IS DIGITAL TECHNOLOGY RESHAPING EMPLOYMENT SYSTEMS IN U.S. TELECOMMUNICATIONS NETWORK SERVICES?

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The four major telecommunications local networks and network services—fixed wire line, wireless, cable television, and the Internet—are undergoing transformations propelled by network digitalization, service competition, and corporate consolidations. Using data from surveys conducted in 1998 and 2003, together with field interviews, site visits at major telecommunications firms, and discussions with industry experts, regulators, and analysts, the author examines how these forces reshaped technician employment systems across these formerly specialized telecommunications networks and services. The principal finding is that despite rising inter-network competition and common digital technologies, most of these networks' fundamental employment systems continued with little change. Consistent with predictions from an evolutionary perspective on institutional change, the three facilities-based networks—wireless, cable television distribution, and wire line—maintained distinctive employment systems "imprinted" by their respective institutional histories, while the Internet Service Providers exhibited fragmentation reflecting their meteoric rise and the industry's current business difficulties and uncertain future.

Recent labor market research identifies computers and digital technology as the critical forces reshaping modern employment practices. Some theorists posit that skill-biased technological change explains a widening of earnings inequality (Krueger 1993); others see a "new division of labor" requiring a new system of education and training (Levy and Murnane 2004); and others describe the demise of firm-based internal labor markets (Cappelli 1999). This paper is about digital technological change and work practices. Specifically, I investigate whether employment practices are changing in firms caught in the vortex of a profound digital transformation that is fundamentally reshaping telecommunications networks. Network digitalization has decoupled service offerings from the underlying network technologies and architecture. This process is basically complete for network backbones and large business and institutional customers. Remaining are the residential and small business markets where specialized analog networks designed for voice service or television broadcasts are being upgraded and replaced. The typical American household or small business is gaining access to a growing set of telecommunications service options for voice, Internet, data, and video, as the network providers, resellers, and consortiums bundle together service packages.

The research in this paper explores what Dunlop called the "industrial relations system" and what I will refer to as the employment system. An employment system can be said to exist only if the actors and rules reflect

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Industrial and Labor Relations Review, Vol. 63, No. 1 (October 2009).
0019-7939/00/6301 $01.00

a considerable degree of stability, cohesiveness, and interdependence. The concept is "deliberately variable in scope; it may be used to characterize an immediate work place, an enterprise, a sector, or a country as a whole" (Dunlop 1993:285). Does the employment system remain vital and viable in this case, or have competition, organizational change, and technological innovation rendered it obsolete? The answer will have implications not only for the telecommunications industry, but also for industrial relations research.

I investigate four major local networks and network services—fixed wire line, wireless, cable television, and Internet Service Providers (ISPs)—to explore how the digital transformation is reshaping technician employment systems across these formerly specialized telecommunications networks and services, and to test the usefulness of the employment system construct. The data are drawn from two unique establishment surveys of telecommunications technicians, one undertaken in 1998 and the other in 2003, years of substantial change in the telecommunications industry.

Digital Telecommunications Networks and Service Competition

Prior research on the telecommunications industry has focused mainly on the restructuring of sales systems for residential and business customers. In a series of articles on call center workers, Batt (1999, 2000, 2004) reported that the industry has continued a process of strategic segmentation of customers based on their characteristics and potential revenue stream, which has allowed companies to match the demand characteristics and potential value of the customer to the characteristics of the work force and to the employment systems that shape the customer-worker interface. Segmentation has resulted in employment patterns ranging from classic mass production approaches for back office workers, operators, and residential service representatives, to greater involvement for small business service providers, to high-involvement practices for middle-market service agents (Batt 2000).

Customer service employees' work faces outward, connecting the consumer through a market transaction to a company's services. In contrast, technicians' work faces inward. Technicians maintain and upgrade the network, while continuously working to provide end users with uninterrupted network services. Technicians' employment is consequently derived from the needs of the networks, which are capital-intensive, technologically complex, integrated systems that operate in conformity with highly precise standards. One way to conceptualize the work system of a telecommunications network is as a geographically unbounded continuous process production system, the products of which—electrical, radio, or light signals—are never touched by the worker but are continuously transformed and processed through the network.

As a result, the employment systems in network services do not resemble those in telecommunications sales. Classic employee management techniques that developed in mass production industries and that are applicable to some sales jobs are not an option for managing technicians. Technicians' work is subject to considerable environmental and technical variability. Technologies, both hardware and software, are constantly upgraded and re-integrated into the network, and they fail in unique and unplanned ways. As a result, technicians enjoy considerable autonomy. Most technicians work without direct supervision. Their jobs often require the exercise of judgment in diagnosing problems, planning interventions, and setting up tasks. Nonetheless, tasks can be bundled in various ways, creating jobs that range from highly skilled to mostly routine and repetitive. Given the amount of technician autonomy and lack of direct supervision, negotiating the effort bargain has been contentious at times. In recent years, most management systems have sought to increase individual accountability. In particular, interconnected tasks that were formerly assigned to a work group have been disaggregated to some extent, so that discrete tasks can be assigned to individuals, whose performance can be more readily monitored and measured than can that of a group. Supporting this stricter accountability procedure are new administrative technolo-

gies that include the electronic monitoring of dispatch information exchanges and location monitoring through the installation of GPS (Global Positioning System) tracking in motor vehicles.

Adapting to technological change has been an integral feature of telecommunications employment systems throughout their history. The historically high levels of productivity growth in this industry have been largely driven by new technologies. In pervasiveness of influence, however, few if any previous changes can match digitalization. It has profoundly transformed how networks operate, allowing each network to directly compete on services. Formerly each network's architecture and hardware determined the service it offered, and its analog signal was the service. Digitalization has now created four layered data networks capable of delivering multiple services. Each ascending layer rides on the layer below. The bottom layer is the network technology substrate; next is the transport layer (for example, TCP-IP—Transmission Control Protocol/Internet Protocol—is the basic communication language of the Internet); above the transport layer is middleware, a network for naming and locating objects (for example, the World-Wide Web); and the top layer is made up of the applications that enable the services of voice, video, databases, search engines, and social network sites (Blumenthal 1994). Telecommunications networks provide the network technology substrate and transport that enable multiple service offerings. The technical constraint on the number and quality of services is bandwidth, while regulation, albeit decreasing in scope, still shapes service competition.

Service competition across networks has accelerated with network deregulation. Since the passage of the 1996 Telecommunications Act, the number of telecommunications access lines has steadily grown in both residential and business markets, as market structures have become more competitive, moving toward national oligopolies with various local and regional competitors. Access lines and connections grew by a factor of 2.5 between 1998 and 2006. The most important long-term development has been the rapid deployment of data lines capable of carrying high-speed TCP-IP traffic. Data lines and connections grew by 7.5 times between 1998 and 2006, from 36 million to 272 million connections. Data access connections accounted for 40% of local telecommunications access services in 2006, up from 13% in 1998.

