

## Measuring the Impact of Electronic Data Management on Information Worker Productivity

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### Introduction and Overview

In this project, we studied the effects of digitizing work on information workers' time-use and performance at a large insurance firm. We were able to determine of direction of causality between technology and performance by exploiting a quasi-experiment: the phased introduction of Electronic Document Management (EDM) across multiple offices at different dates. Our analysis used a "difference-in-differences" methodology to econometrically measure changes in a suite of performance metrics. This allowed us to derive unbiased estimates of the main effects. In addition, the study used three complementary research techniques to support the econometric findings: extensive onsite interviews before, during and after implementation; detailed time use diaries and observation; and a series of surveys. In addition to large changes in time-use and performance, we found that digitization leads to a decline in the routine labor input and an increase in complementary non-routine cognitive labor input. To interpret our results, we describe below a new micro-level mechanism, "IT-enabled slack", that explains how exactly IT can lead to payoff in terms of information worker productivity.

### Background

EDM implementation is one of the most visible manifestations of the ongoing move from analog

to digital organizations, as paper documents and manual routing are replaced by digital documents that are managed electronically. Its salience derives from two facts: valuable information in organizations is stored in the form of documents such as reports, forms, memos, letters etc. and business processes are often driven by document flows (Sprague 1995). Despite its salience, EDM has not received much attention from IS researchers. To the best of our knowledge, no systematic empirical study exists that assesses the business value of EDM. This particular research attempts to fill that void by empirically assessing the impact of EDM using four complementary data sources: 1) extensive on-site observation and interviews, 2) detailed time use records, 3) office-wide surveys, and 4) accounting data on multiple intermediate and final performance metrics.

We are able to address following questions:

- What are the net time savings, if any, that are attributable to EDM?
- What is the task level impact of EDM?
- How does that task-level impact translate to performance gains?

...and more generally:

- What is the impact of digitizing work on tasks at the information worker level?
- How does the task-level impact of IT translate to productivity gains?
- What are the micro-mechanisms that lead to IT payoff?

In an effort to improve our understanding of the true impact of IT, we gather detailed primary data from eight offices in the large insurance company that rolled out the enterprise technology during the course of the study.

Because we measure the key variables over time, we can assess the lagged effects of the new technology.

### **Research Methodology and Data Collection**

Since we were interested in the impact of EDM on information work, we focused our energies in our data collection and analysis efforts on the main information workers in the Workers Compensation division of the insurance company (whose name is withheld for confidentiality purposes). These information workers are called case adjusters or case managers and they handle insurance claims related to injuries suffered by employees on the job. The case managers refer to the injured employee as the claimant and the company in which the injured employee (IE) works and which has a service contract with the insurance company as the customer.

We conducted 17 interviews pre-EDM and 20 interviews post-EDM at various organizational levels (Operations Manager, Claims Manager, Team Manager, Case Manager, Nurses) in the office. During the interviews, we focused on obtaining qualitative insights about the impact of EDM. Specifically, we wanted to know how case managers perceived personal and company benefits/costs of EDM, behavioral effects of EDM and EDM-related process changes, and how any time anticipated to be saved by EDM was re-allocated.

We also conducted office-wide self-reported time use studies at three different time points (one pre-EDM and two post-EDM) to give us a longitudinal sample of self-captured activity profiles of case managers. With assistance from an internal team at the firm, we prepared a complete list of activities (or tasks) that would be performed by the case managers throughout the day. We invited a few managers and case managers to verify that the activity list was reasonably exhaustive. Case managers were asked to record every 10 minutes three pieces of information for each observation: approximate time of observation, category code (9 general

category codes capture main categories of activities), and activity code (each category contains several specific activities).

We further performed direct observations for a smaller group of 4 case managers, all residing in a physical 'pod' configuration and all handling a single customer's account at the office. All four case managers in this time use study were observed personally by one of the researchers. Overall, the self-reported as well as the direct observations time use studies helped us to assess the impact of EDM on the time allocated by employees to various activities at work and to evaluate the efficiency gains in terms of net time savings attributable to EDM.

We also administered to case managers two structured questionnaires (one pre-EDM survey and the other post-EDM survey) consisting of five sections, each containing several questions. The first four sections contained questions for which quantitative data or choice answers were requested. The last section contained open-ended questions written to gather qualitative data. The survey instrument helped us to assess quantitatively and qualitatively the perceived impact of EDM.

