Abstract

Sociology presumes the duality of structure and action, but sociologists rarely model pieces of social structure as agents or individuals as constraining elements of a social structure. In this article we perform such an inversion, and investigate how social structure affects the life chances of jobs. Jobs are persistent entities that require inflows of tasks and people and that compete with other jobs. We theorize that lower-level organizational mechanisms that stabilize jobs’ inputs, such as task interdependence, career paths and hierarchical embeddedness, make jobs less likely to die. These effects operate even when controlling for the substantive content and other features of the individual jobs. We test our theory on three decades of personnel and job-description data for the non-academic staff of one of America’s largest public universities.

Introduction

The duality of structure and agents is a foundation of social theory. Social structure constrains individual action, yet individuals’ actions create and endlessly reproduce social structure (Durkheim 1982, Giddens 1984). Social network theorists define groups of individuals in terms of their organizational co-memberships, but just as easily define groups of organizations in terms of their membership overlaps (McPherson 1983, Breiger 1988). Ethnomethodologists explore how people’s choices of careers influence the careers among which latter persons choose (Barley 1989). Recent “analytic” sociology tries to trace the mechanisms through which individuals, reacting to what they perceive as relational constraints, take actions that modify those constraints (Bearman, Moody & Stovel 2004, Hedström 2005). Indeed, relying on a strong opposition between structure and agents tends to throw up serious theoretical obstacles, such as the difficulty of explaining change or the trivialization of agency (Zucker 1989, Sewell 1992).

If there is an inherent dualism of structure and agents, and because structure is mutable over time, then it should be possible to model some components of social structure as if they were agents, and vice versa. In this article we develop such a model. We study the internal labor market of a large public university, for which we have several decades’ data about the jobs that employees held. Research on status
attainment and stratification often uses this type of data to study individuals’ recruitment into (Fernandez & Weinberg 1997, Petersen, Saporta & Seidel 2000), promotion within (Stewman & Konda 1983, Stewman 1986) and exit from organizations (Sørensen 2004). In taking this approach, in “bringing the firm back in,” such research heeds Baron & Bielby’s (1980) call to consider the fine-grained opportunity structures within formal organizations that constrain people’s choices and outcomes separately from their individual characteristics. Yet such work also implicitly shares White’s (1970) dictum that “Many jobs are social entities as stable and independent as men” (p. 1), that is, that formal organizational structures are static constraints on individual action. We take the opposite approach and assume that jobs are as unstable and as interdependent as men. We focus on the job as the agent and treat other jobs and people as the social structure that constrains the job’s life chances. In line with the idea that jobs are unstable and interdependent entities, we focus on the features of that social structure that make jobs more likely to die.

We focus on job death for several reasons. First, sociologically important but non-human entities like jobs do not have goals or agency of their own, and so we have few comparable measures of the “life outcomes” of jobs other than their survival. The death of a job is also easier to interpret than for example the growth or compensation of a job, both of which are empirically and theoretically confounded by the fate of the organization wherein the job is performed. Second, the birth of jobs has been extensively theorized and studied. The efficiency of the division of labor has preoccupied the social sciences since Smith (1970 [1776]) first detailed work in a Scottish pin factory. The role of technological change in creating new sets of tasks and replacing others is well known (Becker & Murphy 1992). We also know that new divisions of labor can be used to perpetuate social segregation (Strang & Baron 1990), to control fractious workers (Gordon, Edwards & Reich 1982), to enforce status distinctions (Baron & Bielby 1986), to increase employee autonomy and commitment (Lincoln & Kalleberg 1985) and to make internal operations seem legitimate to outsiders (DiTomaso 2001). We know much less about the conditions under which an existing division of labor, which it once made sense to elaborate, is pared back. This asymmetry reflects a wider emphasis within sociology and organizational theory on processes of emergence at the expense of processes of decline (though see Ruef (2004) and Freeman, Larsen & Lomi (2012)), an imbalance we think it would be fruitful to begin correcting. The disappearance of social structures in general is as poorly understood as the disappearance of jobs in particular. Therefore we think that testable hypotheses about why particular divisions of labor disappear are among the more valuable contributions we can make with these data.

We also think that the time is right for studies like this one. Jobs have proven hard to study because detailed job data (often, as in our case, in hard copy) can take prohibitively long to encode and analyze, and because modeling different jobs requires making commensurable large amounts of essentially qualitative information regarding tasks and qualifications. Yet the past few years have seen marked improvements in
methods both for digitizing and parsing archival data and for exploring latent patterns of association among
textual objects like job descriptions (Blei, Ng & Jordan 2003, Grimmer & King 2009, Goldberg 2011).
Earlier studies often operationalized the interdependence of jobs with blunt measures like industry or
production technology, or inferred that jobs were technically related because employees moved between
them. We calculate more fine-grained measures of job association by using the full text of each job’s duties,
responsibilities and qualifications. This means that we can measure how related jobs are in their technical
functions separately from how they are tied together by common career paths. In turn we can examine
the importance of social ties in preserving or changing organizational structure with less concern that those
relationships merely reflect technological imperatives. We think that using content data this way, to control
for some of the “non-social” relations between entities, can be useful in studying other types of social
entities, such as emergent relationship styles (the “hook-up partner” or “friend with benefits”) and transient
informal roles (the “facilitators” of the Occupy movement). Social configurations like these, which have been
of increasing interest to researchers, exist like jobs in a landscape that allows other social configurations and
thus are at risk of disappearing. Research into the appearance of such social structures has been undertaken
under the banner of social-network analysis, an approach with which we sympathize and some measurement
techniques from which we use here. Here we combine a structural analysis of the relationships between jobs
with information on the content of the jobs themselves. We think that combining innovative methodological
techniques of content analysis with measurement methods from social-network analysis can yield new insights
about jobs in particular and the evolution of social structure more generally.

In the rest of the paper, therefore, we proceed as follows. First we sketch out our theory of a “demography
of jobs.” We are not interested in the demographic make-up of such jobs¹ but rather in the jobs’ birth and
death. We treat jobs as entities that lack agency but that need certain resources, primarily tasks and people,
to survive. We hypothesize that organizational processes that stabilize the availability of tasks and people to
a given job, or that stabilize the job’s relationships with other jobs, will reduce a job’s risk of death. We then
describe the setting for our study: thirty years of job descriptions and personnel data from the non-academic
internal labor market of a major American university. We estimate Cox proportional hazard models of job
death that control both for job-level features and for the social structure that a job inhabits. We find that,
consistent with prior research, jobs are more likely to die when they are more idiosyncratic (Miner 1987),
more feminized (Baron & Bielby 1985) or less well-paid. Yet even when controlling for such features, as well
as for a rich set of fixed effects, we find that jobs are more likely to survive when they have greater task
interdependency with other jobs, when more persons in the organization have careers that pass through a

¹The race and particularly sex of a job’s incumbents clearly affects the fate of a job (Baron & Bielby 1985), and we control
for this.
job, and when the job has clear hierarchical relationships with other jobs. We conclude by discussing how future work might extend this approach to modeling the birth and death of other types of social structures.

