

INFORMATION TECHNOLOGY AND THE  
EMPLOYMENT RELATIONSHIP:  
AN EXAMINATION OF THE ADOPTION AND USE OF  
ELECTRONIC HEALTH RECORDS

by

Adam Seth Litwin

B.S. in Economics, Wharton School, University of Pennsylvania, 1998

B.A. in American History, University of Pennsylvania, 1998

M.Sc. in Industrial Relations, London School of Economics, 1999

Submitted to the Alfred P. Sloan School of Management  
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2008

© 2008 Massachusetts Institute of Technology. All rights reserved.

Author .....  
Alfred P. Sloan School of Management  
July 11, 2008

Certified by .....  
Thomas A. Kochan  
G.M. Bunker Professor of Management and Engineering Systems  
Chair, Thesis Committee

Accepted by .....  
Ezra W. Zuckerman  
NTU Associate Professor of Strategic Management  
Chair, Sloan Doctoral Program

THIS PAGE INTENTIONALLY LEFT BLANK

**Information Technology and the  
Employment Relationship:  
An Examination of the Adoption and Use of  
Electronic Health Records**

by  
Adam Seth Litwin

Submitted to the Alfred P. Sloan School of Management  
on July 11, 2008 in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy

**Abstract**

This dissertation advances theory on the interplay of workplace technological change and features of the employment relationship to inform an active policy debate. In particular, many connect US healthcare’s lackluster economic performance—both historically and relative to other industries—to its apparent reluctance to adopt electronic health record (EHR) systems. Drawing on management and employment relations theory as well as a multi-method field study of a large-scale healthcare provider, I first demonstrate that performance improvements depend not on the technology *per se*, but rather on the concomitant adoption of both the information technology (IT) and the rest of its reinforcing work system. In line with prior research, the work system includes workplace-level employment practices like teamwork and training. However, I advance our understanding of these complementarities by showing that their emergence depends on the scope of participatory structures included in the work system. Irrespective of how engaged workers are in the IT initiative, participation only complements the effectiveness of the EHR system where workers could 1.) renegotiate IT-engendered changes in the terms and conditions of employment, and 2.) influence the configuration and deployment of the technology.

Based on these findings, IT adoption does not ensure improved performance, implying a shortcoming in policies promoting the diffusion of EHRs rather than the adoption of EHR-inclusive work systems. Drawing once again on both theory and the field study, I propose that only certain medical practices—most notably, those that finance patient care on a prepaid or “capitated” basis—internalize the benefits of EHR investment. Therefore, physicians affiliated with such organizations are more likely to report that their practice adopted the technology along with financial incentives to encourage its optimal use. Those practices whose IT adoption cannot be explained by their business strategy will be less likely to introduce the requisite incentives. Econometric evidence derived from a nationwide sample of physicians finds strong support for these hypotheses. Therefore, this dissertation warns of the imminent decoupling of EHR technology from its work system while advancing management and employment relations theory.

Thesis Committee Chair: Thomas A. Kochan  
Title: G.M. Bunker Professor of Management and Engineering Systems

Thesis Committee Member: Erik Brynjolfsson  
Title: Schussel Family Professor of Management

Thesis Committee Member: Emilio J. Castilla  
Title: W.M. Young Assistant Professor of Management

Don't give up.  
Don't ever give up.

---

Jim Valvano

You'll see it's all a show,  
keep 'em laughing as you go.  
Just remember that the last laugh is on you.

---

Eric Idle

THIS PAGE INTENTIONALLY LEFT BLANK

# Contents

<b>List of Figures</b>	<b>9</b>
<b>List of Tables</b>	<b>11</b>
<b>1 Introduction and Overview</b>	<b>13</b>
Introduction . . . . .	13
Information Technology and the Employment Relationship . . . . .	18
The Industry and the Case . . . . .	19
The Healthcare Industry and Electronic Health Records . . . . .	19
Kaiser Permanente and KP HealthConnect . . . . .	22
Kaiser Permanente’s Labor Management Partnership . . . . .	24
Empirical Overview . . . . .	26
The Scope of Workforce Participation . . . . .	26
Physicians’ Access to Health IT . . . . .	27
Collective Contributions . . . . .	27
References . . . . .	28
<b>2 Information Technology and the Scope of Workforce Participation: Examining Two Components of an Electronic Health Record System</b>	<b>35</b>
Introduction . . . . .	35
Technological Change in Pluralist Industrial Relations . . . . .	37
Historical Context . . . . .	38
The Scope of Workforce Participation and the Employment Context for New Technologies . . . . .	39
The Case of Two Technologies in One Organization . . . . .	47
Primary Care in the Northwest Region . . . . .	47
Organizational Challenges in the Northwest . . . . .	49
Data . . . . .	53
Qualitative Data . . . . .	53
Quantitative Data . . . . .	53
Results . . . . .	57
Qualitative Evidence . . . . .	57
Quantitative Evidence . . . . .	69
Discussion . . . . .	92
Conclusion . . . . .	95

References . . . . .	96
<b>3 Physician Employment Relationships and the Diffusion of Health Information Technology</b>	<b>101</b>
Introduction . . . . .	101
A Qualitative Illustration: IT at Kaiser Permanente . . . . .	103
Theory and Hypotheses . . . . .	105
Strategic and Organizational Drivers of IT Adoption in Outpatient Healthcare . . . . .	106
Diffusion of Health IT . . . . .	110
Decoupling of Health IT from Its Reinforcing Work System . . . . .	113
Methods . . . . .	116
Sample . . . . .	116
Measures . . . . .	117
Hypothesis Testing . . . . .	119
Results . . . . .	120
Access to Health IT . . . . .	123
Incentives for Physician Use of Health IT . . . . .	132
Disconnecting IT from Its Larger Work System . . . . .	132
Discussion & Conclusion . . . . .	138
References . . . . .	141
<b>4 Conclusion</b>	<b>147</b>
Introduction . . . . .	147
The Scope of Worker Involvement . . . . .	148
Key Findings . . . . .	148
Questions for Further Research . . . . .	148
Alignment of Strategy, IT, and Work Systems . . . . .	150
Key Findings . . . . .	150
Questions for Further Research . . . . .	151
References . . . . .	152



# List of Figures

1-1	Plant-Level Measures of Productivity and Quality as a Function of Indices of Automation and Production Organization for Global Automobile Manufacturers . . . . .	15
1-2	Performance Impact of Information Technology Before and After Accounting for Features of the Employment Relationship . . . . .	17
2-1	Conceptual Framework for Study of the Employment Relationship with Respect to Workforce Participation in Technological Change . . . . .	41
2-2	Interior View of Tualatin Medical Office in Tualatin, Oregon with Localized Waiting Areas Looking Down on Central Waiting Area, Member Services, and a Pharmacy . . . . .	49
2-3	The “Complete Panel View” of Kaiser Permanente’s Panel Support Tool	64
2-4	Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Clinic’s Mean Value for the Engagement Index . . . . .	76
2-5	Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Share of the Clinic’s Workforce Reporting the Presence of a Super-User . . . . .	77
2-6	Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Share of the Clinic’s Workforce Introduced to the Technology by a Fellow Member of the Bargaining Unit . . . . .	78
2-7	Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Clinic’s Mean Value for the Share of the Clinic’s Workforce Receiving Follow-Up Training from a Fellow Member of the Bargaining Unit . . . . .	79
2-8	Performance Impact at Go-Live for KP HealthConnect Administrative Module as a Function of Clinic’s Mean Value for Worker Wholeness .	82
2-9	Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for the Engagement Index . . . . .	83
2-10	Performance Impact at Go-Live for the Panel Support Tool as a Function of the Share of the Clinic’s Workforce Reporting the Presence of a Super-User . . . . .	84

2-11	Performance Impact at Go-Live for the Panel Support Tool as a Function of the Share of the Clinic’s Workforce Introduced to the Technology by a Fellow Member of the Bargaining Unit . . . . .	85
2-12	Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for the Share of the Clinic’s Workforce Receiving Follow-Up Training from a Fellow Member of the Bargaining Unit . . . . .	86
2-13	Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for Worker Wholeness . . . . .	89
3-1	Distribution of $f(x)$ with Threshold Separating Adopters from Non-Adopters . . . . .	107
3-2	Physicians’ Reported Access to Seven Health information technology (IT) Applications Serving as Components of an Electronic Health Record System . . . . .	123
3-3	Physicians’ Adoption of the E-Prescribing Component of an Electronic Health Record System, with and without Ownership Incentives . . . .	137

# List of Tables

2.1	Highlights of the KP HealthConnect Effects Bargain Between Kaiser Permanente and the Coalition of Kaiser Permanente Unions . . . . .	48
2.2	Sources Drawn on to Construct Quantitative Data on Clinics, Workers, and Patients at Northwest Kaiser Permanente’s Outpatient Medical Clinics . . . . .	54
2.3	Workforce Participation for Each of Two Applications of an Electronic Health Record System for Primary Care Support Staff in Kaiser Permanente’s Northwest Region . . . . .	65
2.4	Means for Employment Relations Measures for Two Modules of an Electronic Health Record System . . . . .	73
2.5	Descriptive Statistics for Independent, Control, and Dependent Variables	74
2.6	Coefficients (and z-statistics) for Random Effects Regression Estimates of Patient Satisfaction with the Length of the Phone Call Required to Make An Appointment Over Time as a Function of Variables Describing Information Technology and Employment Relations Context . . .	81
2.7	Coefficients (and z-statistics) for Estimates of Compliance Rates for Cancer Screenings Over Time as a Function of Variables Describing Information Technology and Employment Relations Context . . . . .	87
2.8	Coefficients (and z-statistics) for Location Fixed-Effects Count Models of the Number of Patients Undergoing Lab Testing in a Given Month as a Function of Information Technology and Employment Relations Context . . . . .	91
3.1	Descriptions of Independent and Dependent Variables . . . . .	118
3.2	Sample Means for Independent and Dependent Variables . . . . .	122
3.3	Coefficients (and z-statistics) for OLS and Multilevel Linear Regression Models of a Physician’s Level of IT Adoption as a Function of Variables Describing His or Her Medical Practice . . . . .	125
3.4	Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Primary Care Physician’s Likelihood of Adopting an IT Application for E-Prescribing Medication . . . . .	129
3.5	Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Primary Care Physician’s Likelihood of Adopting Each of Seven IT Applications Serving as Components of an Electronic Health Record System . . . . .	130

3.6	Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Specialist Physician’s Likelihood of Adopting Each of Seven IT Applications Serving as Components of an Electronic Health Record System . . . . .	131
3.7	Coefficients (and z-statistics) for Random Effects Linear Probability Regression Models Predicting the Impact of Prepayment on the Incidence of Physicians’ Incentives for Those Physicians in Practices with 10 or More Doctors . . . . .	133
3.8	Coefficients (and z-statistics) for Random Effects Linear Probability Regression Models Predicting the Impact of Prepayment on the Incidence of Physicians’ Incentives for Those Physicians in Practices with Fewer than 10 Doctors . . . . .	134
3.9	Transitional, Marginal, and Conditional Probabilities Describing Physicians’ Adoption of Seven IT Applications and the Coincidence of Incentives for Quality Care Delivery . . . . .	135

# Chapter 1

## Information Technology and the Employment Relationship: Introduction and Overview

It is now widely accepted that features of the employment relationship mediate the performance effects of workplace information technology (IT). Econometric evidence demonstrates that the right mix of participatory employment practices and work reorganization complements IT (e.g., Bertschek and Kaiser, 2004; Brynjolfsson, Hitt, and Yang, 2002). On the one hand, this finding reveals the robustness of employment relations and management theory developed around individual industries or specific production practices, almost entirely in manufacturing (e.g., Arthur, 1992; Kelley, 1996; MacDuffie, 1995; cf. Batt, 1999). On the other hand, theorists of industrial or employment relations—defined broadly as the study of all aspects of the employment relationship (Roberts, 1994)—actually have a long-standing literature on workplace technological change, and much of what was asserted by scholars as far back as Slichter (1941) and Chamberlain (1948) has yet to inform our understanding of whether and when IT’s supposed complementarities will obtain.

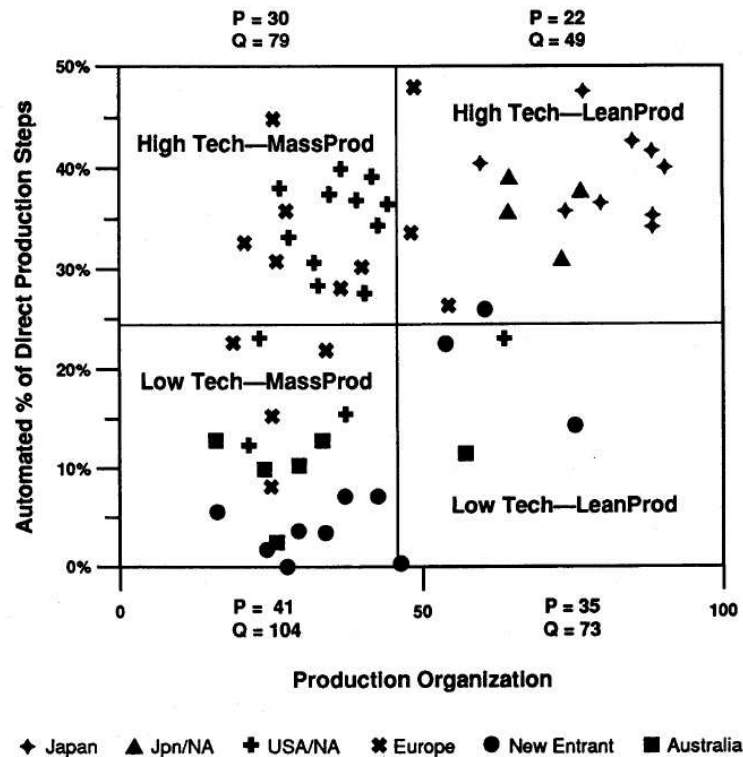
This dissertation seeks to fill this gap by taking an employment relations approach to workplace technological change to diagnose a policy problem and to illuminate the far-reaching phenomenon underpinning it—the application of IT to the production and delivery of healthcare. At first glance, even casual observation points to a sector that has almost singularly declined to invest in IT and has, perhaps coincidentally, delivered poor outcomes relative to other US industries as well as to the healthcare systems of other developed nations (Porter and Teisberg, 2006). This leads to the

conjecture that increased diffusion of health IT, electronic health records (EHRs), in particular, could prove just what the doctor ordered. However, employment relations theory responds with a more-nuanced assessment, contingent on the precise nature and incidence of the work systems required to reinforce the performance potential of this technology. This dissertation offers this response as two studies grounded in the experiences of a single, large-scale, provider and insurer of healthcare. Aside from addressing a genuine concern to policymakers, it advances the field by drawing on and developing employment relations theory originally conceived in the context of earlier technologies. The upshot is a more-nuanced understanding of the circumstances under which workforce engagement bolsters the performance effects of IT.

My research joins two, stylized orientations to workplace technological change to allow for much needed cross-fertilization. Whether one unearths IT's mediation of the link between innovative human resource management (HRM) and productivity (e.g., Ichniowski, Bartel, and Shaw, 2007) or instead uncovers the role of employment practices as a contingency to demonstrate IT's influence on performance (e.g., Bresnahan, Brynjolfsson, and Hitt, 2000, 2002), he or she has identified the same construct—complementarity. Nonetheless, these two paths to complementarity are distinguished by their disciplinary motivations.

Employment relations scholars historically address technological change under the specter of automation's potential for capital substitution. Even far afield from Marxian approaches to technological change from which one expects an air of technological determinism (e.g., Braverman, 1974; Noble, 1984), a more pluralist-oriented literature once looked to collective bargaining (Slichter, Healy, and Livernash, 1960) and now looks more to business strategy (Hunter et al., 2001; Hunter and Lafkas, 2003; Kochan, McKersie, and Cappelli, 1984) as the key determinant of the direction of IT's impact on workers. It is only in the last two decades that theorists of employment relations have sought to justify “high road,” technological empowerment over “low road,” technological displacement on the basis of its business case rather than its moral one. The US automobile industry provided the initial evidence. When domestic auto makers sought to imitate their more-productive foreign competitors, they did so by matching high levels of investment in factory automation. American producers did not, however, recast their employment practices in line with the new technology, discovering only later that the key to Japanese success—both at home and in their North American plants—was the mix of new technologies and innovative employment practices that positioned shop floor workers to “give wisdom to the machine” (MacDuffie and Krafcik, 1992). Figure 1-1 reproduces the rather compelling empirical evidence. The

Figure 1-1: Plant-Level Measures of Productivity and Quality as a Function of Indices of Automation and Production Organization for Global Automobile Manufacturers



Source: MacDuffie and Krafcik (1992)

Notes: Productivity, represented by P, is measured as the number of labor hours required to produce a single unit. Quality, shown as Q, is measured as the number of defects per 100 vehicles produced.

horizontal axis measures work reorganization and HRM practices and the vertical axis measures the level of automation. As one might expect, performance—measured as productivity (number of hours required to produce a single unit) and as quality (defects per 100 vehicles)—improves along an invisible 45-degree line. Those plants that invested solely in automation performed about as well as those low-automation plants that introduced innovative employment practices without new technology. In fact, plants in the bottom, right-hand quadrant outperformed plants in the top, left-hand quadrant with respect to quality. For the field of employment relations, the upshot was a new perspective on technological change. Not only can the right mix of employment practices shield workers from the potentially ill effects of capital substitution. They can also complement the performance gains arising from the technology.

Those more-centered on the managerial or business consequences of IT and information systems (IS) came across complementarities more deliberately, the result

of an explicit hunt for explanations. When Robert Solow (1987) quipped, “You can see the computer age everywhere but in the productivity statistics.”, these scholars responded with attempts to explain the apparent “productivity paradox.” Figure 1-2a captures some of what motivated this research—a generally positive, but somewhat weak and extremely noisy association between IT investment and economic performance. Studies were guided by theory suggesting that computers, much like earlier general purpose technologies, boost productivity by enabling entirely new production methods (David, 1990), but that anticipated gains would only be realized with parallel, complementary investments in new work systems (Milgrom and Roberts, 1990). As Figure 1-2b shows, meticulous collection of disaggregated data on investments in IT as well as the incidence of certain employment practices and organizational reforms, including the restructuring of work and production (Brynjolfsson, Hitt, and Yang, 2002), revealed sizable gains from IT outlays—returns large enough to justify IT’s increased share of investment (Stiroh, 2002) and to dispose altogether with the supposed paradox.

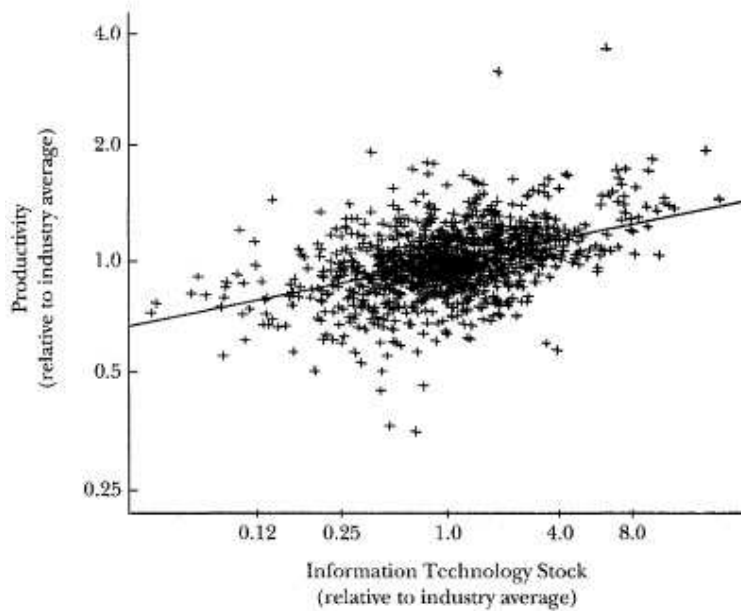
Though distinct paths delivered employment relations, on the one hand, and management and IT, on the other, to the same destination, it is time for these two fields to exchange observations and lessons learned along the way. Such an exchange will advance theory and research on both fronts. For example, juxtaposing those studies referenced in Figure 1-2 with the findings of Caroli and van Reenan (2001) reveals a discrepancy with deep, theoretical implications for the IT literature. The latter study does not identify a complementary effect of employment relations with respect to the IT performance link. However, the employment relations literature on technological change offers a testable theory that could eliminate an important source of unobserved heterogeneity in large- $n$ , production function estimates, one I take up in Chapter 2.

The potential benefits of this cross-fertilization for those who study the employment relationship may be even greater. Studies have made great inroads both theoretically and empirically in linking employment practices to organizational performance (e.g., Guthrie, Spell, and Nyamori, 2002; Huselid, 1995; Ichniowski, Shaw, and Prenzushi, 1997; Panayotopoulou, Bourantas, and Papalexandris, 2003) and in explaining the association between particular business strategies and the employment practices they necessitate (Arthur, 1992; Youndt et al., 1996). Even as strategic HRM’s proponents build a case for re-casting workers and the human resource (HR) function as something strategic (Becker and Huselid, 1998; Wright and McMahan, 1992; Wright and Boswell, 2002), numerous studies have raised doubts over where

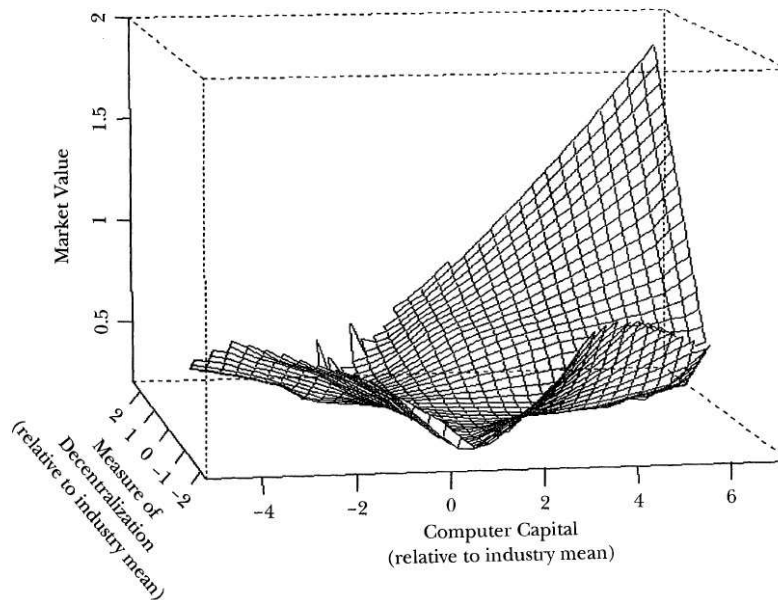


Figure 1-2: Performance Impact of Information Technology Before and After Accounting for Features of the Employment Relationship

(a) Productivity vs. Information Technology Stock (Capital Plus Capitalized Labor) for Large Firms (1988-1992), Adjusted for Industry



(b) Market Value as a Function of Information Technology and Work Organization



Source: Brynjolfsson and Hitt (2000) and Brynjolfsson, Hitt, and Yang (2002).

Notes: The top sub-figure is a scatterplot of predicted values from OLS estimates. The bottom sub-figure charts fitted values from a series of estimated nonparametric local regression models.

the returns to innovative employment practices actually accrue (e.g., Cappelli and Neumark, 2001; Freeman and Kleiner, 2000; Levine and Tyson, 1990). Nevertheless, organizationally-grounded, multi-method approaches, with their careful accounting for production technology and work reorganization, find consistent support for the performance benefits of “high road” employment practices (e.g., Ichniowski, Bartel, and Shaw, 2007; MacDuffie, 1995). The IT literature argues for an even more serious consideration of the relationships between business strategy, technology strategy, and features of the employment relationship. Hitt and Brynjolfsson (1997), for example, show that those firms investing in IT are also reforming employment relations, and follow-up studies reveal patterns in terms of the business strategies chosen by organizations making these concomitant investments in human and technological capital (Bresnahan, Brynjolfsson, and Hitt, 2000, 2002). These call for more nuanced, contingent theory in strategic HRM, theory that helps explain why different organizations get different results from seemingly identical sets of employment practices (Delery and Doty, 1996). Chapter 3 makes strides toward this goal by examining strategic and institutional determinants of investments in both IT and reinforcing employment practices.

## Information Technology and the Employment Relationship

This study follows Dewett and Jones (2001) by using the label “information technology” to refer to business-targeted software platforms and database systems as well as to the hardware and networking peripherals that connect systems to one another and to end-users. At first glance, this leads one to conceive of IT as a deterministic artifact devoid of human agency, much more indicative of the IT literature (e.g., Mukhopadhyay, Rajiv, and Srinivasan, 1997) than of the approach typically taken by scholars of work and employment or of organizations (Orlikowski and Barley, 2001). However, this is done specifically to differentiate IT *per se* from IT as part of a larger, reinforcing work system inclusive of the IT itself as well as the management methods, work organization, employment practices, and other features of the employment relationship (Appelbaum and Batt, 1994) in which the technology is embedded.

Chapters 2 and 3 each examine a subset of the industrial relations structures and processes that flesh-out a work system. Both studies draw on individual- or worker-level data. However, the dissertation’s problem-solving orientation invokes

the employment relationship rather than the individual or the organization as the appropriate unit-of-analysis (Kochan, 1999). Collectively, the analyses consider forces acting both upon and within organizations, drawing on data representative of a wide range of stakeholders in outpatient healthcare, e.g., patients, support staff, and physicians. The implications of the studies also transcend any single stakeholder, instead spanning the range of actors and organizations impacted by changes in the nation's policies and systems for the delivery of healthcare.

## **The Industry and the Case**

### **The Healthcare Industry and Electronic Health Records**

The poor performance of the healthcare industry in the US has been well-documented. Since 2000, premiums have risen at twice the rate of inflation and at five times the rate of real wages. By international standards, the US spends fifty percent more per-capita on healthcare than any other country, while realizing above average rates of medical errors and of infant mortality and below average life expectancies, all while generating the largest uninsured population of any industrialized nation (Kaiser Family Foundation, 2004, 2005, 2007). With its designation as a threat to American competitiveness, the solvency of state and federal budgets, and the health and well-being of workers, policymakers and managers, among others, now take seriously the prospects for healthcare reform. And, most proposals reserve a central role for health IT, particularly, EHRs.

Health information technology is the label applied to those IT applications employed in the healthcare context, whether the information being processed is clinical, financial, or administrative in nature (Bower, 2005). These applications frequently serve as components of an EHR system. EHR systems, at a minimum, store current and historical patient information. They often include clinical decision support (CDS) to alert providers with patient-specific reminders and treatment-related guidance and a clinical data repository (CDR) for secure and convenient access to patient records. An EHR system might incorporate channels that facilitate provider-patient communication, usually via secure web connection or email. This feature is commonly labeled a personal health record (PHR). Automated patient reminders and other personalized health information of value to the patient (or in the case of 90 year-old patients, their 60 year-old children) also falls under the PHR function. Even with all of these features in place, an EHR system becomes even more valuable when joined

with Computerized Physician Order Entry (CPOE). CPOE functionality enables a process whereby physicians' instructions regarding the treatment of patients under their care are entered electronically by the physician and communicated directly to the responsible providers—specialists, lab technicians, etc. One element of this is the “e-prescribing” of medications. Another upshot of CPOE would be the automated insertion of physician-ordered lab test or imaging results into the patient’s EHR. Enabling CPOE functionality facilitates what clinicians refer to as “closing the loop,” a construct rarely realized in the world of paper records. Without an EHR system, physicians can never really know whether or not a patient has followed a physician’s “order” to seek lab tests, pick up a prescription, or take some other action unless the clinician witnesses it personally.

Neither the policy nor healthcare communities has converged on a universal, precise definition of EHRs or EHR systems. Bower (2005), for example, operationalizes the EHR construct based on answers to questions regarding CDSs, PHRs, and CDRs, despite the Institute of Medicine’s (2003) enumeration of eight “core functionalities” that should be required of EHR systems. There has also been confusion discerning between EHRs and electronic medical records (EMRs). Much, but not all of this is semantic. If doctors simply took their existing paper records, scanned them, and had them digitized, say with optical character recognition (OCR) technology, the result would be an EMR. However, many argue that EHRs meet three specific requirements not necessarily met by EMRs. First, an EHR collects data from multiple sources—administration, billing, specialists—and stores it centrally on a patient-by-patient or person-by-person basis. Second, an EHR serves as the primary source of information for clinicians at the point of care, where clinicians enter mainly *discrete* or *structured* data, with minimal use of free form text. Finally, EHRs can be distinguished from EMRs in their provision of evidence-based decision support. This support must be both clinically and professionally context-sensitive. In other words, the information that is provided should be relevant to the specific patient and to the specific modality being addressed by the particular provider interacting with the technology.

Witnessing the challenges to measuring EHR diffusion, the health IT research and policy communities prioritized accurate and consistent accounting of existing EHRs as a prerequisite to credible research linking EHRs to health or business outcomes (Singerman, 2005). Nonetheless, circumstantial evidence certainly leads one to believe that the diffusion of health IT applications could reverse the industry’s record of poor performance. According to Porter and Teisberg (2006), IT investment per worker in the healthcare sector averages about \$3,000 per year, a fraction of the pri-

vate sector average of \$7,000 and an even smaller share of the \$15,000 per-worker indicative of other “information-intensive” sectors such as retail banking. By 2003, conservative estimates suggested that 80-85 percent of patient medical records were still paper-based (Goldsmith, Blumenthal, and Rishel, 2003). Two years later, the most comprehensive study of IT diffusion reported that only 16 percent of US medical practices had transitioned away from paper (Bower, 2005), all in the wake of economy-wide analyses of industry-level data showing that IT investment co-varies positively with productivity and productivity growth (Jorgenson and Stiroh, 1999; Oliner and Sichel, 2000).

It is wrong to believe that EHRs—no matter how well they are implemented—will instantly reverse the industry’s downward spiraling performance record. After all, researchers offer numerous, interconnected explanations for US healthcare’s skyrocketing costs and resulting inefficiencies, including a population that is aging, obese, and inert. They also note the burden of administrative overhead, increased prevalence of chronic diseases, medical errors, and an increased demand for the latest prescription drugs and medical technologies—irrespective of their demonstrated efficacy (e.g., Halvorson and Isham, 2003; Mehrotra, Dudley, and Luft, 2003; Porter and Teisberg, 2006). Nonetheless, a closer look at the specific role IT could play in this industry lends further support to the belief that policies hastening the diffusion of health IT could improve industry performance. Increased use of IT could reduce medical errors, which kill 98,000 Americans annually—slightly more than breast cancer, acquired immune deficiency syndrome (AIDS), or motor vehicle accidents (Institute of Medicine, 2000). Moreover, IT could be leveraged towards the improved management and outright prevention of chronic diseases. By one account, chronic care costs exceed 80 percent of the nation’s annual healthcare bill (Anderson and Knickman, 2001). Much of these costs—both in dollars and discomfort—are avoidable. According to one account, “solid medical science” makes clear, for example, that for those who have suffered a heart attack, the administration of inexpensive beta blockers would reduce their likelihood of a second heart attack by more than 40 percent. However, only about 60 percent of those that should be on beta blockers actually are (Halvorson and Isham, 2003). Along the same lines, early-stage detection and treatment of Type 2 diabetes reduces the likelihood of crippling or fatal—and thus, costly and uncomfortable—complications. Inadequate treatment for pneumonia kills 10,000 patients per year. A shift to widely-agreed-upon best practices for treating hypertension would spare 68,000 lives every year. Unfortunately, physicians are frequently unaware of established best practices. Overall, best practice compliance rates

hover at just 55 percent (McGlynn et al., 2003). Even when providers are aware of best practices, they lack the requisite information to seek-out at-risk patients and to deliver preventive treatment. Finally, significant savings accrue from reductions in the “utilization of care” (Chaudhry et al., 2006). That is, the adoption of EHR systems should reduce demand for unnecessary or duplicative diagnostic and laboratory services (Garrido et al., 2005). It should also allow for the substitution of lower-cost telephone and secure messaging encounters for more costly, in-person office visits (Zhou et al., 2007). According to one study, a system of fully-integrated, interoperable, EHRs could generate \$81 billion in annual savings (Hillestad et al., 2005).

## **Kaiser Permanente and KP HealthConnect**

The analyses in this dissertation center around a single organization, Kaiser Permanente, and its experience developing and deploying its own EHR system, KP HealthConnect. What is commonly labeled “Kaiser Permanente” is actually not one organization, but two. The Kaiser Foundation Health Plans, the health insurer, annually renews its agreement with its medical arm, the Permanente Medical Group (PMG), and each of the regional PMGs provides medical services exclusively to Kaiser members. It is these two, contractually-linked organizations—Kaiser and Permanente—that coalesce to form the entity we label “Kaiser Permanente,” or more simply, “Kaiser.” With its roughly 8.7 million members, 32 hospitals, 421 medical office buildings, 160,000 employees, and 13,000 physicians blanketed through much of the country, Kaiser serves as the largest managed care network in the US. Both lead organizations, and thus, the Kaiser entity, are based in Oakland, California. The structure is reproduced in each of eight regions, providing each its own organizations for the health plan and the medical group. For example, Kaiser Foundation Health Plan of the Northwest and Northwest Permanente, PC, collectively labeled Kaiser Permanente of the Northwest (KPNW), serve the region examined in-depth in Chapter 2. Larger regions are further divided into “service areas,” where the two-part structure occurs once again. In some regions, the Kaiser health plans also own and operate one or more hospitals.

Kaiser’s EHR system, KP HealthConnect, is an amalgam of Kaiser-configured software modules developed by Epic Systems Corporation, a Madison, Wisconsin-based software developer. Once fully-deployed, it will include the full complement of interoperable, administrative and clinical health IT applications described above. By

the end of 2007, Kaiser members across all eight regions could set up their own PHR account through which they could access lab results, medical records, and patient-directed clinical content. The application also enables patients to make and change appointments, refill prescriptions, review their health plan benefits and account information, and exchange secure messages with their providers. As of May 2008, all eight of the regions report providing their patients an outpatient EHR and nearly all Kaiser medical offices have transitioned from paper-based or regional legacy systems to the KP HealthConnect outpatient administrative module, an application used for scheduling appointments and for patient check-in and check-out.

KP HealthConnect was not meant to automate or facilitate existing processes. Instead, CEO George Halvorson intended the technology to occasion a wholesale transformation in the way Kaiser delivered healthcare, one for which EHRs were an indispensable prerequisite and that Kaiser was poised to lead. He and a coauthor articulated this vision in a critique of the healthcare industry just as Halvorson assumed his role at Kaiser.

Real improvement in the quality and consistency of care will require the use of automated medical records that give doctors and patients full information about care and care systems right in the exam room. . . Every other profession makes use of computers to perform these kinds of services. Medicine will soon follow. (Halvorson and Isham, 2003; pp.166-167)

As a reformer, Halvorson believed that the runaway costs and declining care quality detailed above stemmed from the industry's office-visit or "encounter" orientation, where individual problems were disposed of individually. Following this approach, clinicians generally cannot access most historical information on a patient or information gathered by other providers, let alone data on other patients reporting similar symptoms and the success and failure rates of different treatment options. With fully-integrated and interoperable EHRs, providers could deliver consistent, evidence-based care by managing the overall, long-term health of the patient population. This approach, often labeled "population health management," prioritizes prevention over treatment. In situations in which prevention is not possible, it emphasizes a coordinated, active, and once again, evidence-based protocol for managing patients with chronic conditions such as diabetes or congestive heart failure (CHF). As far as Halvorson was concerned, "Most of those terrible CHF crises don't have to happen. Most patients who go through that medical hell do so unnecessarily" (Halvorson and Isham, 2003; p.17).

When Halvorson arrived, Kaiser was well-positioned to enact his reformist agenda. Its integrated structure made it an especially appropriate vehicle for advancing the transformation of healthcare delivery, and thus moving ahead with an investment in KP HealthConnect. Since the Kaiser entity effectively finances the healthcare that it provides, it internalizes the benefits to preventive care and disease management in ways unavailable to most healthcare providers—an argument to be detailed in Chapter 3. EHR deployment could benefit Kaiser in additional ways as well. These also hinged on getting real-time, accurate information to frontline workers. For example, Kaiser was leaving millions of dollars per year “on the table” by failing to “refresh” its Medicare patients. That is, Kaiser was not collecting all of the money to which it was entitled, because it was not complying with the government’s rules for regular, re-demonstration of a patient’s illness burden. Compliance requires that these Medicare patients “check in” with their provider at a pre-determined frequency based on the particular condition, e.g., once per year or per quarter. Without EHRs, a physician has no way of determining, at a point in time, the names and phone numbers of all of his or her patients due for their refresh. Finally, KP HealthConnect would prove an integral ingredient in a larger strategy to expand and improve service delivery. The EHR system would support Kaiser’s new line of high-deductible health plans targeted to individuals. The proliferation of these plans, in addition to the myriad options already available through its traditional, employer- and group-targeted products, yielded a complicated, inconsistent set of co-payments and deductibles. Yet, the revenue arising from cost sharing had grown to become an important source of Kaiser’s income. Frontline staff have to know exactly how far a patient is from reaching his or her deductible and how much a patient’s plan covers for a particular office visit or treatment. Without that information, Kaiser staff instead rely on their own best guesses as well as frequently-outdated information provided by the patient.

## **Kaiser Permanente’s Labor Management Partnership**

One of the central questions motivating this dissertation is how Kaiser’s relationship with its employees affects the success of the KP HealthConnect initiative. Indeed, Kaiser support staff are governed by a unique set of employment structures and processes. Kaiser’s Labor Management Partnership (LMP) is a cooperative arrangement between Kaiser Permanente and thirty union locals representing workers in seven of its eight regions. As of 2008, the Coalition of Kaiser Permanente Unions (CKPU) and thus, the LMP, covers about 86,000 Kaiser employees. The configuration of the



LMP replicates that of its management-side counterparts, creating labor-management “partners” at every level in every region in which the CKPU represents workers. At the apex of the LMP in its Oakland-based office sits a representative from Kaiser—a senior vice president reporting directly to Kaiser’s COO—alongside the CKPU’s director. Similar dyads exist regionally and sometimes, at the sub-regional, “service area” level as well. Partnerships also come about at the national and local levels or even across levels on an ad hoc basis.

Just prior to the bargaining round that resulted in the 2000 agreement, the LMP agreed on principles of employment and wage security. This paved the way for two bargaining rounds, the more recent of which generated the agreement now in operation. Closer to ground-level, LMP-engendered structures for channeling conflict and for facilitating communication between strategic- and workplace-level actors are credited for the success of a handful of Kaiser initiatives, including the opening of a new medical center in southern California and a program of non-trivial service improvements in the Fresno service area.<sup>1</sup> Though the parties may not have realized it at the time, the Partnership’s contributions to these strategic initiatives were small-scale “dress rehearsals” relative to what would be expected of it with respect to KP HealthConnect.

The KP HealthConnect initiative necessitated its own LMP sub-structure. The LMP funds a full-time KP HealthConnect union coordinator to represent the interests of the CKPU with respect to KP HealthConnect’s development, deployment, and ongoing use. As I will detail in Chapter 2, the tenets of the LMP—job and wage security—were spelled out in a national-level KP HealthConnect Effects Bargain. It established the importance of labor to the KP HealthConnect initiative and that KP HealthConnect will advance the interests of the workforce as it advances Kaiser’s goals. It underlined the need for flexibility at all levels in processes and workflows and for the active engagement of labor in developing and implementing KP HealthConnect. In exchange, the document created and funded regional-level KP HealthConnect union representatives to represent labor alongside IT and operations leads at the top of each region’s KP HealthConnect project team. Among other things, it made guarantees with respect to training and preparation as well as a commitment to mitigating the effects of staffing challenges that would inevitably occur in the run-up to implementation.

---

<sup>1</sup>For more details on the LMP, see Eaton, Kochan, and McKersie (2003) and Kochan et al. (2005).

## Empirical Overview

This dissertation draws from two, closely-related studies, each of which is founded on aspects of Kaiser Permanente’s experience with KP HealthConnect. It also includes a short concluding chapter. The first study, Chapter 2, details qualitatively and quantitatively complementarities between IT and the employment relationship in shaping the economic or performance impact of the technology. The second study examines the strategic determinants of physicians’ access to components of an EHR system as well as the apparent and problematic decoupling of the IT from the incentives that reinforce its optimal use.

### The Scope of Workforce Participation

Chapter 2 contrasts the deployment of two of the IT applications that contribute to Kaiser’s EHR system—its administrative module, used by office-based support staff for appointment-setting and patient check-in and check-out, and its panel support tool, used by many of the same employees for determining which of a physician’s patients are due for diagnostic testing. While both initiatives encouraged workplace-level employee involvement (EI), only the initiative behind the administrative module allowed workers 1.) to negotiate changes in the terms and conditions of employment resulting from technological change, and 2.) offered opportunities for workers to shape the configuration of the new work system.