Given this enormous growth of the telecommunications services market and wider basis for competition enabled by digital technology and deregulation, the research question is whether digitalization caused a convergence in telecommunications employment systems. Specifically, as different digital networks compete for the same customers, do they imitate one another's most successful strategies, leading to gradual convergence on a set of "best practices"?

The two oldest, most established networks, telephone wire line and cable television, are directly competing with each other, often overbuilding each other's networks, and converging on similar network technologies. Historically, these legacy networks have had very different employment systems, but given the forces of both technological convergence and service competition, they would appear to be the most likely candidates for employment system convergence. Convergence should be evidenced by a trend toward an emerging unified industry employment system. Leading up to such unification, however, could be a period of disequilibrium characterized by fragmented, incoherent employment practices.

On the other hand, profound transformations may imperil an organization's survival (Hannah and Freeman 1984). The period of transition to a major strategic change is fraught with inherent difficulties and risks independent of the content of the change. Rational managers may forgo such risks even if incurring them might enhance their prospects for success (Barnett and Carroll 1987). The potential benefits of altering a company's deeply held values and longstanding practices have to be traded off against the significant risks that such changes often entail, in terms of undermining internal routines and external relations that help make life predictable and controllable (Baron and Hannan 2002). This population ecology–

evolutionary perspective suggests that there are strong forces sustaining organizational inertia and, consequently, the stability of employment systems.

Network Technician Employment Practices and Systems, 1998 and 2003

To examine stability and change in technician employment practices at the four networks—wire line, cable television, wireless, and ISPs—this study used two stratified random samples drawn from the Dun and Bradstreet listing of establishments in 1998 and 2003. Establishments were stratified by location and size. Almost all establishments with more than 100 employees were sampled so that the survey would cover a substantial percentage of the industry's work force. Sampling of the remaining smaller establishments was done so that the total sample reflects the relative proportion of establishments in each segment of the respective Dun and Bradstreet industry listings. In the fall of 1998 and the summer of 2003, a university-based survey team administered a telephone survey of establishment-based managers with questions related to basic industry characteristics, management strategies, and work and human resource practices. A total of 223 usable sets of answers were obtained about telecommunication technicians in the 1998 survey, and 237 in the 2003 survey.

This study comprehensively examines telecommunications technician employment practices by investigating six sets of rules and practices governing employment: technicians' work technologies, compensation, work practices, unionization, education and training, and staffing arrangements. These parameters are measured at the establishment level. The research relies on 36 variables to evaluate the employment system. This level of detail—more extensive than in prior seminal research on employment relations systems' practices (for example, Katz, Kochan, and Weber 1985; Arthur 1992; and Dunlop 1958)—is necessary in order to provide a thoroughgoing assessment of whether workplace network employment systems were stable during the observation period or were undergoing convergence or fragmentation. Data reduction techniques are rejected, since they might obscure important changes.

The variables used to measure the six dimensions are shown in Table 1. The measures for technology and number of services are included both because they are the contextual variables most likely propelling change and because they may capture omitted work practice variables. The average group size serves as a control. The individual variables are further discussed below.

Data Means

Table 2 provides the overall means and each of the four network means by category and item for both 1998 and 2003. The items and the statistically significant changes between 1998 and 2003 are reviewed below. Generally, as digital technologies were increasingly deployed and the demand for labor slackened, terms and conditions of employment changed as employers shifted toward performance-based pay and adopted more flexible and contingent working arrangements.

During this period, network digitalization advanced greatly, with an average increase from 34% to 51% across all network elements. The largest growth occurred in cable television, where 83% of technicians were working on digital networks in 2003. Wire line carriers also substantially increased the number of services they provided customers. Computer use, which has figured prominently in the debates about skill-biased technological change, is measured by desktop and laptop computer use by technicians. Between 1998 and 2003, laptop use increased from 34% to 39%, but overall technician computer use remained constant during this period at 60%. The range of computer use did vary greatly, from a low of 18% for cable television technicians to a high of 78% for ISP technicians in 2003. Computer use by wire line technicians underwent sizeable growth, from 57% in 1998 to 70% to 2003. It should be noted that general-purpose computers were both replacing and supplementing specialized testing and communications gear. Technicians' use of company-provided cell phones also grew during this period, from 34% to 51%;

Table 1. Variables Used to Measure Six Dimensions of Telecommunications Technician Employment Practices.

Technologies and Network Services

Network Technology: percentage of the network that is digital.
Technical Services: number of network services (voice, Internet, and so on).
Work Technologies: percentage of technicians using (a) a company laptop on the job, (b) a computer on the job, and (c) a company-provided cell phone.
Workplace Technology Control: network control: field-based technicians.

Compensation

Natural Log Average Annual Wage
Benefits as a Percentage of the Wage
Percent Pay Incentive-Based

Work Organization

Electronic Monitoring
Percent Participation in Task Forces
Percent in Self-Directed Teams

Unionization

Whether Establishment Is Union or Nonunion

Education & Training

High School Only
Some College
College
Education Level
Weeks of Qualifying Training

Staffing

Career Staffing:
Percent full-time permanent employees.
Percent employees with less than 1 year.
Percent employees with less than 10 years.
Percent retired in last 5 years.
Percent to retire next 5 years.
Layoff percentage.
Annual turnover (quits + fired).

Staffing Flexibility:
Percent temporary employees.
Percent contract employees.
Exempt technicians.
Number of overtime hours.

Group Size:
Less Than 15.
15 to 60.
More Than 60.

among cable technicians, the rise was even more dramatic—from 42% to 83%.

Annual wage compensation advanced slowly between 1998 and 2003, lagging behind cost-of-living increases for all telecommunications technicians except those in cable television. Wire line technicians received sizeable wage increases, but even theirs were below the rate of inflation. Benefit costs, as a percentage of wages, grew modestly during this period. Nonetheless, the five-year period saw appreciable increases in benefits contributions by wireless carriers (from 21% to 27% of wages) and cable television distribution companies (from 25% to 31%). Performance incentives also grew appreciably—from 3% to 8% (again, as a percentage of total pay) across the industry, as well as among wire line carriers. Among ISPs, however, this form of compensation fell from 13% to 4% during the period, as the companies' profitability and stock performance declined. Perhaps the most surprising fact emerging from the compensation numbers is that cable television operators provided the highest-percentage pay and benefit increases during this period. Still, cable television remained the lowest-paying network in the industry.

The percentage of technicians involved in task force or problem-solving participation increased from 20% to 25%. This broad trend masks considerable variation, however: whereas the number at the wire line carriers grew from 16% to 28%, declines occurred at the ISPs and wireless carriers. On the other hand, electronic monitoring of work performance grew in all sectors. Across telecommunications, 40% of technicians were subject to electronic monitoring in 2003, up from 24% in 1998. The greatest growth occurred among wire line carriers, where the proportion of technicians who were electronically monitored more than doubled, from 22% to 48%.