A Demography of Jobs

Modeling the death of jobs requires a conceptual inversion. We usually think of people as agents who move through a social structure and of jobs as constraining elements of that social structure. It can be equally useful to think of jobs as the entities and people as part of the structure. The genesis, survival, reproduction and death of jobs then have to be problematized. Jobs are persistent entities that assign finite collections of tasks to be performed by individual persons. They take people and tasks as inputs and produce different types of people and tasks as outputs. In more zoomorphic terms, jobs eat tasks and people, metabolize them, and leave behind new tasks and people. Sometimes the tasks and people upon which jobs feed are the metabolic by-products of other jobs; other times their by-products feed others. Jobs die when the organization stops performing its constituent tasks, or when those tasks are assigned to other jobs. Jobs are more likely to die if they run out of tasks or people, or if they clash with other jobs. Thus jobs that have more secure sources of tasks and people and that have stable relations with other jobs live longer. Our hypotheses about the demography of jobs are based on these ideas.

We treat jobs as entities, not as agents. We do not think that they act, strategically or otherwise. Jobs die at different rates because they vary on some measure of fit to an underlying landscape. People matter in the survival of jobs, but only insofar as something about people’s skills or aspirations are more or less congruent with the job itself. We have two sources of inspiration for using biotic language to talk about pieces of social structure. First, organization theorists have long applied ecological and evolutionary concepts to the birth and death of formal organizations (Hannan & Freeman 1977, Carroll & Hannan 2000, Hannan, Pólos & Carroll 2007). We build on work that focuses on the life-chances of a less self-contained but equally socially constructed form, the job (Stewman & Konda 1983, Miner 1987, Miner 1997). Second, sociologists working in a very different processual and pragmatist tradition have long argued that the social relationship, not the discrete biological individual, is the appropriate primitive upon which to construct social theory (Emirbayer & Goodwin 1994, Emirbayer 1997, Whitford 2002, Gross 2009). The “social self” (Mead 1913) can best be understood as a product of the roles that an individual has occupied and the ensuing relations he or she has had with other people; conversely an entity can be understood as “continuous chains of such actions that keep turning out the same way” (Abbott 2007, p. 9). Jobs overwhelmingly consist of patterns of activity that are repeated in time, that specify interaction partners and that can be performed by a succession of different people. As such they are among the more durable relational entities that govern social life. Both
the ecological and relational traditions resemble our demographic approach, insofar as both assume that social structures can meaningfully be thought to be born and die and that persons can be thought of as features in a fitness landscape rather than as units of inquiry in their own right. Both of these theoretical traditions have also produced studies that consider the relational structures between and the life chances of different ways of organizing work, but neither models how a job’s position within such a relational structure affects its life chances.

Organizational ecologists for example have produced several studies that consider the birth and death rates of jobs within organizations. Baron & Bielby’s (1986) study of the proliferation of occupational titles theorizes organizational conditions that will encourage a population of tasks to be divided among a greater number of jobs. Stewman & Konda (1983) formalize the micro-mechanisms through which changes in the structures of jobs will change individuals’ status-attainment prospects. Miner’s (1987) work on the lifespan of jobs is even closer to the approach we take here, insofar as she explicitly models a job’s hazard of death, conditional on various properties of the job. While these studies treat jobs as entities that can be born and die, they do not theorize the structure in which such jobs live. Instead they concentrate on the characteristics of the job itself, such as what share of the job’s occupants are female (Baron & Bielby 1985) or whether the job was created for a specific person (Miner 1987). These job-level features matter but are not solely responsible for a job’s survival or death. Baron & Bielby (1980) made the same point about individuals in their influential critique of status-attainment research: individual-level traits, such as a person’s schooling and their parents’ socioeconomic status, will influence where they work and what position they reach, but so too will the opportunity structure of their employer. If a firm has a flat structure in which managers have a very broad span of control, for example, then workers in that firm will have fewer opportunities for advancement, whatever their schooling or other background. We propose that, when considering the life chances of jobs, we also have to consider the “opportunity structure” that jobs face: alongside the characteristics of a job, such as its size and feminization, we must consider its relations to other jobs and the potential flows of tasks and people on which it can draw. We sketch the relevant dimensions of such an opportunity structure for jobs below.

In contrast, work on professional and occupational boundaries tends to focus explicitly on the relationship of jobs to one another and competition between them. Abbott’s (1988) study of the professions, for example, tries to explain the appearance and transformation of different types of professional work in terms of competition between different groups with overlapping claims of expert knowledge for solving classes of problems. Organization theorists have documented the often fraught boundaries formed by supposedly technical divisions of labor (Noble 1984, Meiksins & Smith 1996, Barley & Kunda 2004, Kellogg 2009). In a similar vein, Barley (1986) and Bechky (2003b) both describe how different occupations dispute the authority to perform
certain tasks, and often rely on objects required by interdependent tasks to assert their own expertise. Such work underlines how jobs exist in a social space that is populated and delineated by other jobs. Yet while such studies problematize the boundaries of different professions and occupations, they rarely take the job itself as the unit of analysis (Though see Kahl, King & Liegel (2012)). The focus remains instead on the men and women who do the work, and their efforts to expand or defend their individual and collective autonomy. As a result, and also because the close observation required to document such inter-occupational conflicts restricts the focus to a handful of jobs, these studies rarely make predictions about the survival of different types of jobs.

One way to integrate these two approaches is to retain the ecological studies’ treatment of the job as the unit of analysis while bringing in the work on professions and occupations’ focus on the relationships between different types of work. In practice, this requires theorizing the social structure in which jobs exist. Having proposed that jobs can be thought of as entities that require tasks and people as inputs and that compete at least implicitly with other jobs, we focus on how the differential availability of these inputs affect jobs’ life chances. We hypothesize that processes within organizations that stabilize the availability of the various inputs will reduce jobs’ chances of death. We describe three types of stabilizers: those that stabilize tasks, people, and relations between jobs.

**Jobs versus tasks: Interdependence as a stabilizer**

Formal organizations perform a multitude of tasks (Stinchcombe 1990). A job can be understood as collecting some subset of those tasks together and assigning a single person to perform them. A firm that produces recycled rubber mats to line the beds of pick-up trucks, for example, must sort used tires, feed them into shredders and do all the downstream activities of molding and curing the mats; inspect the quality of the finished mats as well as the efficiency of the production process; install, maintain and replace the physical plant; market, sell and distribute the mats to wholesalers, retailers and consumers; keep financial accounting and control of its operations; and so on. A fundamental component of job design has always been deciding which tasks should be grouped together in or separated between jobs (Blau 1963, Montgomery 1979, Bechky 2003). Should the person who maintains the conveyor belts between different parts of the production line also maintain the ventilation system? Should the person who monitors the quality of the mats also monitor the efficiency of their production, or do these tasks imply different incentives that should be given to different people? Should the people who mix and cure the recycled-rubber mixture have the authority to rearrange machines on the floor? Different answers to these questions imply different groupings of tasks and thus different jobs.
Tasks appear and disappear in organizations. The reasons are varied. Technological change is one: the spread of the digital word processor largely eliminated the task of typing up handwritten documents, while adding the task of explaining how digital word processors work. Tasks are relocated to other organizations through outsourcing or added through merger and acquisition. Tasks are added and dropped with changes in organizational goals, as when a firm discontinues one product and develops another. From the job’s perspective, the appearance and disappearance of tasks is akin to stochastic genesis and extinction of valuable inputs. While jobs can adapt to feeding on new tasks if given enough time (a clerk today stuffs few envelopes and sends many emails), sufficiently rapid change in the landscape of tasks threatens a job’s ability to reproduce itself. Thus from job’s perspective, it is worth theorizing what processes can stabilize the underlying population of tasks on which a job feeds.

