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Assembling Jobs: A Model of How Tasks Are Bundled Into and Across Jobs

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How are tasks bundled into and across jobs within organizations? In this paper, I develop a model of this process of job design by drawing on a multisite qualitative study of task allocation following the installation of a DNA sequencer. The model that emerges is one of the assembly of tasks through multiple subassembly processes with multiple assemblers. Four activities produced requirements and requests for job designs and propositions about how to meet these: actively searching, passively receiving, doing work, and invoking preexisting ideas. The ideas that emerge from these processes are further transformed through reconciliation, interpretation, and performance. My observations show that this overall process is far reaching and incorporates many elements, not all of which are explicitly intended for job designs. The arrangements that emerge from this process are not the product of a deliberate and controlled job design process within the boundaries of a single organization.

Key words: job design; organization of work; task assembly; job crafting; inhabited institutions; qualitative methods; process theory
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Introduction

Jobs are fundamental organizational building blocks. They are the bundles of tasks performed by employees under administrative job titles. Jobs structure organizational action in a constant, ubiquitous manner, and they shape important outcomes for organizations and their members. The forms of jobs contained in an organization may determine the very form of that organization (Barley 1990). Jobs function as routines—coordinated and repeated organizational activities—and, as such, may enhance organizational- and population-level learning, coordination, and innovation, as well as the ability to adapt (Staw 1990; Miner 1990, 1991; Miner and Haunschild 1995; Feldman 2000; Okhuysen and Bechky 2009). Jobs connect individuals to organizations and thus influence consequential individual-level outcomes, including satisfaction, commitment, meaning, motivation, productivity, and social relations. Despite the importance of jobs, we know relatively little about *how* these building blocks are themselves constructed. How is it that tasks are allocated into and across jobs?

The dominant image associated with job design is that of a manager who places well-understood tasks into stable jobs. This perspective on the question of task allocation is firmly rooted in Adam Smith's classic description (1776/1937) of the most effective organization of pin making—the detailed division of labor into the most minute tasks. Two centuries later, Frederick Winslow Taylor (1931/1967) picked up on this notion of the efficient design of jobs. He wrote extensively about how tasks should be efficiently organized into jobs and aligned with incentives to make workers work harder. His work presumed that there was a best job design and that once managers understood this, they would act to design jobs accordingly. Research in this tradition has evolved to acknowledge a more complex set of managerial objectives. Managers may organize tasks into jobs not only to achieve simplification and efficiency but also to achieve control of workers, job enrichment, and transactional efficiency (e.g., Guillén 1994, Braverman 1974, Hackman and Oldham 1975, Williamson 1975). Regardless of the specific goal, the implied process in this managerialist theory is that managers devise goals for the jobs under their control and act to design those jobs to meet those goals.

One problem with such perspectives is that they were intended as prescriptive theories of what managers should do and not as tools to examine how job design actually occurs. Yet, by their silence on the process, these perspectives imply that managers are able to shape jobs to fit their desires. What managers should do, no matter how well considered, may be less important than what managers actually do. Practice and theory may diverge. The recommendations that come from these perspectives are not necessarily wrong, and managers do at times engage in what might be termed job design. Yet there is much evidence that they often fail to achieve what they set out to accomplish and that the outcomes of job design efforts can vary unexpectedly.

There is ample evidence of variation in task allocation, even in very similar circumstances of technology, settings, product markets, and organizational stages. In two hospitals, CT technicians, who used the same technology to perform essentially the same work, structured that work differently (Barley 1986). The tasks of running recycling programs were performed by full-time recycling managers in some universities and by part-time student staffers in others (Lounsbury 2001). In similarly situated start-up organizations, very different divisions of labor arose and developed over time (e.g., Burton and Beckman 2007, Baron et al. 1999). These and other cases each offer a different local explanation of observed differences. Collectively, these explanations create an image of a job design process that is both constrained and informed by forces and actors beyond managerial control. Thus, broadening the perspective on job design to include these other considerations seems crucial, yet doing so is problematic. Such broadening of perspective suggests that the very notion that jobs are designed may be fundamentally wrong. The term "design" implies a well-ordered and deliberate process of invention controlled by a designer. The evidence, however, suggests that managers are not these designers and that there may not be, in fact, any lone designer of jobs. Perhaps we need to revisit the concept of job design itself to develop something new.

Barley (1986), Thomas (1994), and other scholars have suggested that we might want to embrace such deviations as those seen in hospitals, start-ups, and universities as replicated findings and attempt to understand what produces the differences. I suggest that one way to do that and to develop our understanding of how tasks are allocated into jobs is to look more directly and deeply at the job design process to understand *how* such disparate outcomes are produced. One way to start in this effort is to examine how ideas for the allocation of tasks are developed in organizations: Where do ideas about which tasks belong in which jobs come from? Although ideas about the allocation of tasks may not be the final job designs, they are a backbone of the process. Much of the evidence discussed above in some way rests on the assumption that job design emerges following the production of ideas about how work might be arranged, whether those ideas are in the form of managers' goals or incumbents' preferences and experiences or technology.

To answer the question discussed above, I examined the development and use of ideas for work arrangements following the installation of a new DNA sequencer across nine organizations that varied in institutional environment, age, and other characteristics. Across these sites, I held constant the change in technological artifact and examined the development of the work surrounding it. What I found was that job designs emerged from multiple activities pursued by multiple actors in something that more closely resembled an assembly process than a design process. Four activities produced ideas about job design in the form of requirements that jobs should fulfill, requests that they might fulfill, and propositions about how those requirements and requests might be met. People deliberately sought ideas, they passively received ideas from broadcast mechanisms, they generated ideas in actually doing the work, and they invoked existing but dormant ideas from within the organization. Because the requirements, requests, and propositions were often in conflict or poorly suited for the specific situation, few of them could be job designs without first being reconciled, interpreted, and performed.

This model empirically elucidates a process that until now has largely been taken for granted and, in doing so, contributes to the literature on work. It represents a paradigmatic shift in the imagery used to describe this process. Jobs are not designed. Instead, they are assembled. The important activity of organizing work is not the result of a deliberate, direct, or controlled process such as the design image would suggest. The requirements, requests, and propositions that eventually influenced task allocation often arrived in response to issues that were not directly related to job design. The activities and the actors in this process extended broadly across organizational and institutional boundaries in directions that are not obvious. By describing the assembly process, this paper builds a strong foundation for future research into the organizing and organization of work.

Jobs as Products of Constraint and Interaction

In the centuries since Adam Smith described the best way to allocate the tasks of pin making, scholars have developed rich notions of how jobs should be designed, but much of that work still conceptualized jobs as the product of deliberate, goal-directed managerial action. The task characteristics model developed by Hackman and Oldham (1975) has come to dominate much of the academic work on the topic. Their model suggests that employees will be motivated by jobs that offer more autonomy, feedback, variety, skill, and task identity, moderated by an individual's growth need strength. This model has been widely critiqued on theoretical and methodological grounds and for largely ignoring context (e.g., see Rousseau 1978, Aldag et al. 1981, Roberts and Glick 1981, and Griffin 1991 for related critiques). Yet, over three decades later, no cohesive perspective has emerged to replace this model, and scholars are still building on it to explain how managers should design jobs (see Morgeson and Humphrey 2006 for a recent example).

Research in several traditions hints at ways that such images of managerial job design are at odds with what actually occurs and that to better understand how job design happens, research needs to be more sensitive to the role of actors other than the manager, more aware of the interplay among these various parties, and more contextual. Although not explicitly focused on questions of job design, this research provides insights into factors that might shape the process. Constraints on managerial action originate at one end from the broad environment of the organization in which the work is performed and at the other end from the people who perform the work.

One line of research has shown that job design may be shaped by forces beyond the boundaries of the organization. Building on Bendix's (1974) work, Guillén (1994) examines the extent to which the features and techniques of scientific management, human relations, and structural analysis were adopted in the United States, Spain, Germany, and the United Kingdom. He finds that the patterns of job design and other broader managerial practices varied greatly across countries over time with differences in existing institutions. At a more micro level, Lounsbury (2001) finds that whether recycling work in universities was performed by a full-time recycling manager or part-time staff was shaped by an outside social movement, as well as various organizational and institutional characteristics, including the school's selectiveness and student environmental groups lobbying for an authorized recycling program. Additional evidence shows that the level of division of labor relates to customs, politics, and social relations, as well as to technical and administrative imperatives (Baron and Bielby 1986, Strang and Baron 1990, Baron and Pfeffer 1994, Baron et al. 1999). Taken together, this work provides a strong argument that the organizational environment matters in job design. However, much of this institutional research focuses on organizations and structures at the expense of the people who inhabit them (Hallett and Ventresca 2006). It reveals little about how the parties inside and outside organizations relate to the institutional environment in creating job designs.

Further evidence suggests that there is an active role for job incumbents in the design process. One such body of work focuses on job incumbents as active artisans of their work (Bell and Staw 1988, Wrzesniewski and Dutton 2001, Berg et al. 2010). This work largely focuses on the individual characteristics that might lead incumbents to mold jobs to better fit personal preferences and meanings. Like the managerialist literature, the research on sculpting and crafting suggests that job designs emerge from goal-directed behavior, but in this case, it is the goals and actions of the job incumbents, not the managers, that warrant attention. Although acknowledged, the broader organizational and institutional contexts are not central to this work.

Research on idiosyncratic jobs—jobs shaped around opportunistic hires or developed around the interests and skills of incumbents and organizational needs—places incumbents in a central job design role and also attends to the broader organizational context (Miner 1987, 1990, 1991; Rousseau 2005). Idiosyncrasies may result from intentional efforts by job incumbents to gain power or improve job fit, from managerial actions to improve the fit of the job to those doing it, or through evolution and serendipity (Miner 1987, 1990, 1991; Miner and Estler 1985). These actions and idiosyncratic jobs are more likely to occur when there is more ambiguity in an organization's mission and uncertainty in the environment (Miner 1987). Although such work on idiosyncratic jobs provides tremendous insights into the relative importance of job incumbents within an organizational context in the design process, it does little to show *how* designs develop.