Econometric estimates reveal that despite workers reporting roughly the same levels of engagement in both initiatives, performance improvements are only achieved for the more broadly inclusive of the two applications—the administrative module. The administrative module succeeds in streamlining the patients’ appointment-setting process. It proves even more effective in those clinics whose workers report higher levels of engagement as well as in those clinics whose staff members claim to have been kept whole in the wake of the new technology. On the other hand, the more “top-down” panel support initiative does not manage to increase screening rates for either of two types of cancer. Moreover, these effects prove no more favorable even where workers report high levels of engagement and wholeness. This advises that employment relations and management theory be updated to reflect the finding that performance complementarities between IT and workforce participation are, in fact, contingent on the scope of the participatory structures and processes in play.

## Physicians' Access to Health IT

In the course of investigating KP HealthConnect's performance effects, it became clear that the physicians at Kaiser were at the forefront nationally with respect to EHR adoption. The search for an explanation led to the generation of hypotheses surrounding physicians' employment relationships, based in great part on the way that Permanente physicians related to the Kaiser health plan. As a result, Chapter 3 draws on the Kaiser Permanente case and the employment relations and management literatures to propose under what conditions physicians will report access to various components of an EHR system. These hypotheses are addressed using an unrelated, nationally-collected, cross-organizational, large- $n$  panel of doctors representative of the different circumstances in which physicians deliver outpatient care. Statistical estimates show that one particular model for financing care allows medical practices to internalize the costs and benefits of investments in health IT and that those physicians affiliated with these practices, indeed, are more likely to report access to this technology. Physicians in these strategically-positioned practices are also more likely to report that they themselves face one or more financial incentives encouraging them to make effective use of the technology. However, the estimates also signal that while EHRs continue to diffuse, the complementary incentives to use the technology do not appear to be following suite. These findings highlight the need for policies that promote the adoption of integrated work systems rather than simply the adoption of IT *per se*.

## Collective Contributions

In the aggregate, this dissertation demonstrates that old and new employment relations theory mixes to inform an insightful critique of the drivers and consequences of workplace technological change. On the one hand, seminal theory points to the ways that features of the employment relationship shape workers' responses to the prospect and the reality of IT's larger role in production. The integration of more recent research from the field's strategic HRM research stream then facilitates an explanation of the ways that aspects of the employment relationship determine whether and when one very specific type of worker—physicians—would be likely to have this technology at their disposal, as well as whether or not their medical practices, the industry, and the economy-at-large should anticipate an economic or performance benefit.

What is clear from this study is that a topic that may at first appear anomalous for scholars of work and employment, indeed, fits squarely in the domain of employment

relations research. The adoption and diffusion of health IT and of EHRs should not be about the diffusion of hardware and software, but rather about the diffusion of the work systems required to deliver organizational as well as policy-related goals. The results of Chapter 2 demonstrate that even relatively small differences in work systems can alter the success of an IT initiative, in particular, one involving components of an EHR system. And, Chapter 3 provides compelling evidence that the trend is not toward increased cohesion, but rather toward the decoupling of health IT from the work systems that support it. It is left up to employment relations researchers to leverage studies like this one to assert their role in “information era” policymaking much as they did in setting industrial and employment policy long before the ubiquity of IT.

## References

- Anderson, Gerard and James R. Knickman. 2001. “Changing the Chronic Care System to Meet People’s Needs.” *Health Affairs* 20(6):146–160.
- Appelbaum, Eileen and Rosemary L. Batt. 1994. *The New American Workplace: Transforming Work Systems in the United States*. Ithaca: ILR.
- Arthur, Jeffrey B. 1992. “The Link Between Business Strategy and Industrial Relations Systems in American Steel Minimills.” *Industrial and Labor Relations Review* 45(3):488–506.
- Batt, Rosemary L. 1999. “Work Organization, Technology, and Performance in Customer Service and Sales.” *Industrial and Labor Relations Review* 52(4):539–564.
- Becker, Brian E. and Mark A. Huselid. 1998. High Performance Work Systems and Firm Performance: A Synthesis of Research and Managerial Implications. In *Research in Personnel and Human Resources Management*, ed. Gerald Ferris. Vol. 16 Greenwich, CT: JAI pp. 53–101.
- Bertschek, Irene and Ulrich Kaiser. 2004. “Productivity Effects of Organizational Change.” *Management Science* 50(3):394–404.
- Bower, Anthony G. 2005. *The Diffusion and Value of Healthcare Information Technology*. Santa Monica: RAND.
- Braverman, Harry. 1974. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York: Monthly Review Press.

- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2000. Technology, Organization, and the Demand for Skilled Labor. In *The New Relationship: Human Capital in the American Corporation*, ed. Margaret M. Blair and Thomas A. Kochan. Washington, DC: Brookings pp. 145–184.
- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2002. “Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm Level Evidence.” *Quarterly Journal of Economics* 117(1):339–376.
- Brynjolfsson, Erik and Lorin M. Hitt. 2000. “Beyond Computation: Information Technology, Organizational Transformation and Business Performance.” *Journal of Economic Perspectives* 14(4):23–48.
- Brynjolfsson, Erik, Lorin M. Hitt and Shinkyu Yang. 2002. “Intangible Assets: Computers and Organizational Capital.” *Brookings Papers on Economic Activity* 2002(1):137–181.
- Cappelli, Peter and David Neumark. 2001. “Do ‘High-Performance’ Work Practices Improve Establishment-Level Outcomes?” *Industrial and Labor Relations Review* 54(4):737–775.
- Caroli, Eve and John van Reenan. 2001. “Skill-Biased Organizational Change? Evidence from a Panel of British and French Establishments.” *Quarterly Journal of Economics* 116(4):1449–1492.
- Chamberlain, Neil W. 1948. *The Union Challenge to Management Control*. Hamden, CT: Archon.
- Chaudhry, Basit, Jerome Wang, Shinyi Wu, Margaret Maglione, Walter Mojica, Elizabeth Roth, Sally C. Morton and Paul G. Shekelle. 2006. “Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care.” *Annals of Internal Medicine* 144(10):742–752.
- David, Paul. 1990. “The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox.” *American Economic Review* 80(2):355–361.
- Delery, John E. and D. Harold Doty. 1996. “Modes of Theorizing in Strategic Human Resource Management: Tests of Universalistic, Contingency, and Configurational Performance Predictions.” *Academy of Management Journal* 39(4):802–835.
- Dewett, Todd and Gareth R. Jones. 2001. “The Role of Information Technology in the Organization: A Review, Model, and Assessment.” *Journal of Management* 27(3):313–346.
- Eaton, Susan C., Thomas A. Kochan and Robert B. McKersie. 2003. “The Kaiser Permanente Labor Management Partnership: The First Five Years.” MIT/Sloan Institute for Work and Employment Research.

- Freeman, Richard B. and Morris M. Kleiner. 2000. "Who Benefits Most from Employee Involvement: Firms or Workers?" *American Economic Review* 90(2):219–223.
- Garrido, Terhilda, Laura Jamieson, Yvonne Zhou, Andrew Wiesenthal and Louise Liang. 2005. "Effect of Electronic Health Records in Ambulatory Care: Retrospective, Serial, Cross Sectional Study." *British Medical Journal* 330(581).
- Goldsmith, Jeff, David Blumenthal and Wes Rishel. 2003. "Federal Health Information Policy: A Case of Arrested Development." *Health Affairs* 22(4):44–55.
- Guthrie, James P., Chester S. Spell and Robert Ochoki Nyamori. 2002. "Correlates and Consequences of High Involvement Work Practices: The Role of Competitive Strategy." *International Journal of Human Resource Management* 13(1):183–197.
- Halvorson, George C. and George J. Isham. 2003. *Epidemic of Care: A Call for Safer, Better, and More Accountable Health Care*. San Francisco: Jossey-Bass.
- Hillestad, Richard, James Bigelow, Anthony Bower, Federico Girosi, Robin Meili, Richard Scoville and Roger Taylor. 2005. "Can Electronic Medical Record Systems Transform Health Care?: Potential Health Benefits, Savings, and Costs." *Health Affairs* 24(5):1103–1117.
- Hitt, Lorin M. and Erik Brynjolfsson. 1997. "Information Technology and Internal Firm Organization: An Exploratory Analysis." *Journal of Management Information Systems* 14(2):81–101.
- Hunter, Larry W., Annette Bernhardt, Katherine L. Hughes and Eva Skuratowicz. 2001. "It's Not Just the ATMs: Technology, Firm Strategies, Jobs, and Earnings in Retail Banking." *Industrial and Labor Relations Review* 54(2):402–422.
- Hunter, Larry W. and John J. Lafkas. 2003. "Opening the Box: Information Technology, Work Practices, and Wages." *Industrial and Labor Relations Review* 56(2):224–243.
- Huselid, Mark A. 1995. "The Impact of Human Resource Practices on Turnover, Productivity, and Corporate Financial Performance." *Academy of Management Journal* 38(3):635–872.
- Ichniowski, Casey, Ann Bartel and Kathryn Shaw. 2007. "How Does Information Technology Really Affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement and Worker Skills." *Quarterly Journal of Economics* 122(4):1721–1758.
- Ichniowski, Casey, Kathryn Shaw and Giovanna Prennushi. 1997. "The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines." *American Economic Review* 87(3):291–313.
- Institute of Medicine. 2000. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academies.

- Institute of Medicine. 2003. *Key Capabilities of an Electronic Health Record*. Washington, DC: National Academies.
- Jorgenson, Dale W. and Kevin J. Stiroh. 1999. "Information Technology and Growth." *American Economic Review* 89(2):109–115.
- Kaiser Family Foundation. 2004. *Employee Health Benefits: 2004 Annual Survey*. Washington, DC: KFF.
- Kaiser Family Foundation. 2005. *Health Insurance Coverage in America: 2004 Data Update*. Washington, DC: KFF.
- Kaiser Family Foundation. 2007. *Employee Health Benefits: 2007 Annual Survey*. Washington, DC: KFF.
- Kelley, Maryellen R. 1996. "Participative Bureaucracy and Productivity in the Machined Products Sector." *Industrial Relations* 35(3):374–399.
- Kochan, Thomas A. 1999. Beyond Myopia: Human Resources and the Changing Social Contract. In *Research in Personnel and Human Resources Management*, ed. Patrick M. Wright, Lee D. Dyer, John W. Boudreau, George T. Milkovich and Gerald Ferris. Vol. 4 Stamford, CT: JAI pp. 199–212.
- Kochan, Thomas A., Robert B. McKersie and Peter Cappelli. 1984. "Strategic Choice and Industrial Relations Theory." *Industrial Relations* 23(1):16–39.
- Kochan, Thomas, Robert McKersie, Adrienne Eaton, Paul Adler, Phyllis Segal and Paul Gerhart. 2005. "The Kaiser Permanente Labor Management Partnership: 2002-2004." MIT/Sloan Institute for Work and Employment Research.
- Levine, David I. and Laura D'Andrea Tyson. 1990. Participation, Productivity, and the Firm's Environment. In *Paying for Productivity: A Look at the Evidence*, ed. Alan S. Blinder. Washington, DC: Brookings pp. 183–243.
- MacDuffie, John Paul. 1995. "Human-Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry." *Industrial and Labor Relations Review* 48(2):197–221.
- MacDuffie, John Paul and John F. Krafcik. 1992. Integrating Technology and Human Resources for High-Performance Manufacturing: Evidence from the International Auto Industry. In *Transforming Organizations*, ed. Thomas A. Kochan and Michael Useem. New York: Oxford University pp. 209–226.
- McGlynn, Elizabeth A., Steven M. Asch, John Adams, Joan Keesey, Jennifer Hicks, Alison DeCristofaro and Eve A. Kerr. 2003. "The Quality of Health Care Delivered to Adults in the United States." *New England Journal of Medicine* 348(26):2635–2645.

- Mehrotra, Ateev, R. Adams Dudley and Harold S. Luft. 2003. "What's Behind the Health Expenditure Trends?" *Annual Review of Public Health* 24:385–412.
- Milgrom, Paul and John Roberts. 1990. "The Economics of Modern Manufacturing: Technology, Strategy, and Organization." *American Economic Review* 80(3):511–528.
- Mukhopadhyay, Tridas, Surendra Rajiv and Kannan Srinivasan. 1997. "Information Technology Impact on Process Output and Quality." *Management Science* 43(12):1645–1659.
- Noble, David F. 1984. *Forces of Production: A Social History of Industrial Automation*. New York: Knopf.
- Oliner, Stephen D. and Daniel E. Sichel. 2000. "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* 14(4):3–22.
- Orlikowski, Wanda J. and Stephen R. Barley. 2001. "Technology and Institutions: What Can Research on Information Technology and Research on Organizations Learn from Each Other?" *MIS Quarterly* 25(2):145–165.
- Panayotopoulou, Leda, Dimitris Bourantas and Nancy Papalexandris. 2003. "Strategic Human Resource Management and Its Effects on Firm Performance: An Implementation of the Competing Values Framework." *International Journal of Human Resource Management* 14(4):680–699.
- Porter, Michael E. and Elizabeth Olmsted Teisberg. 2006. *Redefining Health Care: Creating Value-Based Competition on Results*. Boston: Harvard Business School.
- Roberts, Harold S. 1994. *Roberts' Dictionary of Industrial Relations*. 4<sup>th</sup> ed. Washington, DC: Bureau of National Affairs.
- Singerman, Richard. 2005. Office of the National Coordinator for Health Information Technology, United States Department of Health and Human Services. Personal interview, November 17.
- Slichter, Sumner H. 1941. *Union Policies and Industrial Management*. Washington, DC: Brookings.
- Slichter, Sumner H., James J. Healy and E. Robert Livernash. 1960. *The Impact of Collective Bargaining on Management*. Washington, DC: Brookings.
- Solow, Robert. 1987. "We'd Better Watch Out." *New York Times Book Review* p. 36.
- Stiroh, Kevin J. 2002. "Reassessing the Role of IT in the Production Function: A Meta-Analysis." *Social Science Research Network* (352820).
- Wright, Patrick M. and Gary C. McMahan. 1992. "Theoretical Perspectives for Strategic Human Resource Management." *Journal of Management* 18(2):295–320.



- Wright, Patrick M. and Wendy R. Boswell. 2002. "Desegregating HRM: A Review and Synthesis of Micro and Macro Human Resource Management Research." *Journal of Management* 28(3):247–276.
- Youndt, Mark A., Scott A. Snell, James W. Jr. Dean and David P. Lepak. 1996. "Human Resource Management, Manufacturing Strategy, and Firm Performance." *Academy of Management Journal* 39(4):836–866.
- Zhou, Yi Yvonne, Terhilda Garrido, Homer L. Chin, Andrew M. Wiesenthal and Louise L. Liang. 2007. "Patient Access to an Electronic Health Record with Secure Messaging: Impact on Primary Care Utilization." *American Journal of Managed Care* 13(7):418–424.

THIS PAGE INTENTIONALLY LEFT BLANK

## Chapter 2

# Information Technology and the Scope of Workforce Participation: Examining Two Components of an Electronic Health Record System

### Summary

This chapter draws on Kaiser Permanente's experience with KP Health-Connect to determine whether and when workforce participation complements the performance impact of new workplace technologies, particularly information technology (IT). It critiques recent research on the grounds that employee involvement (EI) has been construed mainly as workplace-level engagement, despite a rich body of employment relations theory calling for a more extensive understanding of labor's role in technological change. I propose that apparent complementarities are actually contingent on the *scope* of the EI program and find econometric support for this proposition using data on two separate components of Kaiser's electronic health record (EHR) system.

Few dispute that the performance benefits of information technology (IT) and information systems (IS) hinge on the organizational context in which the technology is deployed. Nonetheless, a closer look at the employment relations literature on workplace technological change actually begs skepticism of studies pointing to the restructuring of work and the reform of training, incentives, and other aspects of the employment relationship as key mediators of the link between IT investment and performance. This is because while employment relations and management analyses of

earlier technologies indeed substantiate the need to develop workplace-level participatory structures, the same literature actually points to a more extensive explanation of whether and when employee involvement (EI) facilitates the deployment of new technology. Specifically, research by scholars of work and employment shows that EI encompasses structures and processes beyond those found on the “front lines” or the shop floor, and suggests that implementing practices from a single, conceptual level of the employment relationship may not yield consistently positive results.

This study tests this proposition by examining Kaiser Permanente’s experience with two software applications seemingly part of its electronic health record (EHR) system, KP HealthConnect. Kaiser engaged its clinic-based, outpatient, primary care support staff in both initiatives. However, only one of the two modules was perceived to be within the jurisdiction of Kaiser’s Labor Management Partnership (LMP). Consequently, only one of the IT applications called for participatory structures encompassing anything more than day-to-day aspects of work and production—what employment relations theorists label the “workplace level” of the employment relationship (Kochan, Katz, and McKersie, 1986). The resulting experimental conditions allow for a conservative test of whether in order to facilitate technological change, EI must transcend the workplace level by incorporating participatory structures at higher conceptual levels of the employment relationship. Namely, must the EI program associated with the technology also allow workers influence over issues regarded as strategic in nature—at the “strategic level”—or related to the terms and conditions governing the employment relationship—labeled the “functional level”?

The Kaiser case largely supports the argument that the use of innovative employment practices complements IT’s performance effects by creating the sort of reinforcing organizational context required to make optimal use of the technology (e.g., Bresnahan, Brynjolfsson, and Hitt, 2000, 2002; Brynjolfsson and Hitt, 2003; Brynjolfsson, Hitt, and Yang, 2002). However, the case additionally reveals that this complementarity itself depends on the scope of EI. By comparing the evolution and short-term performance results from two separate IT initiatives that call on the same workers in the same organization, the case shows worker participation to be a complement of new technologies only when employees are involved on the strategic and functional levels of the employment relationship as well as on the workplace level.

The chapter begins by reviewing the employment relations literature on EI and employment security, particularly within the context of workplace technological change. I then translate the theory into five hypotheses that I will address in the context of Kaiser Permanente’s experience with two applications within its EHR system. This

includes an overview of the strategic goals that KP HealthConnect and Kaiser’s LMP are expected to facilitate.<sup>1</sup> The subsequent section details the case and the data drawn on to address the hypotheses. This is followed first by a detailed qualitative account of events at Kaiser and then a presentation of the statistical results. The chapter concludes by discussing the implications of these findings and suggesting the next steps for this research project.

## Technological Change in Pluralist Industrial Relations

Among the legacies of the High-Performance Work Systems (HPWS) literature of the 1990s was an appreciation for the interplay between technology in the workplace and features of the employment relationship. With respect to organizational or economic performance, technology’s benefits seemed to depend on three variables of interest to scholars of work and employment. First, work must be reorganized to reinforce the overarching efficiency and quality goals intended of the new technology (Adler, 1993). Furthermore, workers must be meaningfully involved in the design of the work systems themselves (Thomas, 1994). Perhaps most importantly, the potentially adverse effects of the technology on workers’ jobs and employment security must somehow be mitigated. Those workers who might be displaced or otherwise adversely affected by changes in technology and work structures must be afforded a level of security in their employment situation. Without a credible pledge from their employer of job or employment security, they will be unwilling to provide the information and the discretionary effort critical to the success of the initiative (Becker and Huselid, 1998; Kochan and Osterman, 1994). Moreover, without attention to how other aspects of their jobs are affected, e.g., the pace of work or the level of effort required, workers are likely to resist using the technology to its fullest advantage. I use the term “wholeness” to describe the effects of employment insecurity as well as these other forms of adverse impact on workers. Where job security is off-the-table—either because workers do not value it or because they already enjoy it as a benefit—it makes sense to think of wholeness as the information-era analog to employment security. Theory suggests that workers are more likely to facilitate their employer’s business strategy when they perceive that they have been treated well and dealt with in good faith (Fehr and Gächter, 2000; Rabin, 1993). In fact, workers’ sense of wholeness captures not only the effect of technological change on themselves, but its effect on

---

<sup>1</sup>See Chapter 1 for more details on Kaiser Permanente, KP HealthConnect, and the LMP as well as on the constituent parts of an EHR system.

their coworkers' status as well (Cappelli, 2004; Krueger and Mas, 2004).

These principals—integration, involvement, and wholeness—serve as a starting point for theorizing about how the features of the employment relationship, particularly those falling under the heading of employee involvement (EI) or workforce participation, mediate the returns to IT investments. Employment relations researchers focus on technology and technological change, however, long pre-dates both HPWS and IT. This historical context sheds light on the impact that EI plays in the technological change process.

## Historical Context

Both theoretical and empirical work reflects the abiding interest of employment relations scholars in workplace technologies and technological change. Recall that Dunlop (1958 [1993]) reserved a place in his theory for technology alongside markets and power as the environmental features defining the area in which parties bargain. On the empirical side, Slichter and colleagues drew on case study evidence to consider the ways that trade unions affect the pace, nature, and effectiveness of new technologies in the workplace. They developed a typology of stylized policies, including “willing acceptance,” opposition, and encouragement, that unions enact in response to impending technological advances (Slichter, 1941; Slichter, Healy, and Livernash, 1960). Labor’s choice of policy turned on the interplay of factors that today might be described as competitive or strategic in nature and in other contexts, examined in the light of the “iron laws” of derived demand (Hamermesh, 1993; Marshall, 1890). In essence, the decision to encourage adoption rests on whether or not the union and its members expect to share in the technology’s benefits, generally through increased wages, an expansion of the bargaining unit, or the assurance of job security. These benefits are weighed against potential losses arising from their opposing the new technology.

Though Slichter, Healy, and Livernash (1960) cover the topic of union-management cooperation in depth, they make little more than passing mention of the specific ways that workers’ active engagement in a technology-related initiative could improve its likelihood of success. It appears that these authors failed to recognize a fundamental set of assumptions about work and organizations held by most organizational theorists and management practitioners alike throughout much of the twentieth century. This view held that management leaders crafted the organization’s strategy, structure, culture, and performance potential, allowing the workforce to enter the analysis only after technological choices and organizational design had been firmly-established

(Kochan, Orlikowski, and Cutcher-Gershenfeld, 2003). Indeed, this is the essence of the model that Douglas McGregor (1960) labeled “Theory X.” Though neither he nor his “Theory Y” spoke directly to the topic of technology in the workplace, others have extended his treatment. Kochan, Orlikowski, and Cutcher-Gershenfeld (2003) argue that an enlightened, Theory Y approach integrates technology with social and work systems to increase the productivity of human capital. This stands in stark contrast to the idea that managers and engineers fashion technology with an eye towards controlling work and minimizing opportunities for human error, which they associate with Theory X.

Aside from the constraints of Theory X assumptions, deep involvement on the part of workers would violate what is also traditionally a normative distinction between the rights and responsibilities of workers, on the one hand, and managers, on the other. In fact, this distinction was reified with the legal interpretation of the Taft-Hartley Act’s (1947) exclusion of business-related decisions such as those involving technology and production methods from the list of “mandatory subjects” of collective bargaining. Nonetheless, Chamberlain’s (1948) early treatment of employee involvement highlights the inseparability of technology-related topics from issues falling squarely within the bounds of mandatory subjects of bargaining.

...Prices and wages are indissolubly related. Financial and accounting policies may likewise bear directly upon the setting of wage rates. The introduction of technological improvements concerns the techniques of production; it concerns likewise the job security of the individual. (p.153)

In the aggregate, these seminal contributions to employment relations carve out an important, dual role for collective bargaining with respect to workplace technological change. In the labor markets and organizations that shaped these earlier studies, it was through conventional, labor-management negotiations that workers extracted a share of the gains attendant to new technologies, typically in the form of job security. The institution of collective bargaining also served as the vehicle through which to address other worker concerns about changes in employment arrangements arising from the implementation of new technology.

## **The Scope of Workforce Participation and the Employment Context for New Technologies**

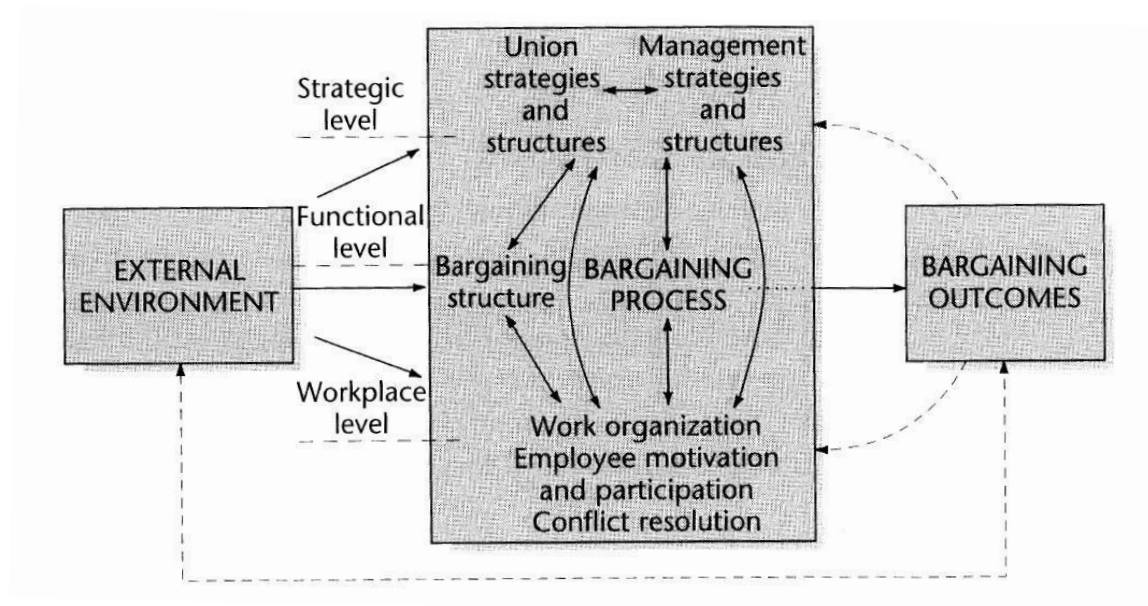
Taking their cue from Chamberlain (1948), Kochan and his colleagues later extended these arguments one level upward by contending that structures for facilitating worker

voice in the consideration of employment issues must be represented at the strategic level of decision-making in addition to the functional level in which negotiations take place (Kochan, Katz, and McKersie, 1986; Kochan, McKersie, and Cappelli, 1984). Given what employment relations theory says about the role of involvement and wholeness in workplace technological change, I propose that the performance impact of EI rests on its *scope* as captured in the three-tiered model of the employment relationship offered by Kochan, Katz, and McKersie (1986). Figure 2-1 reproduces this framework. At the bottom, the workplace level includes the day-to-day interactions of workers, their managers, and, where applicable, their union representatives. This is the setting in which systems for conflict resolution and work organization, among other things play out. The top tier is the strategic level, in which firms and sometimes labor unions undertake long-term planning relating to business strategies and the employment relations systems and structures required in support of organizational goals. Sandwiched between the top and bottom tiers is the functional tier, the stage for formal or informal negotiation over the terms and conditions of employment necessitated by strategic-level decisions coming from above and workplace-level realities or opportunities from below. For clarity and from this point forward, the terms “employee involvement,” “involvement,” and EI synonymously refer to the full range of participatory structures and processes occurring on any of the three levels of employment relationship. Conversely, I will reserve the word “engagement” to refer specifically to the subset of EI activities transpiring at the workplace level.

Much of the existing empirical work inside and outside of discussions regarding technology hints at the importance of scope as a mediator. For example, one econometric analysis of US establishments points towards unionism as the factor determining EI’s influence on productivity (Black and Lynch, 2001). It finds that a set of employment practices promoting joint decision-making at the workplace level coupled with incentive-based compensation negotiated at the functional level to be positively associated with performance, even more so in unionized establishments than in non-unionized ones. Though the finding is reasonable, the myriad aspects of unionism prevent us from pinning down what it is exactly about collective bargaining that would make EI more effective in these settings. One possibility is that unionism itself proxies for a wide range of additional employment practices that complement EI. However, Ichniowski, Shaw, and Prenzushi (1997) demonstrate an effect of employment practices that is distinct from unionism. Another possibility is that the sheer number of activities or aspects of work that are encompassed by worker participation drives its effect on performance. In fact, Levine and Tyson (1990) con-



Figure 2-1: Conceptual Framework for Study of the Employment Relationship with Respect to Workforce Participation in Technological Change



Source: Katz, Kochan, and Colvin (2008)

clude that the productivity impact of EI increases as the number of issues covered under the participation process increases. Organizationally-grounded studies also reinforce these findings. Katz, Kochan, and Gobeille’s (1983) analysis of GM’s quality of working life (QWL) programs, one of the earliest attempts to open up communication channels between workers and managers, reveals that the positive impact of employee involvement depends on the quantity and the significance of the issues taken up through QWL mechanisms. Likewise, an analysis of QWL at the Xerox Corporation found the intensity and range of participatory activities undertaken in a particular work area to be positively correlated with productivity and negatively correlated with scrap rates (Cutcher-Gershenfeld, 1991).

Others have reached similar conclusions by adopting ad hoc frameworks for the scope of EI. For example, in the context of a policy debate, Cappelli and Rogovsky (1998) compared the performance effects of two “flavors” of EI—one limited to decisions regarding the job tasks and responsibilities and another that instead involved workers in setting terms and conditions of employment. They showed the former to be far more instrumental than the latter in predicting organizational citizenship behavior (OCB), underlining the need for researchers, practitioners, and policymakers to pay attention to the range of issues covered in a given EI program. Though they labeled their two types of participation “work organization” and “employment

practices,” Cappelli and Rogovsky’s (1998) study essentially contrasted the effects of workplace-level EI with functional-level EI. Other studies of EI have incorporated EI at the strategic level (e.g., Kato and Morishima, 2002), and some even consider the performance impact of multiple levels of EI simultaneously. For example, analyses of German data find that the productivity effects of shop-floor employee involvement are stronger in establishments that elect to form a works council (Addison et al., 2000; Zwick, 2004). Since works councils have codetermination rights with respect to staffing, leave arrangements, and overtime work (Freeman and Lazear, 1995), among other things, these estimates imply that extending EI to the functional level increases its instrumentality over economic performance. Along the same lines, Kato and Morishima’s (2002) study of Japanese firms revealed that joint labor-management committees at the strategic level and shop-floor committees at the workplace level complement one another’s impact on performance. A more sociological framework put forth by Frenkel et al. (1999) also considers the scope of influence in EI programs. It partitions scope into two categories. “Task-level” participation includes employees in operational decisions related to their work or to their job, whereas participation “above the task level” involves staff in wider organizational and strategic issues. Consistent with most empirical analyses (cf. Cappelli and Rogovsky, 1998), Frenkel et al. (1999) report a positive association between the level of workers’ influence and the quality of employment relations. They find the same association between influence and discretionary work effort. Therefore, it makes sense to consider the role of scope with respect to the rollout and use of new technologies in the workplace.

As noted in Chapter 1, the issue of technological change took center stage in employment relations research in the 1980s. It was at that time that GM fell short in its effort to achieve Japanese levels of productivity and quality despite comparable investments in automation technologies. Studies revealed the “missing link” to be a commitment to employment relations reforms alongside investments in automation.<sup>2</sup> That is, seemingly identical technology is actually used differently under different production systems (MacDuffie and Krafcik, 1992). Under the mass production model then typically ascribed to US producers, technological advances served the Theory X paradigm described above in that they were intended to reduce unit labor costs by lessening reliance on the workforce and by facilitating managerial control. This stood in stark contrast to the approach undertaken under so-called “lean” production systems, then limited almost exclusively to Japanese manufacturers. Shimada and

---

<sup>2</sup>Recall Figure 1-1 on page 15, a two-by-two matrix mapping technology and employment relations measures into productivity and quality outcomes.

MacDuffie (1986) explain that workers in a lean environment were expected to “give wisdom to the machine.” As a result,

a set of production equipment is no longer simply subject to automatic decay and depreciation but rather can be an asset whose capacity may improve and appreciate over time as a result of the interaction with human resources. (p.12)

For workers to give their “wisdom” in the form of production information and sometimes tacit production-related knowledge, they would need evidence of “reciprocal commitment” on the part of their employer. This they typically secured at the bargaining table in the form of job or employment security, much as Slichter, Healy, and Livernash (1960) had observed years earlier. That is, employment security formed the core of the “high-commitment” employment system or HPWS necessary to realize the gains from lean’s signature technological advance—the reduction of buffers in production (Adler, 1993; MacDuffie and Krafcik, 1992; Pil and MacDuffie, 1996). This finding drove employment relations and management researchers to theorize the broader existence of performance complementarities between technology and work organization, on the one hand, and employment practices, on the other.

The complementarity thesis quickly found strong empirical support in manufacturing (e.g., Kelley, 1996; MacDuffie, 1995) and service settings (e.g., Batt, 1999). It also garnered attention from researchers of one particular class of technology—IT and IS. They show that, among other “intangible” production inputs, employment practices supporting shop floor or frontline worker engagement complement the effectiveness of new technologies enough to drive the lion’s share of returns previously ascribed solely to investments in hardware, software, and networking peripherals (Black and Lynch, 2001; Brynjolfsson and Hitt, 2003; Brynjolfsson, Hitt, and Yang, 2002). In fact, it turns out that unobserved heterogeneity in employment relations measures had been the main culprit of the apparent “productivity paradox” that for so long blocked empirically sensible explanations for the returns to IT investments (Stiroh, 2002).

Just as lean manufacturing’s elimination of buffers in production calls for parallel attention to work structures and employment practices, the information era’s application of IT requires a realignment of employment relations variables to fit a new production system. Consequently, employment relations reforms mediate returns to IT investment, consistent with the “integration” hypothesis drawn from the HPWS literature. In this case, IT facilitates the storage, retrieval, organization, and transmission of certain types of information. This allows for the inexpensive transferral

of information away from managers, whose productive use of it was constrained by their “bounded rationality” (Simon, 1951), to front line employees. These workers are already in possession of tacit knowledge (Hayek, 1945) or dynamic and local information only available at the point of production (Aoki, 1986), intangible assets whose productivity is complemented by the use of IT. However, by relocating critical information within the production process, the technology necessitates the reevaluation of workers’ responsibilities and abilities (Brynjolfsson and Mendelson, 1993). This typically results in increased investments in training as well as increased incidence of employee engagement in the form of team-based work systems (Bresnahan, Brynjolfsson, and Hitt, 2000, 2002; Hitt and Brynjolfsson, 1997). It is this integration of employment relations reforms with IT investment that delivers sizable performance gains (Brynjolfsson and Hitt, 2003; Brynjolfsson, Hitt, and Yang, 2002; Stiroh, 2002).

By simply extrapolating from the econometric estimates of IT’s performance effects, we would conclude that those firms that follow the “integrated” approach will reap sizable returns to their investments. However, recall that scholars of work and employment put forth two additional contingencies to the effective deployment of new technology—worker involvement and wholeness—that do not inform these recent studies. Their omission may explain a lingering empirical inconsistency. As noted in Chapter 1, Bresnahan, Brynjolfsson, and Hitt (2002) demonstrate that IT boosts performance more in firms that score highly on an index of organization measures, which include team-based work systems and quality circles. However, a similar study drawing on European data could not identify a statistically significant estimate of this two-way interaction (Caroli and van Reenan, 2001).

Note that irrespective of technology, the empirical link between EI and performance is itself tenuous (Cappelli and Neumark, 2001; Levine and Tyson, 1990; Wagner, 1994). One reason is that EI has been characterized by a diversity of meanings, posing an analytical challenge to those seeking to understand its influence on economic performance (Appelbaum and Batt, 1994). For example, a survey administered by the Society for Human Resource Management (SHRM) and described by Freeman and Kleiner (2000) asked about eight separate practices it considered elements of EI ranging from staff opinion surveys and complaint systems to committees on productivity and the presence of self-managed work teams. Bresnahan, Brynjolfsson, and Hitt’s (2002) aforementioned study considers the use of self-managing teams and the degree of autonomy afforded frontline workers, similar to Caroli and van Reenan’s (2001) measure of changes in the organization of work. The focus of these two studies is understandable given the sort of organizational “de-layering,” described above, that

they theorize is required for IT's effectiveness. However, neither delves into the range of issues—aside from those materializing on the front lines—for which employers seek or allow workforce involvement.

The upshot is that a likely source of unobserved heterogeneity between and within production function estimates is in the sorts of participatory structures and processes at the disposal of firms investing in IT. These “missing measures” speak to the involvement and wholeness constructs discussed above. The involvement thesis hinted at the importance of process in addition to outcomes. That is, workers must be meaningfully involved in the technological change process in order for them to view the transition as an opportunity for achieving mutual gains (Thomas, 1994). Otherwise, management's inattention to process leaves workers unable to influence how the technology is deployed, how it will affect their jobs, and in the present case, how it will facilitate the delivery of quality patient care. As a result, even the most diligent employees are likely to view the new technology as a setback in their efforts to do their jobs and protect their interests. This is also consistent with a Theory X approach rather than one that leverages IT to increase labor productivity (Kochan, Orlikowski, and Cletcher-Gershenfeld, 2003).

### **Strategic-Level Employee Involvement**

The challenge for managers and for the designers of the technology comes in knowing how work really “gets done” on the front lines, and thus, how the workforce needs to be retrained or replaced, the plant retooled, and work structures reformed. However, in the absence of participatory structures at the highest level of the employment relationship, knowledge gleaned from workers through engagement activities at the workplace level cannot inform the larger, strategic goals served by the technology. That is, information cannot be directed towards determining the best ways to leverage the technology towards strategic goals. More generally, when the fruits of participation are constrained to the workplace level, employees influence the ways that decisions regarding business, investment, and human resource (HR) strategies—decisions *handed down from management*—will be executed or implemented on the front lines. On the other hand, broadening the scope of involvement to include the actual determination of strategy integrates worker-provided information into fundamental decisions regarding how IT and employment relations can be optimally configured to achieve strategic goals. To the extent that it is this interface of work and technology where workers are most likely to have knowledge that managers will not have, it follows that measures of employee involvement will complement the effectiveness of IT when EI

encompasses strategic issues in addition to matters at the workplace level.

Excluding workers from participating at the strategic level also undoes the otherwise complementary impact that wholeness has on the effective deployment of IT. This is because strategic-level participation is what patches frontline staff into the organization's vision for the technology, namely the goals it is intended to serve as well as the internal and external drivers of both the strategy and the choice of technologies (Thomas, 1994). Without knowledge of the goals themselves, workers cannot possibly be given discretion to use the technology as effectively as possible to meet agreed-upon organizational targets—to “give wisdom to the IT.” In other words, attempts at integrating work structures and technology are undermined by a Theory X approach to workplace technological change. In sum, workplace-level employee engagement without an EI component at the strategic level should not be expected to boost IT's impact on economic performance.

### **Functional-Level Employee Involvement**

Along the same lines, engaging workers in an IT initiative is unlikely to increase returns to the technology in the absence of parallel EI structures at the functional level where the full range of working conditions are negotiated. As Chamberlain (1948) pointed out, any information volunteered by staff at the workplace level is likely to necessitate changes in the terms and conditions of employment. For example, any suggestion with implications for compensation, benefits, hours, job responsibilities, or staffing levels—the very types of adjustments required to fulfill the goals of integration—cannot be implemented without the involvement of worker representatives and changes in the terms and conditions of employment.<sup>3</sup> This idea is consistent with evidence that the most successful QWL initiatives were those that managed to broaden their mission beyond shop floor engagement to include working conditions and other topics necessitating action on the functional level (Kochan, Katz, and McKersie, 1986) as well as Black and Lynch's (2001) conclusion that innovative employment practices have a much larger effect on economic performance in the context of collective bargaining. The upshot is that engagement should not be expected to complement IT in the absence of a functional-level component of EI.

---

<sup>3</sup>In nonunion settings, responsibility falls either on HR managers or to some nonunion form of employee representation to give voice to these worker interests. In the US, the latter approach risks running afoul of labor law.