We propose that task interdependence between jobs is such a stabilizer. Organizations develop routines to make complex operations faster and more predictable (Nelson & Winter 1982). Durable routines involve a division of labor and coordination among multiple individuals (Cohen & Bacdayan 1994). Organizations that have better-established routines out-perform other organizations, in part because they spend less effort and resources on monitoring and disputes over who should do what work. Yet at the same time, routines are a powerful source of inertia within organizations, because the complex coordination implied by well-developed routines makes changing any one job’s constituent tasks harder without upsetting the larger routine (Hannan & Freeman 1984). Partly as a result, organizations with more deeply embedded routines are more vulnerable to rapidly changing environments, precisely because the interdependence of tasks within routines makes adaptation more difficult (Sørensen 2002). Task interdependence thus has ambiguous implications for the life chances of organizations, but unambiguous outcomes for the survival of jobs. Tasks upon which many other tasks depend are less likely to be eliminated than tasks that can be carried out independently of the organization’s other operations. Therefore jobs that feed upon more interdependent tasks will be more secure.

**Hypothesis 1** *Increases in interdependency between the focal job’s tasks and those of other jobs will reduce the focal job’s risk of death.*

In making this hypothesis, we do not make any prediction about whether such stabilization of a job is good for the organization as a whole. That is, we make no efficiency claims about long-lasting jobs. It is easy to imagine organizations that fail because their members find it too difficult to disentangle the connections between different jobs and thus cannot change the task content of jobs that “should” change, given features of the organization’s environment. But this is not the job’s concern. Organizational inertia is good for a job; it represents a stable environment of tasks and people on which to feed.²

²This discussion does however suggest a different research question, one that is outside the scope of this study: all else equal,
Jobs versus people: Careers as stabilizers

Jobs need people to metabolize tasks. If no member of the organization has the right mix of skills needed to do a job’s tasks then the job may die, even if the job’s tasks are still performed. Picture an environmental advocacy group where one job (“Media Director”) feeds on the tasks of editing and laying out the group’s print publications and maintaining the group’s website and other online presences. If the person upon which the job relies leaves and the group cannot find a similarly skilled person to replace them, then the job may be replaced by two new, more specialized jobs that concentrate on print publication and web development, respectively. Alternatively, if the only people that can be found to staff the job are used to performing other tasks as well, such as corresponding with the press, then the job risks being replaced by a broader job. This can happen when for example people are trained for a job by an external organization, such as a graduate school or vocational institute. Such training can instill expectations about the kinds of tasks that people who receive the training ought to perform, leading to discontent with the task-content of the actual jobs in the focal organization.

Like tasks, people appear and disappear in organizations. For jobs, an ongoing risk is that when an individual upon which it relies leaves, there will be no similarly skilled person inclined to take their place. This implies that organizational processes that ensure a more predictable flow of similarly trained people will increase the life chances of a given job. We propose that careers within organizations are such a stabilizing process. “A career consists, objectively, of a series of statuses and clearly defined offices … subjectively, a career is the moving perspective in which the person sees his life as a whole and interprets the meaning of his various attributes, actions, and the things that happen to him.” (Hughes (1937, p. 413), quoted in Barley (1989, p. 46)). We prefer such a definition because it allows us to distinguish careers from “advancement along a hierarchy of power and prestige” (Barley (1989, p. 48); see also Van Maanen & Barley (1982)). Because people prefer jobs that seem to have a future, that connect to other types of jobs in a sensible progression that allows them to construct narratives about their experiences and offers possibilities for increasing status and security (Van Maanen & Katz 1976), we theorize that the people who use such a career ladder will have an interest in preserving the jobs that constitute its rungs. From the job’s perspective, then, being part of a career ladder makes more reliable the flow of resources in the form of people and raises its life chances.

**Hypothesis 2** Increases in the number of people who pass through a given job within the organization will reduce the focal job’s risk of death.

In addition to giving people sequential opportunities that help them build sensible narratives about their
experiences, career ladders in internal labor markets often provide firm-specific training (Doeringer & Piore 1971). Training that is provided within an organization is more closely tailored to the requirements of specific jobs than training provided outside the organization (Becker & Murphy 1992, Acemoglu & Pischke 1998). This means that other jobs within the organization leave behind people who both are more likely to have the skills that a job requires and are less likely to have incongruent expectations about the task-content of the job. Thus jobs that can draw upon an internal labor market will find higher-quality and more predictable human resources with which to sustain themselves.

Hypothesis 3 Hiring from within the organization rather than from the external labor market will reduce the focal job’s risk of death.

Jobs versus jobs: Hierarchy as a stabilizer

While we want to consider ways that jobs are tied to one another besides the formal organizational hierarchy, it is still important to consider hierarchy’s implications for jobs’ life chances. Power and authority relations are a recurrent source of conflict in organizations (Blau 1963, Morrill 1991), and efforts to resolve questions of subordination have often driven organizational restructurings and the redesign of jobs (Lichtenstein 1989, Fligstein 1990, Freeland 2000). While jobs themselves, lacking agency, have no interest in status, if two jobs’ incumbents have unclear authority relations then the likelihood of conflict and possibly restructuring of the jobs is much greater. This is why Abbott (1988) included subordination of one profession to another as one of the “settlements” that could resolve jurisdictional conflict.

People within organizations seek status. Managers sometimes increase their own staffs at the expense of firm performance (Berle & Means 1932, Galbraith 1968). Executives worry about outsourcing divisions because, though the work is still done, their own direct reports are reduced, and with them their status (Sennett 1998). Because individuals within organizations have motivations to preserve jobs that exist in hierarchical super- or subordination to their own, we propose that jobs that have such hierarchical relationships to other jobs will be more likely to survive.

There is a secondary reason to pay attention to a job’s position within the formal organizational hierarchy. Our assumption is that our measures of task interdependence or career mobility, discussed below, capture much of the technical and personal interdependence of jobs. It could be argued though that, when controlling for such measures, the residual existence of a hierarchical relationship between two jobs indicates some aspect of interdependence between the two jobs that our measures do not capture. In other words, an alternative explanation of the above hypotheses is that the same relationships are captured by a job’s formal position. Thus it is important to control for formal hierarchy even if only to check the robustness of our other predictions.
Hypothesis 4 Jobs that are hierarchically embedded in an organization are less likely to die than jobs with unspecified hierarchical reporting relationships.

A common assumption is that jobs within formal, complex organizations are linked through a hierarchy of reporting, such that jobs concatenate into something like a spanning-tree structure (Martin 2009). Given that assumption, it may seem odd to presume variation in whether jobs are hierarchically embedded. In our data, there are three ways that such variation can occur. First, a job description can fail to specify such reporting relationships, even though they actually exist. In this case the mis-specification would act like classical measurement error, biasing our results toward non-significance. It is because of the risk of such measurement error that we use a liberal coding of hierarchical embeddedness, treating either a supervisory or a subordinate relationship as sufficient information. Second and more commonly, there are jobs within the university that are supervised, but not by another specific job. “Lab Technician” is an example: the job has a common set of qualifications and characteristic responsibilities, but can be supervised by academic personnel, health-and-safety managers, medical staff or departmental coordinators, depending on the technician’s location in the university. “Secretary” is perhaps an even more familiar example. Third and finally, there are jobs that are idiosyncratic enough in their responsibilities or qualifications that, while technically the job is subordinate to a dean, vice president for personnel or similar job, it is basically a free agent. Our favorite example within our data is “Carillonneur,” which oversees composing, choosing and playing music by the university’s clock towers and chapels. Some job doubtless can interfere with the carilloner’s people and tasks, but it is hard to imagine extending the principles of formal organizational structure over this relationship without doing violence to the concept.