To answer questions about how the process might actually unfold, I turn to work with an interactionist perspective (e.g., Barley 1986, 1990; Pentland 1992; Bechky 2003a, b). Although it is not focused on the question of job design per se, this interactionist research provides deeper insight into how the job design process might unfold. The implied job design process in much of this literature is that the actions of various parties somewhat incidentally determine how tasks are bundled into jobs. For example, in his study of workers in two software support hotlines, Pentland (1992) provides an account of how the structure of jobs unfolded through interactions of individuals, existing structures, and technology. Calls, especially unusual ones, to the software hotlines result in a series of different actions, including referral and transfer. Through repetition, these actions eventually become part of the formal structure. Pentland argues that his findings show that specialization and the division of labor come from such interactions and not from deliberate organizational design. Others have provided additional compelling examples of employees working out the division of labor. For instance, assemblers, technicians, and engineers negotiate over the division and execution of tasks, and they do so through the use of boundary objects—drawings and machines—in the performance of the work (Bechky 2003a). Service technicians for photocopy machines meet daily to discuss problems that they encounter, and in creating solutions, they often define their jobs (Orr 1996).

The literature on persistence and change in routines provides related insights into the job design process. The change in routines that is examined within this body of work inevitably involves the performance of tasks that make up jobs. Feldman and Pentland provide evidence that routines change, and much of this change occurs when people perform routines differently, even within the constraints of existing routines (e.g., Feldman 2000, Feldman and Pentland 2003, Pentland and Feldman 2005). For instance, when new processes were created around hiring, training, budgeting, and student housing, those in various roles altered their routines and in doing so developed new tasks (Feldman 2000). Individuals altered or maintained their performance of the set of tasks related to the routine of "roadmapping," depending on their orientations and intentions (Howard-Grenville 2005). This routines literature maintains that there is a recursive relationship between the idea of the routine (the ostensive routine) and the routine as performed in the organization (the performative routine) and that the two may at times diverge (Feldman and Pentland 2003).

Another set of studies explores the microprocesses surrounding the organization of tasks into jobs in the face of technological change (e.g., Barley 1986, 1990; Thomas 1994). When technological artifacts change, so too does the organization of work, though not through a simple one-way, top-down process. For instance, Barley (1986, 1990) examines how the introduction of CT scanners alters structure by altering role relations and how it initially creates two different structural outcomes in two hospitals. Thomas (1994) examines decisions to bring a new technology into such settings as airplane, semiconductor, and auto manufacturing. His work adds explicit consideration of how the dynamics of power and thus the interests of various parties shape interactions and on how organizational conditions and history influence the choice and use of technology. Technology is not exogenous, but rather it is the product of ongoing social choices starting with strategy formation, continuing on to the decision to adopt a new technology, and ending with implementation. Many parties participate across these stages, and through their participation, they exert and gain power. Thus, the interests of those choosing and using the technology, from top-, middle-, and lower-level management to workers, ultimately shape how technology is used, including how tasks are allocated to jobs.

Across such interactionist work, an image emerges of jobs that are less often designed than worked out, whether through negotiations, the application of expertise, conversations, the use of power, or the handling of unusual calls. This, combined with evidence that the ostensive and performative aspects of routines can diverge, suggests that focusing too much on the formal design of the job may not be the best way to understand what people do in their jobs. The work on technology in particular suggests that technology provides an important occasion for the structuring of the work of organizations but in unanticipated ways.

Although all provide substantial insights into job design processes, some challenges across the interactionist studies also exist. They tend to focus on the processes that create outcomes other than jobs themselves. For instance, in the research on the flexibility of routines, the focus, by design, is on routines; the tasks these routines embody may be only a portion of any given job and may cross multiple jobs. Similarly, much of the other work in this interactionist stream examines the development of roles and expertise and the assignment of specific tasks without attending to the unit of the job. Even Barley's work is relatively limited in its explanations of how tasks come together. His scope, by design, is much broader than the amalgamation of tasks into jobs. He examines a technological change that disrupts rules, roles, and interactions between existing and persevering organizational divisions and happens to create very different task structures for different technicians. Furthermore, this work is also fairly limited in the evidence it provides on the effects of organizations and their environments in the process. Even those that look across multiple organizations examine organizations that are very similar in form and function, e.g., two hospitals (Barley 1986) or two software helplines (Pentland 1992).

A related complication specific to using the research related to technology to explain job design processes is that, by design, these studies focus somewhat narrowly on the tasks directly related to the technology itself and not on the other tasks surrounding the technology. One technology rarely defines a job, and as the studies have so skillfully demonstrated, there are choices in how these tasks might be combined with other tasks.

Taken together, these varying perspectives suggest that it makes sense to shift the analytical focus of job design research from the managers alone to a broader set of actors including, but not limited to, the job incumbents, and these actors should be examined as they work in a much broader local and environmental context than previously. Thus, I adopted a methodology that allowed me to directly observe the role of these factors in the job design process.

Research Methodology

Many of the choices made in my research design followed directly from past research on the job formation process. The studies described previously suggest that the process of developing concepts for job design needs to be examined in context and in action so that interactions can be observed. Following this lead, I conducted a qualitative case study of the job design process that unfolded around the installation of a new piece of equipment. Case studies are conducive to studying processes, building theories, and identifying major issues (Edmondson and McManus 2007, Eisenhardt and Graebner 2007), all of which were goals of this research.

The new equipment that I studied is a high-end, high-throughput, automated DNA sequencer made by Biosupply Automated (a pseudonym). The automated sequencer relies on much the same technology that has been used since the mid-1970s for manual sequencing. Automation has increased the speed and safety of sequencing, but it is far from reaching the extreme where a user can put blood in one end of a black box and receive results from the other. Rather, humans must perform complex functions to complete sequencing. The first generation of automated sequencers was developed and used primarily for the human genome project, but as the technology developed and the price of equipment fell, use expanded to individual molecular biology labs, to core or service facilities in industry and academia, and to forensic labs and diagnostic services.

The installation of this equipment provides an appropriate setting for this study for several reasons. First, because installation requires a large investment (over $100,000), it is likely to cause alterations in work arrangements in existing labs or to shape work arrangements in new labs. Second, this equipment is used in a variety of different settings, allowing observation in different contexts. Third, the specific tasks performed for sequencer operation are held constant, though the additional tasks and arrangements surrounding it are not.

Below, I discuss my data sources, some details of how the sequencer operates, and how I analyzed the data. I then move to a discussion of my observations.

Data Sources

I conducted interviews and/or made observations at nine sites where a DNA sequencer was either in use or being purchased. Table 1 presents descriptions of all the sites. I selected the sites opportunistically to represent a variety of different organizations and environments. In one sense, all the labs shared a common institutional environment. All were involved in the work of science and, more specifically, in the work of sequencing. However, there were also differences in the institutional environments across sites. Four sites were academic labs, four were in biotechnology firms, and one was a genome facility. Two sites were new, and three had been using the predecessor model and were expanding their services. The remaining labs had been doing manual or no sequencing.

Across sites, I interviewed between one and nine informants, in some cases up to eight times. The primary subjects in each of the sites were the technicians who ran the sequencers on a day-to-day basis and their supervisors or managers. Although they had a variety of different formal titles, the people who ran the machines were commonly referred to as technicians. Most were female and had a bachelor's degree in a scientific discipline. A few had four-year medical technician training.

Interviews were semistructured and confidential. Initial questions focused on what tasks were performed in the lab and by whom, and how that division of labor occurred. Follow-up visits and interviews were organized around the same issues but were tailored to each site. Observations were often opportunistic; that is, I observed what was happening when I was in the labs for interviews. I also reviewed archival data such as grant applications and descriptions of sequencing services. The amount of data collected across sites differed for at least three reasons: (1) sites differed in the number of informants available for interviews and number of visits allowed, (2) informants varied in how much information they provided in interviews, and (3) the job design process differed in complexity across sites. I continued visiting labs as long as I thought I was gaining new insights. I believe that even in cases with a very limited number of interviews, I gained an understanding of the processes that led to the allocation of tasks into jobs.

For simplicity of presentation, two sites serve as the main data sources for my initial section of findings. These were the two for which I had the richest data. One was the first site I visited, an academic lab. I conducted repeated formal interviews with the principal investigator (PI) and technician in this lab, and I conducted observations of and informal interviews with them and other individuals on 16 different occasions. I also attended multiple training sessions conducted at the lab. The second site was a diagnostics lab in a biotechnology company. Here, I conducted interviews with seven individuals at the lab, observed operations, and interacted informally with employees. I interviewed an additional individual and made observations at a research and development (R&D) lab at the same company. I focus on these two sites in the description of my findings on the processes through which ideas were brought into labs. The observations of the general patterns for these two sites were not substantially different from those for other sites. Even in sites where I was limited to one or two interviews, I learned of elements of this same process. I include some of the examples from these labs in tables throughout this paper. I draw on all of the sites when discussing what was done to further develop these ideas, especially when trying to understand the effect of different organizational and institutional conditions.

In addition, I interviewed three Biosupply Automated employees involved in sequencer sales and service: the product manager, a sales representative, and an applications specialist, as well as 16 members of the sequencer design team. I observed a service engineer installing a sequencer and an applications specialist training users at two sites. These interviews and observations helped me to understand the functioning of the sequencer and the choices that were made around it.

Operating the Sequencer

The machine itself is an unimposing beige metal box about the size of a minibar refrigerator. The packing list includes the machine itself, a gel cassette, a comb and spacers, a set of optical glass plates, a manual, a computer, and software. The buyer also contracts for various services: a setup session with a technician, applications training, phone support, seminars, meetings, and newsletters.