Technician union coverage declined during this period, dropping from 82% to 67% in these surveys. The one exception was wireless networks, among which unionization increased from 8% to 20%, mostly as a result of the unionization of AT&T Wireless.

Some of the education and training statistics from the surveys are unexpected. Most notably, despite ongoing, substantial technological change, the education level of the technician work force fell. As of 2003, only among wireless carriers and ISPs did a large percentage of the technician work force

Table 2. Employment Practices for Technicians: Network Means.
(Means by Sample Year, Weighted by Core Size)

	Wireless		*Cable Television*		*LEC*		*ISP*		*Total Local Access*	
Variable	*1998*	*2003*	*1998*	*2003*	*1998*	*2003*	*1998*	*2003*	*1998*	*2003*
Technology & Services										
Company Laptop	57%	28%	5%	12%	38%	48%	10%	6%	34%	39%
Computer Use on Job	89%	87%	8%	18%	57%	70%**	99%	78%**	60%	60%
Company Cell Phone	62%	40%	42%	83%***	22%	49%***	1%	23%***	23%	55%***
Network Percent Digital	38%	54%	34%	83%***	34%	41%	34%	58%	34%	51%***
Number of Services	4.6	6.2	3.2	3.1	4.7	5.6***	4.3	4.6	4.6	5.1**
Compensation										
Ln Average Annual Wage	10.594	10.441	10.327	10.554**	10.625	10.728***	10.608	10.700	10.607	10.678***
Benefits as a Percentage of Wages	21%	27%***	25%	33%	37%	37%	21%	28%	35%	37%
Percent Pay Incentive-Based	4%	9%	3%	6%	2%	8%***	13%	4%**	3%	8%***
Work Practices										
Electronic Monitoring	32%	55%	7%	13%	22%	48%***	52%	49%	24%	40%***
Participation in Task Forces	40%	19%**	17%	14%	16%	28%***	74%	59%	20%	25%
Self-Directed Teams	16%	23%	14%	10%	5%	5%	30%	40%	8%	8%
Unionization	8%	20%	10%	6%	97%	91%	10%	0%	82%	67%***
Education & Training										
High School Only	4%	1%	60%	74%	37%	66%***	3%	12%	35%	63%***
Some College	43%	48%	27%	22%	63%	34%***	51%	52%	59%	33%***
Education Level	14.8	14.9	12.9	12.5	12.8	12.6	14.8	14.3	13.0	12.7***
Weeks of Qualifying Training	22	12	28	32	61	91***	28	38	55	73***
Staffing										
Full-Time Permanent Employees	100%	97%***	100%	77%***	100%	96%***	99%	91%***	100%	92%***
Employees with Less Than 1 Yr.	16%	14%	12%	22%***	13%	3%***	21%	19%	14%	8%***
Employees with Less Than 10 Yrs.	79%	65%	73%	62%**	34%	35%	63%	77%	40%	43%
Percent Who Retired in the Last 5 Yrs.	2%	1%	1%	0%***	29%	7%***	3%	0%	32%	5%***
Percent to Retire in the Next 5 Yrs.	4%	11%	5%	4%	35%	35%	9%	1%	29%	27%
Layoff Percent	0%	21%	2%	3%	2%	2%	4%	24%***	2%	3%
Annual Turnover (quits + fired)	4%	7%	11%	25%***	3%	3%	7%	23%***	4%	8%***
Temporary Employees	0%	1%**	0%	22%***	0%	3%***	0%	2%***	0%	7%***
Contract Employees	0%	1%	1%	29%***	1%	8%***	1%	20%***	1%	12%***
Average Weekly Hours	49.7	46.4**	44.0	45.9	47.8	42.0***	47.8	46.7	47.6	43.2***
Office Technicians	32%	60%	2%	6%	19%	22%	90%	72%	25%	22%
Exempt Employees	29%	2%**	1%	4%	5%	14%**	20%	35%	7%	12%
Group Size										
< 15	3%	4%	3%	2%	1%	2%	10%	23%	2%	2%
15–60	47%	20%	21%	24%	4%	13%**	7%	77%***	7%	17%***
> 60	50%	24%	24%	26%	5%	15%	17%	0%	91%	81%

**Statistically significant at the .05 level; ***at the .01 level (Hoteling T-test).

Table 3a. Multinomial Logit Logodds with Statistical Significance Levels.

Variable	*Wireless*	*Cable TV*	*ISP*	*Local*
Company Laptop	–7.3532***	–0.9246	–2.9824	1.1541
Computer Use on Job	3.2140	–4.0127*	0.8199	0.3867
Company Cell Phone	–0.0278	5.8023***	0.6527	–1.5742*
Percent Network Digital	–2.7553*	3.0116	–2.5576	0.7446
Number of Services	–0.2121	–1.8355***	–0.4820**	0.7115***
Ln(Average Annual Pay)	–4.5040*	–5.6465**	–3.5390	3.5800**
Percent Pay Incentive-Based	2.7948	2.3185	2.0858	–1.3466
Electronic Monitoring	1.1821	5.0386**	2.6101*	–1.5717**
Employee Participation	–8.8570***	–6.1703***	–0.3550	2.1468***
Self Directed Teams	4.3904***	–0.2606	1.2243	–0.9805
Weeks of Qualifying Training	–0.0490***	–0.0029	–0.0176*	0.0067
Education	1.8509***	0.2461	1.2108***	–1.0403***
Unionization	–5.6654***	–1.2714	–40.1684***	1.7889**
Employee with Less Than 1 Yr.	–1.9092	–10.2340**	–0.7465	0.8418
Employees with Less Than 10 Yrs.	6.3252**	3.6435	3.0404**	–2.4799***
Employees to Retire in 5 Yrs.	–4.4375	–37.9658***	–14.0368	7.0456**
Weekly Hours of Work	0.4090***	–0.1490	0.1263	–0.1340**
Layoff Percent	2.3204*	–5.4129	1.2333	0.2834
Annual Turnover	–7.2421	14.2439***	5.9985**	–4.1639**
Temporary Employees	–12.6021	20.1193	–24.9585	–5.0344
Contract Workers	–25.5608**	1.9088	–0.5488	0.0669
Core Size	–0.0001	–0.0036	–0.0109	0.0037
Year 2003	0.5030	2.6950*	1.7873	–1.6095**
Constant	5.0372	65.5701**	15.2995	–20.4388*

Multinomial Logit parameters:

Multinomial logit (1–4)	*Logit (0–1)*
270 Observations	270 Observations
LR Chi squared = (69),445.84	LR Chi squared (23), 246.31
Prob. > Chi squared, 0	Prob > Chi squared, 0
Pseudo R^2, 0.7794	Pseudo R^2, 0.688
Log Likelihood, –63.105049	Log likelihood, –55.845324

*Statistically significant at the .05 level; **at the .01 level; ***at the .001 level (two-tailed tests).

consist of college graduates (51% and 36%, respectively). Most employers were increasing their reliance on high school–educated technicians. Wire line carriers increased the proportion of their technicians with high-school-only education from 37% in 1998 to 66% in 2003. This reduction in formal education levels was coupled with a considerable expansion in the weeks of qualifying training. This pattern most strongly emerges at the wire line carriers, which increased qualifying training by half, from 61 to 91 weeks. Their firm-specific training was 3 to 7 times longer than that at other networks.