In sum, we hypothesize that jobs are less likely to die when other jobs count on them to perform interdependent tasks; when other jobs produce a reliable stream of people with the necessary skills and aspirations to perform its tasks, or when other jobs need people with skills acquired by performing its tasks; and when other jobs see the focal job as a subordinate or superior. At this stage, we should be clear that we do not make a causal claim regarding these hypotheses. The data we have are observational. We do not have, for example, a redesign of a swath of jobs, such as might alter the task interdependence of some jobs and thus shift their hazard of death (A research setting like the one that Fernandez (2001) exploited to study technological change’s effects on wage inequality, where tasks were reassigned to different jobs but the firm and workforce were held constant, would be a step in the right direction). Our goal at this stage is to build theory about the processes that affect the life chances of social structures, and look for support, even if circumstantial, in available data. At a minimum, a setting for testing these hypotheses will have data on many jobs over a long time span. That data should include information about staffing and personnel movements, as well as substantive descriptions of each job’s duties and qualifications. To get
data on personnel movements, a large organization is preferable to a small one, and an organization that performs many different functions is preferable to a more specialized one. We have such data available in job and employment data from a major public American university, to which we now turn.

Empirical setting: A “Multiversity” labor market

The setting for our study is the internal labor market of the University of Michigan, for decades one of the largest universities in the United States. The university has a large and strikingly diverse internal labor market. In his history of the New Left, Miller (1987, p. 24) described how “The school epitomized the post-war ‘multiversity’—a mammoth institution catering to a multiplicity of constituents, from freshmen in Ann Arbor to the Joint Chiefs of Staff in Washington.” Through Freedom of Information Act Requests, we acquired human-resource data on university employees from 1979 through 2009 as well as the school’s formal, standardized job descriptions for every position within its internal labor market. The choice of a large university like Michigan has several advantages for a study like this one. First, because public universities almost never close down, the school offers us many decades of job and human-resource data that we can use to track the relatively long life-spans of different jobs. Second, because people often build long careers within university systems, we can observe sufficient mobility between different jobs over time to identify connections formed by the flows of people between them. Third, because public universities’ employment practices are often subject to civil-service regulations, there exist detailed job descriptions for positions as disparate as radiologists, glaziers and ships’ captains. Fourth, because the types of jobs at the school are so varied, we can test whether and how sensitive our results are to particular types of jobs.

The human-resource data consist of person-year observations for every employee at the university, starting in January 1979 and running through December 2009. For each employee, we have their full name, job title, salary, departmental affiliation and their full- versus part-time status. Based on employee names we were able to impute gender for 98.8 percent of the employees using existing gender disambiguation databases (For the remaining 1.2 percent, we randomly assigned gender based on the university-wide distribution). The complete personnel data consists of 809,259 person-year observations of 111,982 unique employees. Michigan made major revisions to its human-resources management system in 2005 and changed many job titles; lest we attribute job death to such reforms, we limited our analysis to persons and jobs that appear in the data before 2005. Limiting the HR data to the quarter century between 1979 and 2004 reduces the total person-year observations to 628,860 and unique jobholders to 90,156. There were 17,827 employees in 1979

---

3 Though with the rise of labor-market intermediaries like LinkedIn, it may soon be possible to do similar analyses with external labor market data, thus depending less on a large internal labor market and the concomitant types of organizations.
4 The university historically maintained several ships on the Great Lakes for, among other things, moving around research equipment and museum displays.
and 33,244 in 2004; on average, the university grew by 639 persons every year.

The job description data come primarily from paper descriptions in the archives of Michigan’s human resources department. Descriptions were available for 5,131 unique job titles that we reduced to 3,587 unique job families. We combined job titles into the same job family if the titles were only slightly different (e.g., using “Mgr” rather than “Manager”) and had the same description. The vast majority (more than 98 percent) of job descriptions were issued after 1966. The job descriptions have information about the job’s duties and responsibilities and the desired qualifications for the jobholder. The descriptions also list the job’s pay grade, the description’s issue date, whether another job supervises the described job and whether it supervises another job. For example, the job “Nurse Consultant” was required to “[p]rovide leadership in various area administrative committees including patient education, joint practices, information/communication, computerized inpatient census system” as well as “[d]evelop objectives, coordinate, prepare presentations, present in-services and evaluate educational programs.” Furthermore, the job description indicated that the jobholder was supervised by the position “Director or Assistant Director of Nursing” and exercised supervision over “Clinical nurses and support staff.”

We linked the personnel data to the job description data. We excluded all professorial and teaching staff from our employee data, as the university does not have formal descriptions for positions such as Professor. This reduced the number of person-year observations in our data to 502,961 and the number of unique jobs in the employee data to 2,541. We found job descriptions for 93.5 percent of the person-year observations in the personnel data. Of the remaining 6.5 percent, more than 97 percent are the academic jobs.

Because our analytical task is to understand the determinants of job death, we reduced the person-year observations to job-year observations. This reduction results in 2,541 jobs and 36,530 job-years. Because many of the jobs in this sample were created before 1979, when our personnel data begin, we would face serious problems of left censoring (Singer & Willett 2003) in our data if we used all jobs in our analysis. We therefore only analyze jobs created after 1979. Doing so allows us to trace a job from its birth until its death or right censoring in 2004. As a result, our final sample consists of 1,432 jobs and 14,876 job-years. Below we describe how we constructed the variables used in our analyses.

**Measures**

**Dependent variable: Job death**

The key variable of interest in our analysis is a dichotomous indicator of whether a job “dies” in a given year. We define a job as being “dead” when it is no longer occupied in any future period. For example, the
job “Apprentice Sign Painter,” which first appears in 1990, has no employees in 1993 or any following year through 2004. Thus we define the Apprentice Sign Painter job as having died at the end of 1992. Of the 1,432 jobs that were created between 1979 and 2003, 601 died.

When coding job deaths, we were careful to use the personnel data to double-check that the job was not simply renamed. We could see this happen when for example a job lost all of its incumbent employees between one year and the next and all of the incumbents were present the next year in a common job with a different title. Thus our measure of job death specifically excludes the waves of specious deaths produced for example when the term “supervisor” passes out of fashion in favor of “coordinator,” or when draftsmen are re-christened as draftspersons.

**Independent variables**

In order to calculate the task interdependence of jobs theorized in hypothesis 1, we use the text from the job descriptions’ “duties and responsibilities” sections. Appendix A has examples of such job descriptions. We pre-process the text descriptions by converting all words into lowercase and stripping endings, punctuation and non-alphabetic characters (Hopkins & King 2010). Next, we create an annual corpus of duties and responsibilities texts from jobs that were alive in a given year (i.e., had at least one incumbent in the personnel records). Using this corpus, we model each description as a “bag of words” (Harris 1954) that ignores word order. Each job description in year $t$ is represented by a $1 \times W$ vector, where $W$ is the number of unique words in that year’s corpus. For job $i$ in year $t$, the value of each element of the vector is set to $\frac{f_{w,dt}}{f_{w,dt}^{-1}}$, where $f_{w,dt}$ is the frequency of word $w$ in year $t$’s corpus and $f_{w,dt}^{-1}$ is the inverse frequency of word $w$ in job $i$’s duties and responsibilities section. These corpus-frequency-versus-inverse-job-frequency weightings let us put more weight on words that are particular to a job description; a word that appears often in a description is given more weight but is then downweighted if the word appears in many other descriptions. To ensure that extremely rare words do not bias the task interdependence measure, we exclude from the corpus matrix any words that occur fewer than three times.

