm. I find that in this organization, engineering drawings and machines embed knowledge and therefore are useful in problem solving across boundaries. At the same time, authority over these objects can reinforce or redistribute task area boundaries, and by symbolizing the work of occupational groups, the objects also represent and strengthen beliefs about the legitimacy of the work the groups perform. In particular, while the machines are occasionally employed to challenge the dominance of engineers, the use of drawings successfully maintains and reinforces the engineers' jurisdiction.

RESEARCH DESIGN

I conducted fieldwork for one year between November 1995 and November 1996 at EquipCo (a pseudonym), a semiconductor equipment manufacturing company located in Silicon Valley. EquipCo's employees built the large and complex pieces of equipment that other firms, such as Intel, use to fabricate semiconductor wafers. EquipCo primarily produced wafer-etching machines, many of which were customized to meet the requirements of a particular wafer fabrication facility. Of the firm's 5,000 employees, approximately 1,800 were directly involved in the production process: 570 design engineers, 90 drafters, 60 manufacturing engineers, 140 engineering and manufacturing technicians, 220 assemblers, and the remainder nontechnical administrative support such as planners and schedulers. In the year of the study, EquipCo's revenues surpassed $1 billion and the firm was named one of the top 10 process equipment companies in the semiconductor industry for the seventh year running (VSLI Research 1996).

While at EquipCo, I collected participant, observational, interview, and archival data. I was a participant-observer in the manufacturing technicians' lab for five months, followed by four months as a participant building machines as a member of a final assembly team and three months as an observer of a design engineering team. During this time, I collected copies of the documents that each of the groups used to support and perform their work, including engineering drawings, bills of materials, and meeting agendas and notes. I also closely studied the prototypes and products built by the technicians and assemblers. Finally, in addition to the spontaneous, informal interviews that regularly occurred while I was observing the work, I arranged formal interviews with several informants in each occupational group. I brought two sets of assembly drawings with

bills of materials to each interview and had each informant describe how they would use the drawings, either in designing or building a machine.

As a high-technology manufacturing firm, EquipCo provided fertile ground for studying the meaning and influence of artifacts in the social structure of the production process. New prototypes were frequently developed and built to meet the demands of a quickly changing market. EquipCo was characterized by closely interacting occupational communities, as well as by identifiable workplace artifacts. The different occupational groups involved in the production process communicated via interaction around two central artifacts—the formal engineering drawings and the prototype machines—which changed hands during product "handoffs," when responsibility shifted from engineering to prototyping to manufacturing. I chose EquipCo's new product line as the venue to study these handoffs, since the production process was less routine, which maximized the opportunities to witness the social interactions occurring between occupational communities in relation to these artifacts.

RESEARCH SITE

The new product development and production process at EquipCo progressed in phases, from design through prototyping and into final manufacturing, as displayed in figure 1. In the design phase, a team of engineers designed a new product, working together and using drawings from previous designs. After designing the layout of a new machine as a group, the members of the engineering team divided up responsibility for the bills of materials and the assembly and install drawings and worked individually to complete them. Engineers' work centered on generating representations of the "machine-to-be" on paper; while the process of building the machine was critical to the organization, knowledge about building was not emphasized in the engineering area. Although the engineers met weekly for updates on each product and frequently visited one another's cubicles to discuss projects, engineers spent most of their time alone, and the engineering area was generally quiet and calm.

After the engineers created the basic structure for the drawings and sent the bills of materials to the planners to start ordering material, they would send the preliminary engineering drawings to the technicians' lab. This started the prototyping (or build verification) phase of the production process, in which the technicians verified and changed the engineering drawings. The technicians' lab was the central point in the prototyping of new products, where designs became reality and manufacturability became a consideration. The technicians started building from scratch using the preliminary engineering drawings, changing the drawings and
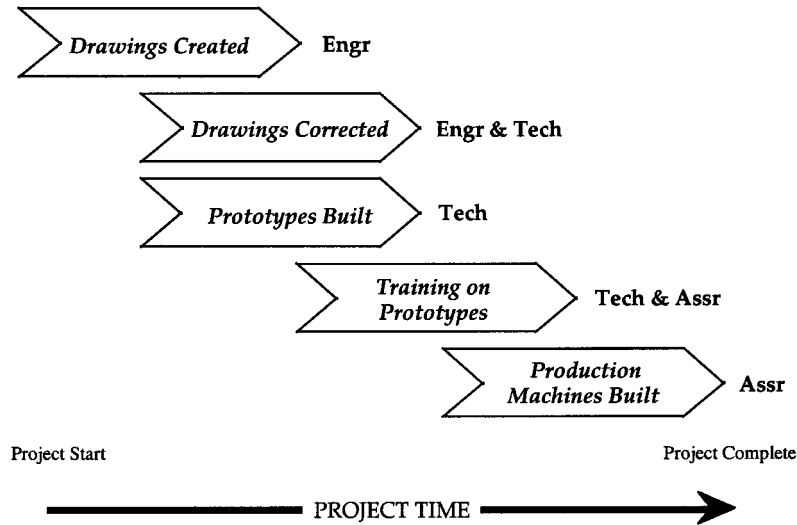
FIG. 1.—The production process at EquipCo

the machine itself as they discovered ways to make it easier to manufacture. As they completed building, they provided feedback to engineers via "redlines," corrected engineering drawings. Their work, therefore, involved both concrete physical interaction with the machine, as they accumulated extensive hands-on product experience by building, and abstract understandings of the product, because they interpreted and redlined the drawings. The 27 technicians sat at benches in an open room and built the machines on the floor space between them. The frequently changing designs and lack of space resulted in a chaotic work environment in which parts piled up in boxes and tools were strewn across benches.