The steps involved in running the sequencer resemble those of pastry making: preparing a shell, assembling the parts, and baking the pastry. First, the sequencer user must make and pour a gel onto a large glass plate, the shell that will hold samples of DNA. The gel is carefully poured between two glass plates and left to set

Table 1 Description of Sites

Site	Singer Academic Lab	Diagnostics Lab	A1 (Shared academic lab)	A2 (Academic museum lab)	A3 (Academic service facility)	B1 (Biotech/research lab)	B2 (Small biotech lab)	B3 (Large biotech lab)	G1 (Genome facility)
Institutional environment	Academic science	Biotechnology	Academic science	Academic science	Academic science	Biotechnology	Biotechnology	Biotechnology	Human genome
Description	Sequencer belongs to one PI who is willing to let others use it	Multiple sequencers used for diagnostics work	Sequencer shared by multiple labs	Sequencer shared by multiple labs	Unit provides sequencing and prep services for campus labs	Machine used for research projects and for a service lab	Sequencer shared between unit and research project	Service unit for large biotechnology firm	Multiple sequencers used for project
Previous conditions	New lab; first sequencer.	New unit; first sequencers.	Existing lab; replacement sequencer.	Existing lab; first sequencer.	Existing lab; first sequencer.	Existing lab; additional sequencer	Existing lab; first sequencer (did manual).	Existing lab; additional sequencer.	Existing lab; replacement sequencers.
Subjects of interviews (number of interviews)	PI (5), senior research assistant (7), two PIs in related labs (1), technician in related lab (1)	Sequencing head (1); robotics head (1); sequencer, night supervisor & trainer (1); sequencer (1); gel pourer (1); shift supervisor (1); robot operator (1)	PI (1), graduate student (1)	PI (1), lab manager (1), technician (1)	Technician (2), supervisor (8)	Senior researcher (1), supervisor (1), technician (2)	Operator (1)	Director (1), research specialist (1)	Director (2), project manager (1), two senior research associates (1), staff bio-chemist (1), R&D head (1), 2 staff physicists (1)
Additional data sources	Sixteen site visits over 10 months, conversations with graduate students, observations of training, interviews with Biosupply Automated technicians and a sales rep	One site visit, including lunch; emails from the director; interviews with the head of R&D group in company	One site visit	Observation of training	Eight site visits over an eight-month period	Three site visits	One site visit	One site visit	Three site visits

for about two hours. Second, the sequencer user loads the gel onto the sequencer and places samples of DNA in lanes across the top of the gel. Finally, the operator starts the sequencer. Between 2 and 10 hours later, the run ends, and data analysis can begin.

There is significant work that does not require direct contact with the sequencer. Users must prepare the samples for sequencing and perform analysis of the data. They must also maintain the sequencer. They must replenish stock solutions, arrange service calls, and clear files from the computer. The machine also requires the performance of tasks to optimize use and for administration. Users may need to purchase water purification systems and additional computer data storage, prepare schedules, create budgets, bill customers, market services, write protocols, train users, and troubleshoot. In addition, some users monitor sequencing developments by reading journals and attending trade shows and conferences. Thus, the sequencer produces a series of tasks necessary to use and maintain it—the physical, administrative, and intellectual upkeep of the sequencer. Many of the tasks associated with the sequencer are largely, though not completely, determined by the sequencer's wares. Other tasks, however, can be performed in different ways.

These tasks were arranged differently across sites at the level of individual tasks and at the level of the whole job. For instance, in-lab follow-up training on the sequencer was provided by people with different job titles. In one lab, a technician provided training and assistance to users from a number of different labs. In several others, there was virtually no training. In one lab with multiple technicians, the most senior technicians would train newcomers. One technician there created and maintained training materials, including tests to assess proficiency, which were required to meet regulatory standards for their lab. There were also significant differences across sites in what other nonsequencing tasks might be included in technicians' jobs. In some labs, work was limited to sequencing work and, in some cases, to only some aspects of sequencing work. In other labs, technicians performed tasks unrelated to sequencing. These differences in the arrangements of individual tasks added up to much larger differences in jobs across sites.

Data Analysis

Analysis of my data was ongoing and iterative between the field, my field and interview notes, the literature, and my discussions with others (Eisenhardt 1989, Strauss and Corbin 1990). I used several tools to help me understand the underlying process that occurred in and across sites. I began by using a narrative strategy (Langley 1999). For each site, I wrote a summary with information about the jobs that emerged, hiring, decisions about bringing a sequencer in, and other events that related to the bundling and unbundling of tasks into jobs. These summaries were meant to record everything I knew about what happened at each site.

I then compared research sites along 28 specific dimensions. Many of these dimensions were drawn from existing literature on job and organizational design. For instance, structuralist research on mobility and attainment suggests that several organizational factors—such as demography, size, and environment (Baron 1984)—shape employment outcomes. Consistent with this research, I considered differences in size in terms of the number of incumbents and the number of sequencers, as well as the environment (biotechnology lab versus academic lab versus genome facility). Other categories emerged as I analyzed the data and included such factors as how the sequencer was financed and who championed its purchase.

From these materials and my original field notes, I created a chronology for each site, detailing the events that related to job design. Examination of the chronologies revealed that although many of the specifics varied across sites, jobs in the organizations emerged through an iterative process in which managers, job incumbents, and others participated in several nonsequential activities across all sites.

I then created a database listing all events at each site and used my initial insights about the activities that people engaged in to provide initial categories for coding the data. Ultimately, I focused on the set of activities related to the development of ideas about how tasks would be bundled. Ideas included anything that was suggestive of ways that tasks might be combined. The data from the nine sites produced a sample of 400 activities related to the development of ideas about work arrangements. The activities included any event directly observed or described by informants that produced ideas that would have any bearing on task arrangements. Table 2 shows a sample of these events. I further examined each event

Table 2 Sample Events from the Database

The person who is later hired as a technician in this lab moves from her job to take another one in a biotech company.
The technician picks up extra work doing tissue culture because DNA is slow and tissue culture is not.
The person who later runs the sequencing group works at a biotech company as a research associate.
The PI of another lab suggests that the PI of this lab hire the technician he was employing when his grant runs out.
The technician revises the lab binder and creates a new protocol sheet.
The supervisor creates a flyer for the sequencing services.
Technician from Biosupply Automated does training.
Lab technician trains the PI on how to do automated sequencing.
PI reopens his search for a technician.
Experiment with gel loaders loading gels on six machines at once.

using axial coding (Strauss and Corbin 1990) to understand what these ideas were, what led to them, and what was done with them. Through this process, I learned three things. First, the ideas took three forms: technical and other requirements for job designs, requests for qualities that job designs might have, and propositions about how to either meet requirements or satisfy requests. Second, many of the activities that produced ideas were linked to problems encountered and environmental demands. Third, often the production of ideas alone did not produce job designs and required transformation in the form of reconciliation and interpretation before becoming part of a job design.

Bringing Ideas Together

Across the nine sites, I observed the convergence of multiple ideas related to job design at multiple junctures. New ideas arrived in four ways: through seeking ideas, through passive reception of ideas, through doing the work, and through invoking existing ideas. These ideas took three different forms—requirements, requests, and propositions. Below, I describe each of the activities that brought in ideas. In the description of these activities, I focus on observations from two labs: Singer Academic Lab and Diagnostics Lab. The main actors were PI Herman Singer and technician Tammy Jones at Singer Academic Lab and the director of Diagnostics Lab, Fred Bauer. (Table 3 provides additional descriptions of these sites and their managers.) Although the circumstances and job design outcomes in these sites differed from those in other sites, the basic processes I observed shared many characteristics with the seven other sites. Together, the two cases provide a comprehensive description of how ideas came together across sites and examples of the three types of ideas. After presenting the activities that brought in ideas for job design, I examine what happened to these ideas in order for them to become part of job designs, using examples from across the sites.

Seeking Ideas

Ideas on aspects of the design of technicians' jobs were brought in from outside of both focal labs. For instance, in her first days at the lab, Tammy went with Herman to visit several other labs with sequencers. Tammy described doing this: "We spent a few days touring labs, asking what's the best equipment, why did you buy this.... I really wanted to see how they were set up and what was good." She talked to the PI of the lab where she had worked previously and learned how he set up the pre- and post-PCR (polymerase chain reaction) rooms. Tammy and Herman also initiated conversations with sales and service representatives from the sequencer's manufacturer to learn how to set up work around the sequencer. Through these visits and conversations, they learned about the organization of tasks, the equipment used, the lab design, and the systems that were created to coordinate sharing of the sequencer.

Once the first staff technicians were hired at Diagnostics Lab, the second focal lab, the director brought in technicians from an R&D lab within the company to train them. They were brought in for both their specific technical knowledge (how to pour gels, how to load samples) and their knowledge of broader work arrangements (who should do what and when). Similarly, individuals from many of these nine labs spoke with, visited, and brought in people from other labs to learn about their work arrangements. In part, these efforts were targeted toward learning about work arrangements, but they were sometimes also targeted toward learning about things other than work arrangements.

It was not always the case that information searches were targeted even in part toward job design. Ideas about job design arrived from the outside as a result of searches that were not directly related to job design. Such learning occurred at several points during Herman's process of recruiting and hiring Tammy. His first step was to create a job announcement. He admittedly had some preconceived notions about what he wanted and what should go in the announcement, but he deliberately gathered more information. He talked with other PIs. He consulted job announcements posted in a university publication. He talked to someone in the personnel office "to find out what to do." He incorporated parts of this information into his announcement and into his interview plan. For instance, he limited his requirements in the posting to concrete skills and experience such as computer experience and avoided including non-job-relevant characteristics such as preferring a woman.

His next step was to review the résumés that his announcement generated and interview the subset of candidates that seemed to fit his requirements. In their résumés and interviews, these candidates provided information relevant to the design of the job, mostly through the skills they did and did not possess. For instance, one candidate had managed 18 people but had not worked at the bench for five years. Several others were strong but had no sequencing experience. What he learned in this hiring process forced him to further consider what was important to him for this job. He refined his concept of the job design to emphasize the qualities that he found lacking in applicants.

When this process failed to turn up any one who he thought was right for the job, he complained to colleagues about his hiring difficulties. One of these colleagues, Mark Mitchell, told him about a technician who had been working in his lab and who seemed to have what Herman considered the right credentials. She had helped Mark get his lab up and running, but her contract was nearing its end. Herman spoke with her