We stack these vectors of job descriptions into an $N \times W$ job-word matrix. We then produce a symmetric $N \times N$ job matrix wherein cell $(i, j)$ records the similarity between vectors $(i, .)$ and $(j, .)$ in the job-word matrix. Cosine similarity measures how related to one another the task content of different jobs are. It it bounded between zero and one, where one represents complete interdependence. Repeating this process for each year in our data produces twenty-five job matrices. At this point, we have $N - 1$ pairwise measures of task interdependence for each job in each year. Our goal is to have a measure of how relatively task-interdependent a job is overall; therefore for each job we sum the ten largest elements of its vector in
the job matrix. This procedure ultimately yields a measure of how related a job’s tasks are to the ten jobs in the university that are most related to it.

This interdependence score has a distribution that is approximately normal, with a mean of 2.85 and a standard deviation of 1.04. (Table 2 presents summary statistics for all variables used in our analyses.) Figure 1 gives an impression of how this measure connects different jobs. In figure 1 we draw a link between jobs whose cosine similarity is 0.4 or greater. While we do not use job titles in calculating interdependence, the inset shows that this measure is quite accurate in recovering relationships between jobs that we might expect to be interdependent, given their titles. Table 1 shows the five most-similar jobs to focal jobs at different points in the score’s distribution, to demonstrate how the components of the score vary. “Locksmith,” at the tenth percentile, is a largely self-contained job; the most-similar job, that of “ Supervisor, University Key Systems,” only has a cosine similarity of 0.223, and even the fifth most-similar job, that of “Heavy Equipment Mechanic,” is obviously an unrelated line of work. By comparison, the “Supervisor, Cyclotron Facilities” job, at the twenty-fifth percentile, has at least two jobs with which it shares a substantial number of tasks; and “Physical Therapy Clinical Specialist,” at the ninetieth percentile, has at least five related jobs.

[Figure 1 about here.]

[Table 1 about here.]

Our use of cosine similarity scores to measure task interdependence differs from standard text-mining practice (see for example Weiss, Indurkhya, Zhang & Damerau (2004)). Cosine similarities calculated off of jobs’ tasks do not directly measure interdependence; they only measure how much those text blocks resemble one another. Two jobs could have different titles but the same tasks and responsibilities, in which case the positions would have high cosine similarities but no interdependent tasks. Rather than being interdependent, these two jobs perform the same work in parallel. If such “identical” jobs drove our similarity scores, interpretation of our results would be different, and problematic. Under such conditions jobs that look like one another are less likely to die—which, given the nature of survivor bias, might just imply that such clusters of jobs are spuriously more likely to survive, for reasons we cannot observe. Our interpretation of cosine similarity as a measure of interdependence is based on examining the texts to understand what drives the scores. Take for example the Physical Therapy Clinical Specialist job shown in table 1. Its characteristic duties and responsibilities include phrases like “Participate in developing rules and procedures with other therapists for a team approach to therapy,” a phrase that also appears in the Occupational Therapy Clinical Specialist job description. Similarly the two jobs both “Plan, implement, evaluate and modify treatment programs for patients in consultation with other therapists.” Such tasks
stipulate consultation and coordination between the two jobs. Other tasks reflect a division of labor that presumes other specialties: both jobs for example are tasked to “Initiate patient treatment when referral is made to the specialty area” and to “Represent the Physical [Occupational] Therapy Division at specialty conferences and medical rounds.” The key point is that the cosine similarity of these documents is driven by near-identical phrases like these, but those phrases are present in both documents because the two jobs are interdependent—indeed the phrases describe the jobs’ interdependence.

The structure of Michigan’s job descriptions also limits the scope of the “parallel jobs” problem. A major goal of such a system is to ensure that people who do similar tasks, wherever they are employed, are assigned the same job and thus evaluated and paid comparably. Thus for example administrative assistants, who work in various departments, centers, institutes and other nooks and crannies of the university administration, are all employed under the various “Secretary” job descriptions. In sociological terms, these formal job descriptions are better thought of as defining role equivalents than structural equivalents (Winship & Mandel 1983).

To track how often people pass through a job as part of their career in the organization, per hypothesis 2, we measure the Churn through a position, defined as personnel inflows plus outflows, as a share of size. Because the typical job has few incumbents and because not every job hires in every year, this variable has a disproportionate number of zero and one values. We therefore also include two variables, All churn and No churn, to parcel out the effects of extreme values.

We built several measures to capture the job’s relationship to the university’s internal labor market. First, we calculate the ELM hire rate, defined as the share of hires in the previous three years that were made from the external labor market rather than from elsewhere within the university. We use a three-year window because not every job hires in every year. (We found no substantive differences with using longer windows.) Still, given that most jobs hire a single person or no one at all in a given period, we include two dummy variables, All ELM and None ELM, to capture the extremes of the distribution. We similarly calculate the ILM place rate, defined as the share of exits from the job in the previous three years that went elsewhere within the university rather than to the external labor market. All ILM and None ILM deal with the small-movement issue in the same way.

We measure whether a job is hierarchically embedded—that is, whether it is linked to other jobs via formal supervisory relations, as theorized in hypothesis 4—based on the text of the formal job descriptions. Those descriptions indicate both whether a job is formally supervised by another job and whether it formally supervises another job. We set a dichotomous variable equal to 1 if the focal job meets either criterion. Approximately 40 percent of the jobs in our sample are hierarchically embedded.
Control variables

Our theoretical interest in this study is the relational structure among jobs that affect the lives and deaths of jobs. However, we know from prior research that characteristics of jobs themselves can affect their death rates. We therefore control for such job-specific features.

First, we control for some basic dynamics, related to the stock and flow of people in a given job, that can effect its life chances. We control for the size of the job, in terms of the number of incumbents in a given year. We control for job growth, defined as inflows minus outflows as a share of size, with the assumption that net hiring is a sign of health. In most models we also include fixed effects for the year the job was created and the current year.

Second, we control for job characteristics that are aggregates of the characteristics of the jobs’ incumbents. Jobs that are created with a single individual in mind are more likely to die, because a job’s “overspecializing” in one type of person’s qualifications and desires makes it harder to secure new incumbents should that person leave (Miner 1987). We cannot tell in our data whether a job description was written with a single person in mind but we can control for whether the job is a singleton, i.e., has only one incumbent in any given year. Jobs that require greater educational requirements have tended to be more stable (Osterman 1987); accordingly, we control for whether a job requires a bachelor’s degree. We know that the feminization of a job can reduce its pay, status and chance of survival (Baron & Bielby (1985); both Shieman, Milkie & Glavin (2009) and Mouw & Kalleberg (2010) review the recent research). We create an indicator of feminization that is set to 1 in a given year if the job’s incumbents are more than 80 percent female. (Lowering the threshold for this variable produces expected changes, with both the magnitude and significance of any associated effect decreasing.) Unionized positions are typically more stable because of work rules and seniority provisions. Unionization is also potentially correlated with several of our explanatory variables, because unionized jobs typically have lower turnover and different hierarchical reporting structures than non-union jobs. While these data do not have direct indicators of union status, we can get a close approximation by including the FLSA exempt status of the jobs. Union jobs are overwhelmingly paid hourly rather than on salary, thus not exempt from the Fair Labor Standards Act; and in Michigan in this time period, hourly jobs are disproportionately unionized. We presume that higher-status jobs are both better paid and more likely to survive. We therefore include the mean salary of a job’s incumbents in each year. We convert the nominal salary from the personnel data into 2011 dollars. Because salary tends to be right-skewed, we include the natural log of this variable in the analyses. We do not make predictions about the effect of incumbents’ tenure in a job; we can imagine both that jobs that have held onto their people for a long time fit well with their external environment and that such jobs might have stagnated, for example becoming less adaptable and
interdependent with the tasks of other jobs. Therefore we control for the mean tenure of a job’s incumbents but do not make any directional predictions about its effect.