After several prototypes were built, and the engineers and technicians believed that the drawings were 95% correct, the assemblers were brought into the process. Members of the new product assembly team trained in the technicians' lab, building the machine as instructed by the technicians. Often they would consult the technicians about how to build the machine properly. They had less discretion in building than technicians, assembling small discrete chunks and installing them on a frame to create the finished product. Assemblers had access to the technicians' binders of redlined drawings and sometimes to the latest engineering drawings, and they were told to use only the drawings as a guide to building the machine. However, they rarely used them, as they found it more effective to ask the technicians or other assemblers for help, or to look at a prototype that was already built for guidance. After the training period, when the assemblers felt

comfortable building a product on their own, they moved back into the final assembly clean room area to build the machines. The clean room environment in which the assemblers worked mandated that they wear a special clean room suit—known as a "bunny suit"—along with gloves, boots, and a hood, in order to reduce the dust particles that could land on the machines and cause air leaks. The air circulation system in the spacious, particle-free clean area kept the room quite cold, while its constant whooshing noise, along with the hoods worn by every member of the team, made it somewhat difficult for assemblers to hear one another.[2]

FINDINGS: JURISDICTION AND REPRESENTATIONS OF KNOWLEDGE, AUTHORITY, AND LEGITIMACY

One can frame the work on EquipCo's new product line in terms of occupational jurisdiction: the engineers' jurisdiction was that of designing the machine, and the artifact associated with this jurisdiction was the engineering drawings. The assemblers' jurisdiction was that of building, a domain associated with the machines. As the group in the middle of the process, the technicians were responsible for the task area of prototyping, which included both building from scratch and changing drawings to match the new building process. The engineering jurisdiction symbolically encompassed the entire production process—beginning with design and ending with the finished product—because the engineering drawings were seen as the means of communication for the production process and guided the building of machines. Also, engineers were responsible for how the product looked and functioned after it was shipped. The engineers' task area therefore shaped the jurisdictions of the other two occupational groups.

Engineers formed the superordinate occupational group in the production process and had higher status in the organization. This status differential manifested in various ways, from engineers' exempt employment status to their higher pay. Technicians were nonexempt employees and were paid less than engineers. Assemblers, the lowest status occupation of the three communities, were not only lower paid nonexempt employees, they were also frequently hired as contract laborers. The red badges they wore symbolized their greater peril in the event of layoffs. A promotion ladder existed informally between the assemblers and technicians, with the most skilled and talented assemblers moving up the hierarchy to become technicians. This career ladder did not extend upward to engineering. When describing their career aspirations, technicians

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[2] For additional detail about the site and methodology, see Bechky (2003).

interested in engineering positions often recounted the story of Tyler, a technician skilled at drawing who had been promoted to test engineering. However, he was the only technician in the lab's history who had ever ascended to engineering.

As table 1 summarizes, the interactions of engineers, technicians, and assemblers around the drawings and machines at EquipCo can be characterized as three analytically distinct but interrelated dynamics of jurisdictional conflict: knowledge, authority, and legitimacy. As representations of knowledge, these objects were useful for solving problems and for reflecting the status of occupational knowledge. The occupational groups enacted claims of authority around drawings and machines by asserting their physical control over these objects and the processes used to create them. Finally, the objects represented occupational legitimacy: because they transmitted reputations, objects were used by workers to claim standing as valid practitioners of a particular occupation. The social dynamics around the objects were not as tidy and distinct in practice as these analytic categories suggest but were simultaneously enacted and closely interrelated. I will begin below by examining these representations separately, and then I will address their interrelationship.

REPRESENTATIONS OF KNOWLEDGE

Since much of what assemblers, technicians, and engineers knew was inscribed into the drawings and machines, both of these artifacts were used at EquipCo as epistemic objects. Because these artifacts inscribed the knowledge of their creators and conveyed information to their users (Latour and Woolgar 1979), they were useful in coordinating and communicating information about work tasks across occupational boundaries.

Engineering drawings epitomized this idea of an epistemic object; they were perceived as showing designers how their ideas worked on paper and communicating to others, such as assemblers, all the information needed for building (see Ferguson 1992). The drawings detailed the way to build a machine, from the precise terms calling out each part to notes standardizing the manner in which the parts should be assembled. Each drawing underwent many revisions on the way to becoming a final representation of the product, and because of this, during the design and prototyping process, the drawings were viewed as open-ended projections of what the product would be.[3]

For instance, on my first day at EquipCo, I helped Theresa, a tech-

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[3] After the design was finalized, the drawings became closed and resistant to change. Because I was studying a new product line, most of the drawings had yet to reach this point.

TABLE 1
The Impact of Occupational Artifacts on Workplace Jurisdiction

	Knowledge	Authority	Legitimacy
Drawings ...	Used by engineers and technicians to represent and communicate design, and to solve problems Discourse reinforced use as knowledge objects: "Build to the print"	Used by engineers to support their authority over the design process Engineers rebuffed assemblers' input and controlled technicians' feedback Engineers claimed "improper interpretation" of drawings to deflect blame for mistakes	Transmitted and reinforced reputation of individual engineers
Machines ...	Used by technicians and assemblers to represent and communicate about product and solve problems Used by engineers and assemblers to solve problems Not recognized as an appropriate knowledge object	Both technicians and engineers felt they owned the machines Physical control over machine allowed technicians to challenge engineers' authority	Technician group reputation and survival depended on well-built, manufacturable machines

nician, build a subassembly that Tom had built the previous week in the lab. We called Tom over to Theresa's bench several times, and he told us that in one case we needed a longer screw than what was called for in the documentation. At another point, he interpreted the diagram for us and showed us that if you turned the assembly a certain way, you could see how it aligned with the diagram. "Don't worry," Tom said, "I already called the [engineer] who drew the documentation to tell him that parts of it need to be exploded, and he said he is already working on it."

The drawings served as a source of knowledge for two occupational communities at EquipCo. Engineers used them to represent their ideas about what the machine would look like and how the parts would fit together. Engineers at EquipCo rarely had a conversation about a design without pulling out a sheaf of engineering drawings. In addition, technicians used the drawings as an illustration of what the prototype should look like, so they could build it. Engineers and technicians also communicated with each other through the drawings, since the technicians provided feedback to the engineers via redlines. Technicians were the "guinea pigs" working to catch the problems in the engineering drawings. As one technician described, "What happens is you get to building it and discover that there were parts you weren't supposed to put together that you already did. So we redline it, correct the things that were wrong with the documentation and give ideas about what would help for when it is manufactured. We're the guinea pigs, it's our job to find the problems and make everything flow smoothly."

Machines were also used as representations of knowledge at EquipCo. While the machine was intended to be the final outcome of the design process, the process of building the final product at EquipCo was in fact quite iterative. The assemblers built the first few as they trained in the technicians' lab, and with each version, they accumulated a better understanding of the building process. Therefore, during the process of building, the machine provided information and generated questions that the assemblers needed answered. In practice, assemblers used the machines as epistemic devices far more often than the drawings because they did not understand the standardized language of the engineering drawings and felt mistrustful of them as a result. The assemblers built machines every day and saw the machines as being clearer and more concrete than the drawings. For instance, an assembler installing a cable compared his work with a technician's prototype machine rather than the engineering drawing, telling me, "Looking at his [machine] is not only the short way. It's easier, but it's also better because the percentage of mistakes you'll make is less. Because [the technician] is good, man, it's done right. If we do it from the print we can get confused, make mistakes." Because the assemblers were not comfortable with the language and notation of the

drawings, they preferred to use the machines as representations of knowledge.