At the same time, the industry shifted toward more flexible contingent employment relations, with statistically significant increases in temporary workers (0% to 7%) and contract employment (1% to 12%) as the annual turnover rate doubled from 4% in 1998 to 8% in 2003. Conversely, there were statistically significant declines in full-time permanent employment. In cable television distribution, where this decline was most severe, the percentage had fallen to 77% by 2003. Statistically significant increases in temporary employment occurred in wireless (from 0 to 1%), cable television (from 0 to 22%), wire line carriers (from 0% to 3%), and ISPs (from 0 to 2%). Large and statistically significant increases in the percentage of the work force consisting of subcontracted technicians also occurred between 1998 and 2003 among cable television providers (from 1% to 29%), wire line carriers (from 1% to 8%), and ISPs (from 1% to 20%). The percentage of employees in the industry who had less than one year of tenure declined

from 14% to 8%; however, this number increased in cable television, from 12% to 22%, as cable television increased its rate of annual turnover to 25%. While the use of layoffs grew at wireless carriers from 0% to 21%, there was no statistically significant overall increase in the use of layoffs to adjust the work force.

The former Bells are noteworthy both because they were the only company segment with a statistically significant number of technician retirements and because more than one-third of their technicians were due to become retirement-eligible in the five years following each survey. As of 2003, those prospective retirees remained participants in some of the last defined benefit pension plans in the industry. In 2003, most technicians in wireless companies (60%) and ISPs (72%) worked in network control centers or offices, while most wire line (78%) and cable television technicians (94%) worked in the field. On average across the telecommunications sector, exempt employees constituted only about 10% of the technical work force in 2003, although at the ISPs the figure was 35%.

In summary, the industry's employment practices for technicians changed in important ways between 1998 and 2003. There was a shift to performance-based pay, increased electronic monitoring, increased reliance on technicians with only a high school education, and an expansion of on-the-job training. The most important shift came as employers increased flexible and contingent working arrangements in response to the softening of the labor market after 2000. The proportion of contract workers and temporary employees then increased, the proportion of full-time permanent employees declined, and turnover rates rose. Nonetheless, these general trends obscure considerable variation at the network and workplace levels of the employment system.

Analysis of Network Employment Practices and Systems

In order to more systematically investigate the various patterns of practices and rules across the different networks, a multinomial logit is estimated on the combined 1998 and 2003 samples. I operationalize the model by using detailed employment practices to predict network identity. The omitted category in the multinomial model is the wire line carriers, which account for the largest number of observations and also made up the original telecommunications employment system. Each employer entering the telecommunications business could have chosen all or some combination of the wire line carriers' employment practices.

The multinomial logit and logit estimates are reported in Table 3a. Table 3b reports the multinomial logit marginal effects evaluated at the means of each independent variable for each of the four networks. The models' log-likelihood ratio chi squares are statistically significant, with a pseudo R-squared of .78 for the multinomial logit and .68 for the logit. The results provide statistically significant and unique estimates by each network. The marginal effects estimates confirm that each network's employment practices were unique. All else equal, compared to other telecommunications technicians, those in wireless services were less likely to occupy network control jobs, to participate in employee task forces, to receive training, to be union members, and to work with contract employees; they were more educated and worked longer hours per week than other technicians, and they were more likely to be members of self-directed work teams and to have under ten years of tenure with their employers. Cable television distribution network technicians, in contrast, earned statistically significantly less pay than their counterparts in other telecommunications industry segments, worked for companies that offered fewer service options, and experienced greater turnover (37% higher); they were more likely to use a company cell phone, more likely to be electronically monitored, much less likely to work with a computer on the job, and less likely to participate in employee task forces. The ISP employers, like cable employers, provided fewer service options than was characteristic across the industry as a whole. Compared to other technicians, ISP technicians were more educated, more likely to be nonunion, lower-tenure, and subject to higher turnover (all statistically significant effects).

Table 3b. Multinomial Logit Model: Marginal Effects Computed at Mean Values.

Variable	*Wireless*	*Cable TV*	*ISP*	*Local*
Network Office Technician	–0.1440***	0.0105	–0.0245	0.1580
Computer Use on Job	0.1337**	–0.1324**	0.0623	–0.0636
Company Cell Phone	–0.0408	0.1457**	–0.0876	–0.0172
Percent Network Digital	–0.0759	0.1123	0.0533	–0.0898
Number of Services	0.0083	–0.0418***	0.0359***	–0.0024
Ln (Average Annual Pay)	–0.0640	–0.0941	0.2097**	–0.0516
Percent Pay Incentive-Based	0.0477	0.0285	–0.1126	0.0364
Electronic Monitoring	–0.0168	0.1050	–0.1354**	0.0472
Employee Participation	–0.2028***	–0.1030**	0.2127***	0.0931**
Self-Directed Teams	0.1134***	–0.0420	–0.0844	0.0130
Weeks of Qualifying Training	–0.0012**	0.0003	0.0011***	–0.0002
Education	0.0408**	–0.0129	–0.0544***	0.0265*
Unionization	–0.1181	0.0204	0.2225	–0.1249
Employees with Less Than 1 Yr.	0.0154	–0.2478*	0.1741	0.0583
Employees with Less Than 10 Yrs.	0.1298	0.0346	–0.1996***	0.0353
Employees to Retire in 5 Yrs.	0.2093	–0.8567*	0.8398***	–0.1924
Weekly Hours of Work	0.0112***	–0.0072*	–0.0065	0.0025
Layoff Percent	0.0880*	–0.1626	0.0111	0.0636
Annual Turnover	–0.3283	0.3711***	–0.2036	0.1607
Temporary Employees	–0.2918	0.7693*	0.4358	–0.9133
Contract Workers	–0.7092*	0.2093	0.3508	0.1490
Core Size	0.0001	0.0000	0.0003	–0.0004
Year 2003	–0.0147	0.0525	–0.0747	0.0369

*Statistically significant at the .05 level; **at the .01 level; ***at the .001 level (two-tailed tests).

A simple logit is also used to display the wire line estimates. The wire line networks offered more service options than other networks. Wire line technicians earned higher pay than other technicians, on average; experienced greater electronic monitoring; had more formal opportunities to participate in workplace task forces; possessed less formal education; were the most likely to be approaching retirement in the next five years; had the lowest turnover; and had the highest rate of unionization.