Third and finally, we want to control as much as possible for the actual content of the job. We focus on structural features such as task interdependence and jobs’ location within careers, but it is possible that certain jobs are simply more “central” to the business of the university, less likely to die, and different from other jobs on our measures of interest. Controls for each different job would make it impossible to identify any model; therefore we need a way to cluster the jobs into a smaller number of job topics, for which we can then include fixed effects. To do this, we used latent Dirichlet allocation, which is an algorithmic method for uncovering latent topics in a large corpus of data, such as texts like we have here. The process, which Blei, Ng & Jordan (2003) describe in detail, can be summarized as follows. First, the analyst specifies the number of desired topics. Second, probability values are assigned to each word, indicating how likely the word is to belong to each topic. Finally, each document is assigned a probability of belonging to each topic, based on the underlying probabilities of its constituent words. We experimented with different numbers of topics and found that the algorithm produced no substantial changes to the corpus classification if we raised the number of topics above ten. We therefore fit the LDA model using ten topics and the variational EM method as implemented in the topicmodels package in R. We fit the model using the text corpuses pooled across all years and discard any term that appears fewer than five times. We decided to pool the descriptions in this procedure to capture “timeless” latent categories of jobs within the university, which, overall, should remain stable even if individual jobs within a topic area are born and die over time. The LDA procedure produces for each job ten values indicating the probabilities that a job belongs to each topic. We dichotomize each variable such that a job belongs to a topic if its probability is greater than 0.2.

Table 2 presents the summary statistics for the variables used in our analyses. Table 3 presents bivariate correlations among the variables.

Results

To test our hypotheses, we estimate extended Cox hazard models with time-varying covariates. Our models estimate whether our theoretical measures—task-interdependence, career paths, connections to the internal labor market and hierarchical embeddedness—are related to a job's hazard of death. We introduce the control variables as described above. All of the models cluster standard errors at the job level because of the
repeated individual observations.

Table 4 presents the estimations. Model 1 shows the main effects of job size and growth. As expected, larger jobs and growing jobs are less likely to die. Model 2 introduces fixed effects for the job’s cohort (the year the job description was published) and the calendar year. These fixed effects have no substantive effect on the estimates. Model 3 introduces the “job-level” controls. As expected, higher-paid jobs and jobs that require a bachelor’s degree or higher are less likely to die, while single-person jobs, jobs with high shares of female incumbents and unionized jobs are more likely to die. Mean tenure increases the hazard of job death, but this effect is substantively trivial.

Model 4 introduces our measure of task dependence. The coefficient on this measure is negative and significant, which supports hypothesis 1. Jobs whose constituent tasks are more often the inputs and outputs for other jobs are less likely to die. A one-standard-deviation increase in task similarity reduces a job’s hazard of death by about 9 percent. To give some comparison, jobs that require a bachelor’s degree are about 34 percent less likely to die than jobs that do not, while “idiosyncratic,” single-incumbent jobs are about 9 percent more likely to die than jobs with more incumbents. Thus task interdependence with other jobs is a non-trivial factor in a job’s life chances: it cannot produce the large differences in employment patterns that we associate with professional and other internal labor markets (Osterman 1987), but it can more than offset the penalty associated with marginal jobs that Miner (1987) for example found.

Model 5 introduces measures of how jobs fit into the career paths within the university. The coefficient on a job’s churn rate is not significant. This is probably due to the underlying distribution of churn rates across jobs, which is bimodal at zero and one. The effects of having no churn or complete churn are in the directions that hypothesis 2 predicts. The ELM hire rate is also positively correlated with the hazard of job death, consistent with hypothesis 3. Model 6 includes our measure of hierarchical embeddedness. Jobs that have explicit superordinate or subordinate relationships with other jobs are more than 40 percent less likely to die in a given year than jobs that do not, which supports hypothesis 4.

The results in models 5 and 6 suggest that jobs that do not hire any employees from the external labor market are more likely to die, once we have controlled for hierarchical embeddedness. This coefficient is potentially confusing, because the None ELM variable conflates jobs that only hired from the university’s internal labor market with jobs that did not hire at all. Thus a job’s higher risk of death might come either from its drawing incumbents from the internal labor market or from its not recruiting new incumbents. The latter situation is consistent with hypothesis 3 but the former is not. To investigate this further, we estimated a new model in which, rather than including the variables for the ELM hiring rate, we instead controlled
for whether a job had inflows and interacted that dummy variable with the ELM hiring rate; we do not include the main effect of the ELM hiring rate. In such a model (the full results are available on request), having inflows somewhat reduces the hazard of job death ($\beta = .023, s.e. = .012$) while hiring a greater share of employees from the external labor market increases the hazard ($\beta = 0.030, s.e. = 0.015$). We get similar results, albeit with smaller standard errors, if we do not include the job’s growth rate, with which inflows are highly correlated. We can also see the relationship between reliance on the external labor market and job death in figure 2: jobs with greater ELM hiring rates are less likely to survive, but jobs that do not take in new people have the worst survival rates of all. The presence of this relationship in the bivariate data gives us additional confidence that hypothesis 3 is in fact supported. At the same time, the rate at which jobs place persons in the internal labor market has no relationship to the hazard of job death, once growth and churn are controlled for.

[Figure 2 about here.]

A major potential problem with the results presented so far is that they do not control for the substantive task content of different jobs. In model 7 therefore we include fixed effects for the different clusters of job topics that we built using LDA, as described above. Including these topics substantially improves the model fit, as evidenced by the improvement in log pseudo-likelihood, but leaves the estimated coefficients on our variables of interest substantively unchanged.

Overall, the results provide support for our hypotheses. Jobs that have more stable sources of tasks and persons, and that have more ordered relations with other jobs are less likely to die than jobs in more turbulent environments. We can identify such stabilizing relationships separately from one another, rather than having to conflate for example technical interdependence and personnel flows as prior research has. In line with previous research, we find that “job-level” characteristics like feminization, job size and the job’s educational requirements affect its life chances; but the relational structure of jobs within the organization continues to play a role in job survival and death even when such job-level features are taken into account.

Conclusion

In this paper, we examine processes that make formal jobs in an internal labor market more likely to die. In line with the sociological practice of recognizing the duality of structure and agency, we treat jobs as the entities and treat tasks, people and other jobs as the social structure. We argue that a key set of mechanisms affecting job death derive from how that job is embedded in the larger social structure of the organization. We posit that three organizational processes affect a job’s survival: task interdependence, career paths and
hierarchical embeddedness. Our empirical results suggest that these three processes do indeed affect job survival, even when controlling for the substantive content and other features of the job.