Artifacts and Cross-Occupational Problem Solving

Artifacts were also used to mediate across occupational boundaries during episodes of problem solving. When problems arose in the building process, both drawings and machines were used as boundary objects between occupational communities to help solve them. Boundary objects are flexible epistemic artifacts that "inhabit several intersecting social worlds and satisfy the information requirements of each of them" (Star and Griesemer 1989, p. 393). In the case of EquipCo, the drawings were used as boundary objects between engineers and technicians because both of these communities had working knowledge of them and were comfortable with communicating via the drawings. For the same reason, the machines were used for problem solving between technicians and assemblers (the appendix provides examples of these uses).

However, when engineers and assemblers needed to solve a problem together, they frequently resolved such problems by using the machine, rather than the drawings, as an epistemic device. For instance, one day in final assembly, an engineer, Eric, came to the parts room in the assemblers' area with a handful of drawings to ask Abe about some scratches and chips on the inside of one of the chambers. Eric inquired, "How did the chips get there?" Abe, gesturing upward with both hands, described the problem: "When you lift the plate, a screw gets caught." Eric looked puzzled. Abe said, "I'll show you," and he went back into the lab, returning with the upper plate of the chamber cover. He showed the plate to Eric, pointing out the screw on the corner that moved and caused scratches inside the chamber.

The engineer did not understand Abe's response at first: he lacked the assembler's concrete physical understanding of the machine and knowledge about how the machine was assembled. However, neither Abe nor Eric thought of examining the drawings to help solve the problem because the drawings did not represent what happened when the plate was lifted. Instead, the assembler brought the part forward, which, as a concrete representation of assembly knowledge, provided an illustration of how the problem occurred in context.[4]

Boundary objects are most effective for problem solving when they are tangible and concrete and when they are loosely enough defined to be usable by both groups (Bechky 2003; Carlile 2002). While the assumption

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[4] For further analysis of the use of these objects for problem solving across groups, see Bechky (2003).

at EquipCo was that the engineering drawings should be the best communication medium, in practice the language of the drawings was too abstract and unfamiliar for assemblers to associate with their concrete understanding of the machine, since they lacked the contextual knowledge of drawings that comes from daily use. In contrast, the concrete nature of the machine engendered its usefulness as a boundary object for problem solving. Engineers did not understand assemblers' descriptions of the machines' problems, because they lacked the daily context of building machines and they approached the interaction with an abstract, schematic understanding of the drawings. However, when the machine (or a part) was presented to engineers, they were able to fit the concrete manifestation into their understanding of the product and get the information they needed. In essence, despite the multipurpose intention of drawings, the machine itself, as the place where the "rubber hit the road," was more effective for problem solving between these two communities.

Discourse around Artifacts and Status of Knowledge

The jurisdictional control that engineers maintained over their task area—the engineering drawings—had implications for the organization's emphasis on the value of both artifacts as representations of knowledge. As I describe in this section, the oft-repeated interpretation of these two artifacts was that only the drawings should be used to communicate knowledge. The engineering drawings were the legitimate means of communication between the occupations participating in the production process: all information needed for building was thought to pass through them.[5] In contrast, while machines were used in practice as boundary objects for the purpose of communicating knowledge, they were not perceived as a legitimate way to communicate within the organization. The perception of the legitimacy of these artifacts as epistemic objects reflects the contest for jurisdiction between the occupational communities at EquipCo. As Abbott (1988) points out, the image that an occupation presents in public discourse frequently diverges from the actual workplace jurisdiction. Similarly, at EquipCo, organizational discourse around representations of knowledge differed from the daily reality of their use.

The relative standing of the drawings and machines for communicating

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[5] Drawings have several qualities that enhance their legitimacy and status as communication devices. Both Ferguson (1992) and Latour (1986) point out that drawings allow visual information to be reliably transferred across space and time. Additionally, Latour (1986) suggests that one source of the power of drawings is their creation of a common place for other information to come together (such as tolerances, sales information, or task information), thereby joining realms of reality (mechanics, economics, and the organization of work) that otherwise are difficult to bridge.

reflected the use of these artifacts as tools to reinforce knowledge claims. Because the technical purpose of the drawings was to communicate standardized information about designing and building the product, one might reasonably expect that they would be privileged as epistemic objects. However, their value in communicating knowledge cannot account for the rhetorical zeal surrounding the use of them, exemplified by the phrase I heard almost daily during my year working at EquipCo: "Build to the print." The drawings were considered the only authority in the design process; the organization's discourse reinforced the idea that drawings were the sole legitimate means of communication at EquipCo. This rhetoric served a jurisdictional purpose, in addition to supporting the standardization of building methods. Because engineers controlled the drawings and the design process, promoting the use of the drawings supported their jurisdiction over their work and their place in the occupational hierarchy.

The discourse surrounding the drawings strengthened the jurisdiction of engineers in two ways: it invoked the superiority of the abstract knowledge of engineers, and it reinforced the legitimacy of the representation of work that the drawings provided. Engineers created engineering drawings to communicate to one another specifically what the finished product should look like and to communicate to others how it should be built. As a result, the drawings were highly formal and abstract instructions about the product. Abstraction, in the sense of elaborated "layers of increasingly formal discourse" about a narrow topic (Abbott 1988, p. 102), can secure and strengthen jurisdiction. Although the engineering drawings were the formal means of communicating how to build, they did not always solve coordination problems across occupational boundaries. As the example above demonstrated, the machines were more effective at solving some of these problems, although their technical purpose was as a finished product. However, by regularly asserting that the standardization and formalization of the drawings made them the most effective way to coordinate the tasks of production, engineers could strengthen their jurisdiction by reinforcing the superiority of their abstract knowledge.

