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Marrying Work and the Technical Artifact Within the Healthcare Organization: A Narrative Network Perspective on IT Innovation-Mediated Organizational Change

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MARRYING WORK AND THE TECHNICAL ARTIFACT WITHIN THE HEALTHCARE ORGANIZATION: A NARRATIVE NETWORK PERSPECTIVE ON IT INNOVATION-MEDIATED ORGANIZATIONAL CHANGE

Marier travail et artefact technique dans les organisations de soins : une perspective narrative de réseau sur le changement organisationnel médiaté par une innovation TIC

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Abstract

Despite the implicit belief that IT innovations brings beneficial change, medical practitioners and healthcare professionals constantly struggle to realize the innovation potential of electronic medical records (EMR) system in revolutionizing clinical practices. To understand this conundrum, this paper uses an in-depth case study of an EMR implementation to develop a grounded theory of why, when, and how IT-innovation mediated change occur. We propose the Narrative Network Perspective that combines the analysis of the processes of configuration, implementation and use of the system. This combined view allows researchers to understand how "production narrative network", infrastructure and the macrostructure in healthcare environment co-evolve with the idealized production narrative network inscribed in the EMR system within and across the three phases. By tracing and taking into account all these elements time, this perspective provides plausible answers to when and why organizational innovation occur with the introduction of IT innovations. (147)

Keywords: Change theory, Health informatics/health information systems/medical IS, Organizational change, Social informatics

Résumé

Afin de comprendre comment les innovations issues des TIC sont porteuses de changement dans le milieu hospitalier, nous avons mené une étude en cas approfondie d'un système électronique d'enregistrement médical. Nous proposons une perspective narrative de réseau afin d'expliquer quand et comment ce changement survient. Cette perspective combine l'analyse du processus de configuration avec l'usage réel du système. Elle étudie également, comment le « réseau narratif de production », l'infrastructure et la macrostructure influencent conjointement le processus.

Introduction

Organizational change has been often been linked to innovations in the technologies utilized by these organizations (Barley 1986). Having eschewed strong technological-deterministic perspective IS and organizational researchers have in general adopted more balanced view that IT innovations are often indeterminate. Research findings have shown that the same technology can result in different structures when embedded in different contexts (Barley 1986; Orlikowski 1992; Orlikowski 1996). While these studies provided us with strong conceptual foundation (viz. Structuration Theory) to describe and understand how IT innovations can impact organizations, they fail to fully account for why change happen. Some scholars proposed that one reason for this weakness of the Structuration approach is that it privileges human agency over other contextual factors and has allowed the role of the artifact to fade to the structural background (Boudreau and Robey 2005; Kallinikos 2004; Volkoff et al. 2007).

The ability to provide an in-depth account of how technology is related to change is especially important in the context of medical informatics. Like the overall business community there has been a similar belief that the injection of appropriate IT can help to make clinical care and research work more efficient (Dick and Steen 1991). Moreover the Institute of Medicine has over the years pushed for the increased use of information technologies to improve the quality of medical care and patient safety (Institute of Medicine 2001). However, parallel to the general skepticism in the business community, the medical community has been also slow to warm to the use of technology in medical work (Blumenthal et al. 2006). One reason for hampering the push for adoption is the problems that have hit high profile projects (for example Kaiser's project (Costello 2007) and Santa Barbara's Regional Health Information Organization's closure). Another reason is the frustrations medical practices have with using these new IT innovations. Recent articles in the medical/health domain reported that about 20 to 33% of electronic medical records (EMR) systems fail within a year of implementation (Chin 2006; Conn 2007). Hence, despite the implicit belief that technological innovations brings beneficial change, practitioners in the business and medical fields constantly struggle with a whole host of factors to bring about the reality of that belief.

Broadly, this paper studies how medical IT innovations (specifically, the EMR system) relate to organizational innovation and why medical IT innovations systems is linked to those changes – both intended and unintended. In particular, this paper uses an in-depth case study of an EMR implementation to develop a grounded theory of why, when, and how IT innovation mediated change occurs. To develop our grounded theoretical framework – the Narrative Network Perspective – we drew on the notions from the "web of computing" model (Kling and Scaachi 1982), "narrative networks" (Pentland and Feldman 2007) as well as other recent research in technology-mediated organizational change (Leonardi 2007; Volkoff et al. 2007). The Narrative Network Perspective proposes that the analysis of change have to combine the analysis of the process of configuration of the IT innovation and the process of use of the system (Leonardi 2005; Orlikowski and Robey 1991). It assumes that the design/configuration process is problematic and political and the negotiations have material impact on the inscribed designs and functionalities. During this phase, the interests of each group as well as the "infrastructure" and "macrostructure" determine these inscribed details. This creates a particular ideal "production narrative network". The implementation phase considers how the actual network of work as defined by the "production narrative network", "infrastructure" and "macrostructure" interact with the ideal production narrative network as inscribed on the artifact. The Narrative Network Perspective proposes the tensions created by gaps between the actual "network of work" and the "ideal network of work" inscribed in the artifact as well as the pressures exerted by existing and new infrastructure and macrostructure are partially resolved during the use phase through fitting.