Table 3 Job Description for Focal Sites

Singer Academic Lab	*The job*: The main user of the sequencer was a technician whose work extended beyond that associated directly or indirectly with the sequencer. The principal investigator of the lab had hired a technician, Tammy, to run the sequencer and take responsibility for such tasks as scheduling other sequencer users, training, ordering sequencing supplies, maintaining stock solutions, and arranging service calls. She, however, would not be the only one to do sequencing work. Graduate students and technicians from other labs would prepare their own samples for sequencing and learn to complete runs themselves. In addition, Tammy's job included such tasks as the maintenance of other lab equipment, the ordering of general lab supplies, and the continuation of a research project. The work she did changed from day to day and from week to week. She could not predict what days she would do sequencer runs or how many runs she would do in a given week, nor could she predict what other work would fill her days. One day, she did battle over the delivery of an exhaust hood that would not fit through the lab doors. Another day, she prepared and labeled dozens of live moths to be frozen for one of her PI's research projects. She spent over an hour recapturing escaped moths from the lab's venetian blinds. On still other days, she restocked lab supplies, attended training for a gel imager, prepared runs on the sequencer, answered questions about sequencing, and gathered and analyzed data for an independent research project. *The manager*: Herman Singer used cutting-edge molecular biology techniques and technologies to study butterflies, moths, trees, and their natural environments. Hired to a tenure-track position at a prestigious research university to launch a systemics lab, Herman was described by a graduate student as "the quintessential academic scientist: an idealist and nerd." He enjoyed discussing the nuts and bolts as much as the philosophy of science, and he believed that scientists irrevocably influence the systems they study. He saw his role as training a generation of research scientists who would broaden scientific knowledge, but the experiments conducted in his lab would be more than a means to advance scientific knowledge—they also advanced people.
Diagnostics Lab	*The job*: The work arrangements in many ways replicated an assembly line. The unit performed diagnostic work using a bank of automated DNA sequencers to detect the presence of genes that indicate a risk for cancer. Jobs at this site were extremely specialized and routine. Every day was typical. Sequencing work was divided across five groups of dedicated specialists, each of whom repeated a routine set of tasks each day. Workers in the first category, gel pouring, were responsible for mixing and pouring the gels onto optical glass plates and wrapping them for later use. On a typical day, a gel pourer began by taking down the gel apparatus from the previous night's run, breaking it down, washing the glass plates, and pouring gels for the next sequencer run. This cycle was repeated for a second and a third run each day. Gel loaders were responsible for putting the gels onto the sequencers, loading DNA samples onto the gels, running the machine, and checking lane tracking. On a typical day, a gel loader loaded samples three times a day. The first round began at 8 A.M., when the technician would wash gels, put combs in the gels, prepare the sequencer, load the samples, pour buffer into the buffer chambers, and then run the sequencer. While the sequencers ran, the technician would track the previous night's gel run and take a morning break. The gel loader would repeat this process twice more. The only differences were in the length of the runs. Technicians in other specializations performed similarly repetitive routines. The robot operators were responsible for processing and loading blood samples onto robots that readied them for sequencing. Quality controllers mixed stock solutions and reagents for use in the sequencing process. Data analysts examined data files. There were only rare deviations in the employees' daily routines—events such as training, experimentation, or the resolution of problems. For example, when a gel loader got a poor gel image, she would ask another gel loader to help her determine the cause. Such deviations, however, were viewed as severe problems because they could alter a day's schedule for two gel loaders, meaning that the third run of the day might not be completed in time for the second shift. There were minor within-group distinctions based on experience or location. For instance, among robot operators, there were those who worked in the cold room with blood and those who processed postblood materials, but everyone in that group did the same work. *The manager*: The company's CEO and board wanted to automate as much of the diagnostic work as possible. With this in mind, they had hired Fred Bauer to direct the lab. Fred had experience in an agricultural biology lab, where work was done on a scale similar to the one envisioned for the diagnostic operations. Ultimately, it would be difficult to separate ideas about jobs from Fred's more general ideas. One of his employees remarked that jobs invariably reflect the personality of the person in charge and provided several examples of how jobs involving the sequencer reflected Fred. He explained that Fred allowed his preschool son to pack his lunch every day. He would faithfully make do with whatever the brown bag contained, even when it was just a large raw potato. This reflected his philosophy in running the lab. Fred spoke of efficiency and of the importance of running things tightly. Yet he also understood that the work took place in a larger system and that the people performing the work were not robots.

and described her as "sharp, enthusiastic, and willing to do brainless things." This led to further refinement. Herman posted an updated job announcement, and he interviewed and hired her. Through the entire process, his ideas about the job evolved, in large part based on the information and ideas he gathered. When he hired Tammy, he brought in someone who he believed fit his conception of the job. He also brought in an additional set of ideas about work arrangements—many of which he did not anticipate.

Throughout these activities Herman was deliberately learning, though his learning was never targeted to be about job design as such. In the process of searching for a technician, he altered his conception of what a technician should do. At other labs, hiring followed a similar pattern. A hiring manager would start with an idea about the job design, consult various sources, refine those ideas, and eventually hire someone who fit them. Hiring was not job design but evoked learning that contributed to the design of jobs.

In both of these focal labs, the process of purchasing the sequencer also involved deliberate information search that produced information about task arrangements and so was intertwined with job design. Information began to arrive as those in charge researched their sequencing options. At Diagnostics Lab, the purchase process began after Fred was hired to direct the lab. The sequencer purchase was one of his first decisions and shaped many subsequent decisions, including those about staffing, skill requirements, and other equipment. He wanted a sequencer that would facilitate an assembly-line–like setup that looked like that used by his previous employer. He surveyed the options available for sequencing and eventually picked this model. Although it was not a perfect fit for the envisioned scale of the operation, he determined that it was the best available. Through this process, he further refined his idea of what was possible for his operation.

Similarly, Herman at Singer Academic Lab surveyed the options for doing sequencing and considered how they fit with his goals for the lab: "I am trying to set up the lab to . . . minimize the sense of factory." Consistent with this, he wanted automated, not manual, sequencing: "[Automated sequencing] has lower hands-on costs, less nitpicky stuff." He decided against doing his sequencing at a core facility because it would not provide training opportunities: "In an academic environment, a core facility doesn't make sense. . . . We are in the business of producing people, not just research." He wanted an automated sequencer, in part, because he thought it was a toy that would attract people to his lab: "Toys mean status, territory, credibility. Things we mock but discount at our own peril . . . . They can attract people interested in ideas not just making a living, the best people." He looked at the automated sequencers available and selected this sequencer for multiple reasons: "for the economy of it, . . . for the future growth potential, [and] for the flexibility it allowed." Furthermore, the design allowed for it to be shared across labs, which he said fit with his lab's overall "philosophy."

In neither case was this sequencer the only one available. The managers selected it from among other options, in part, because it fit with ideas that they had about work. They did so after gathering information about other sequencers and considering how those might facilitate different work arrangements. The decision that Herman and Fred made to purchase this model of sequencer brought in many ideas. In purchasing this sequencer, neither was purchasing a prepackaged job. Rather, they were purchasing a set of tasks that would need to be performed and a broader set of ideas that were relevant for, but not determinant of, overall organizational arrangements. Gels had to be poured, samples prepared, and data analyzed, but there was no one clear way to organize this. The information transmitted by Biosupply Automated was only a set of ideas for consideration—the sequencer itself was an equivoque that needed to be interpreted on the basis of specific circumstances. Nor did the influence of the sequencer on the organization of work end with the importation of tasks.

The purchase of the Biosupply Automated sequencer started a flow of information that was not directly embodied in the machine. After installing the sequencer, Biosupply Automated sent a stream of individuals to provide guidance on its use. Sales representatives, service engineers, and applications specialists were sent; each introduced additional ideas about work arrangements. The service engineer came first and did a sequencer run with a set of users in a circle around her. She answered questions about scratches in the sequencer's glass plates, why the cassette needs to be cleaned, problems with lights, leaks in a buffer chamber, and, more generally, how to use this machine. In her answers, the engineer provided information about what she has seen elsewhere and made frequent references to the user's manual, which describes how to run this equipment. Tammy said, "Most of the procedures are in the manual, but it tells you what to do, not why. I want to know why I'm doing each step." In the course of the session, the engineer recommended getting a gooseneck lamp and water filtration system, to always do what she calls a "prerun" with the machine and to move an object that was in the way of loading. The engineer explained, "Loading is tricky. You just have to work it out. Just don't drink coffee before you do this. You'll shake too much." Each of these recommendations carried ideas about how to do work that would later have job design implications.

Two months later, an applications specialist held the first of multiple training sessions where he transferred additional knowledge on how the sequencer could be used for Tammy, Herman, the lab's graduate students, and technicians from other labs who would use this sequencer. At one session, for example, he described how other users set up reactions and cut recipes for reagents. On the basis of this information, the technicians who attended the sessions adjusted their processes and the work that they would do. Additionally, the specialist explained how many of the protocols described in the sequencer manuals that the service person had referred them to were really only suggestions for how to do things and thus made the users aware that they had choices. Like the service engineer, he made frequent recommendations about running the sequencer. He often acknowledged that these were not the only solutions, using phrases such as "I do" rather than "you should." His training session was peppered with phrases such as "90 to 95% use die terminators," "[name of another lab] does a similar thing," "many people do not like the gel pouring system, and there are other ways to do this," "a lot of people at Biosupply don't even use [the clamp]," and "some people use a vacuum." He later explained that he often transferred information about operations between facilities, as well as from Biosupply Automated. He had been conducting training sessions in academic and industrial service units, individual academic labs, large-scale genome facilities, forensics labs, and hospitals for over four years. At all his on-site visits, he learned how equipment was used, and he incorporated this information into subsequent responses to user questions in other labs, recommendations to users, recitations of what he had seen, and feedback to designers at Biosupply Automated. With each of their visits, the Biosupply Automated technicians supplied new and sometimes contradictory information about how the sequencer was used in other locations, and as a result of this learning, Tammy and Herman adjusted their work arrangements. For Tammy, by following all of the recommendations and the sharing of information by these Biosupply Automated technicians, a new set of tasks came about that she eventually performed. She purchased a water filtration system. She ordered a flow hood. She arranged a demonstration for a gel imaging system and negotiated prices. She rearranged lab equipment.

At a minimum, all labs in this study learned about work arrangements as a result of deliberate search in at least two ways: by hiring and by purchasing this sequencer. I observed additional ideas coming in as a result of search in several labs. Some further examples are provided in Table 4.

Receiving Ideas

At both focal labs, ideas about how to arrange tasks were received without anyone in the lab initiating search. At Diagnostics Lab, several outside regulators provided ideas about work arrangements. One of these was a New York State insurance regulator. The lab was doing sequencing work for medical purposes and would rely on insurance remittance for payment. To qualify for these payments, the lab was forced to comply with the rules of the state where the patient was insured. To comply with the broadest range of regulations possible, the lab focused on the rules of the most stringent state, New York, which mandated levels of skills, experience, and education required for performing work with given levels of complexity. Thus, regulations in force in New York State provided information about how much training a worker needed to do work in the western state where the lab was located. Many other similar regulations had implications for jobs at the lab—what tasks would be grouped together, what skills would be required, what credentials were sought. A supervisor, who was nominally in charge of both personnel and compliance, kept a thick binder explaining the many such regulations.

At Singer Academic Lab, too, ideas about work arrangements arrived in the form of rules, mostly from university bureaucrats. The university human resources department had numerous and strong bureaucratic rules that provided information about work arrangements, such as how to proceed with recruitment and hiring and what title should be given to a job. These rules linked a job's level to the pay and the precise type of work being done. There were also guidelines about what information should be included in a job posting and description. In each of these cases, the rules influenced what skills were sought, who was hired, and, ultimately, who was given certain responsibilities.