The importance of the drawings for use in building was reiterated continually. This was not only a discourse of engineers; it also permeated the technicians' lab, where everyone understood that the goal was to create redlined drawings so that assemblers would be able to manufacture machines to the engineers' specifications. Similarly, when the technicians trained the assemblers, the rhetoric about "building to the print" also predominated. For example, every time Tony, a technician training a group of assemblers, left them to work unsupervised in the lab, he would bark out a variant of the following: "Don't be looking at my machine! I'll kill you if I catch you doing that, just look at the print!" Technicians

wanted assemblers to build the machine as the drawing indicated it should be built. At the same time, the technicians were well aware that the assemblers were more comfortable learning how to build by watching others or mimicking a finished machine. Additionally, they recognized that their own role was to improve the documentation, despite the fact that it might not be used fully. As one technician pointed out to me when I asked if his redlines would be used in the manufacturing area: "No, they aren't supposed to, what will happen is on the next build, we'll have the manufacturing people come in so we can transfer knowledge that is not in the documentation. Then, when the machine really goes to be built in manufacturing it hopefully will have full documentation. It's not supposed to go over there without full and complete documentation."

Thus, the technicians, and even the engineers, were aware that the drawings would never truly represent how to build. The drawings needed to remain abstract not only for their use as an epistemic tool, but also for reasons of boundary maintenance and task control. For drawings to be powerful as a tool to maintain occupational jurisdiction, they must be somewhat unclear to other groups, because if every aspect of the work were easily codified and understood, engineers would be unable to maintain their status as experts. Therefore, the discourse emphasizing the exclusive use of drawings as an epistemic device was helpful in diverting attention from the less acceptable implications of their abstractness—the fact that drawings were incomplete and, further, not as useful in problem solving at occupational boundaries as the machines were. By appealing to the valued goal of efficiency, engineers could draw attention to the positive aspects of the drawings, thereby reinforcing the importance of the knowledge within their own domain. Thus, the discourse supporting the use of standardized drawings that efficiently solved problems and effectively communicated the best way to build reinforced the status of engineers and helped them maintain their jurisdiction.

REPRESENTATIONS OF AUTHORITY

As the second column of table 1 summarizes, artifacts served as representations of authority in the organization, effecting control over the work process. An important jurisdictional issue in the workplace is authority over the work itself. While formally granted through organizational hierarchy, authority is enacted through the control of organizational artifacts, which help to determine who has the right to participate in particular work tasks. At EquipCo, the control of engineering drawings was the well-established domain of engineers, while there was more conflict over control of the prototype machines.

The drawings and machines were central devices in maintaining the jurisdictional control of occupational communities over their work. Because engineering drawings directed the design and production process, engineers' legitimate control over drawings allowed them to directly influence the jurisdictions of the other groups, constraining the organization of the tasks of technicians and assemblers. Their control over the design jurisdiction also gave engineers the power to determine when the other communities could participate in the design process. In contrast, the machines were jurisdictional artifacts in dispute: engineers, technicians, and assemblers challenged each other for control over the machines.

Control of Drawings and Engineers' Jurisdictional Authority

Engineering drawings were the technical means of designing the product, and therefore, they structured the design and production process. The content of the drawings circumscribed the work tasks of technicians and assemblers, whose work entailed building the machine that the drawings directed them to build. Drawings also served a jurisdictional purpose, as they were an instrument for engineers to maintain their authority over the design and manufacturing process. The engineers felt strongly that the only way they could design the machine effectively was by maintaining control over the drawings, and they had final approval over any changes to the design. Daily complaints in engineering centered on the fact that the document-control department made it very difficult for them to produce drawings properly, or as one engineer grumbled when she was told about a new directive from the production-control department, "It is going to be sketches again, crap! They've made it so we can't do our job." Engineers had developed a variety of work arounds to skirt document-control issues, from inserting placeholders on bills of materials to ordering parts through different planners outside the normal manufacturing system channels. These work arounds made it possible for them to create the drawings the way they intended, in a timely manner, allowing them to complete their work and maintain control over the design. Similarly, engineers resented it when members of subordinate occupational groups tried to encroach on their drawing domain, or as one engineer pointed out about a scheduler: "He keeps getting involved in the Engineering Change Notice (ECN) packages, and it isn't his job. It is not his right to question ECN packages! If engineering says to do them, he should just be putting them through [the computer system]." By intruding on their jurisdiction and holding up the drawing packages needed to change the design, the scheduler was making it difficult for the engineers to perform their drawing work and get the design finished.

Participation in the design and drawing process was the seat of influence

in the organization, and assemblers and technicians had different strategies for operating in the jurisdictional arena around the drawings. The assemblers were acutely aware that they had no capacity to contest control over the design, because they lacked the status to participate in the design process. For example, one morning when I was working in assembly, two assemblers were complaining about the problems they were having lifting an interface to install it on a machine. The interface required four men to lift it into place, and when the men were not there, the women could not lift it. As one assembler sketched out a drawing illustrating a fixture to lift the interface, he told me, "We know how to build it, and we told the engineers months ago but they don't listen to us because we don't have the degree, we are just final assembly."

Assemblers were made aware of their lack of influence because engineers repeatedly rebuffed their contributions, even in the infrequent instances when their involvement was requested. The following example, one of only two instances when I saw an engineer consult an assembler for design help, demonstrates how such discounting of input happened. In this meeting, while an engineer and assembler looked at both a physical part and a drawing on the table between them, the engineer solicited the assembler's help in wording a note indicating how to build that particular part. The engineer, Eric, said, "We want to put 'input of coil' . . . but you've done it, Angela, so you know what we mean. What if you hadn't done it?" Angela, the assembler, replied, "Well, what we do on the floor when we train is have them read the notes and ask us questions about how to do it when they don't understand. For the little things, they go by the training we give them on the floor, they don't really listen to the notes, you have to show them how it is done on the line." Eric responded, "So you make up for our poor notes and we appreciate it, but I'd like them to be better." They continued the discussion about the wording of the note for another 20 minutes. The engineer in this example was concerned that his drawings be perceived as clear and manufacturable, which was why he was soliciting the assembler's input. However, when Angela indicated that on the manufacturing floor the assemblers rarely use the drawings to show them how to build, the engineer discounted her statement and continued in his formalization of the drawings.

While this engineer was making an effort to include an assembler's perspective in his design process, ultimately the assemblers' actual practice was excluded from the drawings. The discounting of their perspective frustrated assemblers, some of whom opted not to try to participate as a result. As one assembler reflected about another, Abe, who was trying to present some feedback to engineering: "Abe wants to talk to them, but they never listen. He is right; he wants to do [something] for the company. But he's stupid, why does he have to pay attention so much? I say one

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word, nobody listens, and forget it, I shut up." Assemblers were discouraged when they offered input to engineers, which reinforced their belief that they had little or no influence in the organization.