This paper is organized as follows: The next section discusses the qualitative approach and methods used in this study, which are in line with the logic of inductive studies. We then explicate the Narrative Network Perspective of Innovation Mediated Change based on in-depth case study of the implementation of the EMR system. Finally, we discuss the implications of our perspective for refining current perspectives on technological and organizational innovation.

Methods and Data

Research Approach & Context

As the goal of this research is to generate a grounded framework of IT innovation mediated organizational change we conducted an in-depth, longitudinal case study of an EMR system implementation (Walsham 1995) and employed methods of grounded theory (Glaser and Strauss 1967). While grounded theory typically requires multiple cases so that researchers can implement the constant comparison method (Suddaby 2006), conditions surrounding the phenomenon of technology-mediated change require that we focus on one case over a period of time. Specifically, an EMR system like other package software systems (e.g. ERP system) involves a complex and lengthy process of implementation (Volkoff et al. 2007). Furthermore, the IT innovation mediated change that may occur typically emerges after a certain period of time after its implementation (Markus et al. 2000). We chose the EMR system as the research context because medical practitioners realize that they need to have a better grasp of managing the change that occurs with the introduction of the EMR (Baron et al. 2005; Marlin et al. 2006). There is a similar realization within the IS community to better understand the change issues surrounding the EMR implementation and the medical context (Chiasson and Davidson 2005; Wilson 2004).

Our case study involved the implementation of the EMR system in a family practice clinic that belonged to private hospital system in US – MATH. MATH is a private, not-for-profit multi-hospital system with academic, community and specialty service missions around a Mid-Atlantic state in the United States. It owns and manages seven hospitals and health systems that together account for 1,800 beds. In 2006, as part of MATH's vision to be an integrated enterprise and fine-tune the way it handles its patient medical records across the various clinics and hospitals, decided to implement an EMR system to provide "seamless access to clinical information". Given the scale and scope of the project, the senior management and the project team had decided to adopt a phased strategy. The first pilot site selected was a MATH-owned health center located outside the main hospital campus. Our case study focuses on the implementation of the EMR system – the Ambulatory in this first pilot site – Alpha.

Alpha is a family practice clinic with six clinical providers, four medical assistants, and nine administrative support staff managed by one practice manager. Alpha is overseen by a medical director and network director – they are both part of MATH's Ambulatory Services department. Alpha was setup in 1994 as part of an initiative to provide care to their hospital patients in their own community. As such Alpha is located in the suburbs where most of the hospital patients reside. This meant that patients could receive care for common ailments and chronic conditions without having to make the trip to MATH hospitals. Alpha provides the usual services of a family clinic including adult well/sick care, children well/sick care, immunizations, minor office procedures, health education and preventive care, as well as obstetrical/gynecological care, mental health services, referrals and cancer screenings. It serves 13,000 patients and handle around 23,000 visits a year. In addition to its medical services, they have onsite laboratories run by an external vendor as well as social and psychological services. Although Alpha does not have computerized medical records, its front-end registration and scheduling operations are based on current MATH's computer systems. The clinical office has several computers that allow the clinical providers and medical assistants to access the Internet to check up immunization records as well as access the registration and scheduling system.

Our involvement with the project began in July 2007, which coincided with the start of the configuration and setup phase of the EMR implementation for the Alpha site. We began data collection and observations at both the Alpha site and the EMR project site. This choice was important since we were interested in how decisions made during the configuration phase impacted the use of the system. Our fieldwork for the case study ended in April 2008 and lasted a total of 10 months.

Data Collection and Analysis

As in most in-depth case study, we used multiple data collection methods – viz. archival data, interviews and observations. The motivation and rationale for collecting data from multiple method is succinctly discussed by Pettigrew (1990) where he explained that archival data provides us with facts but are subjected to "selective deposit and survival", interviews provide rich, subtle and personal feeling but may be biased by personal emotions, observations provide direct access to individual and group activities and processes and allow the researcher to confront discrepancies between what people say and what people actually do. Together these three methods allow us to cross check the data as well as draw on each method's particular strengths to answer our research questions.