We collected cross-sectional monthly data for the performance metrics for eight offices of the insurance company for a 24-month time period. We looked at the following performance metrics:

- **Current Year Closure Rate:** Measures the percentage of claims closed that were opened in the current calendar year (CY)
- **Previous Year Closure Rate:** Measures the percentage of claims closed that were opened in years prior to the current CY
- **Year to date (YTD) Average Physical Therapy Paid Amount Per Claim:** Measures the amount spent per claim on physical therapy costs
- **YTD Average Chiropractor Paid Amount Per Claim:** Measures the amount spent per claim on chiropractor care costs

- Retention Rate: Measures the case manager retention rate
- YTD Loss Leakage: Measures the total loss payout on the claims. Losses are defined as additional expenses that should not have been incurred on claims if best practices associated with medical management and disability management processes had been properly followed by the case managers

### Discussion and Conclusions

Through pre- and post-EDM interviews, time use studies, surveys and importantly analysis of office-level objective performance data, we have qualitatively and quantitatively documented the causal impact of EDM. Through this type of “insider econometrics” empirical study (Bartel et al, 2004), in which we focused on the operations of a single firm, we assessed the impact of EDM at the process and office level. Insider insights obtained through direct contact with the managers and information workers were key in this type of study, as they reduced concerns about endogeneity bias and omitted-variable bias in the results (Bartel et al, 2004). Since we focus on a single firm, the results about digitization of work, while applicable to the firm studied may not generalize to other settings without further research; fortunately, we believe that the approach that we employ may be widely applicable in future research or practice.

We demonstrated how EDM changed task composition at the individual level. EDM led to a significant decline in the substitutable routine labor input and an increase in non-routine cognitive labor input at the information worker level. Prior to EDM, the information workers in our setting would need to supply a significant amount of routine labor input for their work: they would need to type verbatim large sections of documents such as medical reports that were available only in paper form. Post-EDM, the paper documents were all scanned and made available in the electronic form. This obviated the need for the information workers to

manually transcribe the paper documents. Thus, EDM directly impacted the supply of routine labor input, which was substituted away by the technology.

In reducing the time to complete various routine tasks, EDM made time available to do other value-adding tasks that involved interaction and higher-order cognitive and analytic skills. With the deployment of IT, some “slack” developed, which allowed the information workers to complete more value-adding tasks. This “IT-enabled slack” led to productivity enhancements in two distinct ways: first, as described above, the slack allowed information workers to spend more time on value-adding communication activities, which directly led to productivity and performance improvements. Secondly, “IT-enabled slack” allowed for more personal time relaxing and resting at work or at home (less overtime).

EDM also brought about an outward shift in the supply of routine informational inputs which complemented the non-routine cognitive labor input (such as interactions and communications) in the sense that they increased the productivity of workers performing nonroutine tasks that demanded those inputs. Pre-EDM information workers would transcribe only certain sections of the paper documents that they deemed salient for their work purposes i.e. information in the paper documents was not completely captured. There was simply not enough time in the day to transcribe complete copies of the documents. Further, pieces of information deemed to be important by one worker may not be captured by another worker, who interpreted them to be less important. The incomplete information entered into the system was thus of a lower quality.

Post-EDM, complete copies of the documents were available in electronic form. In other words, post-EDM, both the quantity and quality of routine informational inputs significantly increased. This improvement in both the quantity and quality of the routine informational

inputs increased the productivity and performance of workers performing non-routine tasks that demanded those inputs. We demonstrated the impact of shift in task composition of the workers on productivity and performance metrics at the office level. Specifically, we found that introduction of EDM is associated with the following effects on the performance metrics:

- 1) improvement in ability to meet or beat current year closure rate monthly goals
- 2) increase in the current year closure rate and decrease in the previous clear closure rate
- 3) decrease in the YTD avg. amount paid for physical therapy on a per-claim basis
- 4) decrease in the YTD avg. amount paid for chiropractor care on a per-claim basis
- 5) increase in the case managers retention rate
- 6) decrease in YTD loss leakage (i.e. losses associated with leakage or overpayments when best practices associated with medical management and disability management processes are not followed)

There are several insights from this research. First, we document the significant performance impact of a specific IT application, electronic document management, not yet examined sufficiently empirically in the economics of information systems literature despite its salience in the context of information management.

Second, we demonstrate using a detailed empirical study how digitization of work changes task composition at the individual information worker level. We also show, at the information worker level, that digitization of work leads to a decline in the substitutable routine labor input and an increase in non-routine cognitive labor input, and that this non-routine cognitive labor input is an economic complement to digitization of work. In doing so, we extend prior work by Autor, Levy and Murnane (2003), who demonstrate similar effects of computerization at the industry level, occupation level and education group level.

Third, we unpack the black box of IT impacting performance and uncover a new micro-level mechanism as to how exactly IT can lead to significant payoff, especially in terms of information worker productivity. We show how with the deployment of IT, some slack may develop; this IT-enabled slack allows information workers to complete more value-adding tasks such as communication activities.

Fourth, we contribute methodologically to the process perspective in the IS literature by using time use studies and differences-in-differences econometric analyses to assess the impact of EDM at the activity and process level. Given the spectacular variety of IT applications and the great need to document the precise causal impact of IT at a micro-level, there is a pressing need for application-specific, differences-in-differences quasi-experimental empirical studies. Our research study addresses that need by assessing the impact of EDM using a quasi-experiment.

Fifth, given the diversity of IT applications and the lack of application-specific studies that use primary longitudinal data to look at the lagged effect of IT, we contribute to the IT impact literature by collecting panel data and analyzing the lagged effects of EDM technology on various performance metrics.

## References

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