Technicians, in contrast, while uncertain of their ability to successfully contest jurisdiction over the drawings, had more authority to do so than assemblers. The technicians regularly participated in the drawing process by providing redlined drawings to engineers; however, the changes they suggested had to be approved by the engineers. This left them relatively impotent as far as making their design changes a reality. The hierarchical structure of the design process protected engineers from technicians' interference; many meetings that occurred throughout the design and prototyping process were off-limits to technicians. For instance, while technicians provided feedback during "install reviews," they were often not welcome at "redesign reviews." Even when technicians were allowed to attend, the timing of such meetings could create barriers to their participation in the design process. For example, one day in December, Tony, a technician, mentioned to Ed, an engineer, that another technician had discovered a problem in building the emergency off (EMO) assembly. "The problem is, you have to put it together and then at the next step, take it apart again, add a part, and put it back together." Ed replied, "Well, if it is a real issue he can come to us with it, but maybe he should save it for phase 2, the February 15 meeting, because on my list it says the EMO is all completed." It was too late for the engineer to incorporate the suggested change into the current round of drawings without significant effort, so he deflected the technician with the phase 2 alternative. As a result, the change would not even be considered for two more months, if at all. Here, the engineer buttressed his formal authority, maintaining his control over his own tasks by excluding the technician's input while deferring to the design process. Although technicians complained about their exclusion from participation in meetings, in the time I spent at EquipCo, they never directly challenged the engineers' authority in this area.

In contrast to this more formal exclusion, many technicians would informally lobby individual engineers and get frustrated when their redlined suggestions to the drawings were not incorporated into the design, which was the source of some amusement to the engineers. For instance, while two engineers made changes to a technician's suggested redlines one afternoon, they joked about the technicians' reactions to the process: "That Theo is so funny, he drives me crazy sometimes, always saying, 'Don't change this, don't change that.'" "And Todd just glares at you: 'I dare you to go ahead and change it.'" Given this reception by engineers, it is not surprising that while the technicians legitimately participated in some aspects of the design process, they were ambivalent about the impact their

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participation might have. As one technician pointed out to me while I was building a subassembly, "Remember that you are the expert on building this once you've finished it. You can make changes [to the drawing]. Well, you can at least send the changes to the engineer, they may not always get made, but you are the one in charge of how to build."

Drawings and Defection of Blame

Engineers also used the drawings and their control over the design process to deflect blame when mistakes were made in the production process. The drawings were an easily maneuvered tool for placing blame because they were open-ended and in a state of flux, as new versions were continually being drawn. Therefore, engineers frequently referred to the improper interpretation of drawings when trying to direct responsibility elsewhere for mistakes that were made in the design and production process.

For instance, several months into his employment at EquipCo, a technician told me the story of the first project he built: "On my print the engineer called out the wrong size screw in several places, he put 1032 when it was 632. He's mad because I told my supervisor and my supervisor pointed it out in a meeting. The engineer stood up in the meeting and said that we read it wrong, that it was our fault." Because the drawing in question was not available at the meeting, and probably had gone through several revisions since the incident, the engineer was able to claim that the technician had made the mistake, not him. When other problems arose in the building of machines, or parts were delivered to EquipCo that were not built as expected, engineers often claimed that others read the drawings incorrectly or did not read them at all. As open-ended representations of knowledge, the drawings were susceptible to interpretation, and these interpretations were subject to dispute. Because the engineers were the occupational group of the highest status, their interpretation tended to prevail.

In contrast, machines were not used to deflect blame. While the machine also was absent from the meetings, machines were much easier to track down. Machines were fixed in a certain place and at a certain concrete material state. They also were perceived by the organization as a product, rather than as a tool for communicating knowledge and information. This made them more resistant to interpretation and, concomitantly, to use in blame placing. Drawings were fluid and ambiguous, had many different versions, and were more mobile (Latour 1986). Technicians were well aware that drawings could disappear, and they tried to prevent drawings from deflecting blame to them by keeping copies of all of their redlines in binders at their benches. When they did not do so, problems could arise, as they did in the case of some cable documentation that Tom, one

technician, corrected. The engineer responsible for designing the cables claimed that he never got the documentation. As Tom's manager pointed out, "We know that he got it. We have some of it, but Tom made the prime mistake of giving him some originals." Having a record of their changes and the original drawings they received provided technicians with some protection when fingers were pointed in their direction. However, because they were excluded from design meetings, technicians and assemblers were often absent when the blame was directed at them via the drawings, and therefore they did not have much recourse.

In general, technicians and assemblers did not participate very often in cross-occupational finger pointing. Because the machines were less open to interpretation, and because engineers did not touch the machines, it would be difficult for technicians and assemblers to engage in blame deflection by utilizing the machine. Technicians and assemblers, constrained from participating in the drawing and design process, did not have the status or power to deflect blame through the engineering drawings. Also, as the jurisdictional incumbents, engineers' "ability to define the problems and measures of success" (Abbott 1988, p. 139) made them relatively resistant to attack on the front of the engineering drawings. The drawings both embodied and reinforced the hierarchical standing of engineers with respect to occupational knowledge and authority.

Control of Machines and Engineers' Authority

In contrast, the technicians' physical control of the machines allowed them to challenge the authority of engineers. As "experts" who were "in charge of how to build," technicians were more comfortable exerting authority in the arena around the machines. While the machines were in their lab, the technicians had control over what work was done to build them. This direct control over the object conflicted with the jurisdictional claims of engineers, who also thought of the machines as belonging to them. One engineer in particular, Ernie, always referred to the parts of the machine that he designed as his "baby," entering the lab and exclaiming "My baby looks better with the right parts!" and "What happened to my baby?" However, because they were the ones considered experts at producing the material machine, the technicians could contest ownership.

For instance, when the engineer working on one product, Evan, went down to the lab and ordered the facilities workers to get the machine running, the technician responsible, Ted, became incensed, claiming that the relationship they had with the facilities workers, who were not EquipCo employees, was too fragile to give them orders. "Too bad," the engineer said, "Ted thinks he's in charge of the machine and he's not. I can do whatever I want on the machine, I don't have to ask Ted what

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I can do." In fact, Ted himself had already started the machine running the day before; he just did not tell Evan, saying to another technician, "I didn't want him to know we could do that." In practice, the machine was not ready to run and test until the technician approved it.