Increasing Cohesion or Fragmentation of Employment Practices?

Before drawing conclusions about network employment systems, I examine how much of the dispersion in employment practices is explained at the network level to investigate whether the patterns of network employment practices are sufficiently cohesive and interdependent to be called an employment system and whether the variation in employment practices has been increasing or decreasing. Given that the period 1998–2003 witnessed turbulence in telecommunications, with considerable restructuring of firms, networks, and workplaces, this is a period in which we might expect to see important changes in practices.

To examine changes in the dispersion of technician employment practices in the overall telecommunications sector and within each network, Gini coefficients were estimated to standardize the measurement of dispersion for each employment practice. The estimates are reported in Table 4. The average Gini coefficient, which is used to measure employment practice dispersion, grew by 0.4% between 1998 and 2003 within the overall telecommunications industry, a finding that is clearly inconsistent with the convergence hypothesis. The network average Gini coefficients reveal that employment practice dispersion grew within the ISP network by 1% in those years, while decreasing in the cable TV network by 7%, in the local exchange network by 1%, and in the wireless network by 4%.

The results for the ISP sector strongly suggest patterns of network employment practices that are insufficiently cohesive and interdependent to be called a network

Table 4. Gini Coefficients of Establishment Employment Practices by Network, 1998 and 2003.

Network Gini Coefficients	*1998 Overall*	*2003 Overall*	*Difference Gini 03–98*	*1998 Wireless*	*2003 Wireless*	*Diff 03–98 Wireless*	*1998 Cable TV*	*2003 Cable TV*	*Diff 03–98 Cable TV*	*1998 Local*	*2003 Local*	*Diff 03–98 Local*	*1998 ISP*	*2003 ISP*	*Diff 03–98 ISP*
Technology & Services															
Network Percent Digital	0.465	0.385	(0.080)	0.4195	0.2569	(0.1626)	0.4236	0.1512	(0.2724)	0.4578	0.4283	(0.0296)	0.5403	0.2330	(0.3073)
Number of Services	0.261	0.272	0.011	0.1879	0.2288	0.0409	0.3847	0.3956	0.0109	0.2521	0.2120	(0.0401)	0.2109	0.2667	0.0558
Company Laptop	0.580	0.580	(0.000)	0.4280	0.6767	0.2487	0.6231	0.6474	0.0243	0.5260	0.4943	(0.0317)	0.9008	0.9070	0.0061
Computer Use on Job	0.357	0.374	0.017	0.1116	0.1117	0.0001	0.6270	0.6628	0.0358	0.3618	0.2782	(0.0836)	0.0055	0.2223	0.2168
Company Cell Phone	0.665	0.433	(0.233)	0.3748	0.6038	0.2290	0.5555	0.1702	(0.3853)	0.6316	0.4816	(0.1500)	0.9462	0.7326	(0.2135)
Compensation															
Ln (Average Annual Wage)	0.008	0.012	0.004	0.0098	0.0179	0.0082	0.0159	0.0151	(0.0008)	0.0062	0.0084	0.0022	0.0116	0.0237	0.0120
Benefits as Percent of Wage	0.357	0.404	0.047	0.2283	0.3425	0.1143	0.1787	0.2943	0.1156	0.3601	0.4220	0.0619	0.2540	0.5237	0.2697
Percent Pay Incentive-Based	0.780	0.806	0.026	0.4661	0.5390	0.0728	0.5902	0.5893	(0.0009)	0.7901	0.8370	0.0469	0.4813	0.7338	0.2526
Work Practices															
Participation in Task Forces	0.569	0.688	0.119	0.4322	0.5581	0.1259	0.5594	0.7017	0.1423	0.5097	0.6769	0.1672	0.2571	0.3622	0.1051
Self-Directed Teams	0.905	0.895	(0.010)	0.8361	0.7384	(0.0976)	0.8204	0.8976	0.0772	0.9393	0.8932	(0.0461)	0.6111	0.5278	(0.0833)
Education & Training															
Education Level	0.042	0.040	(0.002)	0.0462	0.0425	(0.0037)	0.0509	0.0322	(0.0187)	0.0292	0.0329	0.0037	0.0527	0.0556	0.0029
Weeks of Qualifying Training	0.464	0.468	0.004	0.5729	0.4274	(0.1455)	0.5929	0.4118	(0.1810)	0.4132	0.3873	(0.0259)	0.6023	0.7181	0.1159
Staffing															
Full-Time Permanent Employees	0.001	0.065	0.064	0.0000	0.0117	0.0117	0.0026	0.1333	0.1308	0.0003	0.0324	0.0321	0.0056	0.0579	0.0522
Employees with Less Than 1 Yr.	0.459	0.722	0.263	0.4196	0.4143	(0.0053)	0.5230	0.3497	(0.1733)	0.4443	0.7778	0.3335	0.4489	0.5916	0.1428
Employees with Less 10 Than Yrs.	0.398	0.327	(0.070)	0.1269	0.1335	0.0066	0.1064	0.1316	0.0252	0.3883	0.3414	(0.0468)	0.3218	0.1621	(0.1598)
Percent Retired in Last 5 Yrs.	0.711	0.589	(0.122)	0.5496	0.3051	(0.2445)	0.7442	0.9472	0.2030	0.6500	0.4460	(0.2040)	0.8862	0.9158	0.0295
Percent to Retire in Next 5 Yrs.	0.474	0.497	0.023	0.4114	0.7261	0.3147	0.5421	0.7202	0.1781	0.3738	0.3750	0.0011	0.8972	0.8208	(0.0764)
Annual Turnover (quits+ fired)	0.591	0.692	0.100	0.4679	0.3931	(0.0748)	0.4206	0.4106	(0.0101)	0.5516	0.6010	0.0493	0.6617	0.5958	(0.0659)
Temporary Employees	0.860	0.781	(0.079)	0.9677	0.7147	(0.2529)	0.8918	0.4625	(0.4294)	0.8280	0.8354	0.0074	0.8714	0.7895	(0.0819)
Contract Employees	0.867	0.736	(0.131)	0.9575	0.7147	(0.2428)	0.8793	0.4807	(0.3986)	0.8535	0.7748	(0.0787)	0.9048	0.7786	(0.1262)
Average Weekly Hours	0.052	0.057	0.005	0.0516	0.0236	(0.0280)	0.0330	0.0544	0.0214	0.0519	0.0492	(0.0027)	0.0376	0.0826	0.0449
Layoff Percent	0.840	0.960	0.119	1.0000	0.8665	(0.1335)	0.8764	0.9423	0.0659	0.8151	0.9557	0.1406	0.8739	0.7988	(0.0751)
Electronic Monitoring	0.709	0.558	(0.152)	0.4915	0.3276	(0.1638)	0.8352	0.7734	(0.0618)	0.7111	0.4875	(0.2236)	0.4768	0.4225	(0.0542)
Office Technicians	0.752	0.782	0.030	0.6826	0.4038	(0.2788)	0.9776	0.9418	(0.0357)	0.8063	0.7758	(0.0305)	0.1049	0.2804	0.1754
Exempt Employees	0.935	0.884	(0.051)	0.7066	0.9768	0.2702	0.9937	0.9589	(0.0348)	0.9540	0.8632	(0.0908)	0.7983	0.6490	(0.1493)
Unionization	0.180	0.326	0.146	0.9213	0.7954	(0.1259)	0.9011	0.9400	0.0389	0.0328	0.0921	0.0594	0.9030	1.0000	0.0970
Average (ABS(.5-Gini))	0.5109	0.5127 0.4%	0.002	0.4564	0.4366 –4%	(0.0199)	0.5442	0.5083 –7%	(0.0359)	0.4899	0.4831 –1%	(0.0069)	0.5025	0.5097 1%	0.0071