Across the labs I studied, I observed numerous additional examples of learning through idea transmission. Some of these examples are described in Table 5. Whereas ideas were received seemingly without the intent of those connected to the jobs, various parties did make choices that led the jobs to be located in particular institutional environments. For example, ideas came into Diagnostics Lab because it chose to be funded through insurance remittance. For the genome facility, ideas came in because it participated in a larger genome project. In other cases, the choices that led to the reception of ideas were less obvious. Ideas came into university labs because the labs were part of a larger organization with bureaucratic rules.

Development by Doing

Not all ideas about job design came from outside the focal organization. Ideas about how to assemble tasks in jobs were developed when job incumbents performed new or different tasks. This occurred often at Singer Academic Lab. One example involves the work of getting the sequencer to produce. Tammy explained that when her first sequencer run was neither smooth nor predictable, she took several actions to help resolve these problems. She called the technical representative for help while she did troubleshooting, she experimented with gel pouring and installation, she made the representative come to the lab, and she spent the next six weeks doing what she called "fiddling" with the sequencer until she finally produced something she considered an acceptable run. After those six weeks, Tammy was seen as the primary sequencer user, which entailed a larger set of tasks. Other users expected her to train them and to do troubleshooting when they came to her with their sequencing problems. She described the situation: "It changed my life because I became the main user. I did the first gel run. No one had wanted to use it until someone else had optimized it." A similar pattern emerged across a set of related tasks. When the sequencer trainers and technicians first visited, Tammy got involved in scheduling sessions and acquiring parking permits, and this pattern was repeated. Further down the line, she realized that the lab needed a written protocol for new users. She had helped revise a similar document in the lab where she worked previously and so took it upon herself to

Table 4 Evidence of "Seeking Ideas"

	A1	A2	A3	B1	B2	B3	G1	Example data
Evidence from interviews, field observations, and archival material	✓	✓	✓	✓	✓	✓	✓	Before the sequencer was purchased, two senior technicians from the lab made calls to other academic sequencing facilities to understand how they organized their work. One technician visited a facility at another local university. She described the experience as follows: "I went to watch them do sequencing at [City U], at the core facility there, to see how people set up the same machine. We use the same order forms, pretty much the same setup. We learn by seeing. This is how I like to learn. A lot of science is done this way. I also went to see a friend do manual sequencing." (A3) At the genome facility, the head of the group spearheaded efforts to utilize ideas from industry. As a result, employees from a large industrial manufacturing company came in to model the entire sequencing process. The model they created incorporated ideas from industry, including ideas about how work should be done. It later served as a basis for improvements in the process at the facility. The industrial model further informed work done internally. The facility had a large internal R&D group that developed equipment, software, and processes for sequencing. (G1) Complaints from customers about slow turnaround time for sequencing work led to a search for new ideas for the work. Under the preexisting system, technicians could not release their sequencing output to the customer until their part of the analysis was done, quality checks had been performed, and they were confident about the accuracy of their results. The official turnaround time for a sample was two weeks. This waiting time could halt progress on important research projects. After hearing these complaints, one of the technicians gathered information from labs in other organizations about how they managed the process. He learned that some of them released data earlier in the process and shifted the responsibility for accuracy to the client. Based on this information, the two technicians in his lab developed and implemented an alternative system that could provide results as fast as overnight. With this shift, some tasks that were the jobs of the technicians were transferred to the customers. (B3) This lab is involved in several collaborations with academic labs and with Biosupply Automated itself. These collaborations are targeted toward optimizing the sequencing process, but along the way, participants learn about how work is done elsewhere. (B1)

revise it for Singer Academic Lab. Later, she noticed that people were ignoring, or confused about, various procedures; she called and led a lab meeting to discuss these issues. She created a lab binder to track sequencing costs. She also created a want list (square plastic buffer bottles, large crescent wrench, phone/phone line, wipes, sponges, Saran wrap, 2.0-liter graduated cylinder, hand soap, general cleaner) that she would take care of. She commented, "I can stand here and see things to do."

Tammy developed other ideas about task distribution when she performed tasks in direct response to demands and requests from others in the lab. Herman created a series of tasks for her. This began when he purchased the sequencer. The purchase came with an expectation that she would do runs on the equipment and perform many other sequencer-related tasks. For example, she would create a schedule for the sequencer, train other sequencer users, order sequencing supplies, maintain stock sequencing solutions, and arrange service calls. She was also involved in various one-time projects that produced the DNA that would eventually be sequenced. As part of a training grant, Herman collected moths for eight days in the desert, and he asked Tammy to put them in vials so they could be studied and eventually provide the DNA to be sequenced. On her second day at this task, several moths escaped into the venetian blinds in the lab, and she spent the afternoon trying to capture them.

Herman generated additional tasks that were less directly related to the mechanics of running the sequencer and which Tammy would then perform. For instance, he planned to hold a PCR seminar and asked her to arrange for a room. He would often walk through the lab and create lists of tasks for her. She described Herman making such requests: "Herman will wander in and say, 'We should do this.'" In response to such requests, Tammy researched refrigerators and data storage devices, stocked lab supplies, worked on an independent research project, organized demonstrations of equipment, negotiated prices, and arranged equipment deliveries.

Herman also generated tasks for Tammy that she did not perform. For instance, he wanted her to spend more time on her own projects, but instead, she focused on what she called "building knowledge" of the sequencer among users. This was not an isolated incidence of her putting tasks outside of her job by not performing them. Herman complained about numerous incidents where he

Table 5 Evidence of "Receiving Ideas"

	A1	A2	A3	B1	B2	B3	G1	Example data
Evidence from interviews, field observations, and archival material	✓	✓	✓				✓	In the academic museum lab, the principal investigator consulted a representative of the human resources department to create an advertisement for his job opening that would comply with regulations. (A2) A supervisor in the facility where the sequencer was eventually to be housed was asked to hire a technician to run the sequencer. The supervisor had been at the university for nearly 20 years. She believed that she understood the rules for hiring and grading jobs well. She decided that she wanted to hire a technician at a certain grade level. She then selected responsibilities and tasks that matched the grade level. (A3) The genome facility faced a range of requirements. It was connected to a university system with bureaucratic requirements. It was also dependent on outside sources for funding and so, in some aspects of work, was forced to comply with expectations about how things should be done in a genome facility. For instance, findings had to be reported in very specific ways so that they could be shared among various participants in the genome project. (G1)

had to perform tasks that he had asked her to do. He was the one who took calls when there was a problem with the gel imaging system, and people were coming to him with questions about operations that he believed she should answer. He explained, "She thinks that if she doesn't finish things, I will. There is no loss to her in letting things go undone. She doesn't just go ahead and do things."

Development of ideas by doing and not doing was less common in Diagnostics Lab, but it did occur. For instance, soon after the lab was set up, the first two technicians hired conducted training for new hires. In the process, one of them realized that this practice should be standardized and went on to develop the necessary materials. In doing this, she was developing an idea about her own job as well as the jobs of others through the materials. In addition, the technicians at this lab performed unusual tasks and did troubleshooting on the relatively rare occasions when problems arose.

This process of development by doing led fairly directly to a new allocation of tasks. People performed the work, and their performance became the new idea of the job or task allocation. By performing tasks, individuals created, expanded, or contracted ideas about what work should be done and by whom. They also reinforced ideas about how things should be done. When Tammy created the protocol or chased moths in the blinds, she in essence marked those tasks as her territory. When she did not perform tasks, she made those tasks part of other jobs. The actions taken by an individual became a guide for how other similar things would be done in the future.

The remaining sites provided numerous examples of ideas being developed through the performance of work. Some of these examples are described in Table 6.

Invoking Existing Ideas

New ideas were developed against a backdrop of the ideas that already existed, albeit sometimes dormantly, in the labs. Even when a lab was new, there were ideas about work arrangements already in place. For instance, at Singer Academic Lab, Herman carried many ideas with him, largely based on his own experiences. He had supervised automated sequencing work for three years as a postdoctoral employee, supervised construction work, and ran a business employing six technicians. On that basis, he developed a general idea of what he wanted and did not want in his lab, which was invoked when he initiated the hiring process for a technician. He explained, "The arrangement that I reject is what they did at the other lab, where one technician [runs] things.... That is labor intensive and boring, ... requires coordination ... and power games come into play." He constructed an alternative vision of a lab where the technician would train others and coordinate sequencing activity and where the technician and graduate students worked independently, developing their own projects using his ideas and equipment. He joked, "I expect the technician to run the lab and do my work." More specifically, he wanted a technician who had whole organism experience, who could take the edge off of what he called a "locker room atmosphere," who had "the maximum amount of education." Later, when he had become disgruntled with Tammy's performance, he commented, "I know things can be run the way I want because I ran them that way."

Once Tammy was hired, she too brought her own set of ideas about the job based on her experience working in labs as an undergraduate lab assistant and as a technician in another lab. When she discussed how she would organize Singer Academic Lab, she made frequent references to how things were done at her previous job: "At Mitchell lab, we had a sign-up sheet, and that worked as long as people understood the ground rules," "Everyone was responsible for their own gel runs," "We didn't use the clamps at Mitchell," "Things were different because it [Mitchell] was an existing lab." And she brought her own expectations and preferences. For instance, as she attempted to capture live moths,

Table 6 Evidence of "Development by Doing"

	A1	A2	A3	B1	B2	B3	G1	Example data
Evidence from interviews, field observations, and archival material	✓		✓	✓	✓	✓	✓	A graduate student believed a protocol was needed to describe the best way to run the sequencer and decided to forge ahead and write it himself. He later explained that he believed he needed to contribute his part to the lab as a more senior graduate student. (A1) Demand for sequencing services was not picking up as quickly as anticipated. The technician who did the sequencing realized that she needed to generate more customer interest and so posted advertisements (composed by her supervisor) across campus and sent email announcements of the service. (A3) At the biotech/research lab, a new technician was hired and needed to be trained. The supervisor asked the existing technician to do it. In response, the original technician pulled together reading materials for the new technician and worked with her to set up a reaction. (B1)

she commented that she prefers working with inanimate fungi: "I didn't expect to be working with live stuff. I assumed we would get frozen bugs, grind them up, and extract DNA."

She performed some tasks, in part, because those were the tasks that she enjoyed doing. She worked on her own research project. She worked to create general knowledge of how to do sequencing among potential users: "It's little things. [That's] why I work in a lab. When you figure something out.... It's nice when you figure things out." In many ways, when Tammy developed ideas by performing work, she was calling on her past experience to guide her. Because she was the one who so often had to resolve issues related to the organization of work that arose through everyday execution, these experiences, preferences, and beliefs became very important.