Therefore, while drawings seemed to be a successful means for engineers to uphold their authority, technicians effectively challenged engineers in the jurisdictional arena around the machines. The engineers had formal organizational authority over the machine, and their professional status also would suggest that they could regulate the management of the machine and the production process. However, technicians' practical control over the machine while it was being built provided them with the means to contest the engineers' influence over their work tasks.

Artifacts, as demonstrated above, therefore served as both the means to reinforce and contest authority over task areas. The drawings were used to reinforce engineers' authority over the task area of drawing, while control of the machines provided a way for technicians to challenge engineers and maintain authority over the building domain. Additionally, the knowledge and authority represented in artifacts were not separable, as some of the examples in this section demonstrate. For instance, by making claims about the interpretation of the drawings in order to blame others for mistakes, engineers were not only asserting their authority to make judgments about the drawings, but were also leveraging their interpretations of the knowledge embedded in the drawings. The knowledge and the authority represented in these artifacts were not distinct from one another but were drawn on simultaneously in their use at occupational boundaries.

REPRESENTATIONS OF LEGITIMACY

Finally, artifacts serve jurisdictional purposes as representations of legitimacy, as summarized in the third column of table 1. Artifacts allow for judgments of worth, providing a reference point for valuing the work in the organization. As a result, individuals and groups can leverage artifacts to lay claim to the status of an occupational member in good standing. At EquipCo, individual and group reputations were established on the basis of producing good work. The means by which individual and group status was related to the objects differed on the basis of the work practices of the groups, as well as how identifiable the origins of the object were. As Goodman (1978) explains, different types of social relations inhere in objects depending on whether their origins can be distinctly identified. He distinguishes between autographic objects, those with traceable origins that can be directly attributed to an individual, and allographic objects,

those whose origins cannot be traced. At EquipCo, drawings were autographic and machines were not.

Drawings were the means by which engineers' reputations were established. Every drawing was labeled with an engineer's name, which meant that anyone who read a drawing knew whose work it was. Engineers were proud of their drawings and careful to make sure that they reflected their best effort. One engineer explained this to me while he was checking his drawings before releasing them to manufacturing: "I don't like spending so much time checking, but if I designed it, it is going to be a certain way, and my name is on it. I check my drawings to EquipCo standards, but also to mine, and mine are higher." Engineers' performance was evaluated on the basis of drawings, and therefore engineers frequently exhibited concerns about others' impressions of their codified work.

Engineers were sensitive about their reputations among members of other groups, as well as their status within their own occupational community. Engineers felt a responsibility to the design represented by their drawings, and they had a desire to see the machine built precisely the way they intended. Therefore, their reputation among technicians and assemblers was also important for getting their job done. Because the assemblers and technicians had a measure of control over the actual build of the machine, their evaluations of the credibility of the work that the drawing represented could affect the implementation of the design. If an engineer's drawings were misinterpreted, poorly done, or wrong, the machine might not be completed as he expected. For example, as one technician pointed out: "When an engineer puts 'No Fomblin' (a type of grease) on the print, the assemblers will just laugh because it shows how little the engineer knows about how we build. The engineer who wrote it loses credibility and they'll put tons of it on [the machine]." The engineers know that pumping a chamber down to vacuum takes longer when there is too much Fomblin. Assemblers, on the other hand, know that it is difficult to get an O-ring to seal without Fomblin. Therefore, while any engineer had the formal positional authority to tell assemblers what to do via a drawing, if assemblers' knowledge of the production process differed from what was on the print, they might not see the work of a particular engineer as credible, and the engineers' expectations for building the machine might not be met.

Drawings not only represented the work and intentions of engineers, thereby creating their reputations, but they also inscribed the established reputation of the engineer into the drawing. As a design engineer reported, "It is important to do these [drawings] right, you know, engineering doesn't stop at the computer, it goes through to the build, it's a matter of pride. So I tell people that they better not piss [the technicians] off, because you need to get along with them, your reputation precedes you. Because if

they don't like you, they'll see your name on the drawing, and won't give it the same care you would." Therefore, not only was an engineer's reputation at risk on the basis of the quality of his drawings, but if he was having problems with his reputation, the autographic nature of the drawings ensured that his reputation paved the way for his design.

Because the machines were not labeled by name at EquipCo, they conferred the status and reputation of those who created them in a different manner than drawings and had a different effect as representations of legitimacy. Individual contributions were less evident, so reputation created and communicated via the machines was primarily at a group level. Among technicians, not only was the quality of production important, but consistency across a set of builds of the same machine also mattered. Every machine of a certain product line going to the same customer had to be built well, look aesthetically pleasing, and be identical to the others. Technicians went to great lengths to ensure that the machines all looked the same, which occasionally could even mean not building a particular machine completely to specifications. For example, when one technician, Tess, was sending out three machines to the testing lab, she noticed that a small part was missing on the last machine to leave the lab. She asked the assemblers who were building the machines, "Why are we missing a clamp for the harness? Did we miss it on the others?" One assembler remembered putting the clamp on the other two machines, and Tess pressed him for reassurance. "You're sure? Because if we did it on those, we'll put it on there, but if we forgot it, we'll forget it on this one too. We want them to be the same." Shipping a consistent product to their customers was vital to maintaining the technicians' reputation. While consistency of drawings was important to engineers, they could evade responsibility for problems in the drawings, as described in the authority section. However, it was not possible for technicians to evade the consequences of perceptions of inconsistent or poor-quality machines.

Because the technician group eked out its existence by garnering projects from different engineering groups, issues of reputation were particularly salient to technicians and important for maintaining the legitimacy of their jurisdiction over prototyping. If the work of the group was not consistently good, the engineering groups would not send the department new projects. Therefore, good-quality machine production was not only a technical imperative, but also a jurisdictional one. As a result, supervisors in the group regularly exhorted the technicians to think about pleasing their customers and to be concerned about the quality of their work. As one manager reminded the group in a meeting: "Although we are under the gun, always rushing, we need to think of our customers who are paying us to do this—the manufacturing units. When building more than one machine, always make sure the techs are using the same

documentation so they all go out looking the same. It's not a quality issue, it's customer perception; we want them to be consistent."

Similarly, Terry, another manager, was appalled when he discovered that some circuit boards were not soldered properly and several integrated circuits fell out of the board while the technicians were showing their work to an engineering manager. He decided to develop a soldering training class and run every technician through it, because, as he explained in another meeting, "We need to maintain our reputation, we don't want to be a group that engineers avoid working with. One 'Oh shit' can outweigh a hundred 'Atta boys!'" As these examples illustrate, the technicians depended upon the reputation established by their careful, consistent production of prototypes to generate more work for the group, thereby demonstrating that the prototyping work was of value to the organization.