employment system. Variations in employment practices widened between 1998 and 2003, with an increasingly incoherent pattern. The newer wireless network exhibited some instability as it underwent a process of consolidation through mergers. Both the local exchange carriers and cable TV sectors evinced considerable stability and interdependence, but employment practice variation at the operating and workplace levels was apparent even in these relatively stable sectors. As for inter-sectoral variation in employment systems, it was growing, not lessening.

Pulling It Together: Stability within Change or Change within Stability?

The two legacy employment systems, cable television distributors and wire line carriers, have retained their essential characteristics and may have strengthened their traditional employment systems through corporate consolidations during and since the survey period. Wire line companies retain the Bell System's employment practices and internal labor market structure for technicians. These carriers remain highly unionized, pay relatively high wages, experience low turnover, employ mostly full-time permanent employees through retirement, and provide substantial firm-specific training to high school graduates; they also encourage employee participation in task forces, while electronically monitoring employees who are making greater use of computers on the job. The system continues to boost productivity by close to 6% per year. Nonetheless, wire line companies have sought to increase staffing flexibility by increasing their use of temporary employees and contractors, and have shifted to greater use of performance-based pay at the organizational level, not the individual level.

It is true that wire line companies have sought to enhance staffing flexibility by increasing their use of temporary employees and contractors, and have shifted to greater use of performance-based pay at the organizational level, not the individual level. Nevertheless, the basic features of the Bell System internal labor market persist (see Table 5). Wire line technicians continue to have employer-based career jobs. What has changed is the scope of these internal labor market practices, which as recently as 25 years ago dominated the industry. Career jobs are shrinking, not because of a transformation of the former Bell System's employment practices, but because of wire line's shrinking employment in the telecommunications industry. The newer growing networks have rejected career internal labor markets for technicians without much fear of unionization or technician shortages.

Cable television's low cost–high churn technician employment system remains stable. It persists with lower-pay, high-turnover, high school–educated technicians who work side-by-side with contractors and temporary employees. The companies remain vigilantly anti-union; nevertheless, cable technicians did experience sizeable improvements in pay and benefits during the survey period. Cable technicians make little use of computers, but work on cable television networks has undergone the greatest digital conversion. As cable competes directly with wire line in residential markets for voice, high-speed Internet, and video, the key question remains whether cable's current low-cost system or wire line's higher-cost, high–productivity growth system will prevail.

As the wireless industry consolidates into an oligopoly led by Sprint (which has been faltering), Verizon, and AT&T (which is unionized), each with a market share over 25%, an employment system for technicians has emerged. All else equal, the surveyed wireless establishments in 2003 offered their technicians the lowest pay and benefits in the telecommunications industry. In contrast, their sales jobs are some of the best-paying jobs in the industry. Nonetheless, wireless technicians experience modest turnover and rely more heavily on self-directed teams than do technicians in any other network. They also are the best-educated technicians, receive little training, and have relatively brief tenure. Wireless companies rely mainly on full-time permanent employees who are mostly nonunion. During the survey period, these companies consolidated their operations and resorted to layoffs. While wireless technicians

Table 5. Technician Network Employment Systems Summary.

Technician Employment Conditions	*Wireless*	*Cable Television*	*Wire line Carriers*	*ISP*
Compensation	Lowest Pay and Benefits	Low Pay	High Wages	Declining Variable Pay
Turnover	Modest Turnover	High Turnover	Low Turnover	High Turnover
Work Organization	Self-Directed Teams	Electronic Monitoring	Employee Task Force Participation, Electronic Monitoring	Electronic Monitoring
Education and Training	College or Some College, Little Training	High School	High School, Firm Based Training	Some College
Tenure	Less than 10 Years	Less than 10 Years	More than 10 Years, Retirement	Less than 10 Years
Staffing Practices	Full-Time Permanent Employees, Layoffs	Contractors, Temporary Employees	Full-Time Permanent Employees	Layoffs, Temporary Employees, Contractors
Union	Nonunion	Nonunion	Union	Nonunion
Network		Digital	Most Service Options	
Computers	Laptops, Little Computer Use	Little Computer Use	Computer Use Increasing	Computer Use Declining

make little use of general-purpose computers, some do rely on laptops to perform their jobs. After the survey was completed, AT&T Wireless became completely unionized, and according to Current Employment Statistics data, wireless industry wages have improved enough to rival those in wire line.

As the data indicate, the Internet Service Providers' employment practices became increasingly incoherent and unstable in 2003, as they responded to cost pressures and complaints about their increasingly obsolescent service offerings. They have resorted to substantial layoffs, high turnover, and increasing reliance on contractors to perform their technical operations in the United States. As access networks deploy digital technology and become better able to provide TCP-IP services to residential and business customers, the role of the Internet Service Provider is becoming an artifact of legacy regulations rather than a unique network service competence. As Internet users become increasingly sophisticated, they are also less dependent on their gateway provider. While still providing the critical gateway to the Internet, ISPs face enormous cost pressures, to which they have responded by cutting employment costs through outsourcing offshore, hiring contractors, and resorting to employee layoffs. Even though ISP technicians have some things in common—relatively good education, a nonunion work environment, low tenure, and high turnover, for example—it would be hard to characterize an ISP network employment system. Instead, with rising cost pressures and the non-arrival, as yet, of a business model with a low-cost solution for the U.S.-based ISPs, employment conditions are fragmenting.

Institutional Stability and the Power of Inertia

The main findings of this study are consistent with the predictions of the population

ecology theory of industry and organizational inertia. As discussed earlier, this theoretical perspective posits that profound transformations, almost irrespective of their content, can endanger organizations, with the hazard spiking during the transition. Rational managers may therefore choose not to gamble on such transformations, even when the potential gains are great. In this area of life as in many others, predictability is frequently preferred over high-stakes adventure.