Others in the lab also had ideas based on their past experiences. In particular, one graduate student had been in what was considered Herman's predecessor's lab. He had taken on responsibility for getting the lab up and running and had, among other things, collaborated with technicians in biotech and gotten their input on how to run the lab. This became a model for how things could be organized. Ideas from Herman, Tammy, and the graduate student all became relevant at various points. They combined to become a working model of how tasks should be allocated, and the model was revised as new ideas came in through other mechanisms.

At Diagnostics Lab, too, individuals across levels in the lab, especially those who were brought in early on, became sources for ideas about job design. For instance, Fred had been hired by the CEO and board to run this unit specifically because he came with ideas and experience about automating processes—a role he had played when working in an agricultural organization. This experience provided a starting point for Fred's search for equipment for the lab and employees to fill key positions. The first technicians hired in this lab also became sources for ideas. They made some decisions about how work would be done and conducted training. Across other labs, people carried and applied ideas about how work should be organized on the basis of their past experiences. And in labs that existed prior to the installation of the sequencer, there was another source of existing ideas—the arrangements that were already in place that in some cases included automated or manual sequencing. Table 7 provides some examples of situations where such ideas were invoked.

The Forms of Ideas

"Ideas" is a general term for the material these activities produced. All of the ideas were mental models or cognitive mappings of how various pieces of jobs might fit together and in this way could serve as prototypes or guides for the bundling of tasks. These ideas all entered into the set of ideas that guided job design, though they did not necessarily dictate how tasks should be combined to make up the whole or even a part of a job. The ideas came in three forms—requirements, requests, and propositions—and these forms differed in the degree to which they were binding.

Requirements came from multiple sources. Many were technical requirements about what must be done in order to get the desired output: for instance, a gel must be poured to do sequencing, and moths had to be captured and put in vials to produce DNA samples. Some were bureaucratic rules: for instance, a job at this level must contain certain types of tasks to fit in the existing pay structures, and a job with this level of complexity must be performed by a person with a four-year degree to qualify for payment. Some were the personal requirements of job incumbents and managers: for instance, a job must provide variety for an incumbent to continue in it, and a manager insists that the person who does a job must have certain experience to be hired. These were social, political, institutional, and personal requirements as well as technical and administrative ones. They were rarely requirements for job design as such—that task A and B must be performed as part of one job—but had implications for job design. The requirements provided hard constraints in some cases but were not

Table 7 Evidence of "Invoking Existing Ideas"

	A1	A2	A3	B1	B2	B3	G1	Example data
Evidence from interviews, field observations, and archival material	✓	✓	✓	✓	✓	✓	✓	The technician used her experience at another lab doing sequencing and sample prep as a model to set up her work at this lab. (A3) The technician and supervisor in this lab had been sequencing manually and used this as a starting point for organizing the work around automated sequencing. (B2) Based on what they described as their preferences, two technicians developed a division of roles where one senior technician took on the role of interacting with others outside the lab and the other took on the role of handling internal administrative work. (B3) At the large biotech lab, an industrial lab, the person who ran the sequencer wanted experiences beyond the day-to-day running of the sequencer and became involved in a research collaboration that came directly out of his work sequencing a particular gene. (B3)

always deterministic. They had to be met but could be met in different ways.

The second category of ideas, requests, was more negotiable: for instance, a supervisor wanted the technician to gain skills as a result of doing the job, another wanted jobs that would not be too boring, a job incumbent wanted to "own" a process, and a customer wanted sequencing results produced more quickly. Again, these were not directed at job design per se, but they had implications for what tasks would be bundled into a job. These requests did not have to be satisfied, but there were costs for not doing so: for instance, the dissatisfaction of employees or loss of customers.

The final category of ideas produced by these activities was propositions about what tasks might be combined to meet these and other requirements or to satisfy requests. Various actors presented potential solutions to the puzzles of job design: determining what tasks should be combined to meet the requirements and requests. This is the form that is most purely an idea for a job design—a model for how tasks should go together. Propositions were the least binding, and there were no costs for not using these.

Making Ideas Work

The story of how tasks were allocated to jobs does not end with the arrival of these ideas. Rather, these requirements, requests, and propositions were subject to transformation once they entered organizations. Some were in direct conflict with others. There were multiple ideas that could not all be put in place simultaneously. Other ideas were in some way ill-defined or inappropriate for the organization. And in some cases, there was both conflict and misfit. I identified two types of processes that were used in response to such situations. When ideas conflicted, the person with conflicting ideas or the parties with interests in each would work to reconcile the conflict to arrive at the final arrangements. When ideas were not clearly defined or were badly aligned with the organization, someone interpreted how they would be put in place in this particular context. Eventually, all ideas needed to be performed to become a part of the job. Below, I discuss each of these three processes. I also bring in further examples from other sites to illustrate these processes, as well as to highlight differences in what occurred across sites.

Reconciliation

The first process is what I call reconciliation, of which Singer Academic Lab provided several examples. Herman's ideas were in direct conflict with Tammy's ideas about what a technician should do. Tammy and Herman disagreed over her priorities. He thought she should be spending half her time troubleshooting on the sequencer and half her time on projects. He complained that her time distribution was nowhere near that. She thought she should spend as much time as needed right then, answering questions and disseminating information about the sequencer so that people could function independently sooner and she could later focus on her projects. She complained that he tried to micromanage: "I would prefer someone who is more hands-off, who just lets me do my work. He wants too much detail." He complained that she did not have enough initiative, was not assertive enough, and did not follow through on details: "She doesn't seem to have a big enough picture of how things should and do work.... She is less able and experienced than the person I thought I had hired." As a result of this conflict, they began meeting daily to discuss the work that she would do that day. Each meeting presented a new reconciliation or negotiation over priorities and activities. Tammy explained, "This is new. Things are still being negotiated." Work arrangements here were never codified. Eventually, Herman understood that the idea of the job he initially envisioned for Tammy would not be realized. Tammy did perform some of the original tasks and functions that he imagined but also became involved in many additional tasks that he had not considered. They continued to disagree about her work priorities. Several months later, Tammy quit. Herman began rethinking the nature of the work and said that he needed a postdoctorate fellow, not a technician.

The protracted negotiations between Tammy and Herman stemmed in many ways from conflicts between ideas that came from different sources. Some of the ideas came from their past experience. Tammy expected that the job would be organized like her previous one. Herman had expectations based in part on his past experiences. In addition, each had ideas based around the sequencer and the formal job requirements of the university. Tammy also responded to specific problems in the flow of work in the lab by altering her activities. The set of ideas were at times contradictory, and balancing them was in no way simple for either of them.

Similarly, at Diagnostics Lab, as more people filled the very narrowly defined jobs, it became clear to the director that the division of labor was too fine. People mastered and became bored with their jobs. Technicians with downtime could not step in to help in outside areas because they were not trained in those areas. They complained that their jobs were too narrow. The existing idea for allocating tasks into jobs conflicted with the ideas that the people in the job were developing. The managers worried that turnover would become too high. Eventually, the group began moving away from a detailed division of labor to a more team-oriented structure.

The genome facility (G1) had to balance contradictory ideas about how scientific work should be conducted in a university setting with ideas about how a large-scale genome facility should operate. It also balanced these with ideas that were introduced about how work might be organized in a for-profit industrial setting. The situation culminated in an ongoing debate between the director of the lab and the supervisor of the sequencing work. The line supervisor described what she called the "pseudo-argument" that she repeatedly had with the head of the facility about how to organize work. The head of the facility continually argued that more of the process should be automated and labor routinized. He wanted the facility to be like a factory, an image that he constructed in part based on his collaborations with an industrial company. He said that he wanted to "bring the biotech model here," and he took actions to move toward that goal. The line supervisor argued that under those conditions, the workers would become bored, dissatisfied, and careless. The head of the facility countered that it was "just a job." Together, they explored ways to automate the process without stripping all skill from the work. The eventual solution was a hybrid of what the two had envisioned. Jobs were repetitive but did not limit people to repeatedly performing single tasks. Technicians routinely poured gels, loaded samples, and set up analyses instead of performing just one of those tasks.

At the small biotech lab (B2), conflict over the work arrangements began with the discussion of purchasing the sequencer. The technician opposed the purchase altogether. He feared that the technology was too much of an unknown and did not want unfamiliar tasks brought into his organization or his job. His CEO and CFO prevailed and purchased the sequencer. Initially, the technician supervised someone else, who did the tasks. Then the company went through a round of layoffs, and the tasks shifted directly into his job.

Reconciliation of conflicting ideas about work arrangements did not always, or even often, involve protracted or adversarial negotiations. Perhaps the best example comes from the academic service facility (A3). There, based on the way work had been set up previously, the supervisor developed a model of the job where she and the technician would share in the sequencing work and other tasks in the facility. The technician expressed a preference to her supervisor for doing things differently. Her idea of the job, based on her previous experience, involved her "owning" something. The supervisor agreed to her request, and the technician then did all the sequencing.

The hiring process also involved significant nonconfrontational reconciliation of differing ideas about what the job should be. Herman had to work through the ideas he came in with, the ideas about what jobs in the university setting were, the ideas he gathered through research, and the ideas that each job candidate embodied. He described his decision as being similar to solving a puzzle where different people provided different solutions or solutions to different parts of the puzzle. It was not a head-to-head negotiation; rather, it involved one individual making trade-offs.

Reconciliation occurred when the ideas introduced through the various mechanisms conflicted with other ideas. The ideas were not always mutually exclusive or even dramatically different, but they could not exist simultaneously. A choice or compromise had to be made. Conflicts would trigger various reconciliations—conscious negotiations and less overt activities that would determine which idea should be put in place—over the jurisdictions of work (e.g., Bechky 2003a). Across these types of reconciliation, the various parties eventually reached a settlement, and a single idea of the job eventually, if temporarily, emerged.