## The Case of Two Technologies in One Organization

These arguments will be examined in light of Kaiser Permanente’s experience implementing two components of its EHR system across one region’s primary care clinics. The two IT applications—the administrative module and the panel support tool—form two cases within the same organization and in fact, the very same clinics. Both initiatives intend to comply with the existing labor agreement between Kaiser and the Coalition of Kaiser Permanente Unions (CKPU). First and foremost, all unionized support staff enjoy nominal employment security, a protection they have held irrespective of KP HealthConnect since the signing of a 1999 interim agreement. That language was later incorporated into the 2000 and 2005 contracts, along with language on wide-scale, rank-and-file engagement in exchange for employment security. However, those activities that support the larger KP HealthConnect initiative are further guided by the KP HealthConnect Effects Bargain, signed by Kaiser and the CKPU in April of 2005. As Table 2.1 illustrates, the Effects Bargain details the ways that the tenets of the Partnership should be applied in the context of KP HealthConnect. The distinction between the two IT applications studied is that only one, the administrative module, is regarded as part of KP HealthConnect, and therefore, subject to the agreed-upon language of the Effects Bargain and the full range of representative processes built into the LMP. As a result, the administrative module has been developed and deployed with the aid of an EI program encompassing activities at all levels of the employment relationship. The panel support tool, to the contrary, relies solely on workplace-level employee participation, more consistent with a “top-down” approach. This distinction sets up the Kaiser case to address the theory put forth above regarding the interplay of employment relations and IT in effecting economic performance.

### Primary Care in the Northwest Region

Headquartered in the suburbs of Portland, Oregon, Kaiser’s Northwest regional operation, Kaiser Permanente of the Northwest (KPNW), relies on 880 physicians and 8,900 employees to serve just over 480,000 members. The region spans the greater metropolitan Portland and Vancouver, Washington areas, extending south to Salem, Oregon and north to the cities of Longview and Kelso in Washington. Though Kaiser only operates a single hospital in the region, drawing on the resources of smaller, community hospitals to meet excess demand for inpatient care, it offers “ambulatory”

Table 2.1: Highlights of the KP HealthConnect Effects Bargain Between Kaiser Permanente and the Coalition of Kaiser Permanente Unions

Coalition agrees to:		Kaiser agrees to:
<ul style="list-style-type: none"> <li>• commit to the “successful implementation of KP HealthConnect and the full realization of its benefits.”</li> <li>• engage in development, implementation, and continuous improvement efforts at each stage, regionally and nationally.</li> </ul>	<p style="text-align: center;">Joint commitment to create “an environment where all staff freely engage in the transformation effort.”</p>	<ul style="list-style-type: none"> <li>• extend existing language on flexibility and employment and wage security to changes engendered by new technology.</li> <li>• follow a process for incorporating into the bargaining unit new jobs created by the technology.</li> <li>• fund KP HealthConnect labor coordinators for each region and for release, backfill, and training demands arising from the initiative.</li> </ul>

*Source:* KP HealthConnect Effects Bargain, effective April 5<sup>th</sup>, 2005.

care through 27 outpatient medical office buildings.<sup>4</sup>Presently, 15 of these clinics serve as hubs for primary care—family practice, pediatrics, and internal medicine. Medical specialties like otolaryngology, gynecology and obstetrics, and cardiology are also spread across these facilities. With in-house pharmacies and on-site laboratory and diagnostic services as well as health resource centers, outpatient clinics are intended to serve as one-stop “community health centers.” Figure 2-2 shows the interior of one such clinic in the Northwest, the Tualatin Medical Office.

The subset of clinics offering primary care is the main focus of this chapter, in part, because so many of the performance outcomes of interest to Kaiser are shaped by the member’s experience with his or her Primary Care Physician (PCP). This is not surprising given that primary care is the backbone of the Kaiser system and of the Health Maintenance Organization (HMO) model more broadly. Bounding the sample in this way also allowed the researcher to spend time in all of the clinics examining the contextual mediators of the IT’s effectiveness. Furthermore, employing physicians from 47 separate specialties, the variety of speciality care offered by Kaiser is sufficiently wide, generating a mix of work processes and challenges idiosyncratic to each speciality. In some cases, the number of physicians practicing a particular

<sup>4</sup>The term “outpatient” is often used to describe those patients expected to check-in and out of the hospital on the same day. However, since this dissertation does not address anything related to “inpatients” or hospital care, I use the adjectives “ambulatory” and “outpatient” interchangeably.



Figure 2-2: Interior View of Tualatin Medical Office in Tualatin, Oregon with Localized Waiting Areas Looking Down on Central Waiting Area, Member Services, and a Pharmacy



*Source:* Photograph taken by the author.

speciality or the number of patients making use of those services was small enough to prevent the effective use of any quantitative data that might have been collected.

## **Organizational Challenges in the Northwest**

The challenges around which Kaiser leadership in Oakland have been strategizing manifest themselves very clearly in the Northwest region. Recall from Chapter 1 that Kaiser intended KP HealthConnect to occasion a complete reorientation of Kaiser’s approach to healthcare delivery, quite typical of the way many organizations approach an IT investment (Brynjolfsson and Hitt, 2000). Historically, the technology as well as the workflows and work structures supporting it were aligned to support an “encounter-orientation.” This contrasts with the more holistic approach to patient health that KP HealthConnect was intended to foster. Indeed, this message reached Portland undiluted. As one high-level regional manager explained, “KP HealthConnect is not just an IT project. All of the strategic vision is in how we use it.” At the workplace level, this would have to translate into the reevaluation of workflows and work structures to reinforce the organization’s grand strategy for the EHR system. Two technological innovations—the administrative module and the panel support

tool—were introduced as parts of this grand strategy.

### **The Administrative Module**

KP HealthConnect’s administrative module was introduced under the umbrella of Kaiser’s LMP. Therefore, all aspects of the initiative were guided by the KP HealthConnect Effects Bargain (See Figure 2.1). The region rightly anticipated that the organizational side of the transition from an encounter-orientation to a more holistic approach to patient health would prove challenging. The patchwork of legacy systems—some IT and some paper-based—did not interface with one another cleanly. Among other challenges, those support staff charged with setting patient appointments using the legacy scheduling application frequently found themselves asking even long-term Kaiser members for data that should be permanently linked to a member’s health record number (HRN), namely contact information. The system also made it difficult to schedule regularly, recurring appointments and often lacked up-to-date information on providers’ availability vis-à-vis vacation scheduling, “panel support” time, or the use of planned or unplanned leave.

To understand how this would have a negative impact on economic performance, consider the process by which members make a primary care appointment by phone. They dial their clinic’s appointments line. The call is received by a member information specialist (MIS), usually at one of the regional call centers. The MIS opens the schedule corresponding to the member’s PCP and searches for the first available appointment time or the first available time slot amenable to the member. According to one regional manager, this only disposed of about 40 percent of cases. More frequently, large sections of a provider’s schedule would be blocked as unavailable for one of the reasons listed above. The MIS would then transfer the member to the medical assistant (MA) supporting the appropriate provider. If the MA picked up, he or she could override or correct the schedule. If instead the MA were unavailable, the patient could leave a message. If the patient ever calls again, possibly returning a call from the MA, they would start all over again at the call center, where the MIS would again try to make an appointment and likely run into the same complication. The end result was that 75-80 percent of members initially denied an appointment would ultimately be given one within an acceptable time frame. However, this came at the great expense of patient satisfaction with respect to accessing their providers as well as with the appointment-making process. Furthermore, appointment-setting required 4-5 “touches” from more highly-paid MAs in addition to MISs, rather than the single touch of an MIS.

The administrative module to be embedded in KP HealthConnect, Kaiser’s EHR system, is intended as the IT “solution” for the appointment-making process. Given its status as part of the KP HealthConnect initiative, its configuration, implementation, and deployment were guided by the KP HealthConnect Effects Bargain and the LMP representation processes. Therefore, we would expect the participatory structures and processes used in the introduction of the module to span all three conceptual levels of the employment relationship. By doing so, EI helps ensure the IT improves performance and that workplace-level engagement complements the IT effort. This first implies that the application will be effective in its goal of improving performance.

**Hypothesis 2.1.** Implementation of the administrative IT application will be positively associated with measures of organizational performance.

Its status with respect to partnership also points to two reasons why measures of worker engagement should complement the returns to the technology in ways that would not obtain if EI were constrained to the workplace level. First, support staff can inform planning and configuration of the administrative module rather than the mere execution of an existing strategy that was not informed by the workforce. Second, ideas generated through engagement on the workplace level can be operationalized even if they require changes in the employment contract.

**Hypothesis 2.2.** Clinic-level measures of workforce engagement with respect to the administrative IT module will complement the technology’s performance impact.

Finally, by evoking EI structures beyond those at the workplace level, the Effects Bargain paves the way for measures of wholeness to complement the effectiveness of the system. EI at the strategic level ensures workers have a sense of the larger strategy that the technology and their use of it are intended to serve. Involvement at the functional level then offers management and staff the latitude to respond to challenges with simple solutions consistent with the strategic aims of the administrative module but that might not be possible without functional-level EI structures.

**Hypothesis 2.3.** Clinic-level measures of workforce wholeness with respect to the administrative IT module will complement the technology’s performance impact.

### **The Panel Support Tool**

The second IT application, the panel support tool, was introduced in a top-down fashion outside of the LMP, and therefore, beyond the provisions of the KP HealthConnect

Effects Bargain. This application serves Kaiser’s effort to redouble its attention to preventive care. Primary care support staff play a critical part in this initiative. Notwithstanding their role in the appointment-making process, the primary duty of the MA is to serve as the conduit between providers and patients. Aside from “rooming” patients—taking vital signs and undertaking other patient staging before the arrival of the provider, MAs are responsible for replying to telephone messages as well as executing whatever work orders arise from them. Many of them spend such a large portion of their regular, eight-hour shift on the phone, that they choose to wear a headset rather than use the telephone handset. Their work has been further intensified as an increasing number of patients are generating emails in addition to phone calls, all at the tail end of a hiring freeze that hindered increases or readjustments in clinic staffing. On the one hand, the diligence of clinic staff certainly serves Kaiser’s customer service mission. However, encounter-oriented work is the kind of work that is never finished. Even when there are no patients needing be roomed, there are always phone calls or emails to be returned. And, no one has suggested that MAs de-prioritize returning patients’ phone calls and emails. Therefore, existing work structures nearly ensure a tradeoff between the effective handling of every encounter and the organization’s attempt to profit through improved preventive care. Therefore, we have little reason to expect that the IT will boost outcomes at all.

**Hypothesis 2.4.** Implementation of the panel support IT application will *not* be positively associated with measures of organizational performance.

A number of circumstances led to the panel support tool’s designation as independent of the overarching KP HealthConnect initiative. Chief among these was the need for Kaiser to build the application in-house as the vendor that developed the KP HealthConnect suite of applications, including the administrative module, did not yet offer a panel management IT “solution.” Relative to those initiatives included under the heading of KP HealthConnect, Kaiser’s approach to the development and deployment of its panel support tool took a much more limited view toward workforce participation, constraining EI almost entirely to the workplace level. Therefore, measures of frontline engagement should not work to make the IT more effective.

**Hypothesis 2.5.** Clinic-level measures of workforce engagement with respect to the panel support IT application will *not* be associated with increases in the technology’s performance impact.

Finally, since EI was permitted only at the lowest level of the employment relationship, keeping workers whole cannot serve the production function as it might were the EI

components of the initiative more expansive. The lack of strategic-level involvement deprives frontline staff of a deep sense of the shift in strategy that necessitates the technological change. Therefore, the technology is likely to be seen as augmenting and complicating their existing workflows rather than occasioning entirely new approaches to their work. Furthermore, without functional-level EI structures, wholeness is likely to be maintained at the expense of the technology's optimal level of use.

**Hypothesis 2.6.** Clinic-level measures of workforce wholeness with respect to the panel support IT application will *not* be associated with increases in the technology's performance impact.

## Data

The data used to address these hypotheses were collected by the author in the course of organizationally-based fieldwork conducted at Kaiser Permanente. Data collection took place over a two and a half year period beginning in late 2005.

### Qualitative Data

The data include interviews, mostly face-to-face, with high-level organizational actors based in Kaiser's national program office in Oakland, California as well as with managers, union leaders, physicians, and frontline staff in three of Kaiser's operating regions—KPNW, Kaiser Permanente of Colorado (KPCO), and Kaiser Permanente of Northern California (NCAL). The goal of the interviews and of additional hours spent observing the care delivery process in medical clinics was to build an understanding of the organizational and employment relations context in which the paper-based, legacy IT, and new, integrated EHR system were being used. This knowledge laid the groundwork for the quantitative side of the study by highlighting the measures required to determine the effectiveness of the technology as well as the factors that needed to be controlled for in the course of assessing IT's performance impact over time.

### Quantitative Data

All of the quantitative data analyzed in this chapter were collected in and around Portland, Oregon, the center of Kaiser Permanente's Northwest regional operations,

Table 2.2: Sources Drawn on to Construct Quantitative Data on Clinics, Workers, and Patients at Northwest Kaiser Permanente’s Outpatient Medical Clinics

source/instrument	method of collection	variables constructed
employee survey	self-administered	ENGAGEMENT, WHOLENESS, workers’ demographic and job-related info.
patient satisfaction survey	organizationally-administered/archival	PHONECALLLENGTH, LABUSE
patient medical records	organizationally-collected/archival	MAMMOSCREEN, PAPSCREEN, clinic-level characteristics
HR/staffing records	organizationally-collected/archival	BUDGETEDHOURS, ACTUALHOURS

KPNW. Kaiser’s history of regional autonomy created an enormous amount of inter-regional heterogeneity in terms of technologies, workflows, and recordkeeping. Therefore, any attempt to collect or gather reliable data required limiting the scope of statistical analyses to a single region of manageable size and to a subset of the entire EHR system whose performance impact could be understood, modeled, and estimated credibly with respect to the organizational and employment relations context. The resulting dataset was constructed by drawing from a mix of self-collected and archival sources detailed in Table 2.2. It includes employee data provided directly to me as well as data collected by Kaiser from support staff and patients in the 15 ambulatory clinics that offer primary care. These clinics are typically named for their location. However, I de-identify them by assigning them names of respected rock-and-roll drummers.

### Survey of Support Staff

A questionnaire was developed and distributed electronically to KPNW’s unionized support staff. Names and email addresses were provided by Kaiser management with the permission of union leaders. Before the final instrument was made available to respondents, it was tested for clarity and understanding with a “working group” of building-level LMP representatives—themselves members of the target sample—as well as clinic-level managers. Only where a union member could be clearly identified as someone who worked solely in the inpatient setting were they were excluded from

the original sample frame. This decision to “cast the net” so widely yielded a subset of the sample who could not meaningfully respond to the survey. Their responses do not contaminate the data, because respondents had the opportunity to declare themselves non-users of a particular part of the EHR system, allowing them to skip over questions relating to that module. The presence of these respondents in the sample, however, does bias the response rate downward. Even so, after three email reminders to non-responders, 1,655 completed responses were received of the 2,612 surveys sent out, yielding an overall response rate of approximately 63 percent. Responses from all respondents were used to standardize survey items where appropriate. However, the analysis undertaken in this chapter—of the administrative module and of the panel support tool—necessitated only the responses of the region’s 481 medical assistants (MAs) (56 percent response rate) and 309 member information specialists (MISs) (51 percent response rate). Analyses confirmed that those MISs who responded had about the same average age and job tenure as those who did not. The MA responders had the same average tenures as their non-responding colleagues. However, those MAs who responded were marginally older, on average, than those that did not respond—41.8 years vs. 39.3 years ( $t = 2.44, p < .01$ ).<sup>5</sup>

Once respondents answered that they use a particular module in the course of their everyday work, they responded to a set of questions specific to their use of that one application. Included in these questions were items that ultimately composed the engagement and wholeness indices separately for each module. Most questions were answered on a seven-point Likert-type scale. The administrative module engagement index was based on four survey items: 1.) My suggestions about how to design or improve it have been valued., 2.) My issues or complaints about it have been ignored., 3.) There is at least one bargaining unit member in my clinic who helps me a be a better user of the module., and 4.) Before it was rolled-out, the people whose work could be changed by it were asked for guidance. A scale formed by these questions was fairly reliable ( $\alpha = .61$ ). A principal components analysis (PCA) further revealed that the four items loaded onto a single principal component ( $\lambda = 1.90$ ) that accounted for about half the variance represented by these items. That principal component was used to generate an administrative module engagement “score” for every observation in the dataset. The administrative module wholeness index was developed in a similar manner. It is also based on four items from the support staff questionnaire: 1.) It has made it harder for me to do my job., 2.) It has made support staff in my clinic

---

<sup>5</sup>I could not test for randomness with respect to sex. However, nearly all of the MAs and MISs in the original sample frame were woman.

worse off now than they were before., 3.) It has changed my work in ways that are not fair to me., and 4.) Covering for staff engaged in training for the module burdened people like me. This scale has a Cronbach's  $\alpha$  of .82, and two-thirds of its variance can be explained by a single principal component ( $\lambda = 2.65$ ). Analogous and separate engagement ( $\alpha = .60, \lambda = 1.86$ , 46 percent of the variance) and wholeness ( $\alpha = .86, \lambda = 2.83$ , 71 percent of the variance) indices were developed for the panel support tool. Six other binary variables—three for each of the two applications—are constructed directly from items on the staff survey. Respondents answered yes or no to questions about whether or not a fellow member of the bargaining unit introduced them to each module, provided them with their follow-up training on each module, or otherwise serves as an expert or “super-user” for that particular IT application.

### **Medical Office Visit/Patient Satisfaction Survey**

Kaiser conducts its own Medical Office Visit survey in order to evaluate members' most recent visit to a medical office. The survey is conducted by mail and has historically averaged a response rate of around 35 percent. This chapter relies on survey items relating to the patient's experience making the appointment if they did so by phone. Recall that the administrative module was intended to improve the appointment-making process, among other aspects of customer service, by providing staff with more complete and more up-to-date information on provider availability. One question on the patient satisfaction survey asks, “Were you able to get the appointment scheduled by talking to just one person?”. Another asks respondents to rate on a nine-point Likert-type scale their satisfaction “with the length of time spent on the phone to schedule the appointment.” The former will be operationalized as a binary variable and the latter as a standardized, continuous variable. The patient satisfaction survey also provides the underlying information for two crude measures of laboratory tests and screenings, useful for determining whether or not the panel support tool is having its intended impact on disease prevention. Respondents answer yes or no to a question asking if they visited the lab during their office visit. They are also asked if they have received the results from any tests performed during the visit, for which they can respond yes, no, or “I did not have any tests.”. Answers will be aggregated to the level of the medical clinic.



## **Medical Records**

Medical records underpin data on each clinic’s compliance with Health Plan Employer Data and Information Set (HEDIS) “best practices.” This chapter focuses on two well-established measures of clinical quality—breast and cervical cancer screenings. These are computed in accordance with HEDIS standards.<sup>6</sup> Breast cancer screening compliance is measured as the percent of continuously enrolled women age 52-69 who underwent a mammogram in the prior two years. Cervical cancer screening rates are the percent of continuously enrolled women age 21-64 who had one or more Pap tests in the prior three years. I aggregate these measures by clinic-months. Medical records also provided a reliable measure of the number of office visits that took place each month, by clinic, a control variable that appears in the analysis.

## **Staffing and HR Records**

Finally, Kaiser provided access to archival records by bi-weekly pay-periods (i.e., 26 per year) of budgeted and realized staffing—in terms of both hours and full-time equivalents (FTEs). I separated out focal job classifications, i.e., MAs and MISs, and aggregated the data into monthly indicators at the level of the medical clinic. These data enable the construction of clinic-level time series on budgeted staffing as well as on monthly deviations between budgeted and actual staffing levels.

# **Results**

## **Qualitative Evidence**

### **The Administrative Module**

History assured that the Northwest’s LMP apparatus would be tightly woven into the KP HealthConnect initiative, and consequently into the development and deployment of the EHR system’s outpatient clinic administrative module. On its own, the Northwest began migrating away from paper-based health records in the mid-1990s, long before the foundation was set for a Kaiser-wide EHR strategy. At that time, the vendor landscape was sparse, prompting other regions to experiment with untested systems linked to well-branded technology and consulting practices or, in the case of the Colorado region, to begin the arduous process of developing a system in-house.

---

<sup>6</sup>HEDIS standards are developed by the National Committee for Quality Assurance (NCQA), that provides additional information on its web site.

The Northwest, on the other hand, was impressed with a small, Madison, Wisconsin-based software startup, Epic Systems Corporation. According to those active in the region's health IT strategizing at that time, Epic's product appeared especially "patient-centered." This, coupled with a malleable configuration and assurances of quality service put regional managers at ease. Regional leaders, less concerned about scalability, agreed on the fundamental database design employed by Epic and developed an open-ended and comfortable working relationship with Epic's founder and CEO.

Though KPNW had only adopted a small fraction of the Epic Systems products that would eventually be integrated into KP HealthConnect, Oakland saw fit to draw on the experience and expertise of regional managers in the 2003 selection of Epic's product as Kaiser's national EHR "solution." Shortly thereafter, when the union Coalition, the CKPU, sought labor involvement in the baseline configuration of the system, Oakland drafted a Northwest-based registered nurse (RN) to work fulltime as the frontline staff representative in the "national build." One of the first tasks of that representative was to work with the national LMP coordinator for KP HealthConnect to select and appoint regional labor coordinators and to assist their efforts to engage workers in the regional configuration processes.

Over the next two years, the role of these coordinators and, more broadly, the enactment of partnership with respect to KP HealthConnect, became the subject of the special bargaining talks that eventually yielded the KP HealthConnect Effects Bargain (See Table 2.1.). As noted above, these talks and the resulting agreement essentially detailed the ways that the tenets of partnership already agreed to under the national agreement would be operationalized and applied in the context of KP HealthConnect. This solidified strategic- and functional-level components of a comprehensive EI apparatus. For starters, management detailed the ways its provision of employment security would work for those potentially displaced by KP HealthConnect IT applications. However, technological displacement was much less of an issue in the Northwest than in other regions since KPNW had pared down its medical records staff years earlier with its regional transition from paper-based to electronic record-keeping. More germane to the Northwest was the list of KP HealthConnect-related matters over which the parties agreed would be subject to KP HealthConnect effects bargaining. Included were the addition and removal of responsibilities or increases in skill requirements for current positions, the moving of work from one classification to another, design and workflow decisions that impact contractual language, and changes in production standards or work volume.

The Effects Bargain also established the creation for each region of at least one, full-time, KP HealthConnect labor coordinator to serve on their regional KP HealthConnect leadership team. Since the labor coordinator was charged with monitoring KP HealthConnect-related production process and workflow change experiments and pilots, they also took on the job of identifying and responding to demands for front-line worker engagement arising in the course of the initiative. Labor and management also agreed to joint planning around two other key issues arising from KP HealthConnect. First, the parties agreed that effective engagement of the workforce depended on workers' temporary relief from their regular responsibilities. Therefore, management agreed to fund the "backfill" required to maintain operations and quality, the demands of which would be determined by labor and management. KP HealthConnect training would be the primary driver of these backfill demands. Its adequacy and composition—training to use new applications, training to perform new tasks emerging from workflow redesign, etc.—would also be determined jointly, guided by service expectations and "scope-of-practice" constraints. In the aggregate, Kaiser expected labor's active engagement in configuring, implementing, and eventually, using KP HealthConnect as effectively as possible. More broadly, the workforce was expected to support the overarching business strategy, namely, improved service to members and a reorientation towards preventive care. For this reason, management and labor leaders alike adopted the rhetoric that KP HealthConnect was "just a tool" for providing frontline staff the information they need to reorient their approach to patient care.

Back in Portland, the Northwest first signalled its commitment to both the Partnership and to KP HealthConnect by funding two FTEs to serve as KP HealthConnect labor coordinators—one from the Oregon Federation of Nurses and Health Professionals (OFNHP) Local 5017, representing RNs and other professional staff, and one from the Service Employees International Union (SEIU) Local 49, representing members of the clinical support staff including licensed practical nurses (LPNs), MAs, and frontline receptionists, which Kaiser calls MISs. With most of KP HealthConnect's outpatient clinical records functionality already comfortably in place, the region turned to one of KP HealthConnect's non-clinical applications, the administrative module. This application was intended to streamline appointment scheduling, check-in, and check-out for outpatient care, making these tasks interoperable with one another as well as with data stored in patients' clinical records. The coordinators immediately assumed their positions on the local configuration team, alongside IT and operations leaders as well as programmers and application specialists. They

also began assembling a cadre of bargaining unit members to serve as “super-users.” Super-users were support staff end-users—mainly RNs, MAs, and MISs—drawn from throughout the region. These 15-20 workers (membership was somewhat fluid) were the first to learn how to use the administrative module and served as liaisons between frontline support staff and the regional configuration team. As the region grew closer to implementing the system in the spring and summer of 2005, super-users were temporarily transferred on a full-time basis from their regular roles on the front lines, allowing them to travel the region answering questions and facilitating the training of other bargaining unit members. Union and management leadership were also looking ahead to the post-deployment period when these experts would return to their jobs able to serve as their workplace’s de facto leaders and “go-to” people for all matters technological and work-related pertaining to the KP HealthConnect administrative module.

The organization of work at Kaiser posed a unique set of challenges for the transition from the legacy technology to the new administrative module. Aside from carrying pagers and serving as troubleshooters in the months before and weeks after go-live, super-users supplied information that proved vital to the configuration and implementation of the system. It was the super-users who pointed out that the transition between scheduling modules could not be done in waves—by clinic, by department, or by any way other than what would eventually be labeled a “big bang.” This is because members, while assigned to a specific provider in a specific clinic, draw on services from many departments and often multiple clinics. If a patient needs to schedule a lab or speciality visit while seeing their PCP, support staff in their home clinic must be able to access and modify appointment schedules from across the region. Aside from communicating this up to management through their labor coordinators, the team also made a related case with respect to training, also voiced at the strategic level by the regional labor coordinators: all end-users must be trained—something that had not occurred in the other regions that had already implemented this module—and, in fact, trained before go-live.

Management’s recognition of this increased demand for training reinforced the need for backfill as well as for some flexibility from the rank-and-file. The short time frame meant that some training would have to occur in the evenings and on weekends, a decision that would not be welcomed by the workforce. Overall, the decision to go with a “big bang” made the planning and preparation undertaken during the configuration stage even more imperative, as the region could not wait for the first returns from pilot testing to identify and solve problems. In fact, it was also

a super-user that pointed out to regional management through his KP HealthConnect labor coordinator that even the very limited plan for testing—appointments at two clinics in Salem—could not take place until nearly the entire region had been trained, since anyone in the system making appointments for these clinics would have to be comfortable using the administrative module at the start of the short pilot period. An additional lesson conveyed by the super-users group that stemmed from the pilot in Salem was the need to temporarily reduce appointment loads and to allow MAs extra time for checking-in and “rooming” patients around the go-live date. They also pointed out the need for small changes in security access settings, allowing MAs “write” rather than “read-only” access to certain parts of the patient record. This allowed MAs to take vital signs during the rooming process and to enter the results directly into the system, a perfect example of the ways that the new technology engendered simple but efficiency-enhancing workflow changes.

Super-users played just as vital a role in the initiative when they returned fulltime to their regular positions. Managers and frontline staff report their being in-demand as KP HealthConnect resource people in their clinics, providing co-workers with quick answers to the sorts of “just-in-time” questions that arose as those who were already formally-trained became everyday users. Though those workers joining Kaiser after go-live received formal KP HealthConnect training during orientation, they also called on their clinic’s super-users for follow-up questions as they “climbed the learning curve.” Reports from super-users returned to their permanent roles reached the region’s two KP HealthConnect labor coordinators—still fulltime on the project—, revealing a consensus on the need for follow-up training in the system. Frontline staff had by-and-large mastered the basics, but were not taking advantage of the system’s more advanced features that could facilitate routine tasks and improve performance. This led to the development of follow-up “optimization” training to take place during the ongoing-use of the system. Included in these sessions were opportunities for workers to learn how design and implement tools and keyboard shortcuts for regularly-recurring workflows unique to their module, clinic, department, or even to themselves. Even today, super-users still accept and communicate requests and suggestions for system improvements to the labor coordinators as well as to regional IT staff. One recent change to come about this way was the addition of a checkbox on the scheduling interface to denote whether or not a member has cleared any parties for the release of confidential health information, something that has become especially critical since the passage of the Health Insurance Portability and Accountability Act (HIPAA). Though the KP HealthConnect super-users team was effectively

dissolved after the deployment of the administrative module, it has since been reconstituted, including a few of its original members, to facilitate the development and deployment of other KP HealthConnect modules.

In the net, the qualitative investigation of Kaiser’s experience with the administrative module provides initial evidence that this IT application benefited from its inclusion under the KP HealthConnect umbrella. Embedding EI structures into the strategic level enabled information gleaned from support staff to influence fundamental decisions regarding how the technology was rolled out as well as changes in the technology’s configuration intended to make the module more useful to workers. The labor coordinators also served as a bridge between the strategic and workplace-levels, as one management leader argued, helping frontline staff understand the “rationale” for the system. They communicated largely via the super-users the transformative goals served by the administrative module and that the union judged the workforce to have a real stake in the technology’s success. Furthermore, the Effects Bargain instituted flexibility and installed functional-level structures for disposing of matters that might otherwise limit the applications of workers’ ideas, e.g., asking workers to undertake training during non-working hours. Therefore, workplace-level engagement should, indeed, complement the effectiveness the administrative module. Likewise, workers can make effective use of the technology without a sense that they have been made less whole by it. Further qualitative support comes through contrasting Kaiser’s experience with the administrative module with a similar initiative that conceived of EI much more narrowly.

### **The Panel Support Tool**

While frontline staff and even casual observers might lump any of the applications that together constitute Kaiser’s EHR system under the label KP HealthConnect, Kaiser leadership behaved as though there were a clear distinction between HealthConnect and non-HealthConnect IT applications. The latter, while necessarily governed by the LMP-brokered employment security pledge, remain outside the scope of the KP HealthConnect Effects Bargain. This effectively freed management from any obligation to provide EI structures, allowing them to instead ask for workplace-level engagement without offering any avenue for EI at the other two levels of the employment relationship.

One such non-HealthConnect software application is the panel support tool. It grew out of concern that Epic’s product, KP HealthConnect, did not meet all of the demands of Kaiser’s strategic reorientation towards “population care manage-

ment.” As a result, Kaiser’s decision in 2003 to move ahead with KP HealthConnect was followed shortly thereafter by the formation of an in-house team of administrators, researchers, managers, and physicians drawn from KPNW, Kaiser Permanente of Hawaii (KPHI), and Kaiser’s national program office. The team was charged with developing a read-only database that would be populated with data from other databases and systems—what IT researchers and practitioners commonly label an enterprise data warehouse (EDW).

Figure 2-3 provides a glimpse of the panel support tool as it appears to end users. The panel support tool allows physicians and support staff to seek out information on “care gaps” for an entire patient panel as opposed to looking up individual patients to determine all of the tests and procedures for which they are due. Care gaps stem from up-to-date evidence of recommended care, often identical measures to those institutionalized as HEDIS measures, for patients with various conditions and recommended preventive care on the basis of one’s gender or age (Livaudais, Unitan, and Post, 2006). For example, an MA could use the panel support tool to identify which members of their physician’s panel are due for a mammogram or Pap smear. In order to identify who is due for a breast exam, the application searches through the EHR system for continuously enrolled women age 52-69 who have not undergone a mammogram in the prior two years. Likewise, the tool can query patient records for a list of continuously enrolled women age 21-64 who have not undergone a Pap test in the prior three years. The MA can then contact the patient, remind them that they are due for a particular screening or procedure. Kaiser refers to this practice as “outreach.” The panel support tool also enables what Kaiser coins “inreach.” In this case, the panel support tool can be used to generate a list of panel members who have already scheduled an office visit in the coming weeks or months, for each listing their full complement of care gaps. From this, they can contact the patient and suggest that he or she address these care gaps since they already have plans to visit the clinic. In the case of inreach or outreach, with the patient’s approval, the MA can then “pend” the orders for the physician’s approval and schedule the appropriate procedures. That MAs “pend” rather than actually schedule or order screenings and procedures is more than semantic as scope-of-practice restrictions prohibit the latter.

Permanente physicians had an acute interest in the panel support tool since its effective use would allow them to allocate their per-member-per month premium more efficiently, and ideally, leave more in the form of profits for the physicians.<sup>7</sup> Indeed, it was physicians—not support staff—that benefited with bonuses tied to

---

<sup>7</sup>I take up this aspect of physician incentives in Chapter 3.

Figure 2-3: The “Complete Panel View” of Kaiser Permanente’s Panel Support Tool

The screenshot shows a web application interface for Kaiser Permanente's Panel Support Tool. The main content is a table titled 'Complete Panel View' with the following columns: PCP, DEMODOC, Panel Size, NAME, Sex, DM, CVD, CHE, HIN, CND, Last Seen, and Ref'd. The table contains 20 rows of patient data. A legend indicates that 'Y' indicates a condition in the registry. The interface includes a search bar and navigation tabs at the top.

PCP, DEMODOC	Panel Size	NAME	Sex	DM	CVD	CHE	HIN	CND	Last Seen	Ref'd
800000000	76	Patent00	F	Y						
800000000	46	Patent00	M	Y						
800000000	50	Patent00	F	Y					12/10/2004	1/27/2006
800000000	38	Patent00	M	Y			Y	Y	3/6/2004	1/31/2006
800000000	35	Patent00	M	Y				Y		
800000000	45	Patent00	F	Y			Y	Y	7/12/2006	
800000000	62	Patent00	M	Y		Y	Y	Y	12/23/2005	1/31/2006
800000000	43	Patent00	M	Y			Y	Y	8/22/2006	
800000000	27	Patent00	F	Y			Y	Y	8/22/2006	
800000000	86	Patent00	M	Y	Y	Y		Y	7/6/2005	
800000000	45	Patent00	M	Y	Y	Y	Y	Y	1/28/2004	
800000000	79	Patent00	F	Y			Y	Y	8/3/2005	
800000000	48	Patent00	M	Y	Y		Y	Y	4/13/2005	1/31/2006
800000000	79	Patent00	F	Y	Y	Y	Y	Y	8/29/2005	
800000000	48	Patent00	F	Y			Y	Y		1/31/2006
800000000	54	Patent00	M	Y	Y		Y	Y	7/29/2004	
800000000	66	Patent00	F	Y	Y	Y		Y	6/25/2004	
800000000	55	Patent00	M	Y				Y	1/26/2006	
800000000	56	Patent00	F	Y			Y	Y	1/4/2006	
800000000	57	Patent00	M	Y			Y	Y	1/6/2006	1/31/2006
800000000	68	Patent00	F	Y			Y	Y	12/21/2005	
800000000	57	Patent00	F	Y			Y	Y	11/8/2006	
800000000	20	Patent00	M	Y			Y	Y	8/28/2006	

Source: Livaudais, Unitan, and Post (2006).

Note: Some screenshot text is intentionally obscured in the original source.

their HEDIS scores. Further, the panel support tool team—the mix of physicians and administrators that developed and oversaw the deployment of the panel support tool—had little sense how important workforce participation would be to the success of the initiative, despite their awareness that the reaction of support staff would determine its success. For example, project leaders anticipated that workflow changes would press up against scope-of-practice boundaries and that workers would have to be willing to push these limits. They also had big plans for workers to find creative ways to monetize the tool, like calling patients on their birthday to “invite” them in for health exams and screenings. In fact, they plainly expected MAs to convert what used to be the downtime between patient encounters to time spent supporting their physicians’ patient panel. Nonetheless, their circumventing the Partnership and the bargaining associated with it prevented workers from connecting the discretionary effort they were supposed to put forth with any sort of reward, an effect exacerbated by the fact that the physician leaders and the doctors under them so clearly benefited from MAs’ effective use of the panel support application.

The group decided against a “big bang” go-live, instead letting each clinic go-live immediately after the completion of training. A one-hour refresher course was also planned for six months to a year after go-live. The panel support team ultimately



Table 2.3: Workforce Participation for Each of Two Applications of an Electronic Health Record System for Primary Care Support Staff in Kaiser Permanente’s Northwest Region

	IT application	
	Administrative	Panel Support
<b>Strategic Level</b>		
Employment Security Agreement (1999)	+	+
KP HealthConnect Effects Bargain (2005)	+	-
training—content and design	+	-
staffing/backfill	+	-
<b>Functional Level</b>		
employment security	+	+
training	+	-
staffing/backfill	+	-
<b>Workplace Level</b>		
training	+	+
staffing/backfill	+	-
implementation advice/information	+	-

drafted a single MA at the clinic in which the pilot would be conducted to represent Northwest labor’s interests as a super-user in the project from that point forward. She would also assist in the training program organized by the tool’s regional physician leader, which was made up of an hour-long introductory teleconference in each clinic followed-up by a two-hour, face-to-face training session. Those that excelled in each clinic would be called on to “coach” their co-workers as the technology went into use. Despite the fact that the technology was already in the process of being rolled out, the training session also served as an opportunity for workers to voice concerns or suggestions regarding their use of the application. These sessions also provided clinic-level managers the chance to clarify that workers were now expected to use any down time to do inreach and outreach.

Table 2.3 contrasts the incidence of participatory structures at each level of the employment relationship for each of the two IT applications analyzed. Note that frontline staff were nominally engaged in both projects, because members of the bargaining unit were called on in both cases to facilitate training. Likewise, workers enjoyed employment security as protection against displacement from either application. The critical difference is in the relative absence of EI above the workplace level with respect to the panel support tool. This has the impact of decoupling the

complementarity that engagement and wholeness have on the effectiveness of IT. A closer look at one particular set of challenges to the success of the panel support tool helps to clarify this.

*Staffing Challenges Surrounding the Panel Support Tool.* Despite the engagement of clinic support staff at the workplace level, the panel support tool’s location outside the KP HealthConnect system and therefore, beyond the coverage of the KP HealthConnect partnership apparatus, limits the scope of labor’s involvement. No frontline staff member or LMP representative serves on the development team, limiting labor’s eventual role in the initiative to one in which it facilitates the execution of a preexisting plan. That means that the fundamental design of the system, including the work structures in which it is embedded, do not benefit from frontline employee voice. It also leaves the initiative without a link to the functional level. Therefore, the labor super-users cannot address downstream workflow issues. They were never briefed on union work rules pertaining to training and the use of the panel support tool, nor do they report to the regional KP HealthConnect labor coordinators. The absence of functional-level EI structures also served to disconnect workers from the economic gains anticipated of the IT. Managers could communicate to workers the larger strategic goals served by the technology. But, without the aid of the KP HealthConnect labor coordinators, workers were not convinced that they benefited from the technology. Moreover, without the endorsement of their representatives, many workers suspected quite the opposite. In sum, the initiative did not leverage EI to identify and manage the challenges that inhere in integrating the IT application into incumbent workflows.

Particularly challenging are those aspects of integration dependent on adjustments in staffing, since these could not be immediately addressed even if Kaiser were able to detect the problem on its own. As noted above, those MAs who were expected to use the panel support tool simply did not have the time. With few exceptions, MAs were not relieved of their bread-and-butter job assignments—rooming patients in preparation for the provider’s arrival and responding to phone and email messages on behalf of the provider. That is, they were not able to reallocate their time from real-time encounters to “panel management time,” and none were taken off of encounter-style work and reassigned to purely panel management roles. Yet, the system required MAs to run the necessary queries for identifying care gaps, and then to contact patients and “pend” the appropriate lab and diagnostic orders.

The support staff understood that the current staffing model could not accommodate the demands of the panel support tool. Many articulated this to clinic-level

managers either privately or during the panel support tool training sessions. However, without anyone making the case for staffing to their superiors, these managers were themselves unable to redistribute work or even to fill open MA positions. With respect to the panel support tool, workers have no real avenue for suggesting the creation of a “modified” MA position that would be free of encounter-type work, dedicated entirely to panel support outreach. There were also a small number of MAs peppered across the region whose circumstances left them ripe to be devoted more fully to outreach. For example, those MAs medically excused from their rooming responsibilities or those whose physicians were on part-time leave status. However, there was no structure for gathering this information from the workforce nor for permitting let alone encouraging workers to make these adjustments on their own. Without these structures, merely engaging workers in the initiative cannot increase the likelihood of success.

Further examination details the ways that a more broadly-scoped form of EI would have benefited the panel support initiative. Interviews with project leaders and labor representatives pointed to three factors that would make or break the productivity potential of the new system. First, MAs and eventually, MISs, would have to take on more responsibilities that would bump-up against what had historically been expected of those in their role. Real-time encounters would no longer be the sole focus of the MA position, and MIS would eventually be expected to follow suit. This turned out to be a serious source of friction between management and labor. It arose from the system’s creation of a new workflow step—the “pending” of physician orders. Front-line staff needed assurance that they were permitted both contractually and legally to take on this task. Unanticipated downstream effects on workflows exacerbated this problem. Many physicians, particularly those practicing internal medicine felt that their support staff were pending an inordinate number of tests, tests that the physicians themselves would not have ordered. Though they could and often did simply decline rather than approve the pend, many reportedly asked that the staff curtail their pending. This put MAs in the awkward position of having to choose between conflicting directives from two “bosses”—a manager and a physician. It also pressed MAs to make decisions regarding whether and when a particular test was warranted, something clearly beyond the scope of their job both legally and contractually. Specialists also started complaining that they were receiving test results that should have been going to the patient’s PCP. This, it turned out, was a result of an easily avoidable flaw in the panel support tool’s configuration, one that sent all test results to the physician that ordered them rather than to the patient’s PCP. The second critical determinant of the panel support tool’s success would be the adequacy of “backfill”—

the replacement or backup frontline staff required to be in place to facilitate training and calibration sessions as well as during the period of initial use. Previous initiatives had made clear to labor and management that insufficient backfill burdens staff and generates resentment. Third and most important, the existing staffing model, already strapped for reasons noted above, was not built to promote the effective use of the panel support tool.