A number of factors in the telecommunications industry generate structural inertia. Factors internal to organizations include large sunk costs in plant, equipment, and personnel, the dynamics of careers and organizational political coalitions, and deeply embedded normative standards based on years of organizational success. External factors also contribute to inertia. In particular, there are legal barriers to exit from some forms of telecommunications activity and substantial economic barriers to entry into well-branded national telecommunications service markets. Finally, attempting any radical structural change could undercut the legitimacy an organization has established through its past successes, precipitating a loss of internal and external institutional support, disrupting a web of organizational interdependencies, and ultimately jeopardizing the organization's survival (Hannah and Freeman 1984).

According to the evolutionary perspective, the historical period of an industry's or organization's founding is critical in shaping its employment system (Baron, Jennings, and Dobbin 1988; Hannan, Burton and Baron. 1996), and changing that employment system will, at least during the transition, adversely affect organizational performance (Baron and Hannan 2002). This historical imprinting (Stinchcombe 1965) is consistent with the main findings for the three facilities-based telecommunications networks.

The Bell System imprint remains firmly in place in the contemporary wire line industry. The hallmarks of the Bell employment system include a highly articulated internal labor market providing employment security with opportunities for promotions and transfers regulated by testing and seniority. The work force, comprised mainly of high school graduates, acquires firm-specific skills and adapts to new technologies largely through substantial formal and on-the-job training. Workers have company-based careers with low turnover and high levels of retirement. This framework enabled the telephone industry to achieve annual productivity gains of over 5% in the post–World War II era, a record surpassing that of all other major industries. The union contracts have provided employees with rising real earnings, employer-funded pensions and health insurance, just cause for discipline and dismissals, and paid time off for vacations, holidays, sick leave, disability, and personal days (Keefe and Batt 1999). A negotiated Quality of Work Life (QWL) program that had over 1,200 QWL groups by 1983 and eventually involved over 100,000 employees (Keefe and Batt 1997) continued under various new names. Pattern bargaining replaced centralized national bargaining after divestiture.

Cable's low-cost, high-churn employment system, which deliberately shunned most of the Bell System's practices, was developed in the late 1970s. The cable television distribution system was a local monopoly, weakly regulated by municipal franchises and intermittent federal oversight. Although the first cable television systems were established in 1948, the industry was reborn when Time launched HBO using a communications satellite in 1975 to distribute its signal to cable system operators throughout the country (Parsons and Frieden 1997). Once cable developed unique content, the lucrative urban and suburban markets opened to cable distribution after a series of judicial and regulatory rulings permitted competition between cable and broadcast television. Cable entered a decade of rapid growth; employment in the industry nearly tripled (Toto 2000); and it is during this decade that a distinct cable distribution employment system emerged, largely shaped by one company, TCI (Tele-Communications Inc.).

TCI, now part of Comcast, became the largest cable operator in the United States through debt financing, aggressive accelerated depreciation methods, complex financial transactions, and corporate governance

practices that vested control in two minority shareholders. TCI's model for metropolitan cable system acquisitions involved renegotiating franchise agreements, reducing the number of channels offered in basic service, removing any innovative features from the network, cutting payrolls in half, and eliminating incumbent unions through asset acquisitions (Robichaux 2002:76). Asset appreciation, not net earnings growth, was TCI's financial objective. TCI spent as little money as possible on employees, service, and cable system upgrades. The focus was on growing the company. TCI became known "for the poor quality of its service and the unresponsiveness of its employees" (Davis 1998:49).

TCI's employment system remains the imprinted model for the cable industry. The work force remains a mix of both employees and contractors, often working side-by-side. Turnover is high; educational requirements and training are minimal; and job security and retirements are non-existent. Wages and benefits are meager. While cable television had, indisputably, established the least-cost employment system, it also had, undeniably, the poorest productivity growth, quality, and customer service record in the communications industry.

Wireless is the newest network. It first offered service in 1982, but not until it could reduce cost of service, improve reliability, and miniaturize its handsets did it become a substantial service provider and a competitor to wire line service. Wireless is not really a network. Wireless providers offer cellular network access. Once a call is received by a cell tower receiver, it is routed into the wire line network to its destination. Wireless service providers employ relatively few technicians for installation, maintenance, and repair. Cell towers are mostly constructed and owned by a single company, American Tower. The major wireless companies have ownership positions and hold long-term contracts with American Tower, which leases tower access for their transmitters and receivers. At cell sites the wireless electronics, receivers, transmitters, and antennas are usually installed by the manufacturers, not the wireless provider. Wireless technicians oversee network operations, perform network maintenance, and repair customers' cell phones in retail establishments. This allows the wireless companies to focus on phone sales and service. Increasingly, this is being accomplished through retail stores owned and operated by the major carriers, with less reliance on third-party vendors. Sales and service employees make up a larger percentage of the work force in wireless (57%) than in any other telecommunications network. Technicians, who constitute a relatively small percentage of wireless employment (7%) (BLS OES 2007), mainly work in either network centers or retail stores. The imprinted employment system model in wireless reflects wireless companies' adoption of the best practices of their founding period, the 1990s. Many technicians in this sector, for example, are organized into self-directed teams.

Conclusion: The Future of Stability?

The evolutionary industrial change perspective focuses attention on the critical events in an industry's development, which include the birth and death of firms, the creation of new subsidiaries, mergers, and acquisitions, and cataclysmic crises that force organizations to undertake radical change. In the telecommunications industry the diffusion of network digital technology has already produced a profound crisis in the long-distance market, precipitating the bankruptcies of Global Crossing and WorldCom and the near bankruptcy of Qwest. A substantial retail long-distance market no longer exists. The AT&T and MCI network businesses were respectively acquired by Southwest Bell (now the new AT&T) and Verizon. Global Crossing was liquidated, with its network assets sold. Sprint wrote down its long-distance assets to focus on the wireless market and spun off its residential wire line business into a new company, Embarq, which is being acquired by CenturyTel.

Possibly the research time frame for the analysis reported in this paper is too early to capture a transformation that may eventually develop as a result of market competition and the deployment of residential broadband. Not until recently did residential networks

in telephone wire line, wireless, and cable become competitors. Competition has greatly accelerated. With digitalization, cable offers a triple play of video, Internet, and voice, threatening the survival of wire line providers, which lag behind cable in upgrading their networks. As the cable and telephone companies rush into residential fiber broadband competition, a number of observers and Wall Street analysts are asking how many residential broadband networks can be profitably deployed (Cheng 2006). Do we really need two residential fiber or mixed-fiber networks, where one high-quality network might suffice (Hundt 2003)? The more skeptical analysts predict an inevitable price war that will leave both residential networks in financial ruin, if not bankruptcy.

Wireless networks now dominate voice traffic in the United States, and with text messaging and e-mail, they have begun to challenge the wire line providers for Internet access, particularly with the addition of wireless broadband. The AT&T and Verizon wireless businesses now challenge the viability of the AT&T and Verizon wire line businesses.