Our study contributes to several literatures, including those on organizational design, careers, and role structures. First, our study demonstrates how internal organizational structures can undergo endogenous change in response to how different parts of that structure fit together. Second, our research suggests that structural theories of careers, which posit that individual attainment is a function of position rather than of individual characteristics, will need understand how attainment is affected by the vitality of social positions and the dynamics of social structure. In other words, treating jobs as static parts of the social structure puts too much emphasis on the regularity of positions. Finally, our theoretical model and empirical results speak to the broader sociological literature on roles and role-structures. Our results suggest that role structures are quite dynamic but change in predictable ways. We find that formalized jobs and job-systems, a special case of a role structure, appear to be organized in a sort of core-periphery pattern. The core set of roles are tightly related to one another, their obligations are clearly defined, people often move between them and their reporting relationships are clearly spelled out. The peripheral roles overlap less with other ones and have inconsistent flows of people on which to draw. These features make the peripheral roles more vulnerable.5

Our study is methodologically novel as well. We have been able to collect one of the largest longitudinal corpuses of formalized job descriptions and human-resource data to date. The nearly complete data on the various types of jobs in this university system, ranging from janitorial staff to senior academic administrators, as well as the relatively long time-span, allow us to more cleanly isolate the relational mechanisms we propose. Our rich data allow us to take into account heterogeneity among jobs with respect to their internal demographic composition, task-content, rewards, degree of mobility and any sectoral effects of the time in which they were created. Furthermore, we can include period effects that help rule out macro-economic and social forces that are also likely to affect whether jobs survive or disappear. That said, our study does have several important limitations. First, we conduct our analysis within one organization, a large university system. This may make our results less generalizable. However, we believe that this limitation can be resolved in future studies by collecting similar data for other types of organizations, for different time periods, and perhaps in settings like online social networks where relying on a given organization is less necessary. Another obvious limitation is that we cannot make causal claims with observational data such

---

5This finding is broadly consistent with theories of segmented labor markets (Piore 1973, Gordon, Edwards & Reich 1982, Lang & Dickens 1994), but goes one step further. Traditional labor-segmentation theory argued that employment relations were more unstable for individuals in peripheral labor markets, but usually left unasked whether the jobs in such markets were also less stable. More recent work on “networked” and project-based labor markets that exist between and beyond firms (E.g., Barley & Kunda (2004), (Becky 2003a)) implicitly presume that jobs and roles are subject to frequent change but, perhaps because of the starting premise that jobs can be identified with projects, have not investigated the correlates of such turnover within particular labor markets.
as these. For now we cannot rule out the possibility for example that task interdependence or embedding within mobility patterns do not themselves make jobs more likely to survive, but rather that they reflect the importance of jobs that survive for other reasons. The obvious next step for research such as this is to explore settings where the effects of such factors can be more cleanly identified. Having a clearer idea of the mechanisms that can promote or retard job death is a necessary step in designing such future studies.

We believe that our research can be extended in several directions. A formalized job system is only one type of role-structure. Many different role structures exist in economic and social life. The research on categories and categorization in markets (Zuckerman 1999, Hannan, Pólos & Carroll 2007, Negro, Koçak & Hsu 2010), for example, has also begun to study the dynamics of categorization and the relatedness of category in the schema. Our approach may help shed light on the processes by which category schema change and evolve and why certain categories are more durable than others are.
A Some sample job descriptions

TITLE: ASSISTANT TO THE VICE PRESIDENT FOR ACADEMIC AFFAIRS/SPECIAL PROJECTS  
GRADE: 14  
Issued: 09/01/92  
Classification Code # 14857  
Supersedes: NEW  
FLSA: EE

BASIC FUNCTION AND RESPONSIBILITY  
To manage the planning, development and implementation of the Office of Financial Aid systems project.

CHARACTERISTIC DUTIES AND RESPONSIBILITIES

- Act as Chairperson of the project Steering Committee, facilitate decision-making and document and refer appropriate issues to the Sponsoring Committee.
- Direct the project-related activities of Steering Committee members.
- Act as the Steering Committee liaison to the Project Sponsoring Committee for issue presentation and resolution and participate as a member.
- Manage the project operating budget.
- Manage the project plan, make staff assignments and monitor progress.
- Act as the primary contact to the Sigma Corporation and provide onsite leadership to Sigma staff.
- Prepare and coordinate the preparation of special and period reports for the Sponsoring Committee.
- Provide information and presentation materials as requested to the Director of the Office of Financial Aid and others for dissemination to the University community.
- Participate in other Academic Affairs or Office of Financial Aid activities.
- Assure compliance with affirmative action and safety programs.

SUPERVISION RECEIVED
General supervision is received from the Associate Vice President for Academic Affairs.

SUPERVISION EXERCISED
Functional and administrative supervision is exercised over professional and office staff.

QUALIFICATIONS

- A Bachelor’s degree in mathematics, computer science or a related field, or an equivalent combination of education and experience is necessary; a Master’s degree is desirable.
- Considerable progressively responsible systems development and programming experience is necessary.
- Reasonable supervisory and administrative experience is necessary.
- Reasonable knowledge of management procedures and methods is necessary.

TITLE: PRODUCTION MANAGER  
GRADE: 09  
Issued: 05/01/79  
Classification Code # 12396  
Supersedes: New
BASIC FUNCTION AND RESPONSIBILITY
To manage the administrative and operational activities of several media production support service units.

CHARACTERISTIC DUTIES AND RESPONSIBILITIES

- Plan, prioritize and assign the work of unit’s support personnel.
- Coordinate the flow of services between support units and to users.
- Participate in planning and policy making committees.
- Recommend the acquisition of equipment for support units.
- Evaluate and recommend organizational changes and staffing levels.
- Interview, evaluate and recommend salary adjustments for support personnel.
- Develop and recommend policies and procedures for support units.
- Assist in the preparation of cost estimates for service unit clients.
- Supervise the scheduling and activities of media unit production crews.
- Assist producers by evaluating the need for and capabilities of production support service units.
- Approve the scheduling production services and unit activities.
- Monitor progress of projects to assure adherence to budget and completion on schedule.
- Supervise the film and video archives.
- Monitor and approve the expenditure of funds.
- Produce and direct media programs.
- Assure compliance with affirmative action and safety programs.

SUPERVISION RECEIVED
Direction is received from an Executive Producer or other designated official.

SUPERVISION EXERCISED
Functional and administrative supervision is exercised over supervisors and support staff.

QUALIFICATIONS

- Bachelor’s degree in communication or a related field or an equivalent combination of education and experience is necessary.
- Reasonable experience in media production is necessary.
- Reasonable knowledge of production support services in necessary.
- Some supervisory or administrative experience is necessary.

TITLE: ORTHOTIST I
GRADE: HI
Issued: 03/01/93
Classification Code # 110840
Supersedes: 07/15/87
FLSA: EP

BASIC FUNCTION AND RESPONSIBILITY
To design, fabricate and write specifications of orthoses; and to fit orthoses to patients with congenital deformities of the body and disabling conditions of the limbs and spine.

CHARACTERISTIC DUTIES AND RESPONSIBILITIES
• Examine and evaluate patient orthotic needs in relation to disease and functional muscle loss.

• Examine and measure affected areas for factors affecting the fitting of the orthoses.

• Determine type, design and specifications of the orthoses to be made.

• Facilitate and fit orthoses in consultation with physicians and patients.

• Select the components and materials necessary to fabricate orthotic devices.

• Determine the repair and maintenance of orthotic systems.

• Participate as a group member of the rehabilitation team.

SUPERVISION RECEIVED
General supervision is received from a designated official and from the medical staff.

SUPERVISION EXERCISED
Functional supervision may be exercised over Orthotic Technicians, trainees, and volunteers.

QUALIFICATIONS

• Bachelor’s degree in Orthotics or equivalent combination of education and experience is necessary.

• Eligibility for certification by the American Board for Certification in Orthotics and Prosthetics is necessary.
References


Table 1: Sample of the components of a job’s interdependence score. The measure described in the text sums the cosine similarity of the ten jobs with the highest similarity to the focal job. Here we show sample jobs from four points in the task-interdependence distribution, as well as (for sake of space) the five most similar jobs.