A walk through any of Kaiser’s outpatient clinics leaves little doubt that MAs are not awash with downtime. When they are not rooming patients, they generally sit at their desks behind a computer. As noted above, many wear a headset to accommodate their frequent phone use. And, most even appear to be logged into the panel support tool. Survey data confirms the inference of even a casual observer—MAs do not have time to use the technology effectively, particularly for outreach. Recall that outreach refers to the MA contacting the patient to suggest a procedure even if that patient is not already scheduled to be in the clinic, healthcare’s equivalent of the “cold call.” Only 15 percent of respondents denied wanting to allocate more time to outreach. Over three quarters of respondents reported devoting less than one hour per week to outreach, and over 30 percent claim not to have anytime whatsoever for outreach in a typical week. The numbers for inreach are not quite as striking. Recall that inreach is when the MA reaches out to a patient who is already scheduled for an office visit and encourages them to schedule other tests or screenings for which they are due. Half of respondents reported having an hour or less per week to devote to inreach, and over a quarter denied having any time at all for this activity. Talking to MAs and observing their work revealed few exceptions. Some had downtime to devote to inreach or outreach, because of a condition like arthritis that put them on “modified work.” One MA explained that the physician she supports returned to work after maternity leave at half-time rather than full-time, as originally planned. For the time being, she expected to have time to devote to outreach. Even this panel management time, however, was frequently infringed on by having to cover for other MAs on scheduled or unscheduled leave. Encounters, whether by phone, email, or in-person, must always take precedent. Without adequate backfill, encounters regularly displaced panel support efforts.

Staff raised their concerns regarding the panel support tool to their Partnership representatives and to their managers. The region’s two labor coordinators for KP HealthConnect, however, were not part of the process. As noted above, management and physicians determined which members of the bargaining unit would take on super-user duties. These workers were never briefed by management- or labor-side

LMP staff on work rules associated with training, staffing, or scope-of-practice. Since their primary responsibilities were training and troubleshooting, they were chosen mainly for their technical abilities. As the panel management group had started working on the initiative almost three years earlier, the trainers played no role in forming the strategy or the vision for the panel support tool. They were intended more to make sure frontline staff could navigate the interface than to communicate employees' concerns and ideas back to the panel support tool team.

Had the panel support tool been considered part of KP HealthConnect, the Partnership would have been involved virtually from its inception as it was for the administrative application. Therefore, the Partnership would have influenced the development of the panel support strategy that the technology is intended to serve. Any necessary changes to job descriptions or staff expectations could have been anticipated and integrated into negotiations at the functional level and communicated unambiguously to those workers impacted by the changes. Furthermore, structures to facilitate workplace-level EI would likely also have been in place from the earliest days of the project since they would be essential for informing those involved at the strategic level. Consequently, there is good reason to believe that a wider scope of EI could have forestalled obstacles to the initiative.

## **Quantitative Evidence**

### **Statistical Methods and Empirical Strategy**

Recall that KPNW's front-office, outpatient, administrative module, was configured, implemented, and deployed within the ambit of the region's LMP. On the other hand, the panel support tool, a database to be used by back-office MAs, was configured and deployed outside of the LMP. These divergent approaches to implementing two different pieces of their EHR system make for an attractive "natural" experiment comparing the mediating effects of the employment relations variables on the performance impact of new IT. In either case, workers were under the broad, general employment protections negotiated by the LMP. However, only the administrative module could benefit from the LMP's understanding of and influence upon the broader strategic goals set forth for the technology. The administrative module, for example, was intended to provide workers with more accurate and up-to-date patient data and scheduling information in order to streamline the process by which patients call to make an appointment—a process that the region had long targeted as a source of inefficiency and patient frustration. The panel support tool was conceived of as a

tool for closing patient “care gaps”, in effect, raising the region’s HEDIS scores and encouraging compliance with best practices.

Hypotheses 2.1, 2.2, and 2.3 will be tested by examining longitudinal data on the administrative module’s performance impact. As both a robustness check and to maintain a parallel empirical approach between these hypotheses and those that address the panel support tool, I look at the effects of the administrative application on two performance measures—one binary and the other continuous. The first dependent variable, derived from patient satisfaction surveys, is whether or not patients making their appointments by telephone were able to schedule their appointment with the first person they spoke to. Separate, longitudinal logistic regressions for each medical clinic yield clinic-level estimates of the impact of the application’s go-live controlling for the time trend and precluding unobserved heterogeneity between locations. Hypothesis 2.1 can be evaluated by examining the estimated coefficient on the IT variable for each of the clinics. The vector of IT effects will then be projected on a series of scatterplots—each placing a different employment relations measure on the horizontal axis. The employment relations variables were constructed from responses to a staff survey. They are 1.) the clinic-level mean for the engagement index with respect to the module, 2.) the clinic-level mean for an index of worker wholeness with respect to the application, 3.) the share of a clinic’s workforce introduced to this functionality by a fellow member of the bargaining unit, 4.) the share of a clinic’s workforce receiving their follow-up training for the module from a fellow member of the bargaining unit, and 5.) the share of a clinic’s workforce responding that a fellow member of the bargaining unit at their clinic was or is a super-user. Evidence of an increasing performance impact with respect the wholeness index bolsters Hypothesis 2.3 while similar pictures for the other four plots would support Hypothesis 2.2.

These hypotheses are next addressed by estimating a set of random-effects regression models on the panel of outpatient medical clinics. Though a fixed-effects specification would be preferable for eliminating noise stemming from unobserved inter-clinic heterogeneity, reliance on time-constant employment relations measures precludes the use of such models. In this case the dependent variable is the mean, standardized measure of patient satisfaction with the length of time it took him or her to make an appointment by phone. This satisfaction measure is regressed on a vector of independent variables that allow us to “partial out” the impact of the administrative module’s go-live on performance as well as the complementary impact of worker engagement and wholeness on the technology’s performance effects.

In order to address Hypotheses 2.4, 2.5, and 2.6, I examine similar data on the

panel support tool. One way to measure the effectiveness of this application is to look at the share of patients visiting a clinic each month who undergo a lab test, another measure constructed from responses to Kaiser’s patient satisfaction survey. The analysis that follows parallels that undertaken above to identify the administrative module’s performance impact. I use by-clinic, logistic regression to estimate an IT effect for each clinic. These estimates speak directly to Hypothesis 2.4. I then project these estimates onto five scatterplots. However, in this case, I do not anticipate a positive association between the application’s go-live and a clinic’s measures on any of the employment relations variables. As with the administrative module, I also consider continuous performance measures aggregated at the clinic level. I use the panel of medical clinics to examine these two dependent variables of great interest to Kaiser and expected to be favorably affected by the use of the panel support tool—compliance rates for breast and cervical cancer screenings. Despite its similarity to the analysis used to address Hypotheses 2.1, 2.2, and 2.3, we should not find clear evidence that the IT boosted performance nor that efforts to engage workers or keep them whole made this technology any more effective for boosting cancer screening compliance.

In the aggregate, these tests are meant to show that findings from Hypotheses 2.2 and 2.3 appear not to generalize; engagement and wholeness do not universally complement the performance impact of IT. Rather, attention to these employment relations variables only pays off when worker input is channeled into changes in work structures that reinforce the effective use of the new technology. With respect to the panel support tool, rank-and-file clinic support staff argued from the start that constraints on their time made it unlikely that they could devote additional time to inreach or outreach. Had contextual variables been put into play by Kaiser as they were for the administrative module’s implementation, managers would have understood and acted upon the need to increase staffing ratios to allow MAs more time for inreach and outreach. Therefore, I can offer additional support for the importance of more-encompassing EI by estimating a set of clinic fixed-effects Poisson regression models to predict the number of lab tests performed each month in a given clinic. A positive, estimated partial slope for the interaction of the application’s go-live and a measure of the excess in actual over budgeted MA hours worked, controlling for the main effects of these and other variables, implies support for the mediating role of the scope of EI.

## Descriptive Statistics

Table 2.4 presents summary statistics from the survey of the Northwest's unionized support staff. Means are calculated using only responses from those MAs and MISs expected to use each system in the course of their work, and the differences-in-means are each assessed using a *t*-test.<sup>8</sup> The first set of variables includes the four items making up the engagement index as well as the four additional survey questions that measure workplace-level EI. In the net, it cannot be said that the panel support tool initiative did an inferior job at engaging workers at the lowest level of the employment relationship. Workers were more likely in the case of the panel support tool to credit their success to super-users. Likewise, 18.2 percent of the panel support tool's users claim to have had their introductory training led by a unionized colleague, whereas just 11 percent say the same of the administrative module. And, a larger share of respondents report the presence of a panel support tool super-user in their clinic than the presence of one for the LMP-guided IT. The evidence suggests that the panel support initiative succeeded in engaging staff in the project at the workplace level, at least as much if not more than the drive behind the administrative module. This makes it even more intriguing when the performance impact of engagement differs across the two IT modules.

---

<sup>8</sup>The paired nature of the sample data calls for a *t*-statistic rather a *z*-statistic to assess a difference-in-means.



Table 2.4: Means for Employment Relations Measures for Two Modules of an Electronic Health Record System

variable	mean		t-stat. <sup>a</sup>
	Admin.	Panel Support	
engagement index <sup>b</sup>	-	-	-
suggestions have been valued <sup>c</sup>	3.99	4.34	-2.18*
issues have been ignored <sup>c</sup>	3.43	3.49	-0.29
unionized super-user improves my use <sup>c</sup>	4.01	4.64	-3.47***
affected staff were asked for guidance <sup>c</sup>	3.77	3.55	1.24
introduced to technology by a union member	.11	.18	-2.47**
received follow-up training from union member	.18	.16	0.58
relies on a super-user in their clinic	.39	.58	-3.94***
has made specific recommendations for effective use	.15	.18	-0.77
wholeness index <sup>b</sup>	-	-	-
made it harder to do my job <sup>c</sup>	2.69	3.33	-3.47***
made clinic staff worse off <sup>c</sup>	2.62	3.47	-4.78***
changed work in unfair ways <sup>c</sup>	2.74	3.20	-2.59**
covering for staff burdened me and others <sup>c</sup>	3.38	3.33	0.30

*Source:* Self-developed and self-administered survey of Kaiser support staff.

*Key:* \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$  for the two-tailed test.

*Notes:* Respondents only answered questions about a particular system once they affirmed 1.) that they were expected to use that system in the course of their work, and 2.) that their job classification was either MA or MIS. Therefore, these data are based on  $n_{\text{admin.}} = 362$  and  $n_{\text{panel support}} = 148$ .

<sup>a</sup> t-statistic describing  $H_0 : \bar{x}_{\text{admin.}} - \bar{x}_{\text{panel support}} = 0$  with no assumption of equal variances.

<sup>b</sup> Indices are standardized such that  $\bar{x} = 0$  and  $\sigma^2 = 1$ .

<sup>c</sup> Items are coded on a seven point, Likert-type scale in which 1 = “strongly disagree” and 7 = “strongly agree.”

The same cannot be said of the items composing the wholeness index. The LMP-guided initiative, the administrative IT module, did a superior job at keeping support staff whole. For only one of the items, that referring to the burden that training places on co-workers, did the administrative module do no better than the panel support tool. On the other hand, the mean responses for the other three items all revealed a statistically significant difference between the projects. Relative to their feelings regarding the administrative module, respondents felt that the panel support technology made it harder for them to do their jobs, made clinic staff worse off, and changed their work in ways that were unfair to them.

The rest of the variables to be used for hypothesis testing appear in Table 2.5. The right-hand side variables in the top half of the table are staffing-related measures for

MAs, the staff members expected to use the panel support module, and two controls for clinic “congestion”—the number of office visits in a particular clinic-month and the average number of office visits per budgeted working hour. What stands out among the dependent variables, displayed in the bottom half of Table 2.5 is how compressed the distributions are for the two HEDIS compliance measures—screenings for breast and cervical cancers. Nonetheless, the cost to the insurer of late diagnosis and treatment so dwarfs the cost of prevention, that small changes in the share of patients receiving mammograms or Pap tests makes a material difference to the organization. Notice also that the dependent variables include two separate measures for determining whether or not a patient used laboratory services as part of their most recent office visit.

Table 2.5: Descriptive Statistics for Independent, Control, and Dependent Variables

	mean	std. dev.	$n_{\text{obs}}$ <sup>a</sup>	$n_{\text{clinics}}$
<b>independent &amp; control variables</b>				
total actual hours worked <sup>b</sup>	13,494	5,800	313	15
total hours budgeted <sup>b</sup>	13,139	5,846	313	15
excess of actual hours worked over budgeted <sup>bc</sup>	3.79	10.76	313	15
office visits	3,821	2,188	247	14
office visits per budgeted working hour <sup>b</sup>	1.04	.52	313	15
<b>dependent variables</b>				
breast cancer screening compliance	.82	.03	272	15
cervical cancer screening compliance	.80	.03	272	15
made appointment with the first person spoken to	.79	.09	468	15
satisfaction with length of phone call <sup>d</sup>	-	-	468	15
visited the lab during an office visit	30.5	19.19	247	14
office visit included a test or screening	45.0	26.57	247	14

*Source:* Author’s analysis of data from patient medical records, archival staffing data, and a patient satisfaction survey.

<sup>a</sup> Observations are clinic-months unless noted otherwise.

<sup>b</sup> Observations are clinic-quarters, weighted by the number of patient’s “at risk” for a screening.

<sup>c</sup> Variable operationalized as a percentage, i.e.,  $x = \frac{\text{hours}_{\text{actual}} - \text{hours}_{\text{budgeted}}}{\text{hours}_{\text{budgeted}}} \times 100$ .

<sup>d</sup> Indices are standardized such that  $\bar{x} = 0$  and  $\sigma^2 = 1$ .

## Hypothesis Testing

**The Administrative Module.** The first set of hypotheses address the administrative IT application, the technology that was introduced under Kaiser’s Labor Man-

agement Partnership (LMP). Since Hypothesis 2.1 addresses the administrative module's main performance effects, it can be considered in the context of the subsequent hypotheses. Hypothesis 2.2 examined the impact of engagement—workplace-level EI—on the performance gain arising from the administrative module, predicting a greater increase in performance at those clinics whose workers report high levels of engagement. In order to test this hypothesis, I estimated separate equations for each of the 14 clinics providing data on both patient satisfaction and employment relations. Each was a logistic regression of the binary variable describing a key goal of the initiative—whether or not a patient succeeded in making their appointment with the first person he or she spoke to by phone. On the right-hand side were two linear time trends, one starting at the beginning of data collection in October 2004 and the other beginning in September 2005. The starting month for the second time trend allows for a “transition” period beginning one month before the July 2005 go-live and ending with the following month. This transition period, represented by a dummy variable, partials out performance fluctuations in the time leading up to and immediately following go-live, though the results are not sensitive to small changes in its parameterization. Most important on the right-hand side, however, is a dummy variable capturing all of the months in which the new technology was live.

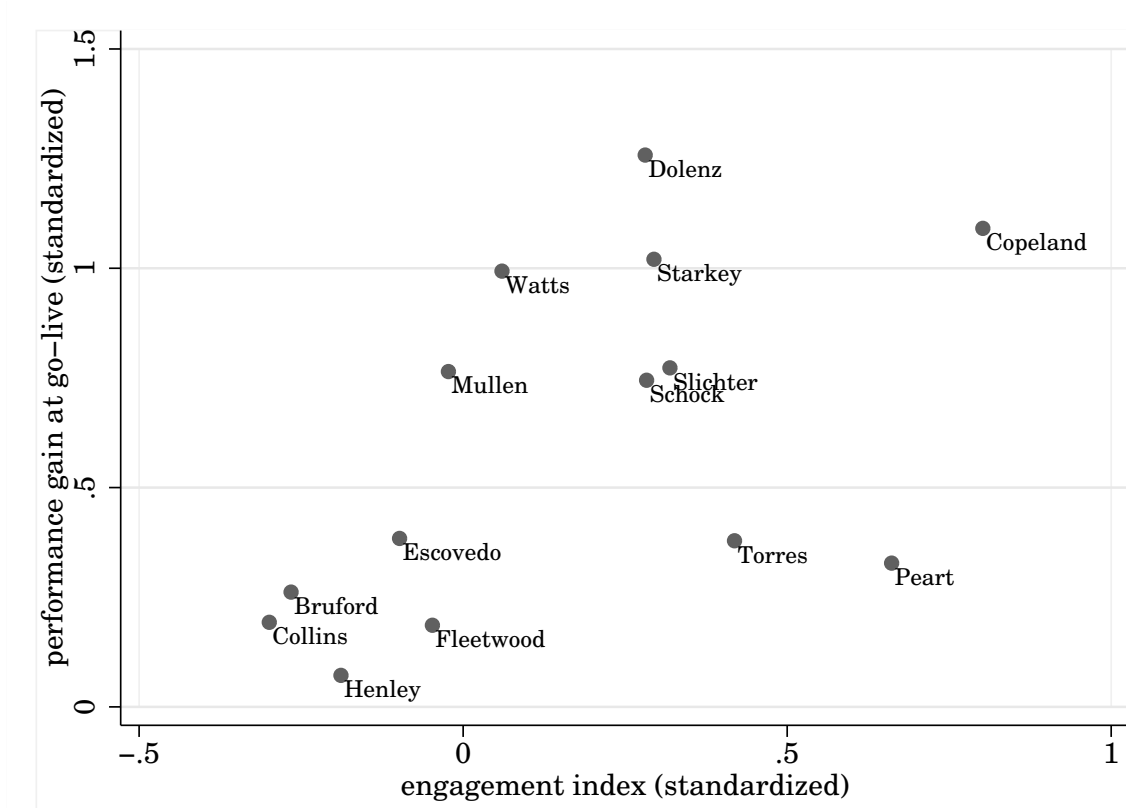
Figure 2-4 displays each clinic's coefficient estimate for the go-live variable as a function of that clinic's mean value for the index of employee involvement.<sup>9</sup> While there is a fair bit of variation in the magnitude of the go-live estimates, not a single clinic experienced a decrement to performance with the implementation of the administrative module. This supports Hypothesis 2.1. Next, note the appearance of a positive association between engagement and the IT-engendered performance gain, providing initial support for Hypothesis 2.2.

Figures 2-5, 2-6, and 2-7 are scatterplots generated in the same way as Figure 2-4, only with alternative measures of engagement on the x-axes. Figure 2-5 displays performance improvements as a function of the share of a clinic's respondents reporting the presence of a super-user—a label used to describe members of the bargaining unit that serve as lead-users and ad hoc troubleshooters—in their clinic. Once again, the 14 points composing the scatterplot suggest a positive association between engagement and effective use of the administrative module. In this case, note the wide variation in the variable measured horizontally. Whereas 80 percent of respondents at Copeland reported the presence of a super-user, only 22 percent of respondents at the Bruford clinic answered the same question affirmatively, differences that appear

---

<sup>9</sup>Recall the clinics' actual names have been disguised.

Figure 2-4: Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Clinic’s Mean Value for the Engagement Index



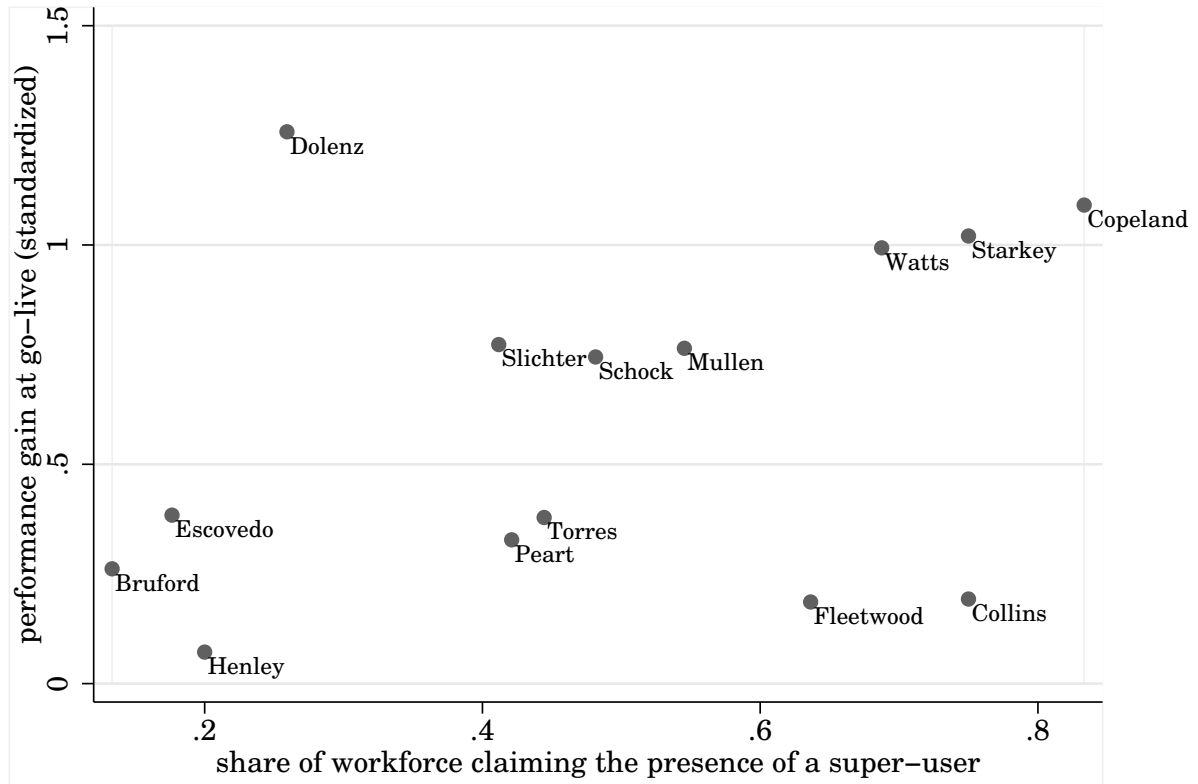
Source: Author’s analysis of data from staff survey and patient medical records.

to have had consequences for the size of the performance gain obtained from the IT application.

Figures 2-6 and 2-7 examine the involvement of frontline staff—lateral co-workers for the respondents—in training for the administrative module. Figure 2-6 looks at introductory training for the system and generates the sort of positive relationship called for in Hypothesis 2.2. That is, those clinics in which a larger proportion of respondents reported having been trained by a fellow member of the bargaining unit appear to have obtained a larger performance benefit from the system. Finally, Figure 2-7 looks at follow-up training for the administrative application. In this case, the shape of the point cloud provides support, albeit less strong than the other plots, for Hypothesis 2.2.

Table 2.6 provides further support for Hypotheses 2.1 and 2.2. It displays estimated coefficients for random effects regression models predicting a clinic’s monthly, average, standardized score for a single question from Kaiser’s Medical Office Visit

Figure 2-5: Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Share of the Clinic’s Workforce Reporting the Presence of a Super-User

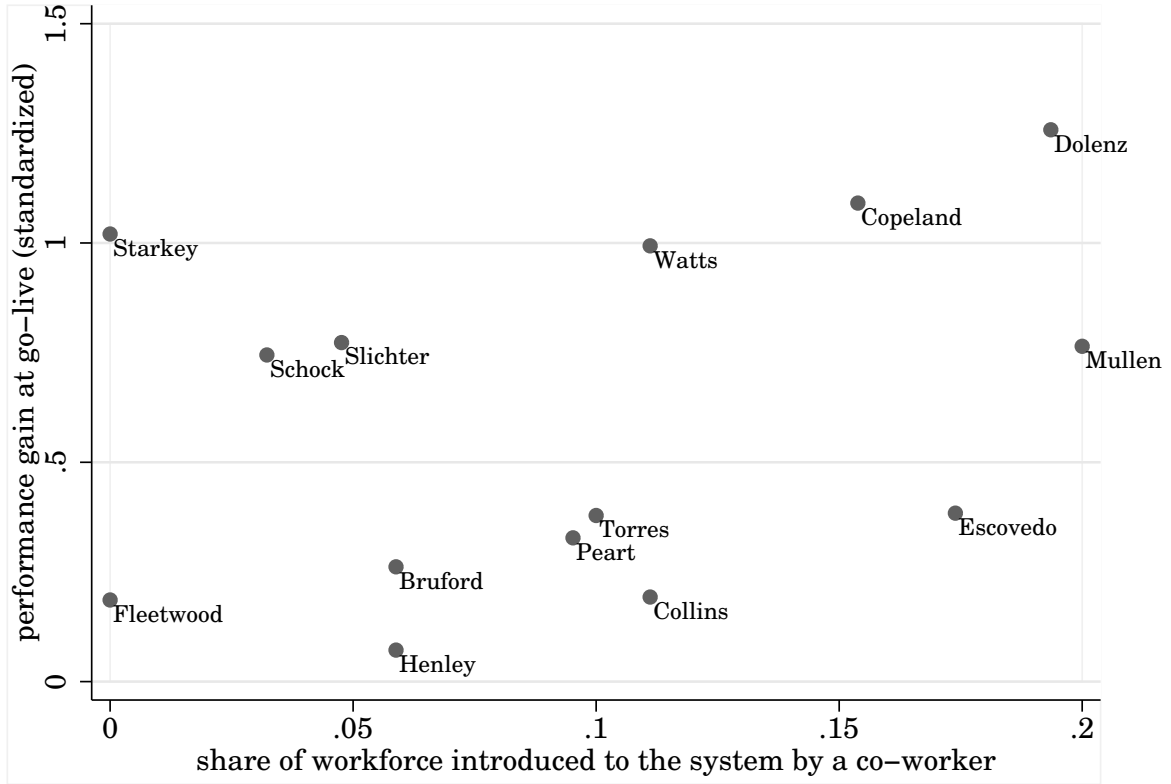


Source: Author’s analysis of data from staff survey and patient medical records.

Survey—the patient’s satisfaction “with the length of time spent on the phone to schedule [his or her] appointment.”<sup>10</sup> That this dependent variable is essentially a continuous version of the one used to generate the scatterplots renders this a robustness check. However, the use of a continuous dependent variable here also allows the analysis for the administrative module to mirror that for the panel support tool. The first column accounts only for time. Note that  $\hat{\beta}_{\text{time}}^{\text{M1}} = .01$  ( $p < .001$ ), implying that each additional month from the start of the observation period is associated with a one percent increase in a clinic’s average score on the dependent variable. Therefore, without any controls whatsoever, there is a slight month-to-month performance improvement over time. The estimated slope coefficient turns negative in the second column with the inclusion of a second time trend variable, one that begins with

<sup>10</sup>Recall that reliance on time-constant employment relations measures precludes the use of a fixed-effects specification.

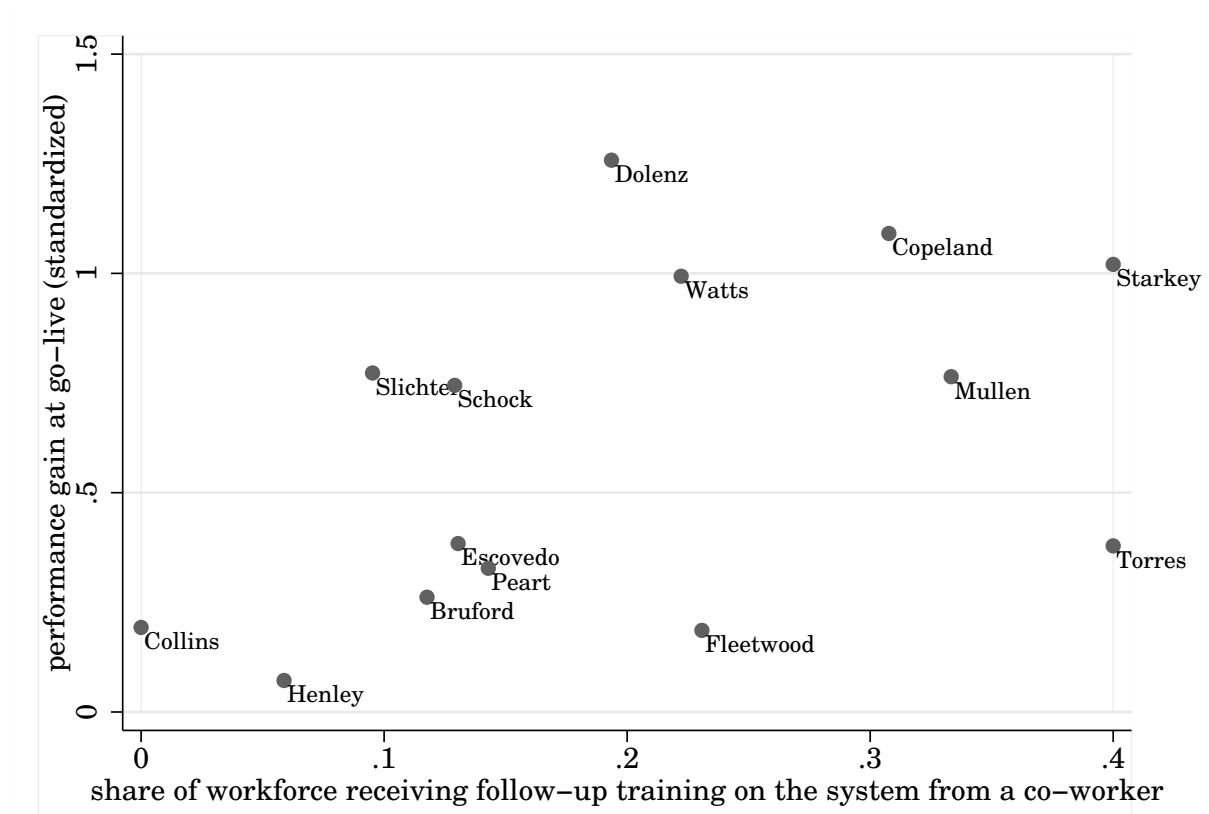
Figure 2-6: Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Share of the Clinic’s Workforce Introduced to the Technology by a Fellow Member of the Bargaining Unit



Source: Author’s analysis of data from staff survey and patient medical records.

the use of KP HealthConnect’s administrative module. This suggests a structural break in the time-series that remains throughout the rest of the models estimated. Consistent with anecdotal accounts, customer service was suffering prior to the implementation of the administrative system, a trend that reversed itself at the same time as the transition to the new system. Estimates in the third column strengthen this finding. With M3’s addition of dummy variables to capture the transition months and the months in which the technology was live, the structural break becomes more pronounced. That is, the estimated negative effects of trend increase in magnitude while the overall impact of the technology increases. This bolsters Hypothesis 2.1 by showing that the average performance effect of the “inclusive” IT application is positive—irrespective of variation in the engagement or wholeness variables. These estimates do remain statistically significant, however, even with the addition of the employment relations measures. Column four adds only the main effect of the engage-

Figure 2-7: Performance Impact at Go-Live for the KP HealthConnect Administrative Module as a Function of the Clinic’s Mean Value for the Share of the Clinic’s Workforce Receiving Follow-Up Training from a Fellow Member of the Bargaining Unit



Source: Author’s analysis of data from staff survey and patient medical records.

ment index, which enters the model with an insignificant point estimate. Notice how this changes with the following model, which adds the multiplicative variable crossing engagement with go-live. It is the fifth column that squarely addresses Hypothesis 2.2 by adding including both variables to capture the engagement construct—a measure of a clinic’s mean value for the engagement index as well as a two-way interaction between the newly-added variable and the dummy representing the administrative module’s being live. Our primary interest is in the latter, as it captures the differential performance improvement associated with the use of the new system between those clinic’s with high and low values of workplace-level engagement. The estimated slope coefficient for the two-way interaction is .19 ( $p < .001$ ), implying that a single standard deviation’s increase in a clinic’s mean value for engagement is associated with an extra 19 percentage points of performance improvement from the use of sys-

tem. This increment to performance comes over and above the 40 percent increase associated with the IT itself. The negative estimate for the main effect of engagement was unexpected. However, it reinforces the argument underpinning Hypothesis 2.2. At least in this case, the benefits of engagement operate indirectly through their complementarity of the KP HealthConnect IT rather than directly through their impact on performance. More critically, the estimates support the argument that engagement complements the technology's performance effect in the presence of EI structures at higher conceptual levels of the employment relationship.

Hypothesis 2.3 predicts that with respect to the administrative module, those clinics scoring higher on the index of worker wholeness will generate larger performance improvements. Figure 2-8 reflects the relationship between workforce wholeness and the binary performance variable called on previously—whether or not the patient respondent was able to schedule their appointment by phone with the first Kaiser staff member to whom they spoke. The scatterplot was generated in the same way as Figures 2-4-2-7. Like the others, the point cloud shows a positive relationship between the wholeness index and each clinic's success with its new administrative IT.

The final three columns in Table 2.6 also speak to Hypothesis 2.3. The third model from the right adds only the single indicator for the wholeness index, estimated as insignificantly different from zero. But, the second to last model adds the two-way interaction to assess the differential performance impact of wholeness. The estimates are directionally identical to those generated for the engagement index. However, both are closer to zero, and neither the main effect of wholeness nor the two-way interaction of wholeness with the IT dummy achieve conventional levels of statistical significance. The model in the second to last column is nested in the final model, which includes the main effects and the two-way interactions from both of the two previous models. The final model actually strengthens support for Hypothesis 2.2. Though both remain insignificantly different from zero, the signs swap on both terms describing the performance effects of worker wholeness.

Though Hypothesis 2.3 does not receive as much support as the previous hypothesis, the estimates should be viewed in light of two statistical issues. First, the insignificance of the wholeness coefficients in M5 would be of greater concern if these estimates were intended to be generalized to a larger population of outpatient medical clinics. Given that the sample and the population to which it generalizes are completely coincident, this should be less of a deterrent to statistical inference as it might otherwise be. Second, the two indices are somewhat correlated in the staff survey from which they were calculated ( $\hat{\rho} = .47, p < .0001$ ) and strongly correlated in the dataset



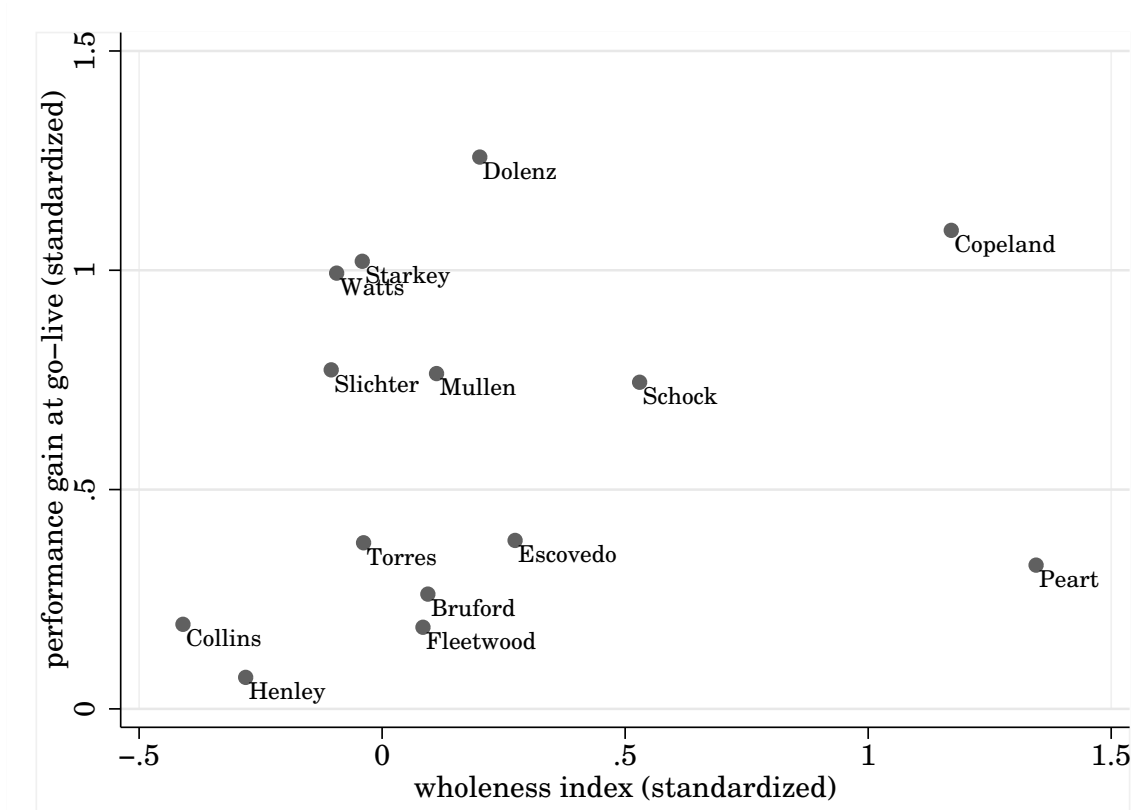
Table 2.6: Coefficients (and z-statistics) for Random Effects Regression Estimates of Patient Satisfaction with the Length of the Phone Call Required to Make An Appointment Over Time as a Function of Variables Describing Information Technology and Employment Relations Context

	M1	M2	M3	M4	M5	M6	M7	M8
time trend	.01*** (6.98)	-.01** (-2.73)	-.05*** (-5.21)	-.05*** (-4.91)	-.05*** (-5.03)	-.05*** (-4.89)	-.05*** (-4.92)	-.05*** (-5.05)
time since “go-live”		.03*** (4.97)	.06*** (5.65)	.06*** (5.34)	.06*** (5.46)	.06*** (5.32)	.06*** (5.34)	.06*** (5.48)
transition period			.15* (2.26)	.15* (2.27)	.15* (2.33)	.15* (2.26)	.15* (2.26)	.15* (2.36)
IT in-use			.44*** (6.31)	.43*** (5.91)	.40*** (5.57)	.43*** (5.90)	.42*** (5.74)	.40*** (5.69)
engagement index				-.02 (-.32)	-.15* (-2.28)			-.28** (-2.65)
IT in-use × engagement					.19*** (3.33)			.31*** (3.55)
wholeness index						.01 (.17)	-.02 (-.56)	.11 (1.58)
IT in-use × wholeness							.05 (1.26)	-.11 (-1.89)
<i>n</i>	496	496	496	468	468	468	468	468
clusters	16	16	16	15	15	15	15	15
<i>R</i> <sup>2</sup>	.11	.16	.26	.25	.26	.25	.25	.27

Key: \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Notes: Significance tests performed using Huber-White standard errors. Dependent variable is the average, standardized measure of patient satisfaction with the length of time it took to make an appointment by telephone for a each clinic in a given month. Variables constructed from author’s staff survey and archival administrative and medical records data.