Archival Data: As part of the negotiation for access to the site, we were given permission to access the MATH's intranet as well as the project team's website where pertinent project documents were stored. These documents included project-proposal reports, system requirements, user manuals, internal and external meeting minutes and presentations, project reports, policy minutes, system documentation, requests for change, bug and issue reports, job and process descriptions and promotional documents. The archival data assisted us to establish the background and the motivations for the project, identify the key participants involved in the implementation process and the project, and understand the sequence of events and history of the project. It also shed some light on the policies, functionalities, work-flows, and job descriptions that will be implemented with the system. As the Alpha site was rolled-out, we accessed the project team's online database to capture documented roll-out issues and bugs and their resolutions, where applicable. In total, we accessed 185 documents that pertained to the Alpha site rollout.

Table 1. Interviewee Profile

Level and Group	No. of interviewees	No. of times interviewed
MATH management (CIO, Ambulatory Service Vice President, Ambulatory Service Medical Director, Alpha Network Director)	4	1 person x 3 2 person x 2 1 person x 1 (N = 8)
Project team management (Project Director, Team leaders)	5	1 person x 3 3 person x 2 1 person x 1 (N = 10)
Project team members (EMR system analysts)	10	2 person x 2 8 person x 1 (N = 12)
Alpha site management (medical director, lead physician and practice manager)	3	3 person x 3 (N = 9)
Alpha site staff (medical assistants, medical records personnel, front-desk registrars and schedistrars)	12	4 person x 3 1 person x 2 6 person x 1 (N = 18)* 2 combined interviews
Total **mgmt = management*	34 - 12 mgmt* - 22 non-mgmt	57 - 27 mgmt - 30 non-mgmt

Interviews: We conducted both informal and semi-structured interviews with key participants at both sites. The informal interviews are spontaneous discussions between the participants and us that occurred during the routine observation of the process of system implementation at the project office and the Alpha site. These notes were recorded as part of a field note memo that we kept during the fieldwork. We also conducted a total of 57 semi-structured interviews – each lasting from 20 to 45 minutes – with 34 project participants and Alpha site staff (See Table 1). All semi-structured interviews were transcribed during the interview session or after the session from tape. The list of key participants was developed by gleaning internal meeting minutes, the formal project structures (e.g. to interview members from different hierarchical levels and project sub-teams) and from our observation at the research site. Our initial interviews with the project team and the management at MATH were aimed at understanding the background and vision of the project and to describe what they perceived were key issues in the configuration of the system. Alpha staff initial interviews focused on understanding their work and how they perceived the impact of the system will be on their work. We also asked Alpha's management what were issues at the Alpha site and how they perceived the EMR's impact on their organization. Immediately after the go-live of the Alpha site, we conducted another round of interviews of the project team, the management at MATH and the Alpha management and staff. This round of interviews was focused on the issues that occurred after the system go-live and, specifically for the Alpha staff, what aspects of their work have changed and how they were coping with it. We conducted a final round of interviews with the management at MATH and the Alpha site management and staff six months after the system had been installed. The goal here was to understand how those issues they faced immediately after go-live had evolved and what new changes have occurred. Given the dynamic nature of the project, the set of questions for each round of interviews were amended and supplemented.

Observations: While archival data and interviews enable one to develop a sense of the project, the dynamic interactions among project participants as well as the rich story behind the dry bones that are recorded in official minutes are often lost. To get the dynamics of the situation, we sat in and observed project meetings at the project site as well as the Alpha site's operational meetings. As different issues and decisions were made at various levels, we attended, where possible, meetings that were at the Project sub-team level (e.g. Charting Tool Meeting), the Project level (e.g. Fortnightly Project Meeting or Project Leadership Meeting), the Advisory Committee level (e.g. Physician Advisory Group Meeting), and at the Steering Committee level. These meetings were important as they "provide insights into areas where problems in the project surface and recur; those that are malleable, those that are not; ... gaps and dilemmas at varying organizational levels" (Gregory 2000). All meeting observations and conversations were transcribed during the meetings and they usually last from 1 to 2 hours. At the end of the fieldwork, we attended altogether 57 meetings and spent 60 days of observations at the project site. Because we were interested on how the system affected the organization, we also carefully observed how work was conducted in the Alpha site before and after the system implementation. We conducted 48 days of observations at the Alpha site: 24 days before and 24 days after the EMR system go-live. Field memos were written up at the end of each observation day. Our field memos captured the tasks that each role undertook in the clinic as well as the interactions among the staff. We also took note of exception events as we became accustomed to what constituted as routine work. As the clinic was separated into various work domains (e.g. front-desk, clinical areas, medical records room), we divided up the observations into each of these work domains. Each observation work-day lasted between 4-8 hours as dictated by the conditions at the site.