<table>
<thead>
<tr>
<th>Locksmith (10th %ile)</th>
<th>Supervisor, Cyclotron Facilities (25th %ile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor, Univ. Key Systems 0.223</td>
<td>Senior Cyclotron Operator 0.584</td>
</tr>
<tr>
<td>Coordinator, Access Control 0.172</td>
<td>Cyclotron Operator 0.440</td>
</tr>
<tr>
<td>Supervisor, Security/Access Control 0.164</td>
<td>Clinical Physicist 0.145</td>
</tr>
<tr>
<td>Maintenance Mechanic II 0.163</td>
<td>Instrument Engineer, Power Plant 0.140</td>
</tr>
<tr>
<td>Heavy Equipment Mechanic 0.157</td>
<td>Manager of Facilities, Univ. Unions 0.140</td>
</tr>
<tr>
<td>Task Interdependence Score 1.59</td>
<td>Task Interdependence Score 2.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Director of Annual Giving Program (75th %ile)</th>
<th>Physical Therapy Clinical Specialist (90th %ile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development Officer II 0.370</td>
<td>Occupational Therapy Clinical Specialist 0.584</td>
</tr>
<tr>
<td>Sr. Assoc. Director, Annual Programs 0.358</td>
<td>Physical Therapist II 0.489</td>
</tr>
<tr>
<td>Director, College Relations/COE 0.354</td>
<td>Physical Therapist I 0.437</td>
</tr>
<tr>
<td>Associate Major Gift Officer 0.351</td>
<td>Physical Therapy Assistant II 0.413</td>
</tr>
<tr>
<td>Assistant Major Gift Officer 0.316</td>
<td>Wound Care Specialist 0.393</td>
</tr>
<tr>
<td>Task Interdependence Score 3.33</td>
<td>Task Interdependence Score 4.16</td>
</tr>
<tr>
<td>variable description</td>
<td>variable name</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Job dies this year</td>
<td>Death</td>
</tr>
<tr>
<td>Task interdependence</td>
<td>Task interdep.</td>
</tr>
<tr>
<td>Rate of entry and exit</td>
<td>Churn rate</td>
</tr>
<tr>
<td>No exit or entry for last 3 yrs</td>
<td>No churn</td>
</tr>
<tr>
<td>Complete churn for last 3 yrs</td>
<td>All churn</td>
</tr>
<tr>
<td>Per hires from ELM for 3 yrs</td>
<td>ELM hire rate</td>
</tr>
<tr>
<td>All hires from ELM for 3 yrs</td>
<td>All ELM</td>
</tr>
<tr>
<td>No hires from ELM for 3 yrs</td>
<td>None ELM</td>
</tr>
<tr>
<td>Placement to ILM for last 3 yrs</td>
<td>ILM place rate</td>
</tr>
<tr>
<td>All placed to ILM for last 3 years</td>
<td>All ILM</td>
</tr>
<tr>
<td>None placed to ILM for last 3 years</td>
<td>None ILM</td>
</tr>
<tr>
<td>Explicit supervisor or supervisee</td>
<td>Hier. Embed.</td>
</tr>
<tr>
<td>Number of incumbents</td>
<td>Job size</td>
</tr>
<tr>
<td>Growth rate</td>
<td>Growth rate</td>
</tr>
<tr>
<td>Bachelors requested or required</td>
<td>Bachelors</td>
</tr>
<tr>
<td>Only one incumbent</td>
<td>Singleton</td>
</tr>
<tr>
<td>More than 80% female</td>
<td>Feminized</td>
</tr>
<tr>
<td>Log of mean salary</td>
<td>ln(Mean salary)</td>
</tr>
<tr>
<td>Mean tenure</td>
<td>Mean tenure</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Correlation Table

<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
<th>(F)</th>
<th>(G)</th>
<th>(H)</th>
<th>(I)</th>
<th>(J)</th>
<th>(K)</th>
<th>(L)</th>
<th>(M)</th>
<th>(N)</th>
<th>(O)</th>
<th>(P)</th>
<th>(Q)</th>
<th>(R)</th>
<th>(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(B)</td>
<td>-0.02</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(C)</td>
<td>0.00</td>
<td>-0.06</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(D)</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(E)</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(F)</td>
<td>0.00</td>
<td>-0.05</td>
<td>0.00</td>
<td>-0.06</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(G)</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.00</td>
<td>-0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(H)</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(I)</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.09</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(J)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.08</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(K)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(L)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(M)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(N)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(O)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(P)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(Q)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(R)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(S)</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Table 4: Cox Proportional Hazard Models of Job Death

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task interdep.</td>
<td>-0.08*</td>
<td>-0.09*</td>
<td>-0.10*</td>
<td>-0.09*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Churn rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.10</td>
<td>0.10</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.07)</td>
<td>(0.06)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>No churn</td>
<td>0.09*</td>
<td>0.09*</td>
<td>0.08+</td>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>All churn</td>
<td>-0.08*</td>
<td>-0.08*</td>
<td>-0.07*</td>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>ELM hire rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.17*</td>
<td>0.17*</td>
<td>0.18*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>All ELM</td>
<td>-0.07+</td>
<td>-0.07+</td>
<td>-0.06+</td>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>None ELM</td>
<td>0.08+</td>
<td>0.08*</td>
<td>0.08*</td>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>ILM place rate</td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.05</td>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>All ILM</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>None ILM</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.05</td>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Hier. Embed.</td>
<td>-0.42**</td>
<td>-0.33**</td>
<td></td>
<td></td>
<td>(0.10)</td>
<td>(0.07)</td>
<td></td>
</tr>
<tr>
<td>Job size</td>
<td>-0.02**</td>
<td>-0.02**</td>
<td>-0.01*</td>
<td>-0.01*</td>
<td>-0.01+</td>
<td>-0.01+</td>
<td>-0.01†</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Growth rate</td>
<td>-0.06**</td>
<td>-0.06**</td>
<td>-0.04*</td>
<td>-0.04*</td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Bachelors</td>
<td>-0.35**</td>
<td>-0.34**</td>
<td>-0.34**</td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singleton</td>
<td>0.09**</td>
<td>0.09**</td>
<td>0.09**</td>
<td>0.09**</td>
<td>0.09**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feminized</td>
<td>0.02**</td>
<td>0.02**</td>
<td>0.02**</td>
<td>0.02**</td>
<td>0.02*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(Mean salary)</td>
<td>-0.02*</td>
<td>-0.02+</td>
<td>-0.01</td>
<td>-0.02+</td>
<td>-0.04**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean tenure</td>
<td>0.00**</td>
<td>0.00**</td>
<td>0.00*</td>
<td>0.00*</td>
<td>0.00*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohort and year F.E.s</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Job topic F.E.s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>14509</td>
<td>14509</td>
<td>14509</td>
<td>14509</td>
<td>14505</td>
<td>14505</td>
<td>14505</td>
</tr>
<tr>
<td>Log Pseudo-likelihood</td>
<td>-3847.79</td>
<td>-3831.15</td>
<td>-3796.90</td>
<td>-3794.98</td>
<td>-3774.58</td>
<td>-3774.58</td>
<td>-3750.06</td>
</tr>
</tbody>
</table>

Notes: 
- Time-constant covariate. Standard errors in parentheses
- * p < .10, ** p < .05, *** p < .01
Figure 1: A network of job interdependencies. The graph shows different jobs at the University of Michigan; ties exist between jobs when the task interdependence measure is 0.4 or greater. Interdependence is calculated from the jobs' duties and responsibilities, not their titles.
Figure 2: Kaplan-Meier survival estimates of jobs, stratified by hiring and reliance on the external labor market.