Figure 2-8: Performance Impact at Go-Live for KP HealthConnect Administrative Module as a Function of Clinic’s Mean Value for Worker Wholeness

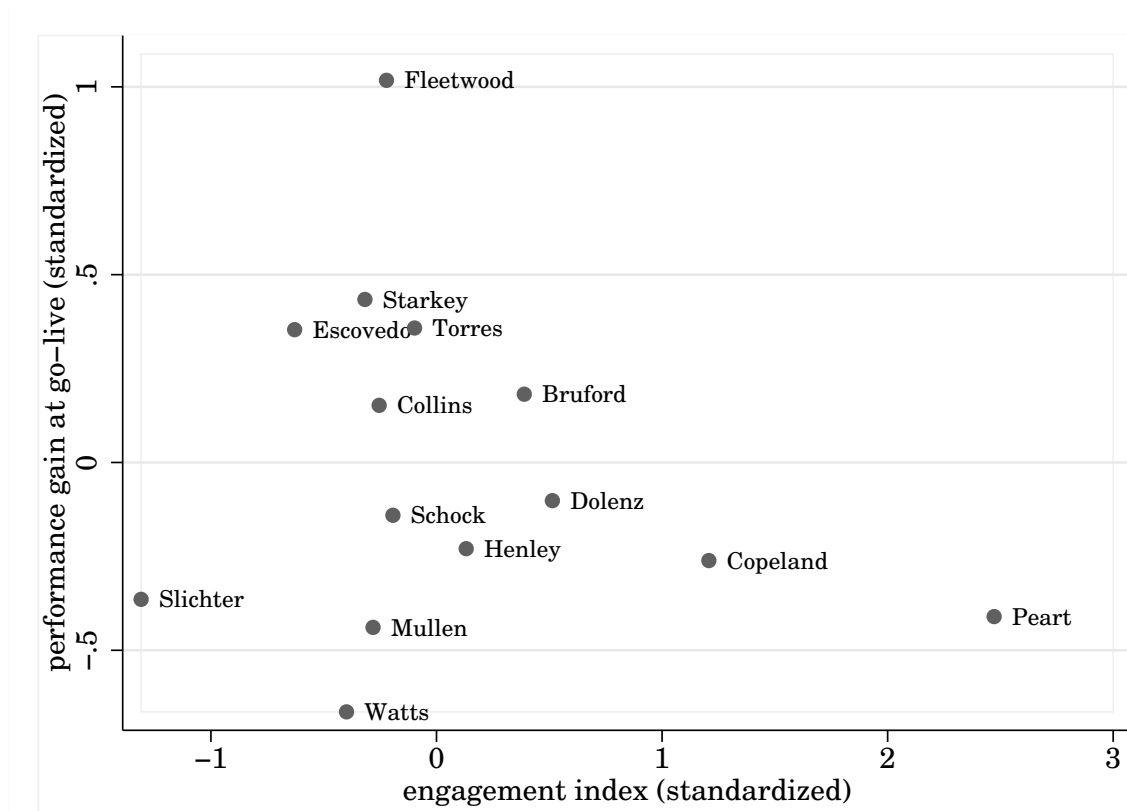


Source: Author’s analysis of data from staff survey and patient medical records.

of clinic-months ( $\hat{\rho} = .59, p < .0001$ ) on which the performance regressions were run. This makes it difficult to isolate the separate effects of engagement and wholeness, particularly given the relatively small number of clusters on which the models were estimated. In the net, engagement and wholeness do come together to complement the performance effects of the administrative module ( $\hat{\beta} = .20, p < .0001$ ).

**The Panel Support Tool.** We now turn to testing the same hypotheses on the panel support IT application, the one introduced outside of the LMP. The statistical testing proceeds just as it did for the previous hypotheses, and in fact, is run on the same sample of Kaiser outpatient medical clinics. Figures 2-9-2-12 speak to Hypotheses 2.4 and 2.5. Note that over half of the clinics witnessed performance declines coincident with the panel support tool’s go-live—in support of Hypothesis 2.4. Furthermore, these scatterplots do not suggest a positive relationship between proxies for engagement and the size of the gains arising from clinics’ use of the panel support tool, nor can they be interpreted uniformly. With respect to the engagement index

Figure 2-9: Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for the Engagement Index

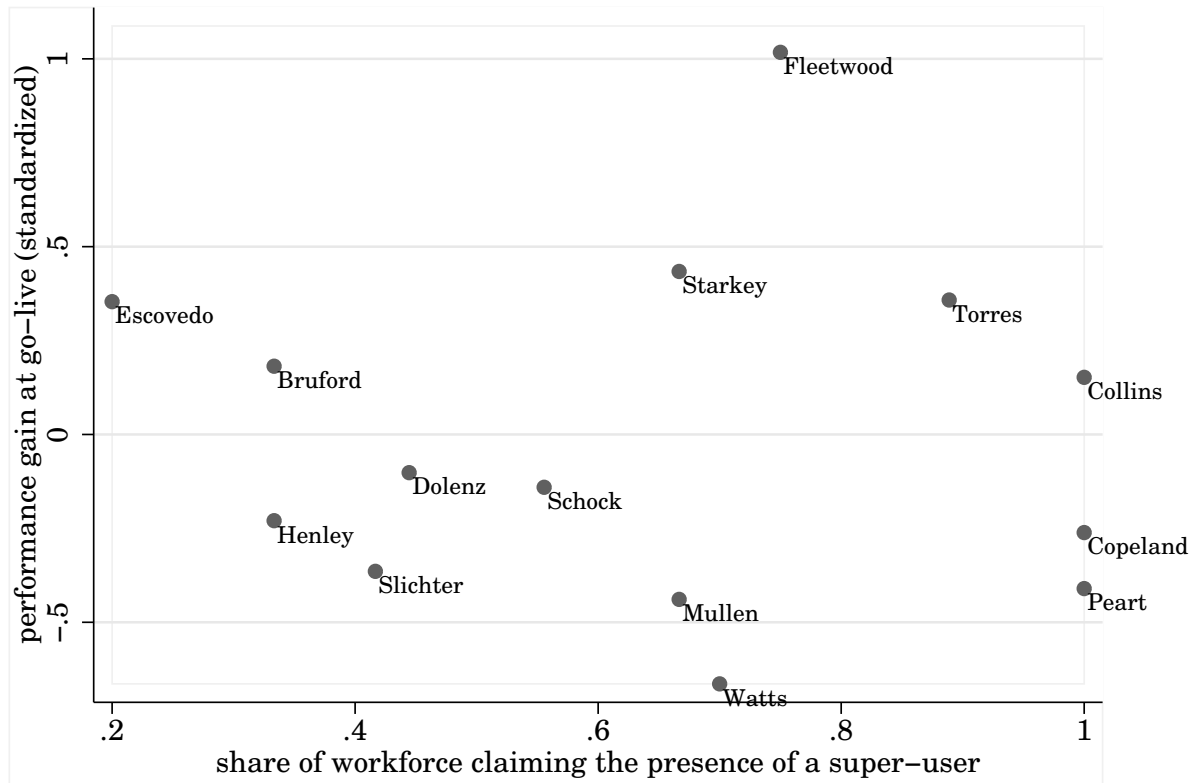


Source: Author’s analysis of data from staff survey and patient medical records.

(Figure 2-9), the points form a vertical line, suggesting a wide range of performance effects for the same approximate level of frontline engagement. Any semblance of a trend arises from three clinics—Dolenz, Copeland, and Peart—that imply a negative association between engagement and the effective use of the panel support tool. This offers initial support for Hypothesis 2.5. Figure 2-10 paints an even more equivocal picture of the relationship between engagement and the effective use of IT. It reveals wide variation in the share of staff respondents in a clinic who report the presence of a panel support tool super-user. Even so, there is no discernable relationship between this proxy for employee involvement and the performance variable measured on the vertical axis.

The figures reflecting the two training proxies, Figures 2-11 and 2-12, also bolster the argument that engagement did not appear to complement this particular IT initiative. Figure 2-11 looks at who conducted introductory training. It yields a vertical line in support of the hypothesis that workplace-level EI will not increase

Figure 2-10: Performance Impact at Go-Live for the Panel Support Tool as a Function of the Share of the Clinic’s Workforce Reporting the Presence of a Super-User

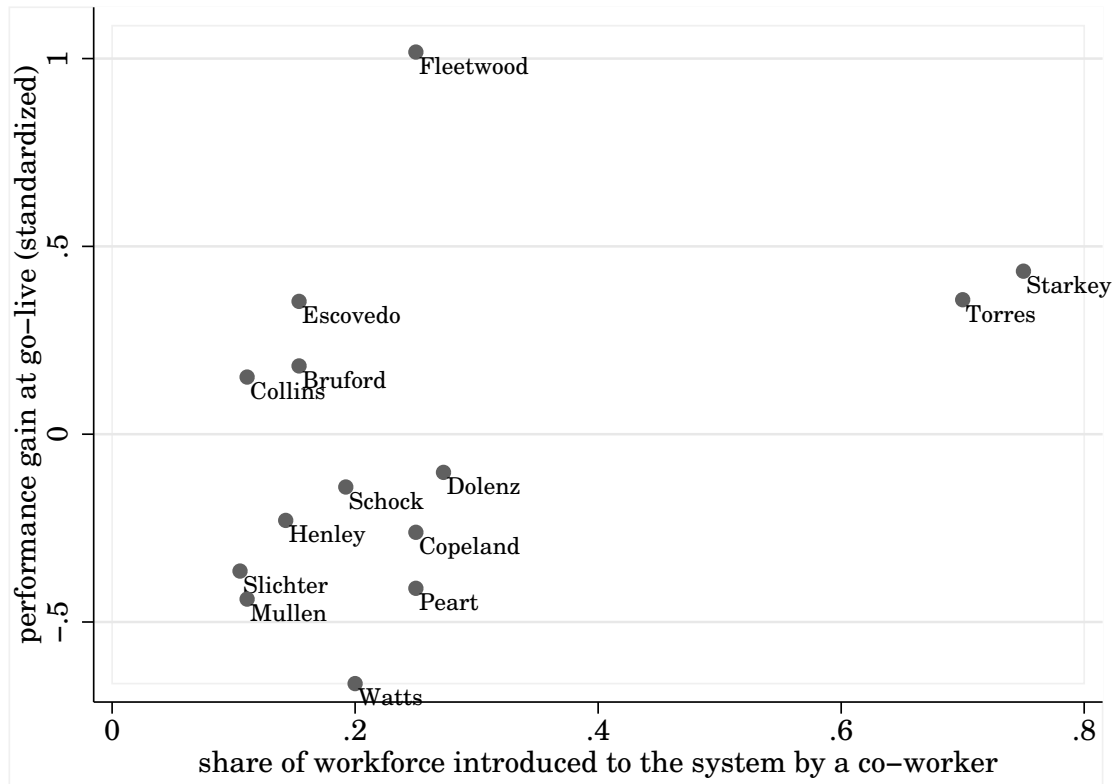


Source: Author’s analysis of data from staff survey and patient medical records.

the effectiveness of the technology when the scope of the involvement is construed narrowly. There are two outliers, however—Torres and Starkey—in which a relatively large share of respondents claimed to have been initially trained by a fellow member of their clinic’s support staff. Though these clinics did not garner a performance improvement anything near the size of that achieved by the Fleetwood clinic, they did relatively well with the panel support tool despite the limited form of employee involvement that characterized this initiative. Figure 2-12 points to the same conclusion, albeit with one fewer extreme value on the independent variable. Though the figures are not entirely dispositive of Hypothesis 2.5, they certainly do not resemble the analogous figures used to support Hypothesis 2.2.

Another test of Hypothesis 2.5 comes in the form of the first and third columns of Table 2.7. This table shows parameter estimates from random effects regression models of a clinic’s monthly rates of compliance for the two types of cancer screenings explained above. Focusing on M1, note that the overall trend for breast cancer

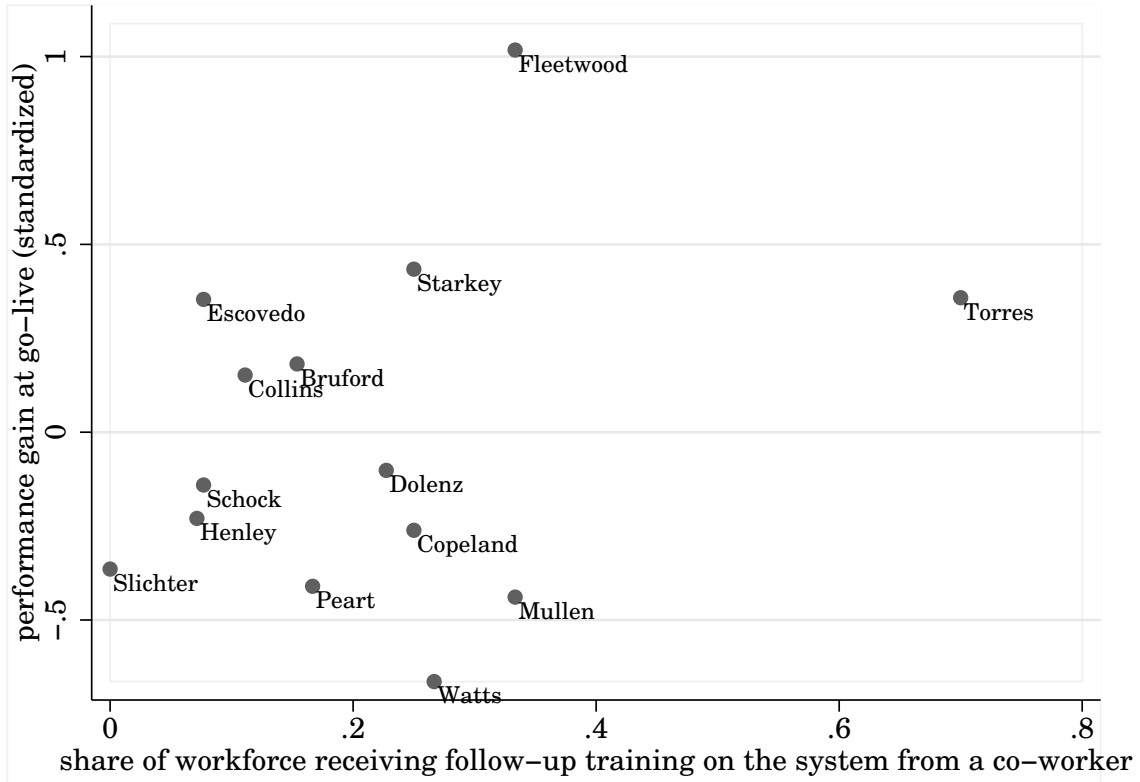
Figure 2-11: Performance Impact at Go-Live for the Panel Support Tool as a Function of the Share of the Clinic’s Workforce Introduced to the Technology by a Fellow Member of the Bargaining Unit



Source: Author’s analysis of data from staff survey and patient medical records.

screening compliance is positive controlling for the variables listed and that the main effect of IT go-live was about neutral on performance. More interestingly, those clinics scoring higher on engagement engender marginally worse performance from the time the panel support tool is effectively turned-on. The negligible impact of the panel support tool and the slightly negative differential associated with EI in the initiative “net out” to render the performance effects of the new technology neutral at best ( $\hat{\beta} = -.007, p \approx 0.14$ ). The estimates describing the effectiveness of the panel support tool for increasing rates of cervical cancer screenings, displayed in the second to last column, are quite similar. In the case of this model, however, the main effect of IT go-live is positive, albeit statistically insignificant to the extent that conventional significance tests can be applied to these data. Nonetheless, the negative differential associated with narrow-scope EI once again combines with the IT’s main effect to render the performance impact of the panel support tool non-positive

Figure 2-12: Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for the Share of the Clinic’s Workforce Receiving Follow-Up Training from a Fellow Member of the Bargaining Unit



Source: Author’s analysis of data from staff survey and patient medical records.

( $\hat{\beta} = -.002, p \approx 0.31$ ). Furthermore, in both cases, this impact is distinct from whatever performance effects materialize from the direct link between engagement and performance, indicated by the positive estimates on the employee involvement variable in both M1 and M3. Between the regression models and the scatterplots, Hypothesis 2.5 emerges well-substantiated. Employee involvement did not benefit the panel support initiative in the same way it bolstered the administrative IT module. It appears that engaging workers at the workplace level only complements the use of IT when workplace-level engagement is supported by additional, participatory structures.

Hypothesis 2.6 proposed that the complementary role played by wholeness in Hypothesis 2.3 was also contingent upon the scope of EI. Figure 2-13 presents another of the scatterplots generated from the two-stage process described earlier. The y-axis shows the performance gains achieved by each clinic coincident with the panel

Table 2.7: Coefficients (and z-statistics) for Estimates of Compliance Rates for Cancer Screenings Over Time as a Function of Variables Describing Information Technology and Employment Relations Context

	Breast Cancer		Cervical Cancer	
	M1	M2	M3	M4
time trend	.002*** (5.52)	.002*** (5.69)	.002*** (7.29)	.002*** (7.10)
time since “go-live”	-.001 (-1.18)	-.001 (-1.30)	.001*** (4.16)	.001*** (4.20)
transition period	.003 (.89)	.002 (.77)	.001 (.28)	.001 (.30)
IT in-use	.001 (.17)	-.0003 (-.10)	.003 (1.47)	.002 (1.36)
engagement index	.02 (1.52)		.03* (2.02)	
wholeness index		.02 (1.07)		.02 (.82)
IT in-use × engagement	-.01* (-2.41)		-.01** (-3.10)	
IT in-use × wholeness		-.02*** (-5.15)		-.01** (-3.27)
<i>n</i>	272	272	272	272
clusters	15	15	15	15
<i>R</i> <sup>2</sup>	.16	.12	.43	.27

*Key:* \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

*Notes:* Significance tests performed using Huber-White standard errors. Dependent variable for M1 and M2 is percent of continuously enrolled women age 52-69 who underwent a mammogram in the prior two years. Dependent variable for M3 and M4 is percent of continuously enrolled women age 21-64 who had one or more Pap tests in the prior three years. Variables constructed from author’s staff survey and archival administrative and medical records data.

support tool's go-live. As noted with respect to Hypothesis 2.5, more than half of the clinics studied actually saw their performance—measured here as the likelihood that a patient underwent a test or screening over the course of their visit—decline with their use of the panel support tool. More important to Hypothesis 2.6 is the non-appearance of an obviously positive curve formed by the dots in Figure 2-13. There are low-performing clinics on either side of the point mass, and the mass itself contains a wide variation of low- and high-performing clinics.

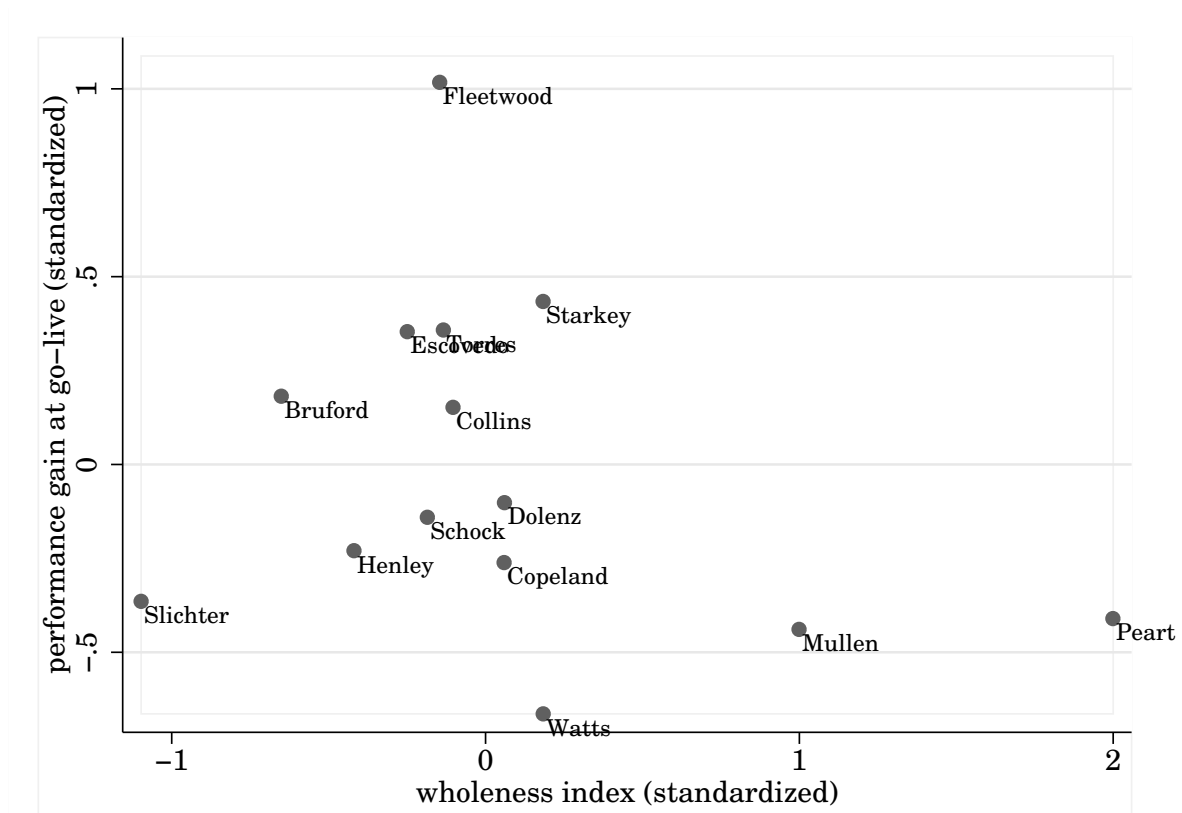
The second and fourth columns of Table 2.7 deliver more rigorous evidence in service to Hypothesis 2.6. Recall that the dependent variables for M2 and M4 are, respectively, breast cancer and cervical cancer screening compliance rates. With respect to either outcome, clinics whose workers feel they have been kept whole appear to have done so at the expense of the effective use of the panel support tool, signified by the negative estimated partial slopes corresponding to the two-way interactions between IT and wholeness. In these models however, note that the main effect of the technology is actually positive. Nonetheless, the tradeoff between maintaining wholeness and using the technology is so stark that the effects “net out” to a reduction in both breast cancer screening rates ( $\hat{\beta} = -.02$ ,  $p < .001$ ) and cervical cancer screening rates ( $\hat{\beta} = -.01$ ,  $p < .10$ ) for those clinics that do a better job of keeping their workers whole in the wake of the new panel support technology. Suffice it to say, keeping workers whole did not improve the performance effects arising with the implementation of the panel support tool, a finding in support of Hypothesis 2.6.

Statistical analysis of the panel support tool was intended to show that narrowly-scoped EI effectively undermines what would otherwise be a complementarity between employment relations measures and the presence of new technologies in the workplace. But, the analysis begs another question that can be tested empirically. If there had been EI structures in place at the strategic and functional levels, might the results have been different? If we accept that broader workforce participation would have given early warning of one problem in particular—a staffing model that did not allow adequate time to use the technology—we can examine the performance effects of the panel support tool as a function of over- or under-staffing. In short, we would expect the panel support tool to be more effective where there were fewer indications of a staffing shortage.

Table 2.8 displays estimated coefficients for a set of multi-level count models in which the dependent variable is the number of patient respondents each month in a given clinic that report to have undergone a lab test during their most recent office visit. As explained earlier, either of two questions on the patient survey can be used



Figure 2-13: Performance Impact at Go-Live for the Panel Support Tool as a Function of Clinic’s Mean Value for Worker Wholeness



Source: Author’s analysis of data from staff survey and patient medical records.

to operationalize this. The first and third models assess the number of patients that underwent testing whereas M2 and M4 count the number of patients that report to have visited the lab. Since these models do not rely on any time-constant independent variables, all four models employ a fixed-effects specification.

The first two specifications are Poisson models. Notice that the parameter estimates for the two models are qualitatively identical, not surprising given that they are intended to model the same construct operationalized in two different ways. In both cases, the number of office visits per month, a control for clinic congestion is essentially zero. The linear time trend is positive and the main effect of the IT is negative, though neither are statistically significant. Interestingly, the time trend that starts when the panel support tool goes live is negative and statistically significant. For M1, we can interpret it to mean that for each additional month after go-live, the mean number of tests or screenings in a clinic falls by about 6.5 percent ( $100 \times e^{\hat{\beta}} - 1 = 100 \times e^{-0.67} - 1 = -6.46$ ), after holding all of the control variables

and any unobserved, time-constant clinic characteristics constant. Two variables address the impact of staffing. As one might expect, the main effect of excess staffing is positive. For each percentage point increase in the number of hours actually worked relative to those budgeted, the mean number of lab tests per month in a given clinic increases by about one percent, after controlling for the variables listed and for clinic-level variation. But, according to the coefficient on the two-way interaction, the staffing effect increases again by about the same amount once the panel support tool is turned on. If one is willing to accept that any endogeneity between excess staffing and lab testing occurs irrespective of the IT being in-use, then the misalignment between the old staffing model and the new technology—something that would have been detected and dealt with had employees been engaged at the strategic and functional levels—undermined the effectiveness of the panel support tool.

The second set of models in Table 2.8 relaxes the assumption of equidispersion underlying the Poisson model. Since the conditional variance of the dependent variable exceeds its conditional mean, the negative binomial regression model may be more efficient and its standard errors are less prone to downward bias (Long, 1997). The estimates in M3 and M4 are qualitatively similar to those of M1 and M2. The two-way interaction falls short of statistical significance in M4; however, as I noted above, the nature of the data used here diminish concerns regarding statistical inference.

In the aggregate, the Kaiser case illustrates the mediating impact of employee engagement and workforce wholeness on the productivity gains arising from the implementation of IT in the workplace. More crucially, it points to the importance of the scope of the EI initiative. Despite the fact that workers felt at least as engaged in the initiative to deploy the panel support tool as they did in the Partnership-guided effort to deploy the administrative module (see Table 2.4), EI only improved the effectiveness of the latter. Likewise, only where EI transcended the workplace level did efforts to maintain workers' wholeness actually contribute positively to IT's performance effects.

Table 2.8: Coefficients (and z-statistics) for Location Fixed-Effects Count Models of the Number of Patients Undergoing Lab Testing in a Given Month as a Function of Information Technology and Employment Relations Context

	Poisson		Negative Binomial	
	M1	M2	M3	M4
office visits	-.0001*** (-14.21)	-.0002*** (-15.78)	-.0001*** (-3.59)	-.0003*** (-7.06)
time trend	.01 (1.20)	.01 (.81)	.003 (.19)	.002 (.12)
time since “go-live”	-.07*** (-9.62)	-.07*** (-8.41)	-.07*** (-2.98)	-.08*** (-2.98)
transition period	-.27*** (-6.34)	-.31*** (-5.92)	-.36** (-2.30)	-.41** (-2.43)
IT in-use	-.02 (-.45)	-.03 (-.51)	-.07 (-.45)	-.11 (-.67)
excess hours over budgeted (as a percentage)	.01*** (4.10)	.01*** (4.43)	.003 (.72)	.01* (1.95)
IT in-use × excess hours	.01*** (4.62)	.01** (2.46)	.01** (2.12)	.01 (1.23)
controls for location	yes	yes	yes	yes
<i>n</i>	247	247	247	247
clusters	14	14	14	14

Key: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Notes: For M1 and M3, the dependent variable is the number of respondents in a given clinic-month that claim to have visited the lab for testing during their medical visit. For M2 and M4, the dependent variable is the number of respondents in a given clinic-month that claim to have underwent testing during their medical visit. Variables constructed from patient satisfaction survey, medical records, and staffing data.

## Discussion

Contrasting Kaiser's experience with two IT applications through the lens of employment relations theory demonstrated that the apparent complementarity of employment relations measures and IT investment hinges on the scope of the participatory structures being analyzed. Where Kaiser managers and physician leaders managed to involve staff at the workplace level without having to bargain with the workforce or include worker representatives in strategic-level activities, neither engaging workers nor keeping them whole improved the effectiveness of the technology. These results show employment relations theory on workplace technological change to be surprisingly resilient given that much of it was crafted long before the advent of the information economy. On the other hand, that literature can be critiqued for its shortsightedness with respect to the stability of employment relations. That work did not consider that employers might ever seek worker participation in matters of strategy or business policy. Therefore, it could not possibly envision the more nuanced set of participatory structures explored here, let alone the possibility that managers would attempt to pick and choose practices from a comprehensive EI system.

Kaiser's experience with its panel support IT application provides one example of this in that managers sought workplace-level engagement without providing workers a seat at the bargaining table. That workers and their union chose to embrace the administrative module and to oppose the panel support tool squares with Slichter, Healy, and Livernash's (1960) suggestion that in order for workers to encourage the adoption of new technologies, they must perceive an opportunity to share in the gains arising from them. With respect to the administrative module and in fact all of the EHR components considered part of KP HealthConnect, the Effects Bargain linked workers' ground-level efforts to "bring wisdom to the machine" (Shimada and MacDuffie, 1986) to negotiations at the functional level. One result was that workers felt more whole in the wake of the administrative module's deployment than they did with respect to the panel support application. More important to the organization, however, is that staff perceptions of wholeness only complemented the effectiveness of IT when workers could link Kaiser's efforts to keep workers whole to labor's contribution to the IT initiative. One way to think about this is that wholeness only proxied for reciprocal commitment in the case of the administrative module. This would explain why IT served as an effective "tool" for workers to achieve the goals of the business strategy served by the administrative module, but not the goals of the strategy of preventive care aided by the panel support tool. While both depended

on the successful integration of IT and work structures, only the former signaled the centrality of workers' contribution to the initiative.

The lack of worker representation at the functional level also limited the impact of worker engagement by limiting the types of work structure changes that workers and their managers could make on the ground. Staffing, in particular, would have to be negotiated explicitly through bargaining. Likewise, the “pending” of diagnostic tests and procedures, a newly-created responsibility for MAs, constituted an employment relations challenge arising directly from the use of IT a matter that could not be readily disposed of without a direct line to the bargaining table. This is not to say that every minute aspect of work impacted by the deployment of IT required negotiations that simply could not take place without a well-defined set of functional-level structures. Kaiser's approach to the administrative module instead relied upon upfront negotiations that paved the way for flexibility with respect the technology and its impact on work—something to which workers could agree given their aforementioned sense of reciprocal commitment and resulting expectations of mutual gains. One union official contrasted this with workers' perceptions of the panel support application.

Management could have said, “Doctors would like you to start pending orders. Do you have any concerns about that? Are MAs prepared for that, or would they need training? Is this going to change their workflows?” They never approached us in this way, so now [support staff] scrutinize everything. For workers, process matters more than outcomes.

Though it may be challenging to conceptualize functional-level EI structures outside the confines of collective bargaining, the management literature's assessment of IT complementarities indirectly acknowledges the importance of the functional level of the employment relationship—much in line with Chamberlain's (1948) thinking on the inseparability of the technological from other aspects of the employment relationship. It does so initially by underscoring the importance of realigning financial incentives to encourage the types of employee behaviors required to make effective use of IT (Brynjolfsson and Mendelson, 1993; Brynjolfsson, Hitt, and Yang, 2002). Incentives are certainly a very concrete mechanism for assuring workers of the technology's potential to generate mutual gains. However, the investigation of Kaiser's IT deployment shines light on other functional-level aspects of the employment relationship that mediate the effectiveness of incentives on the economic gains from IT. Workers must also have discretion to modify work structures by rearranging and reallocating production responsibilities. Without this flexibility and authority, the organization

cannot expect the information and ideas sought through workplace-level engagement to fully benefit performance.

The case also illustrated that the success of the initiative depended on more than convincing workers that their efforts to meet the goals of the strategy would result in mutual gains (Kochan and Osterman, 1994; Thomas, 1994). They also needed to absorb the strategic rationale for the application. Therefore, the case shows that in addition to facilitating upward communication, strategic-level participatory structures connect the larger strategic goals of the organization to the frontline staff being asked to operationalize them. That is, they ensure that workers understand the larger purpose of the technology managers are asking them to use. The KP HealthConnect labor coordinators could have played a fundamental role in conveying the goals of the panel support module to the workforce. The net effect would be as it was in the case of the administrative module, the empowerment of workers to use the technology as they saw fit to meet the goals of the strategy (Kochan, Orlikowski, and Cutcher-Gershenfeld, 2003).

The Kaiser case, itself shaped by employment relations theory, also informs a critique of management's literature's consensus that workforce engagement complements IT capital in the production function (e.g., Bresnahan, Brynjolfsson, and Hitt, 2002; Stiroh, 2002). At Kaiser, the complementary effects of EI were apparent only when participation was leveraged towards planning in addition to execution and where workers could perceive of the IT initiative generating mutual gains. With respect to the former, this translated into the existence of participatory structures and processes at the strategic level in addition to those at the workplace level, a pairing that continues to drive economic performance in empirical studies (e.g., Kato and Morishima, 2002). This finding should not be surprising given the theoretical arguments regarding employers' bounded rationality (Simon, 1951) and workers' tacit knowledge (Hayek, 1945) called upon to explain the association between incidence of innovative employment practices and the profitable deployment of IT. In the present case, these theories substantiate the idea that managers necessarily depend on frontline staff for information on incumbent workflows and advice on how production might be made more efficient (MacDuffie, 1995)—information that management cannot access without channeling the worker input to the strategic level (Levine and Tyson, 1990). But, the same microeconomic constructs have not been called on in this way in the existing studies of IT. They are instead called on only to justify the kinds of workplace-level changes in production that are likely to promote the optimal use of IT, namely increases in the incidence of team-based work systems and the decentral-

ization of decision-making rights. Therefore, whether or not participation occurs at the strategic level could be a source of unobserved heterogeneity in existing studies of IT's performance impact (e.g., Bresnahan, Brynjolfsson, and Hitt, 2002; Caroli and van Reenan, 2001).

Finally, asking which levels of the employment relationship are spanned by a particular set of participatory structures provides answers to questions other than those relating to performance studies of IT. The framework could undergird theoretical explanations for the apparent though empirically inconsistent (Cappelli and Neumark, 2001) performance complementarities thought to exist between employment practices (e.g., Arthur, 1994; Delery and Doty, 1996). As noted earlier, studies have shown that the same employment practices appear to impact performance differently in union vs. non-union settings (Black and Lynch, 2001). The Kaiser case suggests that workers' ability to tap into mutual gains through functional-level negotiating may be the key source of the productivity differential. This argument also squares with other empirical studies finding that the incidence of functional-level EI structures such as the ability to influence policies regarding staffing, hours, and overtime somehow increases the returns to workplace-level engagement efforts (e.g. Addison et al., 2000; Freeman and Lazear, 1995; Zwick, 2004). Likewise, strategic-level EI also appears to complement the impact of shop-floor engagement (Kato and Morishima, 2002). In the net, events at Kaiser help explain how worker participation at any level of the employment relationship can increase the effectiveness of EI structures at the other two levels.

## Conclusion

The preceding analysis advances employment relations and management research along two paths. First, it shows that the positive, complementary impact of EI on technology's performance effects are actually contingent upon the scope of the participatory structures intended to facilitate technological change. The broader, theoretical contribution of the Kaiser case is a more nuanced consideration of workforce participation's mediating role in linking IT investment to organizational performance. The research design used here allowed for a conservative test of the importance of the scope of EI. Despite its performance potential and its nominal engagement and protection of the workforce, the panel support tool initiative left itself open to the challenges of integration that have historically plagued the use of new technologies in the absence of a reevaluation of employment relations context. On the other hand, a similar IT initiative undertaken by many of the same people in the same workplaces, indeed,

benefited from a broader set of participatory structures and processes including those at the strategic and functional levels of the employment relationship. Only in the latter case—the administrative IT application—did measures of frontline engagement and wholeness drive IT’s performance impact in a positive direction. Therefore, while it is true that integration, involvement, and wholeness complement IT investments, this chapter demonstrated that these effects are contingent on the scope of the EI programs under analysis.

There are a number of avenues for advancing this work. One subset of them would attempt to generalize the findings from the Kaiser case, perhaps by constructing a brand new, multi-level dataset bounded at the industry level or lower to guard against the loss of internal validity. A second research program could dig more deeply into the notion of wholeness. We know that job security and later on, employment security are vital preconditions for engaging workers in technological change efforts. Moreover, even when employment security is assured, other worker concerns regarding workload, staffing, and perhaps other factors will influence whether or not they feel they are harmed or kept whole as the technology is implemented. Finally, a third area of research suggested by this study is one that examines how aspects of the employment relationship affect not the effectiveness of IT, but the very decision of whether or not to adopt it. This question regarding the interplay of employment relations and IT diffusion is taken up in the next chapter.

## References

- Addison, John T., W. Stanley Siebert, Joachim Wagner and Xiangdong Wei. 2000. “Worker Participation and Firm Performance: Evidence from Germany and Britain.” *British Journal of Industrial Relations* 38(1):7–48.
- Adler, Paul S. 1993. The Learning Bureaucracy: New United Motor Manufacturing, Inc. In *Research in Organizational Behavior*, ed. Barry M. Staw and Larry L. Cummings. Vol. 15 Greenwich, CT: JAI pp. 111–194.
- Aoki, Masahiko. 1986. “Horizontal vs. Vertical Information Structure of the Firm.” *American Economic Review* 76(5):971–983.
- Appelbaum, Eileen and Rosemary L. Batt. 1994. *The New American Workplace: Transforming Work Systems in the United States*. Ithaca: ILR.
- Arthur, Jeffrey B. 1994. “Effects of Human Resource Systems on Manufacturing Performance and Turnover.” *Academy of Management Journal* 37(3):670–687.



- Batt, Rosemary L. 1999. "Work Organization, Technology, and Performance in Customer Service and Sales." *Industrial and Labor Relations Review* 52(4):539–564.
- Becker, Brian E. and Mark A. Huselid. 1998. High Performance Work Systems and Firm Performance: A Synthesis of Research and Managerial Implications. In *Research in Personnel and Human Resources Management*, ed. Gerald Ferris. Vol. 16 Greenwich, CT: JAI pp. 53–101.
- Black, Sandra E. and Lisa M. Lynch. 2001. "How to Compete: The Impact of Workplace Practices and Information Technology on Productivity." *Review of Economics and Statistics* 83(3):434–445.
- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2000. Technology, Organization, and the Demand for Skilled Labor. In *The New Relationship: Human Capital in the American Corporation*, ed. Margaret M. Blair and Thomas A. Kochan. Washington, DC: Brookings pp. 145–184.
- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2002. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm Level Evidence." *Quarterly Journal of Economics* 117(1):339–376.
- Brynjolfsson, Erik and Haim Mendelson. 1993. "Information Systems and the Organization of Modern Enterprise." *Journal of Organizational Computing* 3(3):245–255.
- Brynjolfsson, Erik and Lorin M. Hitt. 2000. "Beyond Computation: Information Technology, Organizational Transformation and Business Performance." *Journal of Economic Perspectives* 14(4):23–48.
- Brynjolfsson, Erik and Lorin M. Hitt. 2003. "Computing Productivity: Firm-Level Evidence." *Review of Economics and Statistics* 85(4):793–808.
- Brynjolfsson, Erik, Lorin M. Hitt and Shinkyu Yang. 2002. "Intangible Assets: Computers and Organizational Capital." *Brookings Papers on Economic Activity* 2002(1):137–181.
- Cappelli, Peter. 2004. "Why Do Employers Retrain At-Risk Workers?: The Role of Social Capital." *Industrial Relations* 43(2):421–447.
- Cappelli, Peter and David Neumark. 2001. "Do 'High-Performance' Work Practices Improve Establishment-Level Outcomes?" *Industrial and Labor Relations Review* 54(4):737–775.
- Cappelli, Peter and Nikolai Rogovsky. 1998. "Employee Involvement and Organizational Citizenship: Implications for Labor Law Reform and 'Lean Production'." *Industrial and Labor Relations Review* 51(4):633–653.
- Caroli, Eve and John van Reenan. 2001. "Skill-Biased Organizational Change? Evidence from a Panel of British and French Establishments." *Quarterly Journal of Economics* 116(4):1449–1492.

- Chamberlain, Neil W. 1948. *The Union Challenge to Management Control*. Hamden, CT: Archon.
- Cutcher-Gershenfeld, Joel. 1991. "The Impact on Economic Performance of a Transformation in Workplace Relations." *Industrial and Labor Relations Review* 44(2):241–260.
- Delery, John E. and D. Harold Doty. 1996. "Modes of Theorizing in Strategic Human Resource Management: Tests of Universalistic, Contingency, and Configurational Performance Predictions." *Academy of Management Journal* 39(4):802–835.
- Dunlop, John T. 1958 [1993]. *Industrial Relations Systems*. revised ed. Boston: Harvard Business School.
- Fehr, Ernst and Simon Gächter. 2000. "Fairness and Retaliation: The Economics of Reciprocity." *Journal of Economic Perspectives* 14(3):159–181.
- Freeman, Richard B. and Edward P. Lazear. 1995. An Economic Analysis of Works Councils. In *Works Councils: Consultation, Representation, and Cooperation in Industrial Relations*, ed. Joel Rogers and Wolfgang Streeck. Chicago: University of Chicago Press pp. 27–50.
- Freeman, Richard B. and Morris M. Kleiner. 2000. "Who Benefits Most from Employee Involvement: Firms or Workers?" *American Economic Review* 90(2):219–223.
- Frenkel, Stephen, Marek Korczynski, Karen Shire and May Tam. 1999. *On the Front Line: Organization of Work in the Information Economy*. Ithaca: ILR.
- Hamermesh, Daniel S. 1993. *Labor Demand*. Princeton: Princeton University.
- Hayek, Friedrich A. 1945. "The Use of Knowledge in Society." *American Economic Review* 35(4):519–530.
- Hitt, Lorin M. and Erik Brynjolfsson. 1997. "Information Technology and Internal Firm Organization: An Exploratory Analysis." *Journal of Management Information Systems* 14(2):81–101.
- Ichniowski, Casey, Kathryn Shaw and Giovanna Prennushi. 1997. "The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines." *American Economic Review* 87(3):291–313.
- Kato, Takao and Motohiro Morishima. 2002. "The Productivity Effects of Participatory Employment Practices: Evidence from New Japanese Panel Data." *Industrial Relations* 41(4):487–520.
- Katz, Harry C., Thomas A. Kochan and Alexander J. S. Colvin. 2008. *An Introduction to Collective Bargaining and Industrial Relations*. 4th ed. Boston: McGraw-Hill/Irwin.