Interpretation

The second transformation process was what I call interpretation. One of the best examples of this occurred in a university setting, where several labs were faced with identical bureaucratic requirements for creating a technician position. The requirements played out differently in the labs. At A3, the requirements were not viewed as particularly intrusive or confining. The person who wrote the job posting knew the rules and how to use them to create a higher-level position. She successfully fought to get the job a higher classification. Her colleague claimed this was because supervising the higher-level job would improve her own position. The same requirements were interpreted differently and seen as much more intrusive at Singer Academic Lab. They presented more of a hard constraint, though they still required interpretation. Herman described the position as being caught between two levels and said that he did not know how to handle it. He described himself as having to make choices between job levels that fit clear bureaucratic categories but did not necessarily describe the job he wanted to create. Furthermore, he believed that there were too many onerous rules that he had to comply with to fill the job. For instance, there were stringent requirements about what information to include in his job posting. To aid in complying with these, he simply copied a posting that had already been published and met with approval even though the position differed from what he wanted: "I'm getting close with the hiring requirements. I believe I've fulfilled the spirit and legality of the requirements." At yet another lab with the same bureaucratic system, A2, the requirements were interpreted differently. The PI described himself as having had a difficult time understanding what information his job posting should contain. He went to the human resources department for help in determining what information he should include in the posting and how he should phrase the ad to hire the kind of person he wanted.

The same rules governed all three of these organizations, but because of different experiences and approaches to dealing with such rules, the lab managers developed differing interpretations of the same institutional requirements. The manager who had more experience in the environment could manipulate the requirements to her purposes, effectively keeping the requirements from presenting any real constraints on her actions. The manager with less experience with the environment saw the rules as very constraining. In the third lab, the manager sought help in interpreting the rules.

In a similar way, at Diagnostics Lab, several ideas that entered had to be interpreted. Fred commented that he knew of "no one else who is doing diagnostic sequencing at the same scale" as they were, and as a result, there was no exact model they could replicate. They had to adapt things to work for them. For instance, the rules presented to Diagnostics Lab by insurance regulations were interpreted before they affected work arrangements. Complying with the most stringent guidelines of New York State insurance regulators, in effect, made all other rules irrelevant. The solution they created in the lab—tasks grouped with other tasks of similar levels of complexity and jobs filled by people with minimal skills (for gel pouring, a high school diploma; and for other jobs, a four-year degree)—was not the only possible response to this set of requirements. Nor was it an enduring interpretation. As the technology developed further, Fred created a new, somewhat anticipatory, interpretation of these rules. He believed that the gel pouring step would soon be eliminated, and thus the ability to employ technicians at lower skill levels would be eliminated. As a result, he stopped hiring people without four-year degrees, even for the minimally skilled jobs.

This type of interpretation was not limited to ideas that entered through coercive methods. The ideas delivered through interactions with Biosupply Automated, visits to other labs, and other outside information often had to be interpreted to make sense in a particular context. In some sense, all labs had to translate the ideas that came with the sequencer to fit their particular environment. Even ideas that came from seemingly local sources required interpretation. This was the case at Diagnostics Lab when ideas were introduced from the R&D unit within the same company. In the R&D lab, there was significant interdependence. At Diagnostics Lab, the goal was to keep jobs distinct and to limit interdependence, as Fred described it: "It's the opposite in research; we want overlap." Another example of the interpretation of information that was sought came from A3. The supervisor of this lab visited an academic lab but could not simply replicate the routines of the lab. As she described it, "The [academic] lab is not a core [service] facility, so it's not the same.... They do things sort of like here. A person does it daily and has a manager.... In a core facility, you have to do volume to keep the rates down." To make her observations of work at the academic facility useful, she adapted them to her specific circumstances.

Across these situations, interpretation was necessary because an idea was somehow poorly defined or ill suited to a lab (e.g., Zbaracki 1998). Interpretation was often necessary when an idea was relevant to work arrangements but was not explicitly an idea for how to arrange work, as was the case with the sequencer, the insurance regulations, and the job posting requirements. Ideas that were imported from elsewhere, intentionally or otherwise, might not have been well suited for use in a particular lab. The interpretation of ideas often occurred when unsolicited information was received, as well as when information was intentionally sought. This was often the case when there were bureaucratic rules or regulatory requirements in place. The ideas that entered through coercive transmission mechanisms were not purely coercive. Instead, they presented starting parameters that required interpretation before they became meaningful for work arrangements. Across these cases, various parties in the labs—most often the manager—found ways to apply ideas in their context. People made decisions about how to adapt a particular model to their own uses, in effect translating it to their requirements. In some cases, these actors sought help in interpreting information; in others, they based their interpretations on past experiences. As with negotiation, an idea for task allocation eventually emerged through this process and was performed by the job incumbents.

Performance as Acceptance

By definition, a job is a set of tasks that are performed.[1] This suggests that if the work is not actually done, it is not a part of the job. I have discussed ways in which the ideas that entered these organizations through doing became the new status quo as incumbents performed the new tasks. Ideas that emerged from processes of interpretation and negotiation also had to be performed to become the performative part of job routines (e.g., Pentland and Feldman 2005). Herman and Tammy's discussions about what she should do in her job became meaningful only when she performed (or did not perform) the tasks they discussed. The discussion at G1 about job complexity became meaningful only when technicians started performing additional tasks. The technician's idea about owning the sequencing in A3 became real only when she took over all the sequencing from her supervisor. Similarly, interpretations of how to comply with New York State regulations became real only after people were hired and began performing the work. Thus, the person performing the job had potential power over the design or assembly of the job.

Toward a Model of Job Assembly

I began this paper by noting that existing theory about how tasks come to be allocated into and across jobs cannot fully account for empirical accounts of either job design outcomes or processes. To this day, much job design theory rests on assumptions of managerial determinism—the idea that managers can and do bundle tasks into stable jobs to fit with their goals. Other theory puts these assumptions aside but does not fully specify the process. By directly observing how ideas relevant to job design entered and how these ideas were developed and used in nine organizations following the installation of a new DNA sequencer, I gained significant insights into the activities that help determine the allocation of tasks into jobs. I now look at how these many activities came together in the larger process, depicted in Figure 1.

The central phases in this model were the generation and transformation of ideas. The primary triggers of the first phase were problems and institutional demands. Following these and other triggers, new ideas arrived through three activities: searches, reception from others, and development by actually doing the work. These ideas were introduced against the backdrop of preexisting ideas about the organization of work that were embodied in the people and processes already in place. Some of these ideas were already in use. Others were dormant in the organization—usually held in the minds of those involved in the work as incumbents and managers—and were invoked throughout the process. The set of ideas produced by these activities included harder requirements, softer requests, and propositions about how to put these elements together. They came in many shapes, e.g., rules about insurance remittance and job postings, a researcher's need for faster service, instructions about gel pouring and sequencer operations. Many other requirements and requests corresponded to the personal preferences of those doing and supervising the work.

These requirements, requests, and propositions did not take the form of job designs per se, nor were they sufficient to produce final job designs. Each idea entered into a broad set of ideas that would be transformed into a job. When an idea conflicted with other new and existing ideas, this transformation took the form of a reconciliation process. When an idea was misfit for the specific organizational context, the transformation process took the form of interpretation. Finally, the ideas that emerged from these activities and transformations had to be performed to become actual job designs rather than just ideas about job design. The job designs that finally emerged from these transformation activities then became part of the context, as managers, job incumbents, and environmental actors iterated through future rounds of the process.

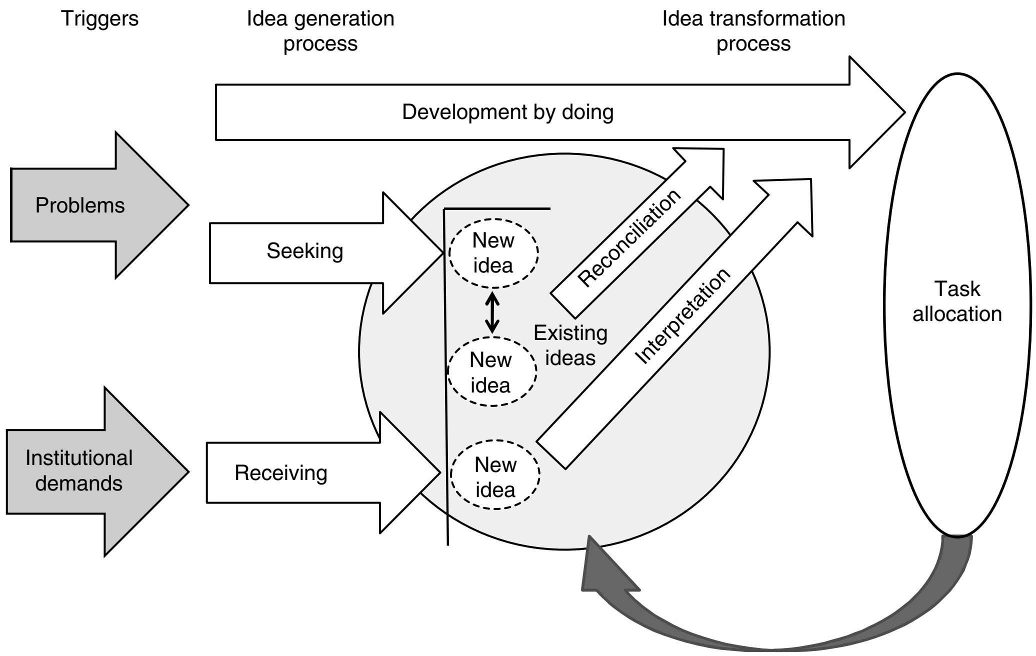
Taken as a whole, these observations are at odds with the image of a unified design process and more consistent with the image of assembly. Multiple assemblers with varied and varying interests participated sequentially and in tandem to fit pieces together into jobs. They did not create job designs by fitting tasks together to comply with known objectives. Furthermore, these observations suggest that to understand this allocation process, it is important to look beyond the tasks that are being assembled. The boundaries that defined these jobs enclosed much more than that set of tasks. They enclosed the people who performed and managed them, the competencies and experiences of those actors, technology, formal and informal rewards, locations in a status hierarchy, human resources policies, bureaucratic rules and regulations, as well as the various requirements, requests, and propositions that each of these elements produced. Through this assembly process, all of these elements influenced the contours of jobs.

This empirically grounded model of job assembly informs several ongoing conversations in the field and suggests that jobs and the processes of assembling them warrant much further research. This analysis puts jobs into the foreground and reveals several ways in which current thinking about jobs is incomplete and that developing a more complete picture of jobs contributes to our understanding not only of job requirements but also of institutions and power.

Producing Job Requirements

Far from being given, the requirements, requests, and propositions for jobs were produced on an ongoing basis. They were not and could not be known from the start and were not defined by technology or efficiency alone. Job design was not a single idea or a response to known and cohesive requirements. Rather, it was an

Figure 1 The Job Assembly Process



evolving response to the ebb and flow of information and interactions. Ultimately, because these jobs contained so many elements beyond tasks, this job assembly process brings together requirements, requests, and propositions from seemingly unconnected worlds: e.g., New York State insurance regulators influence jobs in the West, a manufacturing company influences a set of jobs at a genome facility, a PI's experience in a construction company shapes jobs in a lab, and an agricultural facility influences a medical diagnostics facility.