Data Analysis

Given the significant set of data that was collected from the field-work, we decided to focus our coding analysis on the interviews and meeting minutes while using the archival data and observation field-notes to verify and triangulate the issues and concepts that we were finding from the coding. Both researchers coded the interviews and met to discuss concerning the categories found and verify that against the archival and observation data. We used the Nvivo software package to organize and code the data. As recommended by grounded theory, we followed the sequence of open, axial and selective coding (Glaser et al. 1967) but remained open to the need for alternative analysis as required for a better understanding of the phenomenon (Suddaby 2006). Our first phase of analysis looked at the substantive issues that were found in the interviews and the meeting minutes e.g. what system functions were discussed. We were initially interested in how the system afforded organizational innovations. We were also mindful to group the coded concept into the configuration phase and the use phase as this was an a priori theoretical frame that we had adopted. The next phase of axial coding attempts to collapse the large group of concepts into broad categories – i.e. conditions, actions/interactions, consequences of the new system functions (Glaser 1978; Strauss and Corbin 1998) as well as attitudes towards the EMR system. At this point, we found that the category of conditions revolved mainly around the work and routines that the Alpha staff was carrying out and shifted our focus from system affordance to work routines. We began integrating the literature on technology (e.g. Kling and Scacchi 1982), organizational change (Volkoff et al. 2007) and routine to help provide insights into this particular aspect of our data. From the literature search, we came across Pentland and Feldman's (2007) "narrative network" and began exploring that as an analytical tool to surface this aspect of our coded data. This move is in-line with Miles and Huberman (1994) recommendation for creating data displays to complement and enrich the theoretical model generated from the coding analysis. In parallel with the creation of narrative networks of the key conditions, we also shifted to selective coding that was guided by the key themes that we saw emerging from the data as well as by the extant literature we found corresponded to emerging themes and data. We discuss the theoretical model that emerged from our analysis followed by the findings from our observations and interviews that substantiated our perspective.