- Katz, Harry C., Thomas A. Kochan and Kenneth R. Gobeille. 1983. "Industrial Relations Performance, Economic Performance, and QWL Programs: An Interplant Analysis." *Industrial and Labor Relations Review* 37(1):3–17.
- Kelley, Maryellen R. 1996. "Participative Bureaucracy and Productivity in the Machined Products Sector." *Industrial Relations* 35(3):374–399.
- Kochan, Thomas A., Harry C. Katz and Robert B. McKersie. 1986. *The Transformation of American Industrial Relations*. New York: Basic Books.
- Kochan, Thomas A. and Paul Osterman. 1994. *The Mutual Gains Enterprise: Forging a Winning Partnership Among Labor, Management, and Government*. Boston: Harvard Business School.
- Kochan, Thomas A., Robert B. McKersie and Peter Cappelli. 1984. "Strategic Choice and Industrial Relations Theory." *Industrial Relations* 23(1):16–39.
- Kochan, Thomas A., Wanda J. Orlikowski and Joel Cutcher-Gershenfeld. 2003. Beyond McGregor's Theory Y: Human Capital and Knowledge-Based Work in the Twenty-First Century Organization. In *Management: Inventing and Delivering Its Future*, ed. Thomas A. Kochan and Richard L. Schmalensee. Cambridge, MA: MIT pp. 85–113.
- Krueger, Alan B. and Alexander Mas. 2004. "Strikes, Scabs, and Tread Separations: Labor Strife and the Production of Defective Bridgestone/Firestone Tires." *Journal of Political Economy* 112(2):253–289.
- Levine, David I. and Laura D'Andrea Tyson. 1990. Participation, Productivity, and the Firm's Environment. In *Paying for Productivity: A Look at the Evidence*, ed. Alan S. Blinder. Washington, DC: Brookings pp. 183–243.
- Livaudais, Gerard, Robert Unitan and Jay Post. 2006. "Total Panel Ownership and the Panel Support Tool—'It's All About the Relationship'." *Permanente Journal* 10(2):72–79.
- Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks: Sage.
- MacDuffie, John Paul. 1995. "Human-Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry." *Industrial and Labor Relations Review* 48(2):197–221.
- MacDuffie, John Paul and John F. Krafcik. 1992. Integrating Technology and Human Resources for High-Performance Manufacturing: Evidence from the International Auto Industry. In *Transforming Organizations*, ed. Thomas A. Kochan and Michael Useem. New York: Oxford University pp. 209–226.
- Marshall, Alfred. 1890. *Principles of Economics*. London: Macmillan.

- McGregor, Douglas M. 1960. *The Human Side of Enterprise*. New York: McGraw-Hill.
- Pil, Frits K. and John Paul MacDuffie. 1996. "The Adoption of High-Involvement Work Practices." *Industrial Relations* 35(3):423–455.
- Rabin, Matthew. 1993. "Incorporating Fairness into Game Theory and Economics." *American Economic Review* 83(5):1281–1302.
- Shimada, Harauo and John Paul MacDuffie. 1986. "Industrial Relations and 'Humanware': Japanese Investments in Automobile Manufacturing in the United States." *MIT/Sloan School Working Papers* (1855-87).
- Simon, Herbert A. 1951. "A Formal Theory of the Employment Relationship." *Econometrica* 19(3):293–305.
- Slichter, Sumner H. 1941. *Union Policies and Industrial Management*. Washington, DC: Brookings.
- Slichter, Sumner H., James J. Healy and E. Robert Livernash. 1960. *The Impact of Collective Bargaining on Management*. Washington, DC: Brookings.
- Stiroh, Kevin J. 2002. "Reassessing the Role of IT in the Production Function: A Meta-Analysis." *Social Science Research Network* (352820).
- Thomas, Robert J. 1994. *What Machines Can't Do: Politics and Technology in the Industrial Enterprise*. Berkeley: University of California.
- Wagner, III, John A. 1994. "Participation's Effects on Performance and Satisfaction: A Reconsideration of Research Evidence." *Academy of Management Review* 19(2):312–330.
- Zwick, Thomas. 2004. "Employee Participation and Productivity." *Labour Economics* 11(6):715–740.

## Chapter 3

# Physician Employment Relationships and the Diffusion of Health Information Technology

### Summary

Before workers even have the opportunity to use information technology (IT) effectively, their organizations must adopt it. However, as the previous chapter shows, mere adoption of health IT applications is not enough to improve organizational or industry performance. This chapter relies in part on Kaiser Permanente's experience with KP HealthConnect to develop a set of hypotheses that together predict a growing discrepancy between the adoption of IT in the outpatient or ambulatory setting and the adoption of incentives promoting physicians' optimal use of the technology. I then test these hypotheses using an unrelated, nationally-collected, cross-organizational, large- $n$  panel of doctors representative of the many settings in which physicians deliver outpatient care. These estimates highlight the need for policies that promote the adoption of integrated systems of technology and employment practices rather than simply the adoption of IT *per se*.

Healthcare is a sector of our economy that has not had the advantage of information technology. As a result, it's a system that is saturated with inefficiency. It can and must change.

—Michael O. Leavitt, US Secretary of Health and Human Services, March 24<sup>th</sup>, 2008

Americans are acutely aware of their nation's ailing healthcare system, and researchers and policymakers now believe that the industry's reluctance to digitize

its paper-based recordkeeping and business processes contributes to its poor performance. The firm-level link between IT and economic performance across the economy has been well-documented (e.g., Black and Lynch, 2001; Brynjolfsson and Hitt, 2000, 2003) and has rightly informed those aiming to reform the healthcare industry. Their approach, however, wrongly ascribes the industry’s inefficiency to the slow diffusion health IT when, as Chapter 2 showed, performance improvements depend on both the technology itself and the presence of reinforcing features of the employment relationship that govern its use.

This chapter draws on the Kaiser Permanente case as well as the employment relations and management literatures to critique the reductionist notion that more widespread diffusion of health IT will improve industry outcomes. Indeed, theory and some evidence suggest that in the proper organizational and employment context, health IT delivers value to patients and payers—namely, workers, their employers, and the public sector (Chaudhry et al., 2006; Garrido et al., 2005). The costs, however, are generally concentrated on medical groups, which will only invest in IT if they can capture its returns. Since doctors access elements of an electronic health record (EHR) system through their medical practices, diffusion and effective use of these technologies should be examined through the lens of the physician employment relationship. I propose that certain medical practices are more likely than others to invest in health IT for purely economic or strategic reasons. In particular, those medical practices that benefit from keeping patients healthy and from managing the treatment of chronic diseases should find IT investments more viable than would more conventional outpatient<sup>1</sup> medical practices that do not benefit from the prevention and active management of their patients’ ill health. However, the business imperatives that appear to drive early IT adoption are actually promoting an entire “work system” centered on improving the health of the practice’s entire patient “panel.” EHR technology serves as one element of this work system, no more important than the set of incentives that physicians face to use the technology as effectively as possible, as they see fit, to meet the strategic goals of the organization. As a result, policy and institutional pressure to adopt health IT *per se* will lead to an unfortunate decoupling of the technology from the work system that supports it. The same strategic exigencies that prompted adoption of IT and incentives will continue to do so. But, a great many other later adopters will invest in the technology without reforming physicians incentives to encourage its optimal use. I test this theory with data from

---

<sup>1</sup>As in Chapter 2, I use the adjectives “ambulatory” and “outpatient” interchangeably since this dissertation does not address anything related to “inpatients” or hospital care.

a national sample of US-practicing physicians that allows me to connect measures of medical practice business strategies to the IT applications at physicians' disposal as well as to the incentives faced by these physicians.

Though this analysis relies on survey data, it has been informed by interviews, site visits, and archival data gathered in support of the companion case study detailed in Chapters 1 and 2. I begin by highlighting the key lessons from that exploratory work that suggest the ways that medical practices and the physicians that practice within them approach health IT applications. The subsequent section situates this account within the existing body of employment relations and management research in this area to generate the six hypotheses to be tested statistically, after which I detail the dataset and the methods employed to analyze it. I then present the results, and conclude with a discussion of their implications for research and for policy.

## A Qualitative Illustration: IT at Kaiser Permanente

As detailed in Chapters 1 and 2, Kaiser Permanente, the largest managed care organization in the US, now provides nearly all of its 11,000 physicians access to health IT in the form of its comprehensive EHR system, KP HealthConnect. The system provides each Kaiser patient an integrated EHR that incorporates data from all of the patient's providers as well as from Kaiser's administrative arm. Physicians can access and modify the record at the point of care, and patients can view it via secure web connection. Patients can also use the portal to communicate with their providers, view test results, and order prescription refills, all of which advance Kaiser's attempt to "manage utilization" by encouraging patients to employ the technology as a substitute for some conventional office visits.

Simply by linking a patient's many providers to one another, IT facilitates communication and information-sharing that cannot occur when patients have separate, disconnected paper records with each of their doctors. But, much of the technology's benefits stem from the ways that patient data, administrative data, and "clinical content" can be brought together to serve the patient. Clinical content comes in two forms—universally-determined best practices, such as the prescription of beta blockers, and Kaiser-specific practices, such as the prescription of one drug over another. Each region—the smallest of which employs almost 600 physicians—has its own clinical content team, which typically includes representatives from a national body. The group decides which practices and protocols should be formalized and embedded into the technology based on input from the administrative and clinical sides of the busi-

ness. It also decides how and when certain elements of decision support should be “fired” and whether and when physicians should be permitted to override the system’s recommendations for treatment, medication, or some other aspect of care.

Clinical content, when meshed with patient-specific information, enables Kaiser to shift its resources from expensive, palliative treatments for chronic conditions to much less expensive, preventative measures. Instead of treating each patient encounter as an isolated event, Kaiser can manage the patient’s overall, long-term health, including an integrated approach to treating each specific patient’s problem or ailment. Kaiser also manages the health of its entire patient population by targeting for outreach those in need of preventative care or those engaged in treatments requiring regular monitoring. Indeed, this was the specific goal set out for Kaiser’s panel support technology initiative documented in Chapter 2. This allows physicians to be proactive, preventing the eventual onset of conditions that will be unpleasant to the patient and costly to the insurer. What is more, Kaiser physicians face strong incentives to contribute to the organization’s reorientation towards managing the overall health of the patient population. Many are “shareholder” physicians, entitling them to a predetermined share of their regional practice’s annual revenue, net of costs. All are subject to incentives based on their monthly performance against pre-determined, objective performance targets. Most of these targets fall along the lines of the Health Plan Employer Data and Information Set (HEDIS) data discussed earlier.<sup>2</sup> A few are more administrative in nature, but provide immediate benefit to the organization and probably to the patient as well. For example, Medicare requires certain patients “check-in” with their physicians on a regular basis and offer providers a substantial financial incentives for performing what they label a “Medicare refresh.” Each of the Permanente practices administers its own patient satisfaction survey, and providers are availed their scores relative to medical office and regional scores. However, these scores do not have a direct influence on physicians’ take-home pay.

Kaiser’s size and reach—8.5 million patients seen in 400 medical office buildings, precludes us from generalizing from its experience. However, understanding the returns that Kaiser gleans from IT in its outpatient medical centers clarifies the benefits of health IT and aids theoretical development. In particular, Kaiser appears to internalize the benefits of its investment, which has led it to provide its physicians access to IT. This implies that physicians’ employment relationships link them to organi-

---

<sup>2</sup>Some performance metrics are of the same “flavor” as HEDIS. For example, when regional physician leaders determined that HEDIS standards for diabetes care and monitoring were not high enough, they developed more stringent ones.



zations that may or may not benefit from IT. The principal distinctions appear to be their employers' business strategy, followed by the scope and scale of services that the medical practice provides.

## Theory and Hypotheses

If organizations like Kaiser Permanente anticipate a net benefit from the transition to EHRs, why have so many other providers been slow to follow suit? Suspecting a case of market failure, the federal government has responded with a hodgepodge of proposed legislation, none of which has become law. These bills seek to encourage physicians' adoption of EHR systems by providing a mix of direct subsidies, tax incentives, and higher, "preferred provider" Medicare reimbursement rates for those doctors meeting enumerated adoption targets.<sup>3</sup> While Congress is correct to approach low adoption rates as a case of market failure, policies that directly incentivize or even require the installation of EHRs pay no attention to why the technology has been so slow to diffuse. Without this insight, legislative attempts to address the issue may well succeed in hastening the spread of EHR systems. However, these laws will not deliver the true objective—improvements in organizational and industry-level performance.

This chapter offers a theory to address this deficiency. I argue that policymakers' goal should be the deployment of work systems inclusive of IT rather than the deployment of IT *per se*. Toward that end, the empirical tests are designed to see if in fact diffusion patterns reflect the factors that influence the effective use of EHR systems. Events at Kaiser Permanente bring to life the theoretical explanations offered to explain which physicians will have access to elements of an EHR system and whether or not the physicians and the technology will be ensconced in the sorts of work systems expected to deliver high-performance. The first two hypotheses developed below establish two key drivers of health IT adoption in outpatient medical practices. The next pair of hypotheses predict that despite evidence of diffusion, the main strategic or competitive force acting on adoption appears to have weakened in influence. The final two hypotheses establish the coincidence of health IT and incentives for its effective use, but the apparent decoupling of the technology from these incentives.

---

<sup>3</sup>At present, only one such bill has made it past committee. The "Wired for Healthcare Quality Act" (S.1418) was passed unanimously by the US Senate, but died before it could be taken up by the House of Representatives. Senator Edward M. Kennedy (D-Massachusetts) has since reintroduced it in the present Congress (S.1693). It has already been passed onto the full Senate for a vote. However, it once again appears to be stalled at the committee level in the lower house (H.R. 3800).

## Strategic and Organizational Drivers of IT Adoption in Outpatient Healthcare

Recall from Chapter 1 that the poor performance of the healthcare industry stems from the under-provision of preventive care and the inefficient management of chronic disease across the patient population. The systematic failure of healthcare providers to comply with agreed-upon best practices in these areas arises largely from the fact that for most patients, no single provider or organization internalizes the financial benefit to keeping patients healthy.<sup>4</sup> Existing research can be used to argue that physicians based in the minority of organizations that do, indeed, internalize the benefits of patient health should already have access to elements of an EHR system. Hypotheses 3.1 and 3.2 establish this link.

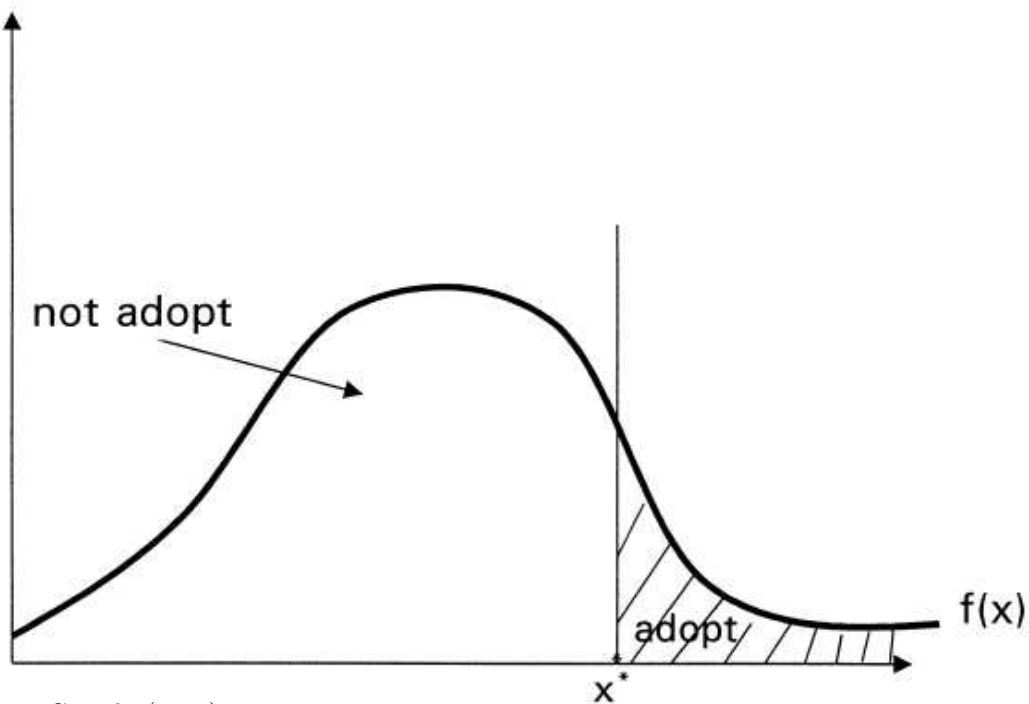
One way to theorize the medical practice IT adoption decision is by examining observable differences between these organizations and how these differences co-vary with respect to adoption. Geroski (2000) offers a framework typical of the management literature's approach to technology diffusion. It is illustrated in Figure 3-1. The idea is that the adoption decision is a function of an observable characteristic,  $x_i$ , and that past some particular threshold value,  $x^*$ , organization  $i$  will decide that the investment in elements of an EHR system makes sense from an economic or strategic perspective. Referring to Figure 3-1, one can think of the area under the truncated distribution function  $f(x_i)$  as the gross benefit arising from the technology for organization  $i$  or for organizations with the same level of  $x$ , everything else held steady. In this light, the area under the truncated function  $f(x^*)$  can be thought of as the cost associated with acquiring the technology. It follows that organizations with levels of  $x$  in excess of  $x^*$ , i.e.  $x_i \geq x^*$ , will anticipate net benefits from an investment in the focal technology. The net benefits are represented by the shaded region in Figure 3-1. As Geroski (2000; p. 612) states, "the trick... is to identify interesting and relevant characteristics  $x_i$ ." With respect to health IT applications in the outpatient setting, "capitation"—to be explained below—emerges as a prime candidate for one such important ascription.

The strategic or structural position of a physician's medical practice within the larger healthcare industry landscape strongly influences the extent to which the or-

---

<sup>4</sup>Some argue quite accurately that the patient himself or herself internalizes many of the costs and benefits to remaining healthy. Indeed, this has prompted the development of web-based personal health record (PHR) systems by Google, among others, aimed directly at the patient population, with the idea that patients will be the keepers of these records and will demand that their providers enter information directly into them.

Figure 3-1: Distribution of  $f(x)$  with Threshold Separating Adopters from Non-Adopters



Source: Geroski (2000).

ganization can benefit from IT investment. In particular, under what arrangements and by whom is the medical care provided by the practice actually financed? One can begin to answer this question by considering two very stylized models for funding outpatient healthcare.<sup>5</sup> Under one scenario, physicians and other providers essentially work for a health insurer. In the other case, doctors work for an organization that provides care, but does not finance it.<sup>6</sup>

Under the more common fee-for-service or “indemnity” model, medical practice organizations deliver patient care by contracting with multiple health plans that “indemnify” the provider on a claim-by-claim basis according to pre-negotiated rules regarding which procedures are covered and at what rate the practice will be reimbursed (Cutler, McClellan, and Newhouse, 2000). Organizations profit as residual claimants on each of these payments. Consequently, these practices benefit from pro-

<sup>5</sup>Physicians, in general, are not employed by hospitals; rather, medical practices contract with hospitals to access resources, e.g., beds and overnight coverage, required for some treatment regimens. Therefore, issues surrounding inpatient IT are outside the scope of this paper.

<sup>6</sup>I use the phrase “work for” or even the word “employee” to refer to any person paid by an organization for the use of his or her labor, along the lines of von Nordenflycht (2007). Furthermore, for the purposes of this study, one should not construe the phrase “employment relationship” to preclude the partnership or ownership arrangements that physicians typically enter into.

viding the services of each claim as efficiently as possible and from generating as many reimbursable claims as possible, with an emphasis on those treatments that leave more claims revenue in excess of costs.

Some practices finance care quite differently. Under the prepaid or “capitated” model, the medical practice internalizes the risk of its patient population, effectively assuming the role of healthcare insurer or health plan in addition to its role as healthcare provider. It does this by charging a per-member, per-month premium from which it finances all required care. These organizations profit as residual claimants on the monthly premium. The capitated model can itself be divided into “sub-models” based on the structure linking the provision and insurance functions. In some cases, the physicians and support staff literally work for the same organization that markets health plans to groups or individuals in addition to employing doctors to care for patients. Other medical practices falling under the same financing model instead contract with one or more separate entities that market health plans. It follows that those physicians delivering care according to this arrangement do not work directly for a health insurer; however, because these medical practice finance care with a pre-negotiated, per-member, per-month prepayment, doctors in this setting work for an organization that has assumed the role of health insurer, at least with respect to the internalization of risk. This particular arrangement, in which a physician is based in a medical practice that contracts with multiple health plans also explains why the indemnity vs. capitation dichotomy proves false. Physicians often deliver care in a practice that contracts with many health plans, some on an indemnity basis and others on a capitated basis, giving rise to something of a continuum between the two stylized models of healthcare financing.

What remains is an explanation of how this notion of capitation, if inserted into the framework above to operationalize  $x_i$ , would be expected to influence adoption. The Kaiser case can help clarify this. Kaiser Permanente operates under the capitated model, so it provides a window into the business strategy employed by these organizations. “Kaiser” is actually the name of the firm marketing health plans to groups and individuals. Kaiser contracts with eight regional “Permanente” medical groups, agreeing on a per-member, per-month prepayment from which the medical practices must finance all the care they provide. By negotiating and accepting an insurance prepayment, the medical groups effectively assume the financial risk and responsibility arising from each patient.

The distinction between the indemnity and capitated models implies variation in the structure of physicians’ employment relationships: some work for insurers and

others do not. As a result, physicians will be employed by organizations with different business strategies. Irrespective of strategy, most practices should anticipate some benefit from having fewer “touch points” and ideally, fewer errors in billing and scheduling, as well as eliminating the movement and storage of paper charts (Wang et al., 2003). Nonetheless, theory points to specific ways that IT can improve organizational performance, and these processes are more likely to apply under one financing model than the other. With respect to Kaiser, for example, recall the ways IT facilitates the updating and the transmission of industry-wide best practices or preferred organizational solutions. None other than Friedrich von Hayek (1945; p.522) asserted that frontline workers, with their detailed and real-time knowledge “of people, of local conditions, and special circumstances” lead the march toward neoclassical market efficiency. However, their productivity, he argued, is limited by the information that they cannot access, and therefore, cannot incorporate into their decision-making. EHR technology ensures that broadly-determined best practices, many of which change over time, are disseminated to physicians at the point of care. That is, information on treatment and prevention gets crossed with patient data to deliver context-relevant decision support to the front lines. This explains why much of the gains from EHRs stem from population health management (Crosson and Madvig, 2004) and utilization management (Porter and Teisberg, 2006)—neither of which comport with the goals of the indemnity model. Along the same lines, one can think of health IT facilitating a substitution of cheaper, preventative care for the costly treatment of chronic diseases, improving resource allocation much the same way IT has done in other contexts (Hubbard, 2003). It does so by incorporating up-to-date best practices into all aspects of patient care, which it can fold into on-the-spot, real-time patient data, to improve decision-making and to prevent the continued use of ineffective or scientifically-disproved treatment options (Halvorson and Isham, 2003). Though most patients and their insurers would benefit from IT, only those organizations operating under the capitated model have a clear path towards monetizing the investment. This suggests that those physicians whose practices operate according to the capitated model should be more likely than other doctors to report access to health IT. With respect to Figure 3-1, rightward movement of  $x_i$ , all else constant, increases the likelihood that  $x_i \geq x^*$ .

**Hypothesis 3.1.** Those physicians that work for practices that finance healthcare on a capitated or prepaid basis will report greater access to health IT applications than those doctors delivering care in fee-for-service settings.

Hypothesis 3.1 establishes that characteristics of the organization in which physi-

cians practice influences their likelihood of accessing elements of an EHR system. Aside from the strategic goals of the organization creating an opportunity for medical practices to internalize the benefits accruing from IT investment, the scope of care delivered by the practice—whether it provides only primary care, only speciality care, or both—should similarly shape whether or not the organization provides its physicians with the new technology. In the language of the technological diffusion framework employed above, scope, like capitation, is a suitable candidate for  $x_i$ .

Once again, the Kaiser Permanente case sheds some light. Note that despite slight interregional variation in practice scope, each of Kaiser’s eight medical groups employs nearly all of the providers—generalists and specialists—that a patient will ever require. As a result, the medical groups can capture the returns to investments that facilitate greater coordination of patient care. It is true that much of the returns to coordination come in the form of improvements in preventive care and a reduction in treatment costs, gains that have already been accounted for by Hypothesis 3.1. Nonetheless, incremental benefits of improved coordination include reductions in redundant tests and treatments that arise when multiple, disconnected providers are working to address the same symptoms in the same patient. Indeed, improved coordination is a typical benefit of IT (Malone, Yates, and Benjamin, 1987; Malone and Crowston, 1994). Interdependent production processes strap organizations with costs attendant to communications and data and information transfer, pressure that IT has been shown to alleviate (Forman, 2005; Hitt, 1999).

Some medical practices provide only primary care such as family practice, internal medicine, or pediatrics. Others provide only specialty medical care, like that provided by pulmonologists, gynecologists, or neurologists. However, those medical practices encompassing both primary and specialty care—an integrated or team approach—can internalize a greater share of the coordination benefits arising from IT than can other practices. Therefore, we would expect that those physicians based in practices spanning primary and speciality care will be more likely to report access to components of an EHR system than will physicians in more narrowly-scoped medical practices.

**Hypothesis 3.2.** Those doctors working in practices that offer both primary and specialty care will be more likely than other doctors to report access to health IT.

## Diffusion of Health IT

One attractive feature of the model depicted in Figure 3-1 is the ease with which it can be made dynamic. Say an organization had not adopted at  $t = 1$  but had

adopted by  $t = 2$ . This framework suggests adoption could have occurred in the interim because the organization's value on  $x$  transcended the threshold value. For example, perhaps the composition of patients served by the practice has shifted from predominantly fee-for-service patients to majority prepaid patients. Alternatively,  $x^*$  could have fallen to below  $x_i$  in the period between the two survey rounds. This could happen any number of ways. For example, the technology may have become less expensive. These possibilities are not mutually exclusive. All that matters is that the movement of one exceeds the movement of the other enough to reorder  $x_i$  and  $x^*$ .

The next two hypotheses address the issue of diffusion, i.e., changes in adoption behavior over time. The first essentially positions time in the role of  $x_i$ , proposing quite simply that EHR technology has, in fact, diffused in the inter-survey period. Broad-based, national studies of health IT diffusion come to differing conclusions with respect to the speed of this diffusion. Burt and Sisk (2005) examined data for the years 2001, 2002, and 2003, reporting less than a single percentage point increase over the period in the number of physicians claiming access to office-based health IT. On the other hand, a more comprehensive study by the RAND Corporation concluded that EHRs are diffusing at a rate similar to IT in other industries (Bower, 2005). Unfortunately, with just two data points as opposed to a continuous domain of values for  $x_i$ , only a simple linear prediction is possible. However, if we trust the Figure 3-1 framework, the adoption function must be positive in time. In fact, the familiar, monotonically-increasing  $S$ -curve often used to describe diffusion, the one in which the number of users is plotted against time, actually comes from differentiating the probability density function (pdf) in Figure 3-1 with respect to time.<sup>7</sup>

**Hypothesis 3.3.** Physicians will report greater access to health IT in the later round of the survey than they will in the earlier round.

Despite its apparent triviality, Hypothesis 3.3 paves the way for an important advance to be made with the remaining hypotheses: Despite the fact that health IT is diffusing—to be shown in support of Hypothesis 3.3—adoption no longer appears to be the product of competitive or strategic forces. Recall that Hypothesis 3.1 casts capitation in the role of  $x_i$ . It proposes that to the extent capitation can be thought of as a continuous measure, increases in this variable are associated with an increased likelihood that the practice's physicians will report access to health IT.

---

<sup>7</sup>In the language of statistics and probability, the  $S$ -curve is the cumulative distribution function (cdf) associated with the normal distribution. That is,  $F(x)$ —not  $f(x)$ —is the probability density function (pdf) and is actually what appears in Figure 3-1. Formally,  $F(x) = \int f(x)dx$ .

This relationship obtains, I argue, because capitation creates a strategic impetus for practices to provide their physicians with this technology. So, why would a practice that had not adopted at  $t = 1$  adopt by  $t = 2$ ? As noted above, it could be that an increasing share of the practice's revenue comes in the form of capitation—a rightward movement of  $x_i$  to a point in which  $x_i > x^*$ . Alternatively, and I argue, more likely, is that something has worked to move  $x^*$  to the left, reducing  $x^*$  to below  $x_i$ . That is, the costs to adopting the technology have fallen or costs of not adopting it have risen, irrespective of capitation.

One possible cause of the leftward movement of  $x^*$  has been the identification of antiquated recordkeeping as a primary culprit of the industry's poor performance (e.g., Halvorson and Isham, 2003; McGlynn et al., 2003), and the further belief that this inefficiency could be a major threat to the entire US economy. This has generated the flurry of proposed legislation discussed earlier. Recall that bills put forth at the federal level call for preferential tax treatment for those opting to invest in health IT. Others demand that providers adopt the technology in order to continue serving government employees as patients through the Federal Employees Health Benefit Program (FEHBP). Though none of the major pieces of federal legislation have made it out of committee, the executive branch has funded an initiative within the Department of Health and Human Services (HHS) to accelerate the diffusion of interoperable EHRs throughout the country. Below the federal level, state and municipal governments have taken similar steps, some seeing themselves as a potentially scalable model suitable for the whole country. State and local agencies each contributed to a \$60 million project intended to provide all residents of New York city with an EHR and to outfit all the city's providers with the required hardware and software to make the transition. Aside from government action, private sector employer consortia have formed specifically to leverage their collective clout as healthcare payers to demand major reforms on the part of providers. One such group has even brought two large national unions, the Communications Workers of America (CWA) and the Service Employees International Union (SEIU) into the fold. That consortium, led by Intel Corporation and Wal-Mart, has invested \$15 million in developing its own system of portable EHRs for its employees, demanding that providers maintain and update these records in order to keep their "preferred provider" or "in-network" status. Finally, access to EHR technology no longer requires a major investment along the lines of what Kaiser devoted to its project. In addition to dedicated vendors and application developers, like Epic Systems Corporation, "off-the-shelf" solutions are becoming more ubiquitous. For example, the Cleveland Clinic endorsed Google's



EHR product, and Microsoft has also begun marketing an EHR application of its own.

If these forces are effectively moving  $x^*$  in Figure 3-1 to the left, then the effect of capitation predicted in Hypothesis 3.1 will not interact positively with time. That is, the overall likelihood of physicians to adopt health IT may be increasing in accordance with Hypothesis 3.3 and may be positively associated with a measure of capitation as called for in Hypothesis 3.1. However, increases in adoption cannot be ascribed to capitation.

**Hypothesis 3.4.** The diffusion predicted in Hypothesis 3.3 cannot be explained by an increased association between capitation and adoption.

## Decoupling of Health IT from Its Reinforcing Work System

The two remaining hypotheses together propose that those physicians whose practices provided them with health IT early on—those practices that were more likely to do so because it comported with organizational goals under capitation—also provided their physicians the incentives to use the technology. On the other hand, those that adopted later on were not as assiduous in adopting the complementary elements of the work system. That is, it appears that the technology is being decoupled from the set of physician incentives believed to promote its effective use.

Management theory serves as a foundation for these hypotheses. Strategic human resource management (HRM), in particular, has sharpened our understanding of the links between an organization's employment practices and its business strategy through constructs like "alignment" and "complementarity." Alignment or "vertical fit" describes the relationship between a firm's broadly-defined business strategy and the human resource (HR) practices chosen to operationalize it (Becker and Huselid, 1998; Wright and McMahan, 1992; Wright and Snell, 1998). In a series of studies on steel minimills, Arthur 1992; 1994; 1999 showed that systems of employment practices covary in predictable ways with business strategy. Though his sample did not afford the necessary variation, other empirical studies of manufacturing have demonstrated that attention to "aligning" particular business strategies with a specific set of employment practices improves performance (Youndt et al., 1996). Complementarity, sometimes labeled "horizontal fit," refers to the internal consistency of a firm's HR practices (Delery and Doty, 1996; Huselid, 1995), the idea being that individual employment practices, when bundled into coherent employment systems, have a larger aggregate performance impact than they would have had we simply summed their individual effects. Alignment and complementarity are meant to be distinct constructs. How-

ever, many of the empirical studies substantiating the complementarity thesis (e.g., Ichniowski, Bartel, and Shaw, 2007; Ichniowski, Shaw, and Prennushi, 1997; MacDuffie, 1995; cf. Devaraj and Kohli, 2003) do so in the context of new technologies, like “lean manufacturing.” Therefore, they highlight the complementarity between individual employment practices as well as the complementarity between technologies, work structures, and employment practices. Both theoretical (e.g., Brynjolfsson and Mendelson, 1993) and empirical accounts (e.g., Hitt and Brynjolfsson, 1997) have substantiated the notion of alignment with respect to IT, in particular.

The lead-up to Hypothesis 3.1 explained why capitation would encourage the adoption of health IT across the physician sample, much as it had done at Kaiser Permanente. Hypothesis 3.5 uses strategic HRM to argue that the same competitive goals that drive IT adoption, namely a greater focus on preventive care and the improved management of patient health, align with a set of incentives for physicians to use the technology. That is, the IT and the incentives to use it compose the work system that aligns with the strategic goals of the medical practice. More specifically, we would expect those doctors working under the prepaid model to see some of their compensation contingent on how successful the practice is at meeting its strategic goals—the same goals meant to be facilitated by the IT. For many physicians, particularly those in smaller practices, it is not difficult to imagine them in the role of residual claimant, since they are very likely to own the practice outright. It is also common for physicians in larger practices to own part of their practice through a professional partnership, again providing the physician with a clear stake in the success of the organization and in the success of its EHR deployment. Recall that some physicians at Kaiser Permanente, for example, had such an ownership stake. Kaiser also illustrated that when physicians are not full owners of the practice in which they are based, there are at least two other ways to align doctors’ incentives with those of the organization and of the EHR initiative. First, doctors could be paid based on the practice’s ability to meet certain quality standards, along the lines of the HEDIS measures discussed on Chapter 2. Indeed, it is these healthcare process measures in particular that EHRs are expected to raise, which is why Kaiser relied on them and measures like them for its incentive program. Second, doctors’ pay could depend in part on patient satisfaction scores. Kaiser did not rely on patient satisfaction scores in this way, undoubtedly because there is no obvious theoretical connection between patient satisfaction and the organization’s economic performance. Even so, across a sample of physicians, we should expect that capitation will be positively associated with the incidence of these sorts of incentives for physicians.

**Hypothesis 3.5.** Capitation will be positively associated with the incidence of incentives such as ownership or contingent pay that promote physicians' effective use of health IT.

According to the hypotheses already laid out, capitation drives the adoption of health IT. However, adoption rates are increasing, and these increases cannot be explained by increased incidence of capitation. Capitation also promotes the adoption of certain incentives for physicians. Hypothesis 3.6, the final hypothesis, predicts an increasing discrepancy between IT adoption and the incidence of the incentives that physicians have to use it. The discrepancy comes about because of the differing motivations between early-adopters and more recent adopters. For early adopters, health IT was adopted as part of a coherent work system—the IT “tools” and the incentives to use them. This parallels the role played by technology in studies of the automobile industry (e.g., MacDuffie, 1995) and of the service sector (e.g., Autor, Levy, and Murnane, 2002; Batt, 1999; Hunter et al., 2001). This work system aligned with the goals of population health management and disease management. However, the pressures on later adopters were not as strategically-driven. Instead, later adopters invested in health IT as a response to forces that did not at the same time call for the adoption of other important elements of the work system.

**Hypothesis 3.6.** Those adopting IT early will do it as part of a larger initiative involving incentives, whereas those adopting later are more likely to adopt IT without embedding it in an aligned employment system.

The above hypotheses cannot be tackled without thinking seriously about the importance of one particular medical practice attribute—size. There is good reason to believe that larger medical practices will be more likely to invest in IT than would otherwise identical smaller practices (Bates, 2005; Burt and Sisk, 2005; Lee et al., 2005). Surveys of medical practice leadership point to capital cost outlays, estimated at nearly \$50,000 per physician (Audet et al., 2004; Miller et al., 2005), as the single greatest concern and deterrent to health IT investment (Accenture, 2005). Cost can be prohibitive in other ways that discriminate against small practices. Consider Kaiser's experience building its database of clinical content. Some clinical content comes from third-party vendors, but most of it is developed in-house at the national and regional levels. Aside from effort to gather and agree on clinical content, regional teams must work to embed it into the software, making sure that alerts appear for the right patient, at the right time, and in a form that is actionable on the part of the clinician. Notwithstanding demands to keep this information up-to-date, clinical content aids

each additional decision at near-zero marginal cost. This cost structure and the resulting scale economies are typical of information's role as a production input, and therefore, of the technology used to process it (Arrow, 1974; Wilson, 1975). Whatever effort and expense go into workflow and business process reorganization can be used more intensively—and thus, more profitably—by larger practices than by smaller ones (David, 1975; Geroski, 2000). However, the literature has suggested numerous reasons for organization scale to be positively correlated with adoption (e.g., Forman, 2005; Geroski, 2000; Rogers, 2003), just as scale seems to drive a range of economic outcomes (e.g., Brown, Hamilton, and Medoff, 1990) aside from diffusion.

Determining precisely what it is that scale is proxying for in this analysis requires its own study. For the purposes of this research, it is much more critical that the effects of scale be controlled for. The primary justification for this decision relates to the phenomenon and the resulting policy challenge. In the United States (US), four out of five doctors work in practices of ten or fewer physicians. These small practices also serve as the setting for 88 percent of all outpatient office visits (Lee et al., 2005). However, since size can instrument for so many other variables that themselves might be expected to associate positively with adoption (Geroski, 2000), the inclusion of size controls render estimates of the key predictor variables especially conservative.

## Methods

### Sample

The hypotheses will be tested on an unbalanced panel of physicians sampled once in 2001 and again in 2005 for the Community Tracking Study (CTS). The Center for Studying Health System Change (2003, 2006) administers the CTS and the Robert Wood Johnson Foundation sponsors it. The 2001 and 2005 cross-sections contain 12,406 observations and 6,628 observations, respectively, representing the universe of all physicians practicing in the contiguous US who provided direct patient care at least 20 hours per week. The pooled sample includes data from 14,606 distinct physician respondents, and the balanced panel—those physicians who were surveyed both years—incorporates data from 4,428 different physicians.

## Measures

### Access to IT

Table 3.1 explains the construction of each of the variables called on in the study. With respect to operationalizing IT adoption, surveyors asked physicians for which of seven activities their practice used IT. Each of the seven IT applications—writing prescriptions, communicating with patients, researching treatment information and guidelines, checking the contents of the formulary, generating reminders for preventative services, accessing patient notes, and exchanging clinical data and images with other physicians—was first measured independently with a binary variable equal to one for an affirmative response. A principal components analysis revealed that all seven variables contributed to a single construct, one that accounts for 36 percent of the total variance of these measures. So, in order to capture the intensity with which a physician’s medical practice adopts IT, I summed affirmative responses to the seven separate survey questions. Consequently, the primary measure of IT access called on in the analysis—ITUSE—is an ordered, categorical variable between zero and seven, inclusive. However, for reasons explained below, it will be treated as if it were a continuous variable of the same domain.

### Physicians’ Incentives

Hypotheses 3.5 and 3.6, which incorporate physician incentives into the analysis, use three, separate, binary dependent variables, each taken from a single item on the CTS questionnaire. For our purposes, OWNERSHIP takes on just two values. However, the survey instrument allowed respondents to differentiate between full and partial ownership. This allowed surveyors to direct questions such as those used to construct CAREQUAL and PATIENTSAT only to those who are *not* full owners of their practices. This makes sense, since a full owner of a practice is neither explicitly divvying out rewards to themselves according to care quality compliance scores, i.e., CAREQUAL, nor in response to patient satisfaction surveys, i.e., PATIENTSAT. However, this routing logic also means that the number of respondents providing information for CAREQUAL and PATIENTSAT is necessarily less than the number of respondents having values for OWNERSHIP.