Thus, artifacts served as a means for the occupational groups to enact both individual and group legitimacy. Drawings and machines reflected the value of the groups' work, and perceptions of these objects influenced the behavior of other groups accordingly. These representations of legitimacy also were not separable from the representations of authority and knowledge analyzed earlier. For example, good-quality prototyping not only ensured that the organization found the technicians' work valuable and legitimate, but if it caused engineering groups to continue to allocate the prototyping work to the technicians' lab, good prototyping also served to reinforce the technicians' authority over that jurisdiction. Similarly, by creating understandable drawings, an engineer could shore up his authority by asserting his legitimacy—if his drawing was perceived as legitimate, his "baby" emerged looking as he expected. If, however, his drawing included information that assemblers regarded as invalid, as in the Fomblin example, the engineer might find that the knowledge represented in his drawing undermined his legitimacy. Because knowledge, legitimacy, and authority were interrelated, in the process of negotiating task areas, occupation members evoked them together, which could both fortify and dilute the strength of their jurisdictional claims.

"WORKMANSHIP": ENACTMENT OF KNOWLEDGE, AUTHORITY, AND LEGITIMACY

The use of the term "workmanship" at EquipCo provides an illustrative example of how jurisdictional issues around artifacts simultaneously played out through dynamics of knowledge, authority, and legitimacy. Workmanship generally referred to aspects of the practice of building, but it had contrasting meanings depending on the occupational groups'

perspectives. When engineers used the term *workmanship*, they intended it to mean the "tricks of the trade" or "tribal knowledge" of building that was not called out on the blueprint. For example, when a technician questioned an engineer about why the notes for assembling the fiber optics in the chamber were absent from the drawing, he replied, "Most of that is just workmanship, it doesn't need to be on the print." Workmanship was the extra knowledge that did not need to be explained in the drawing, either because assemblers and technicians were expected to know how to build to a certain standard or because the building process was seen to be elementary enough that it did not need directions.

Among technicians and assemblers, on the other hand, the workmanship exemplified in the machines represented their effort and skill in building well. In the technicians' lab, managers frequently reminded technicians to be careful about their workmanship, and both technicians and assemblers felt that a completed machine embodied their skill and technique. In one meeting of the technicians, for instance, the supervisor of the lab suggested that as a result of some feedback from the testing lab, he had three ideas for improvement: "Workmanship, workmanship, workmanship."

These differences in the treatment of workmanship reveal embedded representations of knowledge, authority, and legitimacy. First, the knowledge that was inscribed in the engineering drawings did not include representations of workmanship. Since workmanship was defined by engineers as "what everyone knows about building," it was not included as part of the design or instructions for building. Similarly, many technicians and assemblers felt that their skill was not something that was incorporated into the drawings, but was transmitted through their practice. The treatment of workmanship also reflected the authority of the engineers: the engineer who created the drawing had the authority to decide what was included. Therefore, engineers decided what building practices qualified as "workmanship" and thus were not included on the print. Finally, workmanship was an activity that embedded representations of legitimacy as well. For the technicians and assemblers, good work that produced high-quality machines required workmanship. In essence, workmanship was the effort that enhanced the legitimacy of the work each group performed. At the same time, because this work was not included on the drawing, its legitimacy was devalued.

By excluding the workmanship of technicians and assemblers from the drawings, engineers effectively excluded their work practice from the legitimate representation of work in the organization. As Bourdieu (1994, p. 239) notes, certain groups have "monopoly of the legitimate—i.e. explicit and public—imposition of the legitimate vision of the social world," and this "official naming" garners them symbolic power. At EquipCo, engi-

neers created the design and the structure of the production process within which everyone else had to work. The engineers not only had the authority to officially designate what work was legitimate within the organization, but they also encouraged discourse supporting their claims of abstract knowledge. This helped them to strengthen their jurisdiction over their work and to ensure their continuing high status in the organization.

CONCLUSIONS

Artifacts are an important part of organizational life: they surround us, and our work and roles are dependent upon them. As an integral part of work processes, objects help us to accomplish tasks, but not in a merely technical manner. Artifacts, subject to interpretation, participate in the constitution of the social dynamics of organizations. In this article, artifacts were shown to mediate the relationships between three occupational communities, symbolizing their knowledge, inciting their rhetoric, and defining task boundaries between them.

In particular, the study of EquipCo demonstrates how one set of artifacts—engineering drawings and machines—was used to both construct and reflect occupational jurisdictions in the workplace. As epistemic representations, they embodied the work and knowledge of the occupational communities and were used for problem solving. As representations of authority, they provided the means for occupations to circumscribe and defend their task areas. As representations of legitimacy, artifacts signified value and were used to make judgments on occupational skill and worth. These properties were closely linked and mutually reinforcing.

These objects were used to reinforce occupational status and the organizational structure. For instance, assemblers' low occupational status was emphasized through the enactment of occupational conflict at the workplace. When engineers rebuffed assemblers' input, this served to support the assemblers' belief that they "don't have the degree" and therefore cannot participate. Similarly, engineers' formal authority was enacted through workplace interaction with technicians and assemblers. The consistent repetition of "build to the print" emphasized the superiority of the engineers' abstract knowledge and supported their authority to control the design and building process. In this way, engineers used objects to support an important attribute of their professional power: the ability to pass blame on to lower-status groups.

At the same time, workplace interaction granted leeway for movement at task area boundaries. While an engineer's education means he is the person in the hierarchy who knows how to draw, and thus formally controls the drawings, this knowledge was enacted every day at the work-

place. On some occasions, training was not enough to gain control over the task area; for instance, the engineer also had to keep his reputation intact and ward off input from others in order to have complete control over the drawing process. This study suggests that by challenging one another in the workplace, occupations can shift the lines that demarcate control over tasks.

The analysis of EquipCo demonstrates that interoccupational conflicts in the workplace are an important means for maintaining and justifying occupational jurisdiction, and it suggests that we should pay closer attention to the interactional dynamics of occupations. While much of the literature about the professions hints that the workplace is important, it is rarely considered a significant force in the competition for jurisdiction. The hints offered by such studies, however, support my contention that examining workplace enactment provides a fuller picture of the process of occupational conflict. For instance, Halpern's (1992) study of four jurisdictional disputes among medical specialties demonstrates that political, institutional, and cognitive factors all played a role in the settlement of these jurisdictions. I would suggest that in addition to these factors, the enactment of occupational competition at the workplace was a means for settling such disputes.