Although it is not addressed as such, the idea that job designs must meet requirements and requests is fundamental to each of the literatures introduced earlier in this paper, but, by design, work in each of these streams must take for granted that some goals of this process are known and understood—e.g., that jobs should be designed to be technically efficient (Smith 1776/1937, Taylor 1931/1967) or to be more motivational (Hackman and Oldham 1975). Interactionist work shifts the focus from prescribing job designs that will meet such goals to explaining how parties act to achieve goals (e.g., Barley 1986; Bechky 2003a, b). Because none of this work is explicitly intended to explain job design processes, it is logical that it treats job design goals in these ways. However, it makes it somewhat difficult to understand how the full set of requirements is produced and brought together and how the job design finally emerges. This study allows us to see how those varying requirements and other ideas come together.

The implications of this can be understood by looking at the relationship between requirements and job crafting. The job crafting literature (Wrzesniewski and Dutton 2001, Berg et al. 2010) places incumbent requirements as central: How do job incumbents proactively shift task boundaries to meet their requirements for meaning and identity? Consistent with this, some crafting did occur in these sites. For instance, Tammy performed some tasks, in part, because those were the tasks she enjoyed. A technician at A3 took over all the sequencing work because she wanted to "own" something. However, my observations suggest that the dynamics of job crafting were more complex than existing theory suggests. Little of the job crafting that occurred was as premeditated or self-directed as the job crafting framework suggests, no matter how motivated the incumbents were. In each of these cases, a crafting opportunity—an occasion to develop and introduce new ideas about work arrangements—was created before any crafting could take place. Most job crafting was facilitated by the onset of problems that allowed incumbents to work out solutions and thus revise their jobs. Incumbents rarely actively created these opportunities. Instead, they were well situated and more than able to take advantage of the occasions that emerged along the way. By focusing on the broader process of job design rather than on job crafting per se, it becomes clear that the crafting that occurred was embedded in the context of the larger job assembly process. Similarly, the requirements and processes considered in each of the perspectives discussed earlier are better understood when viewed in the larger context surrounding them.

Institutionalizing Job Design

The shift of focus to jobs and the cognitive processes that shape their contours provided insights into why and how institutions enter job assembly. Past empirical studies provided indications that institutional forces are an important influence on the bundling of tasks into and across jobs, without specifying how these demands might be brought into and used in organizations (Baron and Bielby 1986, Strang and Baron 1990, Baron et al. 1999, Lounsbury 2001). By examining job design directly, I observed that demands from beyond organizational borders arrived frequently but rarely in direct ways that evoked simple or direct responses.

Ideas arrived through several paths. First, employees carried ideas into organizations based on past outside experiences. They called on these experiences as issues arose, often replicating what they had seen and done in previous workplaces. Second, managers and incumbents looked beyond their organizational boundaries when seeking information about work arrangements. Third, when managers and incumbents sought one piece of information or the solution to one problem, it often came packaged with unanticipated information about work arrangements. Finally, outside rules, regulations, and norms provided information, usually in the form of requirements about work arrangements. Once they arrived through these various pathways, institutional requirements, requests, and propositions were placed in the context of many other ideas, and these had to be reconciled and interpreted.

The empirical evidence developed here also showed several ways that the institutional influences on task assembly were inhabited (e.g., Hallett and Ventresca 2006). Rather than passively receiving and applying ideas from their environment, these actors interacted with their institutional environment and institutional inputs across these job assembly activities. People made many choices that connected them to particular institutions and environments. For instance, they chose to hire people with certain types of experiences in certain types of organizations. They made informed choices to seek information about how specific others performed their jobs. They made a series of choices that led to the purchase of this particular piece of equipment. They also made many of the choices that put them in a particular organizational field or environment—for example, to be part of the genome project or to do diagnostics work. Furthermore, although institutional forces provided raw material in the form of requirements, requests, and propositions about task arrangements, these forces rarely provided sufficient material to conclusively define jobs. This meant that various parties were active in transforming these institutional inputs. Managers especially had to make decisions about how to apply particular rules or how to use the sequencer in their circumstances. They had to negotiate between all of the ideas from all sources, institutional and others. It was the inhabitants of these processes and the full series of their interactions within and outside of the organizations that ultimately determined how institutions influenced job design.

The Power of Problems and Ideas in Job Assembly

Finally, the development of this job assembly process revealed power dynamics that might otherwise be overlooked. As described here, job assembly takes and makes power. It was those people with power who got to supply the ideas that brought about shifts in task arrangements. Those with power also influenced the outcomes of the transformation process in two ways: they took part in it directly, and they supplied binding requirements. People's relative power shifted across the idea generation and transformation phases of the process. It also shifted when arrangements shifted. Depending on the choices that were ultimately made, this assembly process could serve to reinforce or to alter the distribution of power in the organization. Those who ended up with control of the critical tasks ended up with more power (e.g., Emerson 1962, Pfeffer and Salancik 1978).

Actors often had power in this process as a result of their formal positions, dependence relationships, specialized knowledge, or regulatory mandates that allow them to influence the process (e.g., Pfeffer 1992). The power they had was not always or often the power to design jobs as such and was rarely exercised intentionally toward the end of making job designs. More often it was exercised to serve interests that somewhat coincidentally influenced job design. For instance, managers wanted outcomes that included more efficient processes in their labs, employees who were not making errors because they were mind-numbingly bored with their work, and the completion of various tasks. The incumbents wanted ownership of their work, work that they found interesting, the ability to perform their work effectively, some measure of autonomy to determine their own activities, and simply to get the work done. The outside actors in the regulatory arena wanted compliance with their particular set of rules. Biosupply Automated wanted to ensure that users had positive experiences using their equipment so that they would continue to use it. Few of these parties' interests were directly about job design, but all of them provided influential ideas in the assembly process. Not all of these ideas became part of the final job design, but that these ideas were part of the set considered at all is an indication of the influence of each of these parties in the process.

Problems were central in these power dynamics. Because their resolution so often required the generation of ideas, the onset of problems and unexpected events provided many occasions for the various parties to exercise and increase their power. The problems that triggered these inflows of ideas and ensuing power shifts rarely seemed to carry dire consequences; for example, slow turnaround time and escaped moths invoked idea production but, if unresolved, were unlikely to bring down the lab. Nor were these problems always directly related to job design. They were more often encountered in the day-to-day execution of work or as unanticipated consequences of organizational decisions only distantly connected to job design: e.g., the hiring of a specific person, the purchase of equipment, or the pursuit of a particular line of business. In some cases, the pursuit of solutions unearths requirements for job designs. Other scholars have demonstrated that problems, unexpected events, and uncertainties play a role in altering work arrangements (e.g., Miner 1987; Pentland 1992; Bechky 2003a, b; Bechky and Okhuysen 2011), but my observations point to another mechanism through which this functions—provoking ideas about the organization of work.

Much of the power held by incumbents was related to their expertise, which was not a fixed property. It changed with the onset of these problems. As a result of their physical and intellectual location in these labs, the technicians, rather than the managers, were likely to be the ones to solve problems. They had distinct knowledge that meant they managed a technical interface (e.g., Barley and Bechky 1994)—in this case, the sequencers—and so were positioned to identify problems and devise solutions. As they solved problems, incumbents also enhanced their knowledge. They learned new things that could become more relevant with changes in the job (e.g., Thomas 1994).

The picture presented here paints managers as somewhat powerless in the face of a continuous stream of problems and various technical and bureaucratic requirements and requests from within and beyond organizational boundaries. Indeed, managers were much more constrained than various managerialist models would suggest, but the system of constraints did not render managers entirely powerless. It was most often the manager alone who worked through the set of ideas that arrived. When ideas competed, managers were typically the ones to reconcile them. When ideas were ill suited, managers were typically the ones to interpret them. Even as they solved problems and performed new tasks, incumbents were forced to negotiate with managers to make their solutions more permanent. Managers were rarely forced to accept arrangements. Even hard technical requirements were not deterministic, and some managers were better placed to exert control in the face of such requirements. More experienced managers could apply knowledge to gain flexibility in interpretation processes. In the cases examined here, the important experience was not only that of designing jobs or running this sequencer; rather, it was broader organizational and institutional experience. For instance, the supervisor at A3 had not designed and supervised a large number of jobs nor had she done any sequencing. She had, however, spent years working in the university bureaucracy, and it was this experience that allowed her to exert control over job design. This dynamic is likely to apply to requirements and requests from all sources.

Conclusion: Bringing Jobs Back In

My work here raises an additional set of questions related to jobs and the job assembly process. The first of these concerns is how this process might differ across organizations. My study focused largely on the shared set of activities that unfolded across a set of organizations. Some differences arose, for instance, in the chronology of events across these organizations. Future research might explore whether there are any patterns in this variation and other variations in job assembly activities across labs. Similarly, my study demonstrates that the broader institutional environment plays a role in job design, and future work could delve more deeply into when and how these institutional influences play out.

Another area for future exploration concerns the instigating event for job assembly. My work was built around a change in technological artifacts: the installation of a DNA sequencer. Although the arrival of this technological artifact altered the set of tasks to be performed and provided some hard constraints, this change turns out to have been only one of the elements that brought about change in the design of jobs. Furthermore, the focus on technology raises questions about how such processes might differ with other types of technology and other types of instigating events—for example, when the technology is more stable and known or when the change surrounds something other than technology, such as policies, business strategies, or personnel.

Finally, this job assembly model was developed by focusing on a set of activities that led to the development and use of ideas about how tasks fit together, and this particular focus may have diverted consideration of still other activities that shape jobs. For instance, when ideas were developed by doing, new tasks were often created, and this task production may be an important aspect of job assembly. The framework developed here demonstrates the power of making jobs and job design the central focus of organizational analysis, and it provides a starting point for further exploration around such questions.

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Endnote

[1]The definition of a job that I have used throughout this paper—a bundle of tasks performed under an administrative

job title—follows a long tradition in the sociological literature, where "job" has been defined as *a stable amalgamation of tasks performed under an administrative title or single individual* (Miller 1988, Miner 1991). A job has also been defined as *a common work* (Abbott 1989). In all these cases, the implication is that the job is what is done, not what is supposed to be done.

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