Table 3.1: Descriptions of Independent and Dependent Variables

Variable Name	Description & Construction
<i>Dependent Variables</i>	
ITUSE	Intensity of IT use by the practice, constructed by summing values for seven measured IT uses. (discrete, ordered variable ranging from zero to seven)
ITPRESC	...to write prescriptions?"
ITCOMM	<b>"In your practice, are computers or other forms of IT used...</b> (binary = 1 for "yes")
ITTREAT	...to communicate about clinical issues with patients by email?" ...to obtain information about treatment alternatives or recommended guidelines?"
ITFORM	...to obtain information on formularies?"
ITREMIND	...to generate reminders for you about preventative services?"
ITNOTES	...to access patient notes, medication lists, or problem lists?"
ITCLIN	...for clinical data and image exchanges with other physicians?"
OWNERSHIP	Physician has partial or full ownership stake in his or her medical practice (binary = 1 for "yes")
CAREQUAL	Physicians' compensation influenced by objective measures of care quality (binary = 1 for "yes")
PATIENTSAT	Physicians' compensation influenced by patient satisfaction measures (binary = 1 for "yes")
<i>Independent Variables</i>	
CAPITATION	Medical practice serves as an HMO (binary = 1 for "yes")
COMPETITION	Practice in intense competitive situation (binary = 1 for "yes")
PERPREPAID	Percentage of practice revenue received on a prepaid basis (continuous variable)
SCOPE	Medical practice offers primary and speciality care (binary = 1 for "yes")
ORGSIZE	"How many physicians, including yourself, are in this practice?" (continuous variable)

*Source:* Variables constructed from rounds 3 and 4 of the Community Tracking Study Physician Survey conducted by the Center for Studying Health System Change (2003, 2006).

## Strategic and Organizational Drivers of IT Adoption

Capitation, the healthcare financing model that I argue is bolstered with by health IT, is most simply conceived of as a binary measure—CAPITATION. This is constructed from a series multiple choice questions asking physicians to classify their medical practice. I assign a value of one to this dummy variable for those describing their practice as any type of HMO, since this model is synonymous with capitation. However, as noted earlier, there are many hybrid practices that serve some patients on a capitated basis and others on a fee-for-service basis. Therefore, I use a continuous variable, PERPREPAID, to pick up variation along this continuum. Finally, since my focus on capitation represents a larger interest in whether or not practices are adopting for strategic and economic reasons, I also consider the physician’s perspective on the competitive environment in which their practice operates. This is operationalized as a binary variable, COMPETITION.

The organizational variables, SCOPE and ORGSIZE, are also constructed from responses to the physician survey. SCOPE is a simple binary variable set to equal one in practices that deliver both primary and speciality care. As noted above, controls for size are critically important to the credibility of the estimates, despite the fact that size is not a focus of this study. The variable ORGSIZE is itself the untransformed number of doctors working out of the respondent’s practice. In some models, this variable is transformed or converted into a set of dummies to improve model fit.

## Hypothesis Testing

In order to address Hypotheses 3.1-3.4, I first estimate a taxonomy of OLS and multilevel linear regression models predicting ITUSE, i.e., the overall level of access to health IT reported by respondent physicians. Recall that the dependent variable is actually an ordered categorical variable, implying that an ordered logistic or ordered probit regression would be more appropriate than OLS regressions. In all cases, results from ordered logits were qualitatively identical to OLS estimates. For ease of interpretation, I report OLS estimates. The initial models in the taxonomy rely solely on the more recent cross-section of physicians. After fitting a model that includes all the relevant regressors, I then re-estimate the same model on the 2001 cross-section to ensure that the expected relationships hold independently in both snapshots. I then pool the samples to exploit the benefits of a panel design, namely the opportunity to check the robustness of findings pertaining to Hypotheses 3.1, 3.2, and 3.3 as well as to provide a “first pass” at Hypothesis 3.4.

After building-up to a model incorporating all of the key predictor variables and controls for scale, I will repeat the exercise for the individual IT applications, just to ensure that the use of the “omnibus” dependent variable is not obscuring substantial heterogeneity in the mechanisms leading to adoption. This requires estimating seven, separate multilevel logistic regression equations—one for each of the health IT applications. In an effort to dispose of another possible source of estimation error, I run these estimates separately for Primary Care Physicians (PCPs) and specialists.

The last two hypotheses examine the relationship between capitation, IT adoption, and the adoption of reinforcing “work systems,” in particular, the incidence of incentives for physicians to make the best use of the technology. In order to test Hypothesis 3.5, I estimate equations independently for each of the three measures of physician incentives—OWNERSHIP, PATIENTSAT, and CAREQUAL. I estimate four models for each of these outcomes. This allows for two separate measures of capitation as a driver of the dependent variable, each of which is run separately for physicians in small practices and for physicians in large practices. Given the binary nature of the dependent variable, multilevel logistic (or probit) regression is the most appropriate functional form for these estimates. However, for ease of interpretation, particularly of the fitted slope coefficients on the two-way interactions (Ai and Norton, 2003; Jaccard, 2001), I employ the linear probability model without loss of generality (Aldrich and Nelson, 1984). Lastly, I address Hypothesis 3.6 by calculating a set of transitional, marginal, and conditional probabilities that allow me to paint a picture of the decoupling of health IT from its reinforcing work system. In short, the calculations show what share of those adopting each IT application between the two survey rounds also provide the physician incentives. They also illustrate the weakening association between IT adoption and physician incentives by comparing the coincidence of these variables across the two, disjoint two cross-sections.

## Results

Table 3.2 displays sample means stratified by cross-section as well as for the matched sample, i.e., those physicians appearing in both the 2001 and 2005 survey rounds. Figure 3-2 relies on the summary data to express the diffusion of each of the individual health IT applications. Note that even as of the 2005 administration of the survey, physicians reported access, on average, to fewer than three of the seven forms of IT. It also stands out that the most commonly-accessed IT is that employed for researching treatment options, which can include basic internet searches. It is not surprising



that e-prescribing is the least-diffused form of IT, since it calls for the physician's medical practice to adopt IT that is interoperable with one or more retail pharmacies. Finally, note that means are roughly equivalent whether calculated for each of the cross-sections or based only on the matched sample of physicians surveyed in both survey rounds.

Table 3.2: Sample Means for Independent and Dependent Variables

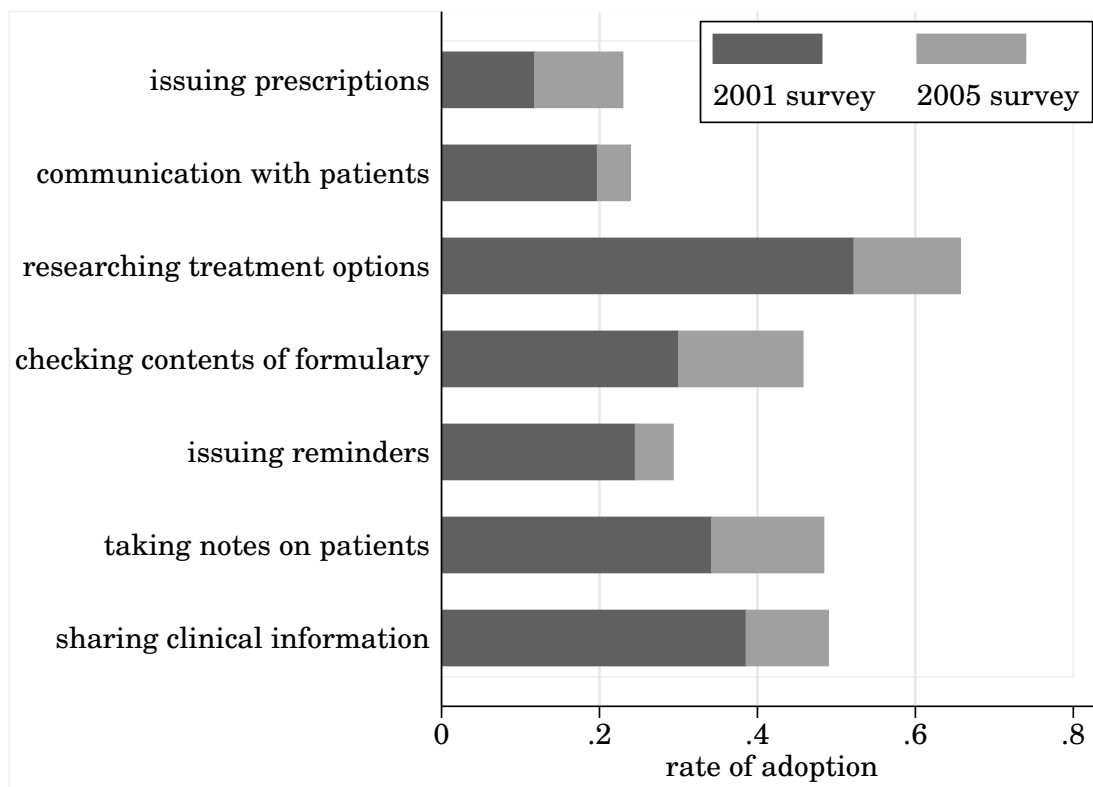
	Cross-Sectional <sup>a</sup>		Matched <sup>b</sup>	
	2001 survey	2005 survey	2001 survey	2005 survey
<b>independent &amp; control variables</b>				
CAPITATION	.05	.04	.04	.04
COMPETITION	.21	.18	.20	.18
PERPREPAID	17.0	15.1	16.0	14.5
SCOPE	.08	.07	.08	.07
ORGSIZE	39.0	48.3	38.0	45.8
<b>dependent variables</b>				
ITUSE	2.1	2.8	2.1	2.8
ITPRESC	.12	.23	.11	.22
ITCOMM	.20	.24	.19	.24
ITTREAT	.52	.66	.53	.64
ITFORM	.30	.49	.29	.44
ITREMIND	.25	.30	.23	.29
ITNOTES	.35	.48	.35	.46
ITCLIN	.39	.49	.39	.47
OWNERSHIP	.51	.52	.54	.57
CAREQUAL	.44	.46	.43	.48
PATIENTSAT	.48	.50	.47	.52

*Source:* Variables constructed from rounds 3 and 4 of the Community Tracking Study Physician Survey conducted by the Center for Studying Health System Change (2003, 2006).

<sup>a</sup> For the 2001 cross-section,  $n = 12,406$ . For the 2005 cross-section,  $n = 6,628$ . Means calculated by estimating  $y_{i,t} = \alpha_0 + \beta_{i,t}\text{ROUND4}_{i,t} + \zeta_i + \epsilon_{i,t}$ , where  $y$  represents the dependent variable in the left-hand column, ROUND4 is a binary variable equal to one for year 2005 observations,  $\zeta_i$  is a random intercept at the physician level, and  $\epsilon_{i,t}$  is the residual for each physician  $i$  on each survey  $t$ . Therefore,  $\hat{\alpha}$  is the mean value of  $\hat{y}$  for the 2001 survey and  $\hat{\alpha} + \hat{\beta}$  represents the mean value of  $\hat{y}$  for the 2005 survey. All estimated means were highly significant. Except for the variable CAPITATION, all inter-survey differences-in-means were also statistically significant at conventional levels.

<sup>b</sup> For the panel,  $n = 4,428$ . Means calculated by estimating  $y_{i,t} = \alpha_0 + \alpha_i I + \beta_{i,t}\text{ROUND4}_{i,t} + \epsilon_{i,t}$ . This is similar to the model described in the previous footnote, except that the random intercept  $\zeta_i$  has been replaced by the fixed-effect  $\alpha_i$ , where  $I$  is a vector of dummy variables representing each distinct physician sampled, for those physicians sampled in both 2001 and 2005. Once again, all estimated means were highly significant, and except for the variable CAPITATION, all inter-survey differences-in-means were statistically significant at conventional levels.

Figure 3-2: Physicians' Reported Access to Seven Health IT Applications Serving as Components of an Electronic Health Record System



Source: Author's analysis of data from rounds 3 and 4 of the Community Tracking Study Physician Survey (Center for Studying Health System Change, 2003, 2006).

## Access to Health IT

Table 3.3 presents estimates for a taxonomy of OLS and multilevel linear regression models predicting the overall number of health IT applications adopted by the respondent physicians' medical practices. The first four models are run solely on the more recent, 2005 cross-section. Focusing on these, note that the first variable entered into the model is CAPITATION. It maintains its statistically significant, positive relationship to IT adoption across all four estimates run on the 2005 cross-section. The second model incorporates three dummy variables to account for the number of physicians working in the respondent's practice, the referent category being those practices with fewer than five physicians. Parameterizing scale initially in this way served two goals. First, it allowed us to separate out the smallest practices which will prove useful later on for analytical purposes. Second, it revealed that while ITUSE is increasing in scale, the relationship may not be linear. The significance levels of

the estimates in M2 can be interpreted as saying that physicians are more likely to be provided access to health IT in practices of any size greater than four physicians. However, Wald tests of various linear combinations of coefficients further reveal that estimated the size effect at each “jump” is greater than the size effect of the previous jump. Furthermore, the size effect is somewhat *S*-shaped in that it grows quickly, slows down, and grows quickly again.<sup>8</sup> The third model adds the dummy variable, SCOPE, but its estimated slope coefficient is insignificantly different from zero. This could well be the result of “over-controlling” for size as well as the strong collinearity between the size dummies and SCOPE.<sup>9</sup> Therefore, the next model, M4, instead controls for size using linear and quadratic versions of the ORGSIZE variable.<sup>10</sup> Both of these variables are statistically significant. More important, this change allows the estimated coefficient for the SCOPE dummy to achieve statistical significance. The last of the cross-sectional estimates is presented in the fifth model. M5 is identical to M4, except that M5 has been estimated on 2001 data. That the results are qualitatively (and sometimes even quantitatively) equivalent is meant to show that the model constructed piece-by-piece using the 2005 data appears to describe the drivers of IT adoption in the earlier data as well.

The remaining three models in Table 3.3 are multilevel linear regression models. The first of these, M6, replicates M5, but adds one more regressor—a dummy variable set to equal one for observations in the 2005 dataset. The statistically significant, positive estimate for this variable clarifies that controlling for capitation, size, and scope, physicians report, on average, access to .65 more health IT applications in the later survey round than in the earlier one. It is equally important that the fitted coefficients on the other variables remain largely unchanged in size and significance. The next model, M7, adds a two-way interaction between CAPITATION and the indicator for the 2005 survey round. To the extent that the estimate for the new variable is negative, it supports Hypothesis 3.4. Unfortunately, it falls far short of statistical significance. One possibility is that the variables describing size, which have yet to be crossed with the 2005 survey indicator, should be parameterized once again using the

---

<sup>8</sup>Say  $\hat{\beta}_0 = 0$  represents the estimated size effect for the smallest category,  $\hat{\beta}_1 = .48$  represents the estimated size effect for the next bin,  $\hat{\beta}_2 = .95$ , etc. Then,  $\hat{\beta}_1 - \hat{\beta}_0 > 0$  ( $p < .0000$ ),  $\hat{\beta}_2 - \hat{\beta}_1 > 0$  ( $p < .0000$ ),  $\hat{\beta}_3 - \hat{\beta}_2 > 0$  ( $p < .0000$ ), and  $\hat{\beta}_4 - \hat{\beta}_3 > 0$  ( $p < .0000$ ). To see that the rate of growth is non-linear, note that  $(\hat{\beta}_4 - \hat{\beta}_3) - (\hat{\beta}_3 - \hat{\beta}_2) > 0$  ( $p < .0000$ ),  $(\hat{\beta}_3 - \hat{\beta}_2) - (\hat{\beta}_2 - \hat{\beta}_1) \approx 0$  ( $p < .9423$ ), and  $(\hat{\beta}_2 - \hat{\beta}_1) - (\hat{\beta}_1 - \hat{\beta}_0) > 0$  ( $p < .0000$ ).

<sup>9</sup>Over 99 percent of the 2,792 respondents in the referent category, i.e. those physicians in practices with fewer than five doctors, reported that their practice did *not* provide both primary and speciality care.

<sup>10</sup>The quadratic term is divided by 10,000 to allow the estimate to appear with just two decimal places.

Table 3.3: Coefficients (and z-statistics) for OLS and Multilevel Linear Regression Models of a Physician's Level of IT Adoption as a Function of Variables Describing His or Her Medical Practice

	M1	M2	M3	M4	M5	M6	M7	M8
CAPITATION	2.26*** (19.52)	1.14*** (8.86)	1.15*** (8.65)	.97*** (6.84)	1.03*** (10.94)	.98*** (10.70)	1.03*** (9.44)	1.18*** (11.16)
5-9 physicians		.48*** (6.83)	.48*** (6.80)					.20*** (4.51)
10-99 physicians		.95*** (14.96)	.95*** (14.08)					.35*** (7.45)
100+ physicians		2.09*** (19.93)	2.08*** (18.77)					1.37*** (15.39)
ORGSIZE				.01*** (15.32)	.01*** (14.14)	.01*** (18.25)	.01*** (12.85)	
(ORGSIZE) <sup>2</sup> × 10,000				-.07*** (-10.96)	-.04*** (-8.77)	-.05*** (-12.40)	-.04*** (-8.19)	
SCOPE			.02 (.17)	.27** (2.81)	.33*** (5.41)	.31*** (5.58)	.31*** (5.57)	.25*** (3.80)
indicator for follow-up survey						.65*** (26.03)	.62*** (22.92)	.47*** (14.28)
follow-up × CAPITATION							-.10 (-.68)	-.15 (-1.04)
follow-up × 5-9 physicians								.28*** (3.78)
follow-up × 10-99 physicians								.55*** (7.47)
follow-up × 100+ physicians								.47*** (3.66)
follow-up × SCOPE								-.15 (-1.37)
<i>n</i>	6,538	5,398	5,398	5,398	10,262	15,660	15,660	15,660
clusters	-	-	-	-	-	12,309	12,309	12,309
<i>psuedo</i> - <i>R</i> <sup>2</sup>	.35	.37	.37	.36	.39	.38	.38	.38

Key: \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Notes: Significance tests performed using Huber-White standard errors for the last three models. Dependent variable is the number of functions for which a physician's medical practice has adopted IT which takes on only integer values in the range [0,7]. The *psuedo* - *R*<sup>2</sup> measure employed here is the share of predicted values falling within one unit of their actual values for the dependent variable.

dummy variables called on to estimate M2 and M3. It could also be that the incorporation of the two-way interaction between ORGSize and the 2005 survey dummy will increase the precision of the other point estimates. The final model addresses all of these possibilities. It reverts to the alternative method of controlling for organization size and crosses those dummy variables with the indicator for the later survey round. It also adds the multiplicative counterpart for the SCOPE variable. Indeed, the point estimate for the capitation interaction variable becomes slightly more negative and almost doubles its  $z$ -value. It is still however, insignificantly different from zero.

The taxonomy presented in Table 3.3 speaks directly to Hypotheses 3.1 - 3.4, finding support for all of them. The point estimate for CAPITATION is positive and statistically significant in every specification, robust to the full complement of control variables that appear in the final model. This finding bolsters Hypothesis 3.1. Likewise, Hypothesis 3.2 finds support in cross-sectional and panel estimates, as the fitted coefficient describing SCOPE is always positive and nearly always statistically significant, even controlling for scale. Notice further that despite the inclusion of variables capturing the main effects of capitation, scale, and scope as well as the differential effects that these variables have over time, the estimated coefficient on the dummy assigned to the 2005 observations is always positive and always statistically significant. In particular, it remains positive despite the inclusion of a two-way interaction between this time dummy and CAPITATION. Therefore, these estimates imply strong, initial support for Hypotheses 3.3 and 3.4.

The next stage of the quantitative analysis undertakes a similar approach to that taken above, only it does so by predicting the likelihood of a physician having access to one particular IT application—one that facilitates so-called “e-prescribing,” the use of computerized tools to create and sign prescriptions. The final model will be estimated independently on all seven of the applications. The choice to develop the taxonomy around the variable ITPRESC was somewhat arbitrary, though its status as the least-diffused of the applications under study makes it appealing. The single-application analysis also allows for robustness checks along numerous lines. For example, it shows that the hypothesized independent variables influence adoption in similar ways across all seven IT applications under study. It is also in the single-application equations that I divide the sample into PCPs and specialists. In accordance with existing studies (e.g., Schoen et al., 2006; Wang et al., 2003; Zhou et al., 2007), this checks for material differences in the processes that determine IT access for these two groups. These estimates also further address Hypothesis 3.4 by including not only the CAPITATION dummy, but the continuous variable PERPREPAID. They also incorporates another

binary variable, COMPETITION. COMPETITION and CAPITATION are not equivalent constructs; however, the former can shed light on whether or not IT adoption, particularly in the earlier data, really was at least driven by economic and strategic goals.

Table 3.4 shows the estimates from a taxonomy of multilevel logistic regression models predicting ITPRESC for a sample restricted to doctors delivering primary care. The first model shows only the unconditional mean of the dependent variable in the pooled sample of 2001 and 2005 survey responses. When juxtaposed with the second model, it is obvious that e-prescribing technology has become more prevalent in the inter-survey period. Since these are logits and not OLS regressions, interpreting the coefficients requires that they be exponentiated and expressed in terms of log-odds. Therefore, based on M2 estimates, PCPs are almost four times as likely ( $e^{\hat{\beta}_{2005 \text{ survey}}} = e^{1.35} = 3.86$ ) to have adopted e-prescribing technology in 2005 than they were in 2001. The next model, M3, adds both the COMPETITION dummy and the two-way interaction between COMPETITION and the variable flagging observations from the 2005 data. Notice that the fitted coefficient describing COMPETITION is positive while the fitted estimate for the product term is negative, both statistically significant. The strength and direction of these estimates changes little in the course of estimating the rest of the models. This is consistent with the idea that those adopting the technology early on did so, at least in part, to meet competitive pressures. However, the drive to adopt later on appears to have stemmed from something else.<sup>11</sup> Though this provides support for Hypothesis 3.4. The three models that follow try again to address the effects of capitation directly. M4 adds the two variables to test the effects of the CAPITATION dummy. M5 does the same for the continuous variable, PERPREPAID, and M6 includes all four variables in a single specification. The main effects of both the binary and continuous measures are always positive and always significant. However, in these three models, the estimated partial slopes for the product variables describing the effects of capitation over time are never statistically significant. Nonetheless, the addition of controls for scale in M7 manages to improve the estimates of the capitation variables. With controls for scale, both sets of capitation variables behave in accordance with the notion that capitation comes to matter less over time—the crux of Hypothesis 3.4—though the two-way interaction for the dummy variable remains insignificant. For the sake of completeness, the final model adds the two variables

---

<sup>11</sup>While researchers should be wary of interpreting estimated partial slopes for interaction variables in logit models (Ai and Norton, 2003; Jaccard, 2001), an analogous taxonomy of linear probability models confirms both the direction and, in most cases, the statistical significance of the effects shown in Table 3.4.

describing the relationship between practice scope and IT adoption.

By and large, the relationships that emerge in Table 3.4 with respect to the dependent variable ITPRESC obtain for the other six IT applications as well. Table 3.5 makes this clear by replicating the final model in Table 3.4 separately for each of the IT application dummies. Once again, these models are estimated on the sub-sample of physicians providing primary care. For ease of comparison, the first model in Table 3.5 repeats the last model from the previous table. In all cases, the likelihood of adoption is greater in 2005 than in 2001. Note that intense competition is always positively associated with IT adoption, a relationship that is almost always statistically significant. However, in all cases, the two-way interaction for COMPETITION is negative, though only achieving significance for three of the applications. This is fully consistent with Hypothesis 3.4, since it is only necessary that the two-way interactions be non-positive. The estimated partial slopes for the two variables measuring binary capitation are generally of the same direction and significance (or insignificance) for all of the applications, with the exception of the product variable in the equation describing adoption of IT for communication between providers. The variables picking up the main and interaction effects of the continuous measure of capitation perform similarly since none of the estimated coefficients for either variable are ever statistically significant when they are of the “wrong” sign. Once again, the estimates for SCOPE are consistent with Hypothesis 3.2.

Table 3.6 replicates the estimates from the previous table, this time for the sub-sample of specialist physicians. Interestingly, competition may never have mattered as much for specialists as it did for PCPs, and certainly did not matter any less in 2005 than in 2001. This finding suggests that for specialists, the influence of competitive factors on health IT lags relative to its effect on PCPs, a proposition that can only be explored by extending the time series with additional data. However, the estimates corresponding to the two capitation measures prove similar to the estimates describing adoption for PCPs. That is, there is some evidence from the continuous measure of capitation that prepayment mattered more in the earlier round than in the later one. Note that only one of the 14 point estimates describing the relationship between scope and adoption is significant, and many are even “incorrectly” signed. This suggests that SCOPE behaves in accordance with Hypothesis 3.2 more for generalists than for specialists. That is, for PCPs, the presence of specialists matters for adoption, but not vice versa.



Table 3.4: Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Primary Care Physician’s Likelihood of Adopting an IT Application for E-Prescribing Medication

	M1	M2	M3	M4	M5	M6	M7	M8
intercept	-2.53*** (-25.34)	-3.28*** (-22.96)	-3.36*** (-22.53)	-3.38*** (-22.66)	-3.77*** (-21.59)	-3.67*** (-21.57)	-3.86*** (-18.96)	-3.85*** (-18.95)
indicator for follow-up survey		1.35*** (14.37)	1.44*** (13.92)	1.40*** (13.48)	1.62*** (11.56)	1.57*** (11.44)	1.16*** (7.09)	1.16*** (7.07)
COMPETITION			.34** (2.52)	.29** (2.18)	.30** (2.22)	.26** (1.98)	.28** (2.07)	.28** (2.04)
follow-up × COMPETITION			-.52** (-2.34)	-.45** (-2.05)	-.51** (-2.30)	-.44** (-2.02)	-.45** (-1.96)	-.45* (-1.93)
CAPITATION				1.85*** (9.33)		1.63*** (8.08)	1.09*** (4.82)	1.22*** (5.12)
follow-up × CAPITATION				.29 (.92)		.38 (1.17)	-.23 (-.63)	-.37 (-.95)
log PERPREPAID					.21*** (6.66)	.15*** (4.78)	.11*** (3.26)	.11*** (3.23)
follow-up × log PERPREPAID					-.07 (-1.44)	-.07 (-1.54)	-.13** (-2.37)	-.12** (-2.37)
log ORGSIZE							.20*** (5.18)	.17*** (4.22)
follow-up × log ORGSIZE							.22*** (3.91)	.25*** (3.99)
SCOPE								.32* (1.82)
follow-up × SCOPE								-.32 (-1.08)
<i>n</i>	10,960	10,960	10,960	10,960	10,960	10,960	9,361	9,361
clusters	8,662	8,662	8,662	8,662	8,662	8,662	7,516	7,516
$\chi^2$	-	206.62	208.66	267.67	233.67	276.86	257.44	258.45

Key: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Notes: Standard errors account for clustering at the physician-level. Dependent variable is whether or not physician’s practice uses IT for writing prescriptions.

Table 3.5: Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Primary Care Physician's Likelihood of Adopting Each of Seven IT Applications Serving as Components of an Electronic Health Record System

	ITPRESC	ITCOMM	ITTREAT	ITFORM	ITREMIND	ITNOTES	ITCLIN
intercept	-3.85*** (-18.95)	-3.43*** (-19.76)	-.26*** (-3.67)	-1.97*** (-20.72)	-2.08*** (-19.04)	-2.61*** (-20.15)	-1.88*** (-20.35)
indicator for follow-up survey	1.16*** (7.07)	.59*** (3.79)	.74*** (6.27)	1.05*** (8.96)	.32** (2.48)	.97*** (7.04)	.41*** (3.51)
COMPETITION	.28** (2.04)	.22* (1.67)	.07 (.76)	.45*** (4.72)	.30*** (2.82)	.32*** (2.76)	.10 (1.04)
follow-up × COMPETITION	-.45* (-1.93)	-.09 (-.39)	-.25 (-1.39)	-.31* (-1.82)	-.02 (-.12)	-.35* (-1.74)	-.25 (-1.41)
CAPITATION	1.22*** (5.12)	.64*** (2.83)	.41** (2.18)	1.48*** (8.25)	1.32*** (6.49)	2.12*** (9.21)	.75*** (4.25)
follow-up × CAPITATION	-.37 (-.95)	-.15 (-.39)	-.08 (-.20)	-.94*** (-2.89)	-.18 (-.52)	-.44 (-1.09)	.35 (1.03)
log PERPREPAID	.11*** (3.23)	.10*** (3.14)	-.03 (-1.41)	.09*** (3.86)	.06** (2.21)	.02 (.75)	.05** (2.03)
follow-up × log PERPREPAID	-.12** (-2.37)	-.04 (-.82)	.03 (.61)	.01 (.33)	.04 (.88)	-.06 (-1.35)	-.05 (-1.26)
log ORGSIZE	.17*** (4.22)	.32*** (8.04)	.20*** (6.68)	.10*** (3.58)	.11*** (3.42)	.40*** (10.79)	.38*** (12.73)
follow-up × log ORGSIZE	.25*** (3.99)	.03 (.42)	.15*** (2.86)	.15*** (3.22)	.13** (2.41)	.09 (1.60)	.10** (2.06)
SCOPE	.32* (1.82)	.03 (.18)	-.18 (-1.40)	.27** (2.17)	.15 (1.04)	.73*** (4.90)	.31** (2.57)
follow-up × SCOPE	-.32 (-1.08)	-.34 (-1.16)	-.12 (-.47)	-.45** (-2.02)	-.21 (-.84)	-.14 (-.54)	-.09 (-.41)
<i>n</i>	9,361	9,355	9,353	9,342	9,344	9,358	9,349
clusters	7,516	7,510	7,509	7,503	7,504	7,513	7,506
$\chi^2$	258.45	205.00	275.51	405.75	218.47	396.18	418.69

Key: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Notes: Standard errors account for clustering at the physician level. Dependent variable is whether or not physician's practice uses IT for each of seven regular activities—each with its own model.

Table 3.6: Coefficients (and z-statistics) for Random Effects Logistic Regression Models of a Specialist Physician’s Likelihood of Adopting Each of Seven IT Applications Serving as Components of an Electronic Health Record System

	<b>ITPRESC</b>	<b>ITCOMM</b>	<b>ITTREAT</b>	<b>ITFORM</b>	<b>ITREMIND</b>	<b>ITNOTES</b>	<b>ITCLIN</b>
intercept	−3.94*** (−16.14)	−3.10*** (−17.30)	−.12 (−1.43)	−1.87*** (−17.25)	−2.15*** (−17.08)	−1.74*** (−15.80)	−1.36*** (−15.39)
indicator for follow-up survey	.47*** (2.72)	.25 (1.61)	.30** (2.51)	.53*** (4.31)	.08 (.61)	.31** (2.34)	.27** (2.31)
COMPETITION	−.04 (−.24)	.56*** (3.95)	.00 (.01)	.10 (.94)	.24** (2.03)	−.11 (−.97)	−.02 (−.21)
follow-up × COMPETITION	.32 (1.35)	.13 (.58)	.13 (.76)	.22 (1.29)	.46** (2.46)	.21 (1.14)	.32** (1.97)
CAPITATION	1.74*** (4.97)	.77** (2.15)	.76** (2.33)	.86*** (2.92)	2.02*** (6.34)	1.55*** (4.11)	.07 (.23)
follow-up × CAPITATION	−.64 (−1.38)	.14 (.29)	.11 (.21)	.15 (.35)	−.01 (−.03)	−.94 (−1.63)	.16 (.34)
log PERPREPAID	.11** (2.20)	.13*** (2.78)	.11*** (2.90)	.25*** (6.56)	.15*** (3.81)	.22*** (5.63)	.22*** (6.43)
follow-up × log PERPREPAID	−.03 (−.40)	−.09 (−1.35)	.02 (.34)	−.13** (−2.49)	−.10* (−1.69)	−.08 (−1.32)	−.14*** (−2.88)
log ORG SIZE	.22*** (4.43)	.24*** (4.99)	.12*** (3.30)	.22*** (6.03)	.03 (.73)	.46*** (10.70)	.41*** (10.92)
follow-up × log ORG SIZE	.29*** (4.26)	.05 (.73)	.11** (2.02)	.12** (2.33)	.04 (.70)	.25*** (4.04)	.21*** (3.88)
SCOPE	.39 (1.49)	−.12 (−.45)	−.04 (−.19)	.28 (1.43)	.31 (1.43)	.12 (.57)	.01 (.03)
follow-up × SCOPE	−.07 (−.20)	.02 (.05)	−.35 (−1.10)	−.23 (−.77)	.46 (1.41)	−.54 (−1.61)	−.59** (−1.97)
<i>n</i>	6,472	6,471	6,468	6,463	6,446	6,470	6,467
clusters	4,996	4,996	4,996	4,989	4,982	4,996	4,994
$\chi^2$	214.13	131.80	142.79	268.72	154.93	356.93	368.48

Key: \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Notes: Standard errors account for clustering at the physician-level. Dependent variable is whether or not physician’s practice uses IT for each of seven regular activities—each with its own model.

## Incentives for Physician Use of Health IT

Hypothesis 3.5 proposed that prepayment would promote the incidence of physicians' incentives to use IT effectively, just as those physicians working under this arrangement would be more likely to report access to the technology itself. Addressing Hypothesis 3.5 called for regressing the incidence of a particular incentive on measures of capitation. However, these estimates account for scale not by partialing it out, but rather by running the estimates separately for physicians in large practices and physicians in small ones. On the one hand, this choice makes these results responsive to Lee et al.'s (2005) findings regarding the skewed share of physicians based in practices with fewer than 10 providers as well as the disproportionate fraction of primary care patient appointments that take place in these small practices. It is also the case that these incentives take on different meanings in small practices than in large ones. For example, recall that CAPITATION is determined by whether or not a physician designates his or her practice as being part of an HMO. Measured in this way, it makes sense that CAPITATION would be positively associated with OWNERSHIP in large practices, e.g., "shareholding" physicians at Kaiser, but negatively correlated for solo or dual-physician practices.

The results of this exercise appear in Tables 3.7 and 3.8, each of which presents six multilevel linear probability models. The first table presents estimates from physicians based in large medical practices, i.e., those with 10 or more physicians. Note that all but one of the models imply a positive association between capitation and the provision of incentives, one that is generally stable over time. In large practices, the only incentive that may be dwindling is that measured by OWNERSHIP, though even these negative estimates are statistically insignificant. Turning to the smaller practices, Table 3.8, capitation is understandably negatively associated with OWNERSHIP. Nonetheless, as anticipated by Hypothesis 3.5, capitation appears to promote the incidence of compensation based on care quality or the results of patient satisfaction surveys, manifested by statistically significant, positively-signed point estimates for all of the four main effects estimated.

## Disconnecting IT from Its Larger Work System

Having presented evidence of the changing drivers of health IT adoption as well as the influence of capitation on the provision of physicians' incentives for using EHRs, what remains to be shown is the growing discrepancy between IT adoption and the adoption of complementary incentives for its effective use. These arguments, encap-

Table 3.7: Coefficients (and z-statistics) for Random Effects Linear Probability Regression Models Predicting the Impact of Prepayment on the Incidence of Physicians' Incentives for Those Physicians in Practices with 10 or More Doctors

	Ownership		Care Quality		Patient Satisfaction	
intercept	.22*** (37.76)	.23*** (27.32)	.21*** (30.57)	.17*** (17.68)	.30*** (38.24)	.25*** (22.72)
indicator for follow-up survey	.01* (1.78)	.02* (1.90)	.03*** (2.73)	.02 (1.54)	.02 (1.49)	.03 (1.57)
CAPITATION	.08*** (3.98)		.28*** (9.75)		.32*** (11.81)	
follow-up × CAPITATION	-.04 (-1.50)		.02 (.39)		.03 (.70)	
log PERPREPAID		.00 (.08)		.04*** (8.78)		.04*** (9.38)
follow-up × PERPREPAID		-.01 (-1.45)		.01 (1.30)		.00 (.16)
<i>n</i>	7,662	7,662	5,865	5,865	5,865	5,865
clusters	6,292	6,292	4,876	4,876	4,876	4,876

*Key:* \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

*Notes:* Significance tests performed using Huber-White standard errors. Only non-owners are included in the samples for the Care Quality and Patient Satisfaction regression models. Variables constructed from rounds 3 and 4 of the Community Tracking Study Physician Survey (Center for Studying Health System Change, 2003, 2006).

sulated in Hypothesis 3.6, are first substantiated by the probability grid displayed in Table 3.9 and then by Figure 3-3. To make sense of the grid, consider the values that run across the top row of the table corresponding to ITPRESC. The first five probabilities, labeled  $\mathbf{P}_1$ - $\mathbf{P}_5$ , correspond to the incentive represented by the dummy variable, OWNERSHIP. The first probability,  $\mathbf{P}_1$ , represents the transitional probability that a physician will adopt e-prescribing technology in 2005 conditional on their not having adopted it by 2001. Therefore, of those respondents surveyed in both rounds who had not adopted e-prescribing by the first round of the survey, 17 percent had adopted by the 2005 round. The next two probabilities,  $\mathbf{P}_2$  and  $\mathbf{P}_3$ , break down the 17 percent into those claiming to have an ownership stake in their practice,  $\mathbf{P}_2$ , and those that do not,  $\mathbf{P}_3$ . In this case, just under half of those inter-survey adopters reported being at least partial owners of their practice. The remaining two proba-

Table 3.8: Coefficients (and z-statistics) for Random Effects Linear Probability Regression Models Predicting the Impact of Prepayment on the Incidence of Physicians' Incentives for Those Physicians in Practices with Fewer than 10 Doctors

	Ownership		Care Quality		Patient Satisfaction	
intercept	.70*** (137.19)	.75*** (120.01)	.20*** (23.14)	.15*** (13.25)	.27*** (27.64)	.21*** (16.54)
indicator for follow-up survey	.03*** (4.27)	.01** (2.00)	.01 (.39)	.02 (.83)	-.02 (-1.49)	-.00 (-.05)
CAPITATION	-.47*** (-8.98)		.24*** (3.65)		.28*** (4.22)	
follow-up × CAPITATION	-.06 (-.56)		-.16 (-1.24)		-.11 (-.93)	
log PERPREPAID		-.04*** (-11.59)		.03*** (6.18)		.03*** (6.00)
follow-up × log PERPREPAID		.00 (1.26)		-.01 (-.56)		-.01 (-1.28)
<i>n</i>	11,112	11,112	3,089	3,089	3,089	3,089
clusters	8,942	8,942	2,797	2,797	2,797	2,797

*Key:* \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

*Notes:* Significance tests performed using Huber-White standard errors. Only non-owners are included in the samples for the Care Quality and Patient Satisfaction regression models. Variables constructed from rounds 3 and 4 of the Community Tracking Study Physician Survey (Center for Studying Health System Change, 2003, 2006).

bilities,  $\mathbf{P}_4$  and  $\mathbf{P}_5$ , correspond to the disjoint 2001 and 2005 cross-sections. Each represents the probability that a physician reporting access to e-prescribing technology also reports being an owner of their practice. Therefore, in 2001, 46 percent of those who were e-prescribing also had an ownership incentive to use the technology. By 2005, only a third of those with access to this health IT application reported having an ownership stake in their practice. Continuing along the same row, the next five probabilities were developed along parallel lines. However, instead of examining the coincidence of ITPRESC and OWNERSHIP, these show the same calculations for a different incentive—having a portion of one's salary dependent on objective measures of care quality. The remaining probabilities in the row perform the same exercise for a third incentive to use the technology, pay determined, in part, by responses to patient satisfaction surveys. The remaining rows replicate these calculations for the

Table 3.9: Transitional, Marginal, and Conditional Probabilities Describing Physicians' Adoption of Seven IT Applications and the Coincidence of Incentives for Quality Care Delivery

	Ownership					Care Quality					Patient Satisfaction				
	$\mathbf{P}_1$	$\mathbf{P}_2$	$\mathbf{P}_3$	$\mathbf{P}_4$	$\mathbf{P}_5$	$\mathbf{P}_1$	$\mathbf{P}_2$	$\mathbf{P}_3$	$\mathbf{P}_4$	$\mathbf{P}_5$	$\mathbf{P}_1$	$\mathbf{P}_2$	$\mathbf{P}_3$	$\mathbf{P}_4$	$\mathbf{P}_5$
ITPRESC	.17	.48	.52	.46	.33	.17	.44	.56	.45	.39	.17	.50	.50	.52	.42
ITCOMM	.16	.51	.49	.45	.37	.16	.47	.53	.44	.42	.16	.52	.49	.49	.43
ITTREAT	.47	.56	.44	.49	.39	.47	.47	.53	.44	.40	.47	.51	.49	.49	.43
ITFORM	.34	.52	.49	.45	.35	.34	.46	.54	.46	.42	.34	.50	.50	.51	.46
ITREMIND	.20	.56	.44	.54	.44	.20	.52	.48	.51	.50	.20	.55	.46	.54	.50
ITNOTES	.31	.49	.51	.42	.35	.31	.42	.58	.42	.38	.31	.46	.54	.49	.42
ITCLIN	.33	.56	.44	.41	.35	.33	.43	.58	.41	.37	.33	.45	.55	.47	.42

*Notes:*

$\mathbf{P}_1$  is the probability that a physician will adopt the technology in 2005 conditional on their not having adopted it by 2001, i.e.,  $P(IT_{i,t=2}|IT_{i,t=1}^c)$ .