The facilities-based telecommunications networks—wire line, cable television, and wireless—developed distinct and divergent network-level employment systems. Corporate consolidations have also reinforced path dependence based on a pattern of institutional imprints, with each network relying on its established employment system in the current competitive and technological environment, so that multiple systems co-exist and compete (Katz and Darbishire 2000). Even when networks, such as AT&T and MCI, have expired and then re-emerged with changes entailed by re-acquisition, the established employment system for the network's technicians has carried forward.

Nevertheless, while these network employment systems retain their distinct historical imprints, some convergent employment practice trends are evident. Between 1998 and 2003, all networks shifted to a moderate increase in performance-based pay, increased electronic monitoring, and increased hiring of technicians who have only a high school education and are prepared for their responsibilities by way of intensive on-the-job training. Network employers also expanded their use of flexible and contingent working arrangements. In particular, sizeable growth in the proportion of contract workers and temporary employees has meant both a smaller proportion of full-time permanent employees and an increase in turnover rates. Only time will tell whether these changes are minor adaptations in stable systems or precursors of more profound changes. What can be said is that currently stable employment systems remain robust in the face of enormous technological and competitive challenges; and an important implication for industrial relations researchers is that the employment system as a theoretical construct remains viable and useful.

Appendix
Network Correlations: Statistically Insignificant Correlations Set to Zero

	1998				*2003*				*Both Years*			
Variable	*Wireless*	*Cable*	*LEC*	*ISP*	*Wireless*	*Cable*	*LEC*	*ISP*	*Wireless*	*Cable*	*LEC*	*ISP*
Technology & Services												
Company Laptop	0	0.4554*	0.2079*	–0.1941*	0	0.5600*	0.3562*	0	0	0.4962*	0.2665*	–0.1690*
Computer Use on Job	0	–0.5187*	0	0.3061*	0	0	0.3759*	0	0.1418*	–0.3567*	0	0.2249*
Company Cell Phone	0.2412*	0.2257*	0	–0.2053*	0	0.4126*	–0.2169*	0	0	0.2722*	–0.1797*	–0.1931*
Network Percent Digital	0	–0.3372*	0	0	0	–0.5188*	–0.4524*	0	0	–0.4101*	–0.2426*	0
Number of Services	0	0.2810*	0	0	0	0	0.3295*	0	0	0.1644*	0.2024*	0
Compensation												
Ln (Average Annual Wage)	0	0	0.2188*	0	–0.2192*	0	0.3477*	0	–0.1220*	0	0.2664*	0
Benefits as Percent of Wage	0	–0.2198*	0.2209*	0	0.1803*	0	0	0	0	–0.1648*	0	0
Percent Pay Incentive-Based	0	–0.1850*	–0.3284*	0.4466*	0	0	0	0	0	0	0	0.1269*
Work Practices												
Electronic Monitoring	0	0	0	0.2587*	0	0.2197*	0.2732*	0	0	0	0	0.1464*
Participation in Task Forces	0	–0.2403*	–0.3831*	0.5089*	0	0	0	0	0	0	–0.1289*	0.3390*
Self-Directed Teams	0	0	–0.2936*	0.3033*	0.1568*	0	–0.1927*	0.2208*	0	0	–0.2481*	0.2702*
Unionization	–0.3189*	0.3658*	0.8506*	–0.5627*	–0.2254*	0.3005*	0.7952*	–0.2194*	–0.2764*	0.3373*	0.8274*	–0.4009*
Education & Training												
High School Only	0	0	0	–0.1999*	–0.2889*	0	0	–0.1635*	–0.1781*	0	0	–0.2099*
Some College	0	0	0.1690*	0	0	0	0	0	0	0	0.1415*	0
Education Level	0.3177*	–0.3745*	–0.4808*	0.4818*	0.4486*	–0.2051*	–0.1935*	0.2196*	0.3640*	–0.3005*	–0.3338*	0.4109*
Weeks of Qualifying Training	0	02217*	0.2659*	–0.1636*	–0.2141*	0.2141*	0.4325*	0	–0.1624*	0.2080*	0.3207*	–0.1447*

Continued

Appendix. *Continued*

	1998				*2003*				*Both Years*			
Variable	*Wireless*	*Cable*	*LEC*	*ISP*	*Wireless*	*Cable*	*LEC*	*ISP*	*Wireless*	*Cable*	*LEC*	*ISP*
Staffing												
Full-Time Permanent Employees	0	0	0	0	0	0.1908*	0.4893*	0	0	0.1272*	0.3593*	0
Employees with Less Than 1 Year	0	0	0	0.1828*	0	–0.2717*	–0.6566*	0	0	0	–0.3088*	0.1912*
Employees with Less Than 10 Years	0.2356*	0	–0.4774*	0.2484*	0.1981*	–0.5531*	–0.5197*	0.2086*	0.2175*	–0.2925*	–0.4919*	0.2239*
Percent Retired in Last 5 years	0	0.3106*	0.2992*	–0.2108*	–0.1595*	0.2079*	0.5081*	0	0	0.2365*	0.2427*	–0.1193*
Percent to Retire in Next 5 years	–0.1810*	0.2086*	0.4433*	–0.2644*	0	0	0.5284*	–0.1616*	–0.1669*	0.1805*	0.4802*	–0.2202*
Layoff Percent	0	0	0	0	0	0	0	0	0	0	0	0
Annual Turnover (quits + fired)	0	–0.2126*	–0.2784*	0	0	–0.3216*	–0.6007*	0.1530*	0	–0.2545*	–0.4785*	0
Temporary Employees	0	0	0	0	0	0	–0.4576*	0	0	0	–0.3349*	0
Contract Employees	0	0	0	0	0	0	–0.3265*	0	0	0	–0.2513*	0
Average Weekly Hours of Work	0	0.1960*	0	0	0	0	–0.2971*	0	0	0.1290*	0	0
Office Technicians	0	–0.8582*	–0.2818*	0.4526*	0.2059*	–0.7136*	0	0.1852*	0	–0.7985*	–0.1451*	0.3757*
Exempt Employees	0.1757*	0	–0.1665*	0.1658*	0	–0.2926*	0	0	0	–0.1949*	0	0.1254*
Group Size												
< 15	0	0	0	0.1666*	0	0	0	0.2129*	0	0	–0.1121*	0.1686*
15–60	0.3077*	0	–0.2412*	0	0	0	–0.1682*	0.2417*	0.1555*	0	–0.2172*	0
61–150	0	0	0	0	0	0	0	0	0	0	0	0
> 150	–0.1545*	0	0.2256*	0	0	0	0	–0.1791*	–0.1158*	0	0.2034*	0
Size	–0.1829*	0.2000*	0.3836*	–0.2209*	0	0	0.2064*	–0.1754*	–0.1598*	0.1364*	0.3316*	–0.1579*
Observations	17	23	94	37	20	40	101	17	37	63	195	54

*Statistically significant at the .01 level.

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