Halpern points out that anesthesiology did not attain the level of jurisdictional control that other specialties were able to attain. While she focuses her analysis on the intraprofessional factors constraining anesthesiologists, her data also imply that workplace processes and interaction played a part in the struggle over who could anesthetize patients. For instance, anesthesiologists fell prey to "politics" in the surgical suite (1992, p. 1013): surgeons were unwilling to cede authority to other physicians in the operating room and preferred interacting with nurse anesthesiologists, who would acquiesce to their orders. While Halpern's intention was not to demonstrate the importance of workplace processes, her data that workplace interaction influenced anesthesiologists' ability to circumscribe their task area are consistent with my argument that examining the workplace provides us with a fuller picture of how occupational conflict is enacted in practice.[6]

Investigating the workplace interactions of professions yields greater explanatory power, illustrating how authority and legitimacy are enacted in organizations. Because this study is an ethnographic analysis of the occupational relations within one firm, it cannot directly address juris-

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[6] As an anonymous reviewer pointed out, my analysis also confirms Halpern's study, in that the external hierarchy of occupations in this case is reinforced by workplace dynamics. Because of the large status imbalance of the occupations at EquipCo, the engineers' status is reinforced despite interactional challenges from technicians.

dictional conflict at the level of the professional field. However, analyzing the occupational conflict at EquipCo further refines our understanding of the processes by which jurisdiction is claimed and maintained in the workplace. The results of this study suggest processes that are different from what a macrosociological analysis focusing on political processes, institutional structures, or representational strategies might predict. For instance, theories of professional power or occupational composition that rely on access to institutional resources as a lever for jurisdictional control might suggest that the engineers at EquipCo retained control over the design and production process via their education or occupational status. In contrast, my findings at EquipCo demonstrate that this picture is too simple—jurisdictional control is complicated by the daily interactions necessitated by organizational life.

While engineers were able to maintain control over the engineering drawings, they sometimes lost control over the design once the process moved into the arena of the machines. For instance, the technicians who physically controlled the machine in their lab also had authority over what happened to the machine in the production process. The engineers' higher status and education did not result in their full control over the process. Similarly, the engineers' design could be derailed via the reputational effects of the drawings. As the Fomblin example suggests, assemblers might change the way the machine was built on the basis of their reading of a drawing. While the engineer's abstracting of design principles into the drawing led him to add the note about Fomblin, the assemblers' knowledge of building attested to the efficacy of the grease. In this instance, the engineers' cognitive strategy of codifying their expert knowledge decreased their control, rather than solidifying it.

These examples suggest that another mechanism for challenging and maintaining occupational jurisdiction might be physical control over artifacts. We know that organizational objects are important for symbolizing status, identity, and elements of culture (Pratt and Rafaeli 1997; Elsbach 2000; Trice and Beyer 1993). However, this study demonstrates that such objects are also used in social situations as a means for some groups to maintain control and power. At EquipCo, engineers used drawings as both technical objects and jurisdictional ones; technicians and assemblers did the same with machines. The use of artifacts described in this article is specific to EquipCo. Of course, social relations will coalesce around objects in different ways depending on the setting. However, while the occupational dynamics reported in this study would not be reproduced identically in other settings, the findings illustrate that artifacts can be useful jurisdictional tools.

Further, analyzing jurisdiction at the workplace level allows for the interplay of occupational and organizational status. While jurisdictional

battles within systems of professions often occur at a legal or public level as professionals compete for a client base, most occupations encounter one another most frequently at the workplace itself. These groups interact on a daily basis within organizations, and the interdependence of their work makes occupational outcomes less predictable. Powerful occupational groups can accrue advantages due to status and superior resources, but they still have to contend with control issues at the level of the task boundary.

The study of EquipCo demonstrated that the occupational group with the most hierarchical power and human capital, the engineers, was most effective in preserving its jurisdiction at the workplace. Power and position were influential factors in the definition of which artifacts and interpretations were significant. They also colored the perception of which groups had the ability to draw boundaries around their expertise and challenge the expertise of others. This power was partially a consequence of engineers' historical and institutional dominance; however, their location in the organizational hierarchy allowed them to leverage their status to support their claims in the workplace. Technicians' and assemblers' hierarchical position provided them with less power; at the same time, workplace interaction, primarily around the control of machines, allowed them to challenge the jurisdiction of engineers. It is only by looking closely at such workplace enactments that we can chart these relational dynamics, specifying the processes of occupational competition in greater detail.

APPENDIX

Examples of Cross-Occupational Problem Solving

Drawings as Boundary Objects

The engineer, Evan, and Tim, the technician, were discussing the cable routing for an AC/DC box, while looking at a drawing of it on the engineer's computer. Tim asked, "Would it be better to have a little harness on the power supply? How long is the supply? That would be great for modularity." Evan replied, "There's the issue of reliability . . ." "We've done it that way before," Tim interjected, "although I think space is an issue." "Space wise I think you might be okay, if you go out in Z direction," Evan indicated. "This box is almost 11″ deep and there's nothing here." Excited, Tim responded, "Could you give me a copy of that top view?" "Sure," said Evan, "and this is the interconnect diagram, you can get kind of the flow."

Machines as Boundary Objects

Abe, an assembler, was building a power box. He lifted the box off the floor and pushed it into the enclosure, but it would not fit in all the way and stuck out about a quarter of an inch. Abe said, "It's stuck on something," and pulled it out to check inside. The pins seemed okay, and there was not anything obstructing the way. He tried again, but it still did not go all the way in. Pulling it out a little, he tried to see underneath. Another assembler, Andy, walked over to help, saying, "It's like that, you have to jam it in." Andy pushed it really hard, but it still stuck out of the enclosure.

Ted, the technician training them, approached and asked, "Are you sure all the back is right, you checked?" Abe said yes, so Ted pulled it out, jiggled it and pushed it in hard, and it finally went in. He and Sam looked closely at the holes for the screws, which did not quite line up. Pointing at the enclosure, Ted said, "This is sagging from all the weight, take the cover off and reach in with a wrench." Abe removed the plastic cover and Ted used the wrench to push the enclosure upward. The holes still did not align, so Ted suggested, "You might have to slot these holes a little bit too. These are 632s, the design is messed up, the vendor messed up and it doesn't quite fit."

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