$\mathbf{P}_2$  is the probability that a physician has the particular incentive to use it conditional on their having adopted the technology between the two survey rounds, i.e.,  $\frac{P((IT_{i,t=2}|IT_{i,t=1}^c) \cap INC_{i,t=2})}{P(IT_{i,t=2}|IT_{i,t=1}^c)}$ .

$\mathbf{P}_3$  is the probability that a physician does *not* have the particular incentive to use it conditional on their having adopted the technology between the two survey rounds, i.e.,  $\frac{P((IT_{i,t=2}|IT_{i,t=1}^c) \cap \neg INC_{i,t=2})}{P(IT_{i,t=2}|IT_{i,t=1}^c)}$ .

$\mathbf{P}_4$  is the probability that a physician who has adopted the technology also has the particular incentive to use it, for those physicians appearing only in the 2001 cross-section, i.e.,  $P(INC_{i,t=1}|(IT_{i,t=1}|IT_{i,t=2} = \emptyset))$ .

$\mathbf{P}_5$  is the probability that a physician who has adopted the technology also has the particular incentive to use it, for those physicians appearing only in the 2005 cross-section, i.e.,  $P(INC_{i,t=2}|(IT_{i,t=2}|IT_{i,t=1} = \emptyset))$ .

*Source:* Probabilities calculated with data from rounds 3 and 4 of the Community Tracking Study Physician Survey conducted by the Center for Studying Health System Change (2003, 2006).

six, additional EHR components.<sup>12</sup>

The probability grid substantiates Hypothesis 3.6. With respect to the probabilities calculated for the disjoint cross-sections,  $\mathbf{P}_4$  and  $\mathbf{P}_5$ , there is not a single case in the entire grid in which the probability of having the incentive alongside the technology did not fall. That is, based purely on the cross-sectional data, incentives are less aligned with adoption in the more recent round of the survey data than they were in the earlier round. In one case, the discrepancy grew by as much as 13 percentage

<sup>12</sup>Note that since the focal incentive, e.g. OWNERSHIP, CAREQUALITY, or PATIENTSAT, does not enter into its formula,  $\mathbf{P}_1$  will be constant across all three incentives examined within a single IT application. Similarly, notice that  $\mathbf{P}_2$  and  $\mathbf{P}_3$  always sum to unity (net of rounding error) for each IT application for each of the three incentives.

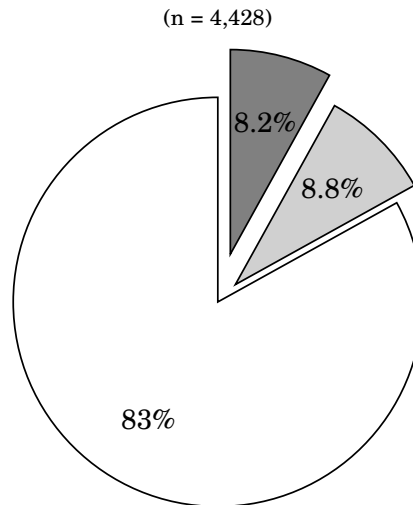
points. The panel data—those physicians surveyed twice—provide additional numbers in support of the growing discrepancy. First, note that the largest value taken on by  $\mathbf{P}_2$  is .56. That means that the highest rate of coincidence across all seven of the applications and all three of the incentives measured was 56 percent, which occurred for the variable ITREMIND when crossed with the ownership measure. Excluding two ties, i.e., when  $\mathbf{P}_2 = \mathbf{P}_3$ , these data suggest that the health IT applications were adopted alongside reinforcing incentives less than half of the time.

That we are essentially wasting our healthcare IT resources at least half of the time is reinforced by Figure 3-3. Figure 3-3a, the top panel, is derived from  $\mathbf{P}_1$ ,  $\mathbf{P}_2$ , and  $\mathbf{P}_3$  of the top row of Table 3.9. The largest slice of the pie represents those physicians who had not adopted e-prescribing as of the first survey round and had yet to adopt it by the second round—83 percent of physicians surveyed. The two shaded pie slices, together, represent those physicians that, indeed, adopted e-prescribing technology between 2001 and 2005—17 percent. However, notice that under half of the IT adopters also reported having an ownership stake in their practice—just 8.2 percent of the sample. The remainder of the inter-survey IT adopters had the technology without the incentive. Figure 3-3b, on the bottom, now draws from  $\mathbf{P}_4$  and  $\mathbf{P}_5$  of the top row of Table 3.9. First, notice that in both rounds, physician adoption of the IT itself is rather low. Even so, the shaded share of the right-hand pie is, in fact, larger than the shaded area of the 2001 pie, illustrating the increased uptake in physicians’ reported access to e-prescribing technology. However, notice that while the share of “incentivized” adopters rose over time—7.3 percent vs. 5.1 percent—most of the growth in IT adoption has not been accompanied by the provision of ownership incentives. Since Table 3.9 shows the “raw data” for these pie charts, it is clear that analogous figures developed for the other six EHR components and the other two physician incentives would yield similar results.

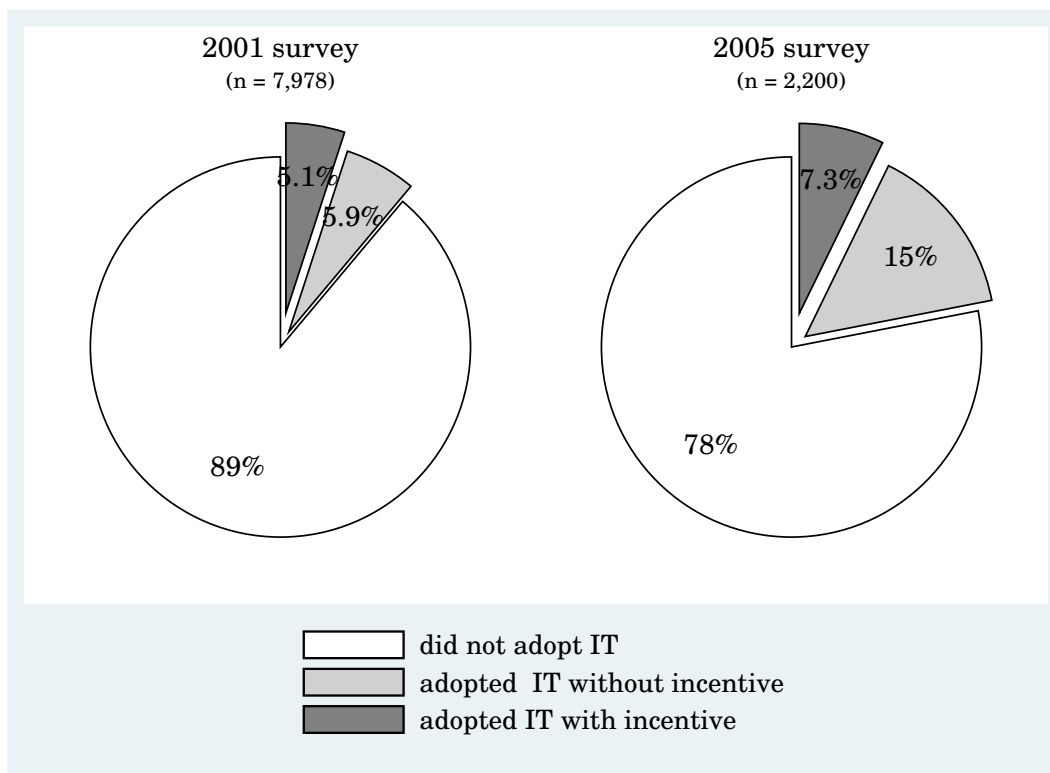


Figure 3-3: Physicians' Adoption of the E-Prescribing Component of an Electronic Health Record System, with and without Ownership Incentives

(a) Physicians Surveyed in Both 2001 and 2005



(b) Physicians Surveyed Only Once, by Survey Year



Source: Author's analysis of data from rounds 3 and 4 of the Community Tracking Study Physician Survey (Center for Studying Health System Change, 2003, 2006).

## Discussion & Conclusion

The statistical analysis, informed by the qualitative investigation of Kaiser Permanente, demonstrated that strategic and structural features of a physician's medical practice organization predict the extent to which he or she will be provided access to the health IT applications that constitute an EHR system. Those physicians delivering care in practices whose business strategy aligns with IT investment and whose breadth of services—primary care, speciality care, or both—complements IT were more likely than other physicians to report access to the technology. This explains why the extent to which the practice provides prepaid care has served as one particularly important competitive driver not only of health IT adoption, but of financial incentives that encourage physicians to make effective use of the technology. That is, prepaid care or “capitation” drove medical practices to adopt an entire work system, which includes IT, rather than to adopt IT *per se*. It is also shown that health IT applications are diffusing. Controlling for a number of strategic and structural factors such as the scope and size of a physician's medical practice, the probability of adoption rose substantially between the two survey rounds. That the probability of adoption increases despite these controls implies that something other than the capitation or competition—perhaps the increased ease with which practices can purchase EHR technology—has become an important influence on adoption. Unfortunately, whatever these forces that are urging diffusion of health IT applications, they are not urging the adoption of the physician incentives expected to reinforce the goals of the technology. That is, despite the diffusion of health IT, signs point to a growing and troubling discrepancy between the adoption of the technology and the adoption of the employment practices required for it to generate anticipated performance improvements.

When integrated with existing research, these findings send a clear reminder to policymakers that EHRs may be a means, but they are not an end. Simply putting the technology in the hands of those without an aligned business strategy or those without the work structures to complement it is unlikely to deliver desired results. Indeed, this oversight probably explains why some health IT, once in place, does not appear to improve health outcomes (e.g., Han et al., 2005; Linder et al., 2007). Practices that approach patient encounters independently of one another rather than maximizing the value of care delivered over the course of the entire care cycle cannot internalize the benefits of chronic disease management and prevention. Therefore, even if these practices were given IT, they would be unlikely to use it as produc-

tively as those organizations that would adopt it on their own and in concert with a set of reinforcing employment practices—an employment system that aligns with an observable business strategy.

So, how can policy promote the adoption of entire work systems? It can do so by focusing on the ultimate goal—increased efficiency of healthcare delivery in US, namely incentives for delivering high-quality care and for activities aimed at disease prevention. Policymakers must craft a set of institutions that force physicians and their medical practices to internalize the costs and the benefits associated with keeping patients healthy. For example, if medical practices are to reorient themselves towards aggressive disease prevention and the management of chronic diseases, they must be in a position to forego income in the event that patients require costly treatments. Based on this study's findings regarding capitation, only in this way will these organizations adopt the work systems required to meet organizational goals. EHRs will likely be part of these work systems, so the diffusion of health IT would be a byproduct of this approach. However, practices and their physicians can make their own decisions regarding which technologies, work structures, and employment practices align with their possibly unique business strategy.

Along the same lines, most practices and the physicians within them could benefit from improved coordination between the members of the provider team caring for a particular patient (Porter and Teisberg, 2006). The incentives for keeping patients healthy, suggested above, would go a long way towards encouraging intra-practice coordination, because practices incorporating a broad slice of the primary and specialty care needs of their patients can actually internalize the returns to improved coordination. However, physicians must coordinate better with those beyond their own organization's walls. Charging a patient's PCP with the responsibility to coordinate all of the care delivered to the patient is one way to internalize the benefits of coordination, much like the role increasingly played by hospitalists in the inpatient setting.

This study also advances the field of employment relations by applying findings and theory from strategic HRM to crystallize a phenomenon, to diagnose its causes, and to inform those seeking to address it. In this case, strategic HRM's notions of alignment and complementarity underpinned a set of propositions to explain why a technology expected to lift the performance of an ailing industry and to deliver economy-wide increases in social welfare has been relatively slow to diffuse. More important, received research counters policymakers' present inclination to encourage adoption of health IT applications. It does so on the grounds that the technology

will not achieve its intended goals when extracted from its reinforcing work system, and that organizations will only adopt all the necessary components of this work system when they adopt a business strategy served by the technology. That is, medical practices must internalize the costs and benefits of patients' ill health if they are to take all of the necessary steps to reorient themselves for a new focus on disease prevention and improved management of chronic diseases. This result increases the utility of HRM's earlier findings relating business strategies to employment practices, employment practices to one another, and each of these variables to measures like productivity (e.g., Ichniowski, Bartel, and Shaw, 2007; Ichniowski, Shaw, and Prenzushi, 1997; MacDuffie, 1995), quality (e.g., Cutcher-Gershenfeld, 1991), or profits (e.g., Huselid, 1995). In this case, theories of strategic alignment pointed to a particular subset of employers expected to internalize returns to IT investments, applying the conclusions of Arthur (1992) and others (e.g., Hunter et al., 2001; Youndt et al., 1996) to connect organizational strategy to choices regarding the organization of work.

This study did not test for theorized complementarities between new technologies and features of the employment relationship apparent in large- $n$  econometric analyses (e.g., Black and Lynch, 2001; Brynjolfsson and Hitt, 2000, 2003) and more-grounded studies (e.g., MacDuffie and Krafcik, 1992; Chapter 2 of this study) by showing that doctors employed by organizations whose incumbent work structures complement IT achieve better outcomes. Therefore, the most immediate next steps for this research revolve around the performance question. The findings from this study suggest that performance returns will be larger for early adopters than for later ones, but that even this variation should be largely accounted for by the incidence of complementary incentives for using the technology. Performance differences should also be explained by capitation or other indicators that the adoption of health IT served an economic or strategic purpose for the medical practice. With respect to the latter, it is this strategic impetus that signals a willingness to reform aspects of the physician employment relationship, including incentives, necessary to reinforce the logic of the new technology. These propositions can be addressed by taking advantage of the CTS Household Survey, an analog to the survey of physicians employed in this study. However, these data were not collected in a way that allows one-to-one matching between a household respondent and his or her specific doctor, and aggregating at a higher level of analysis may obscure important variation in IT adoption or performance and health measures. An alternative would be to collect primary data from one or more large practices. This allows for the matching of patients and providers over time. Candidate sites should be "mixed" practices that serve patients under both the fee-for-service and

capitated insurance models, with the goal of teasing out differences in the incidence of preventive medicine and disease management provided to these two different types of insured patients. It is difficult to imagine a design that does a better job of holding all contextual variables constant between the experimental and control cases.

Future studies might also delve deeper into variation in medical practice scale. From this study, size clearly matters with respect to the diffusion of EHRs, just as it has been shown to matter in a great many other studies in the diffusion of innovations (e.g., David, 1975). However, this study does not firmly establish why scale has such a strong influence on adoption, and it assuredly does not make a determination as to the direction or strength of scale's impact on medical practice performance. What the results here tell us for certain is that physicians employed by larger practices report greater IT access than those physicians working in smaller practices. It is tempting to explain this phenomenon with economic theory that points to the scale economies that supposedly inhere in information when the latter is construed as a production input (Arrow, 1974; Geroski, 2000; Wilson, 1975). With such an overwhelming preponderance of physicians based in small practices, these theories must be tested in the context of outpatient EHR technology. Only then can policymakers determine whether or not they should be promoting industry consolidation in order to increase the efficacy of health IT and to bring about long-awaited improvements in industry efficiency.

## References

- Accenture. 2005. "Electronic Health Records Survey: Achieving High Performance in Health Care."
- Ai, Chunrong and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit Models." *Economics Letters* 80(1):123–129.
- Aldrich, John H. and Forrest D. Nelson. 1984. *Linear Probability, Logit, and Probit Models*. Beverly Hills: Sage.
- Arrow, Kenneth J. 1974. *The Limits of Organization*. New York: Norton.
- Arthur, Jeffrey B. 1992. "The Link Between Business Strategy and Industrial Relations Systems in American Steel Minimills." *Industrial and Labor Relations Review* 45(3):488–506.
- Arthur, Jeffrey B. 1994. "Effects of Human Resource Systems on Manufacturing Performance and Turnover." *Academy of Management Journal* 37(3):670–687.

- Arthur, Jeffrey B. 1999. Explaining Variation in Human Resource Practices in US Steel Minimills. In *Employment Practices and Business Strategy*, ed. Peter Cappelli. New York: Oxford University pp. 11–41.
- Audet, Anne-Marie, Michelle M . Doty, Jordan Peugh, Jamil Shamasdin, Kinga Zapert and Stephen Schoenbaum. 2004. “Information Technologies: When Will They Make It into Physicians’ Black Bags?” *Medscape General Medicine* 6(4).
- Autor, David H., Frank Levy and Richard J. Murnane. 2002. “Upstairs, Downstairs: Computers and Skills on Two Floors of a Large Bank.” *Industrial and Labor Relations Review* 55(3):432–447.
- Bates, David W. 2005. “Physicians and Ambulatory Electronic Health Records.” *Health Affairs* 24(5):1180–1189.
- Batt, Rosemary L. 1999. “Work Organization, Technology, and Performance in Customer Service and Sales.” *Industrial and Labor Relations Review* 52(4):539–564.
- Becker, Brian E. and Mark A. Huselid. 1998. High Performance Work Systems and Firm Performance: A Synthesis of Research and Managerial Implications. In *Research in Personnel and Human Resources Management*, ed. Gerald Ferris. Vol. 16 Greenwich, CT: JAI pp. 53–101.
- Black, Sandra E. and Lisa M. Lynch. 2001. “How to Compete: The Impact of Workplace Practices and Information Technology on Productivity.” *Review of Economics and Statistics* 83(3):434–445.
- Bower, Anthony G. 2005. *The Diffusion and Value of Healthcare Information Technology*. Santa Monica: RAND.
- Brown, Charles, James Hamilton and James L. Medoff. 1990. *Employers Large and Small*. Cambridge, MA: Harvard University Press.
- Brynjolfsson, Erik and Haim Mendelson. 1993. “Information Systems and the Organization of Modern Enterprise.” *Journal of Organizational Computing* 3(3):245–255.
- Brynjolfsson, Erik and Lorin M. Hitt. 2000. “Beyond Computation: Information Technology, Organizational Transformation and Business Performance.” *Journal of Economic Perspectives* 14(4):23–48.
- Brynjolfsson, Erik and Lorin M. Hitt. 2003. “Computing Productivity: Firm-Level Evidence.” *Review of Economics and Statistics* 85(4):793–808.
- Burt, Catherine W. and Jane E. Sisk. 2005. “Which Physicians and Practices are Using Electronic Medical Records?” *Health Affairs* 24(5):1334–1343.
- Center for Studying Health System Change. 2003. *Community Tracking Study Physician Survey, 2000-2001*. Ann Arbor: Inter-university Consortium for Political and Social Research.

- Center for Studying Health System Change. 2006. *Community Tracking Study Physician Survey, 2004-2005*. Ann Arbor: Inter-university Consortium for Political and Social Research.
- Chaudhry, Basit, Jerome Wang, Shinyi Wu, Margaret Maglione, Walter Mojica, Elizabeth Roth, Sally C. Morton and Paul G. Shekelle. 2006. "Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care." *Annals of Internal Medicine* 144(10):742–752.
- Crosson, Francis J. and Philip Madvig. 2004. "Does Population Management of Chronic Disease Lead to Lower Costs of Care?" *Health Affairs* 23(6):76–78.
- Cutcher-Gershenfeld, Joel. 1991. "The Impact on Economic Performance of a Transformation in Workplace Relations." *Industrial and Labor Relations Review* 44(2):241–260.
- Cutler, David M., Mark McClellan and Joseph P. Newhouse. 2000. "How Does Managed Care Do It?" *RAND Journal of Economics* 31(3):526–548.
- David, Paul A. 1975. The Mechanization of Reaping in the Ante-Bellum Midwest. In *Technical Choice, Innovation, and Economic Growth: Essays on American and British Experience in the Nineteenth Century*, ed. Paul A. David. Cambridge: Cambridge University Press pp. 195–232.
- Delery, John E. and D. Harold Doty. 1996. "Modes of Theorizing in Strategic Human Resource Management: Tests of Universalistic, Contingency, and Configurational Performance Predictions." *Academy of Management Journal* 39(4):802–835.
- Devaraj, Sarv and Rajiv Kohli. 2003. "Performance Impacts of Information Technology: Is Actual Usage the Missing Link?" *Management Science* 49(3):273–289.
- Forman, Chris. 2005. "The Corporate Digital Divide: Determinants of Internet Adoption." *Management Science* 51(4):641–654.
- Garrido, Terhilda, Laura Jamieson, Yvonne Zhou, Andrew Wiesenthal and Louise Liang. 2005. "Effect of Electronic Health Records in Ambulatory Care: Retrospective, Serial, Cross Sectional Study." *British Medical Journal* 330(581).
- Geroski, Paul A. 2000. "Models of Technology Diffusion." *Research Policy* 29(4-5):603–625.
- Halvorson, George C. and George J. Isham. 2003. *Epidemic of Care: A Call for Safer, Better, and More Accountable Health Care*. San Francisco: Jossey-Bass.
- Han, Yong Y., Joseph A. Carcillo, Shekhar T. Venkataraman, Robert S.B. Clark, R. Scott Watson, Trung C. Nguyen, Hüyla Bayir and Richard A. Orr. 2005. "Unexpected Increased Mortality After Implementation of a Commercially Sold Physician Order Entry System." *Pediatrics* 116(6):1506–1512.

- Hayek, Friedrich A. 1945. "The Use of Knowledge in Society." *American Economic Review* 35(4):519–530.
- Hitt, Lorin M. 1999. "Information Technology and Firm Boundaries: Evidence from Panel Data." *Information Systems Research* 10(2):134–149.
- Hitt, Lorin M. and Erik Brynjolfsson. 1997. "Information Technology and Internal Firm Organization: An Exploratory Analysis." *Journal of Management Information Systems* 14(2):81–101.
- Hubbard, Thomas N. 2003. "Information, Decisions, and Productivity: On-Board Computers and Capacity Utilization in Trucking." *American Economic Review* 93(4):1328–1353.
- Hunter, Larry W., Annette Bernhardt, Katherine L. Hughes and Eva Skuratowicz. 2001. "It's Not Just the ATMs: Technology, Firm Strategies, Jobs, and Earnings in Retail Banking." *Industrial and Labor Relations Review* 54(2):402–422.
- Huselid, Mark A. 1995. "The Impact of Human Resource Practices on Turnover, Productivity, and Corporate Financial Performance." *Academy of Management Journal* 38(3):635–872.
- Ichniowski, Casey, Ann Bartel and Kathryn Shaw. 2007. "How Does Information Technology Really Affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement and Worker Skills." *Quarterly Journal of Economics* 122(4):1721–1758.
- Ichniowski, Casey, Kathryn Shaw and Giovanna Prennushi. 1997. "The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines." *American Economic Review* 87(3):291–313.
- Jaccard, James. 2001. *Interaction Effects in Logistic Regression*. Thousand Oaks, CA: Sage.
- Lee, Jason, Carol Cain, Scott Young, Nancy Chockley and Helen Burstin. 2005. "The Adoption Gap: Health Information Technology in Small Physician Practices." *Health Affairs* 24(5):1364–1366.
- Linder, Jeffrey A., Jun Ma, David W. Bates, Blackford Middleton and Randall S. Stafford. 2007. "Electronic Health Record Use and the Quality of Ambulatory Care in the United States." *Archives of Internal Medicine* 167(13):1400–1405.
- MacDuffie, John Paul. 1995. "Human-Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry." *Industrial and Labor Relations Review* 48(2):197–221.
- MacDuffie, John Paul and John F. Krafcik. 1992. Integrating Technology and Human Resources for High-Performance Manufacturing: Evidence from the International Auto Industry. In *Transforming Organizations*, ed. Thomas A. Kochan and Michael Useem. New York: Oxford University pp. 209–226.



- Malone, Thomas W., JoAnne Yates and Robert I. Benjamin. 1987. "Electronic Markets and Electronic Hierarchies." *Communications of the ACM* 30(6):484–497.
- Malone, Thomas W. and Kevin Crowston. 1994. "The Interdisciplinary Study of Coordination." *Communications of the ACM* 26(1):87–119.
- McGlynn, Elizabeth A., Steven M. Asch, John Adams, Joan Keesey, Jennifer Hicks, Alison DeCristofaro and Eve A. Kerr. 2003. "The Quality of Health Care Delivered to Adults in the United States." *New England Journal of Medicine* 348(26):2635–2645.
- Miller, Robert H., Christopher West, Tiffany Martin Brown, Ida Sim and Chris Ganchoff. 2005. "The Value of Electronic Health Records in Solo or Small Group Practices." *Health Affairs* 24(5):1127–1137.
- Porter, Michael E. and Elizabeth Olmsted Teisberg. 2006. *Redefining Health Care: Creating Value-Based Competition on Results*. Boston: Harvard Business School.
- Rogers, Everett M. 2003. *Diffusion of Innovations*. 5th ed. New York: Free Press.
- Schoen, Cathy, Robin Osborn, Phuong Trang Huynh, Michelle Doty, Jordon Peugh and Kinga Zapert. 2006. "On the Front Lines of Care: Primary Care Doctors' Office Systems, Experiences, and Views in Seven Countries." *Health Affairs* 25(6):w555–w571.
- von Nordenflycht, Andrew. 2007. "Is Public Ownership Bad for Professional Service Firms? Ad Agency Ownership, Performance, and Creativity." *Academy of Management Journal* 50(2):429–445.
- Wang, Samuel J., Blackford Middleton, Lisa A. Prosser, Christiana G. Bardon, Cynthia D. Spurr, Patricia J. Carchidi, Anne F. Kittler, Robert C. Goldszer, David G. Fairchild, Andrew J. Sussman, Gilad J. Kuperman and David W. Bates. 2003. "A Cost-Benefit Analysis of Electronic Medical Records in Primary Care." *American Journal of Medicine* 114(5):397–403.
- Wilson, Robert. 1975. "Informational Economies of Scale." *Bell Journal of Economics* 6(1):184–195.
- Wright, Patrick M. and Gary C. McMahan. 1992. "Theoretical Perspectives for Strategic Human Resource Management." *Journal of Management* 18(2):295–320.
- Wright, Patrick M. and Scott A. Snell. 1998. "Toward a Unifying Framework for Exploring Fit and Flexibility in Strategic Human Resource Management." *Academy of Management Review* 23(4):756–772.
- Youndt, Mark A., Scott A. Snell, James W. Jr. Dean and David P. Lepak. 1996. "Human Resource Management, Manufacturing Strategy, and Firm Performance." *Academy of Management Journal* 39(4):836–866.

Zhou, Yi Yvonne, Terhilda Garrido, Homer L. Chin, Andrew M. Wiesenthal and Louise L. Liang. 2007. "Patient Access to an Electronic Health Record with Secure Messaging: Impact on Primary Care Utilization." *American Journal of Managed Care* 13(7):418-424.

## Chapter 4

# Information Technology and the Employment Relationship: Conclusions and Next Steps

What does information technology (IT) have to do with the employment relationship? Or, why should actors in an economy driven by information and the IT used to process it care about employment relations? This dissertation sharpens our understanding of whether and when features of the employment relationship enhance the returns to IT investments. In particular, it shows that in the course of an IT initiative, engaging workers in training and soliciting their suggestions only boosts the technology's performance effects when workers also have access to a broader array of employee involvement (EI) structures and processes. The dissertation also demonstrates that characteristics of the employment relationship partially determine labor's access to workplace technologies. More specifically, the goals and strategies of employers shape organizational choices regarding not only technology *per se*, but the work systems within which technology is deployed.

Examining the IT applications composing electronic health record (EHR) systems illustrated the nature of the work system required to make optimal use of the technology. It then suggested that external pressures to diffuse the technology in the absence of these reinforcing work systems may lead to greater adoption, but quite doubtfully to improved organizational or sectoral performance. This chapter summarizes the major findings from the previous chapters. It also formulates some of the new questions that emerge in the course of the study as well as potential directions one might take to dispose of them.

# The Scope of Worker Involvement

## Key Findings

In Chapter 2, I found that variation in what Kochan, Katz, and McKersie (1986) might label workplace-level EI, which I refer to as “engagement,” indeed, interacts with IT in production function estimates, largely in line with the chapter’s hypotheses. Nonetheless, these findings advance existing theory on supposed complementarities between innovative employment practices and new technologies in the workplace. Previous research suggests that new workplace technologies, including IT, deliver greater performance improvements in conjunction with measures of engagement (e.g., Bresnahan, Brynjolfsson, and Hitt, 2000, 2002; Kelley, 1996). However, Kaiser Permanente’s experience with its EHR system identified a critical contingency anticipated by received theory in employment relations. At Kaiser, complementarity only obtained for one of two IT initiatives examined—the one in which EI opportunities transcended workplace-level structures such as peer training and suggestion boxes to include EI structures at the two, additional, higher levels of the employment relationship.<sup>1</sup> That is, engaging workers did complement the technology, but only when workers could bargain over the terms and conditions of employment and could shape the broader decisions regarding business strategy, work organization, and system configuration. Therefore, the potential for worker engagement to complement IT, in fact, depends on the presence of EI structures at the functional and strategic levels of the employment relationship.

## Questions for Further Research

Since this study’s propositions were developed in the context of a well-controlled, but constrained organizational setting, the next logical step is to generalize the emergent theory. One route towards generalization requires working outward from these findings with research designed expressly to allow continuous variation in involvement measures along all three levels of the employment relationship, but for a single IT application. On the other hand, one can start by revisiting existing, large-*n* studies and refashioning them to test for the presence of unobserved heterogeneity with respect to functional- and strategic-level EI variables. For example, findings from this dissertation might help to reconcile empirical inconsistencies in the management literature

---

<sup>1</sup>See Figure 2-1 on page 41 for the conceptual framework to which this refers.

on complementarity such as those that exist between Bresnahan, Brynjolfsson, and Hitt (2002) and Brynjolfsson, Hitt, and Yang (2002), on the one hand, and Caroli and van Reenan (2001), on the other. Along the same lines, better accounting for the scope of participation might help account for findings in employment relations showing the performance effects of innovative employment practices to be weak or inconsistent (e.g., Cappelli and Neumark, 2001).

Chapter 2's findings also raise questions about the role of job security in determining workers' responses to new technologies. Few would argue against the historical importance of job security in this context. However, the Kaiser case held this variable constant across the contrasting IT initiatives, paving the way for a broader conceptualization of whether or not workers perceive themselves as secure in the wake of each of the new EHR components. This construct—labeled “wholeness”—captures a wider range of technology's potentially adverse effects on work and workers. Interestingly, workers do report higher levels of wholeness with respect to the more-broadly inclusive EHR component even though they report similar measures of engagement. And, though the results are not as strong in the performance regressions as were the corresponding estimates for engagement, the complementary impact of wholeness was also predicated on EI structures spanning all levels of the employment relationship. At any rate, it may be that concerns regarding changes in workload or staffing, for example, now play a role as critical as that which historically had been played by concerns over job or employment security. Thus, employment security may be a necessary but insufficient condition for addressing workers' interest in technological change.

Finally, this dissertation very deliberately defines industrial or employment relations as the study of all aspects of the employment relationship, in accordance with Roberts (1994). One reason for doing this was to highlight the fact that this analysis does not apply solely to unionized workplaces and employment relationships. Nonetheless, the case itself does occur under the cover of collective bargaining, and the intentional use of the phrase “terms and conditions of employment” may further signal that nonunion workplaces need not be concerned with functional-level EI. Quite the opposite is true. In the union sector, it is relatively easy for managers and workers to install structures for processing the changes in compensation, benefits, hours, job responsibilities, or staffing levels arising from the strategic realignment of work structures around new technologies. In the nonunion context, now representative of the vast majority of employment relationships in the US, the onus most likely rests on an organization's human resource (HR) managers to develop alternative structures for collecting production- and workflow-related information from workers and ensuring

its reflection in updated terms and conditions. As if this were not already a challenge, in the US, he who solicits opinions regarding terms and conditions outside the confines of collective bargaining walks a labor law tight rope (Kaufman and Taras, 2000). In a very real sense, the generalizability of the findings in Chapter 2 hinges on whether or not the HR function succeeds in filling this gap created by declining union density. This is an empirical question, one at the center of a very lively conversation amongst scholars of work and employment (e.g., Bryson et al., 2007; Charlwood and Terry, 2007; Pyman et al., 2006).

## **Alignment of Strategy, IT, and Work Systems**

### **Key Findings**

Chapter 3 was motivated largely by the apparent link between the poor performance of the healthcare industry and its slow uptake of IT. In it, I find that characteristics of a physician's employment relationship determine the extent to which he or she has access to components of an EHR system. In particular, those physicians whose practices are paid on a capitated basis are more likely than others to report high levels of access to health IT. The same physicians are also more likely than others to have a portion of their compensation contingent on their medical practice's performance, either through conventional ownership or through incentives tied to objective measures of care quality or to patient satisfaction scores. These findings comport with employment relations theory emerging from the strategic human resource management (HRM) literature on alignment and complementarity (e.g., Arthur, 1992; Becker and Huselid, 1998) as well as with empirical results from studies of IT (Bresnahan, Brynjolfsson, and Hitt, 2002; Hitt and Brynjolfsson, 1997; Ichniowski, Bartel, and Shaw, 2007). In short, EHR systems facilitate a business strategy geared toward keeping patients healthy, either through improvements in preventive care or through the active management of chronic disease. This same strategy is also served by incentives motivating physicians to use the technology as best they can to meet the organization's objectives. Based on studies of complementarities, including Chapter 2 of this dissertation, it is likely that physicians embedded in work systems inclusive of both EHRs and the incentives to use them are achieving higher levels of performance than their counterparts. The analysis further reveals that this technology is, indeed, diffusing. However, there are signs of a growing discrepancy between the incidence of health IT and that of the other work system elements—in this case, physician incentives—indispensable to its

effective use.

## Questions for Further Research

Future research must “close the loop” with respect to EHRs and performance. In other words, we can see that capitation drives the adoption of EHRs and of physician incentives. However, at this stage, we can only theorize based on previous research that EHR systems boost performance more when they are coincident with a business strategy guided by the prepayment of insurance. Likewise, strategic HRM’s notion of alignment implies outcomes should be even larger when strategy, EHRs, and incentives are all crossed with one another. Aside from providing a much-needed test of one of strategic HRM’s core propositions, this would further inform our understanding of the phenomenon. For example, according to strategic HRM theory, those “later adopters” of health IT who forgo the parallel adoption of reinforcing incentives should achieve little or no performance return from the technology. However, those who adopt the entire work system, irrespective of when they adopt, should reap greater returns from the investment.

Even when diffusion appears to be well-described theoretically, reliance on just two data points—in this case, 2001 and 2005—prevents one from making an airtight empirical case. Therefore, an initial robustness check of these findings awaits the next round of Community Tracking Study (CTS) physicians data, already being collected. However, even these data will probably leave unaddressed another well-known limitation of available data on EHR systems (Singerman, 2005). In particular, the data employed in Chapter 3 cannot be used to assess the interoperability of each of the health IT applications examined with one another or with the applications used by other providers. For the time being, the causes and consequences of health IT interoperability—a critical issue given the industry’s present fragmentation—may be best addressed with qualitative case studies. However, the dissertation’s main implications are empirically testable with longitudinal data that matches patients to physicians and relies on healthcare process measures like the Health Plan Employer Data and Information Set (HEDIS) used in Chapter 2. Consider, for example, testing the performance effects of EHRs, mediated by both capitation and physician incentives. Ideally, data could come from a small number of large-scale medical practices each delivering care according to the fee-for-service model, the capitated model, and various points along the continuum between them. If doctors know to which health plan each of their patients subscribes, then exogenous variation in IT implementa-

tion dates and in physicians' incentives should generate predictable movements in physician-level outcomes. Within physicians, additional, patient-level variation along the indemnity/capitation continuum should also affect compliance rates in ways predicted by the theory proposed in Chapter 3.

Admittedly, accessing such detailed data in any industry, let alone this one, could prove especially challenging. On the bright side, a recent announcement by the presidential administration of George W. Bush that some physicians will receive higher Medicare reimbursement fees if they adopt EHRs may offer the right "natural experiment." Under the program, physicians in certain regions of the country will be incentivized, in some cases, merely to prove they have adopted the technology. Eventually, physicians will be able to achieve even higher reimbursement rates by demonstrating improvements in care quality (Department of Health and Human Services, 2008). It remains to be seen whether or not this sign of commitment from the public sector brings with it the access and transparency necessary to evaluate the program rigorously and objectively. Nonetheless, in the context of this particular phenomenon—the delayed digitization of the healthcare industry—both are required if the field of employment relations is to stay true to its distinctive, problem-solving legacy as it works to test and advance the theories offered in this dissertation.

## References

- Arthur, Jeffrey B. 1992. "The Link Between Business Strategy and Industrial Relations Systems in American Steel Minimills." *Industrial and Labor Relations Review* 45(3):488–506.
- Becker, Brian E. and Mark A. Huselid. 1998. High Performance Work Systems and Firm Performance: A Synthesis of Research and Managerial Implications. In *Research in Personnel and Human Resources Management*, ed. Gerald Ferris. Vol. 16 Greenwich, CT: JAI pp. 53–101.
- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2000. Technology, Organization, and the Demand for Skilled Labor. In *The New Relationship: Human Capital in the American Corporation*, ed. Margaret M. Blair and Thomas A. Kochan. Washington, DC: Brookings pp. 145–184.
- Bresnahan, Timothy F., Erik Brynjolfsson and Lorin M. Hitt. 2002. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm Level Evidence." *Quarterly Journal of Economics* 117(1):339–376.



- Brynjolfsson, Erik, Lorin M. Hitt and Shinkyu Yang. 2002. "Intangible Assets: Computers and Organizational Capital." *Brookings Papers on Economic Activity* 2002(1):137–181.
- Bryson, Alex, Rafael Gomez, Tobias Kretschmer and Paul Willman. 2007. "The Diffusion of Workplace Voice and High-Commitment Human Resource Management Practices in Britain, 1984-1998." *Industrial and Corporate Change* 16(3):395–426.
- Cappelli, Peter and David Neumark. 2001. "Do 'High-Performance' Work Practices Improve Establishment-Level Outcomes?" *Industrial and Labor Relations Review* 54(4):737–775.
- Caroli, Eve and John van Reenan. 2001. "Skill-Biased Organizational Change? Evidence from a Panel of British and French Establishments." *Quarterly Journal of Economics* 116(4):1449–1492.
- Charlwood, Andy and Mike Terry. 2007. "21<sup>st</sup>-Century Models of Employee Representation: Structures, Processes and Outcomes." *Industrial Relations Journal* 38(4):320–337.
- Department of Health and Human Services. 2008. "HHS Secretary Announces 12 Communities Selected to Advance Use of Electronic Health Records in First Ever National Demonstration." US Department of Health and Human Services. News release, June 10.
- Hitt, Lorin M. and Erik Brynjolfsson. 1997. "Information Technology and Internal Firm Organization: An Exploratory Analysis." *Journal of Management Information Systems* 14(2):81–101.
- Ichniowski, Casey, Ann Bartel and Kathryn Shaw. 2007. "How Does Information Technology Really Affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement and Worker Skills." *Quarterly Journal of Economics* 122(4):1721–1758.
- Kaufman, Bruce E. and Daphne Gottlieb Taras. 2000. Nonunion Employee Representation: Findings and Conclusions. In *Nonunion Employee Representation: History, Contemporary Practice, and Policy*, ed. Bruce E. Kaufman and Daphne Gottlieb Taras. Armonk, NY: M.E. Sharpe pp. 527–557.
- Kelley, Maryellen R. 1996. "Participative Bureaucracy and Productivity in the Machined Products Sector." *Industrial Relations* 35(3):374–399.
- Kochan, Thomas A., Harry C. Katz and Robert B. McKersie. 1986. *The Transformation of American Industrial Relations*. New York: Basic Books.
- Pyman, Amanda, Brian Cooper, Julian Teicher and Peter Holland. 2006. "A Comparison of the Effectiveness of Employee Voice Arrangements in Australia." *Industrial Relations Journal* 37(5):543–559.

Roberts, Harold S. 1994. *Roberts' Dictionary of Industrial Relations*. 4<sup>th</sup> ed. Washington, DC: Bureau of National Affairs.

Singerman, Richard. 2005. Office of the National Coordinator for Health Information Technology, United States Department of Health and Human Services. Personal interview, November 17.