Narrative Network Perspective of IT Innovation Mediated Change

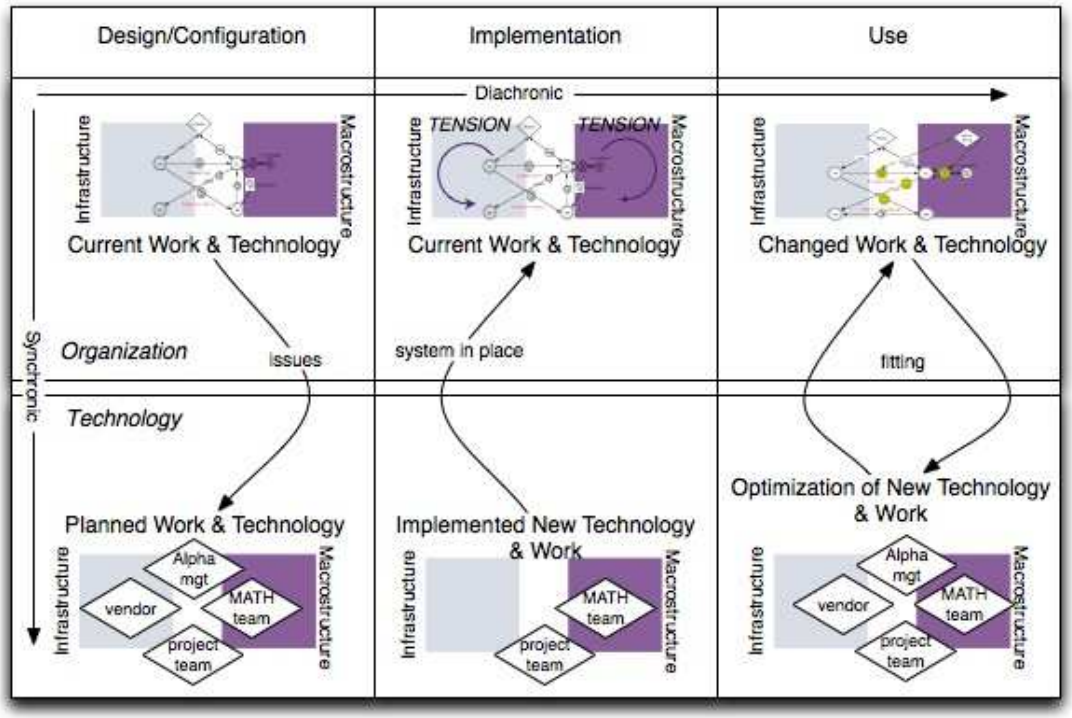

Figure 1. Narrative Network Perspective of IT Innovation Mediated Change

Figure 1 above reflects the framework that evolved from the grounded theory analysis described previously. The findings are organized around one of the core aspects of work within Alpha – the front-desk operations[1]. We present the key issues that surrounded the configuration, implementation and use of the EMR system for Alpha's front-desk operation as well as the "narrative network" (Pentland et al. 2007) view of the operation as described in each stage. Specifically, the issues are described with the concepts derived from Kling and Scacchi's (1982) "web of computing model". Briefly, Kling and Scacchi's "web of computing model" attempts to understand the development, impact and use of IT as part of "a larger social and technical mosaic" (pg. 4). They propose that the social and technical mosaic is built on four structural/conceptual elements: lines of work, production lattice, macrostructures and infrastructure. At the core of the "web model" is the line of work or what people actually do in a job (pg. 17) and the production lattice that emerge as the lines of work converge and interact. They view the production lattice mainly from the computing artifact and define it as "the way in which a user of computer based services receives critical computing-related resources from others or different groups in different organizational locations provide different elements which contribute to some final product" (pg. 75). Surrounding, enabling and constraining this core of work and production lattice are the local infrastructure and larger macrostructure (pg. 69). . The local **infrastructure** refers to "resources which help support the provision of a given service or product and it includes resources such as skilled staff as well as physical systems" (pg. 74). The **macrostructure** on the other hand refers to the larger environment that is linked to the computing and production core or as they put it "the union of broader organizational arrangements, and extraorganizational arrangements which influence the production lattice" (p.g. 79). Examples of macrostructure are organizational procedures and policies. Pentland and Feldman's (2007) notion of "narrative network" carries forward the core idea of production lattice by re-animating our view of how technology and organization are intertwined at its center. The narrative network provides both a language and a concrete way to visualize and analyze the production lattice and work. By describing work and production as interconnected narrative fragments, this view allows us to "make movement visible" (Pentland and Feldman, pg. 781). However the narrative network does not just explicate realized sequence of actions and events but can be applied to make visible

[1] We had analyzed both the front-desk operations and the clinical operations for Alpha but only are able to present data for the front-desk operations due to space constraints.

idealized and potential narratives. We therefore integrate the narrative network concept to reconceptualize the production lattice as sets of actions and events that not statically embedded in webs but are dynamically interconnected as networks. To reflect this new notion, we re-label the production lattice and lines of work as "**production narrative networks**". We show that these production narrative networks as well as their attending infrastructure and macrostructure are key in understanding how technology and organizational changes are related in each phase of the development and use as well as over the time across these phases.

This focus on the temporal and cross-sectional views of change is important not just because we aim at developing a process theory (Mohr 1982) but that the seeds of change, the process of change and the impact of change are intimately related at each phase and over time (Leonardi 2005; Orlikowski et al. 1991). As some IS scholars have recently reflected, these phases that have been artificially imposed on IS research have to be considered jointly as they are intrinsically mutually constituted (Leonardi 2005; Volkoff et al. 2007). We show that the production narrative networks in reality and as idealized in the design phases are interlinked by production narrative actors' engagement with the EMR configuration activities. These ideal narrative networks are outcomes of the negotiations among the participants of the configuration process and are driven by the participants' vested interests. As the ideal narrative networks inscribed on technological artifacts meet the real narrative networks, tensions between the two emerge. The tensions are not only due to the simplistic notion of fit/misfit between the inscribed and the real but also due to pressures exerted by the infrastructural and macrostructural elements that these networks are built upon. These tensions are worked out through the adaptation of the new production narrative network and the infrastructural and macrostructural elements (Gasser 1986; Strauss 1988). We adopt Gasser's notion of **fitting** to describe the adaptation process and is defined as "activity of changing computing or changing the structure of work to accommodate for computing misfit" pg. 214. These acts of "fitting" lead to emergent and planned organizational changes. We now turn to the evidence from our case study that ground and explicate our theoretical perspective.

Current Work & Technology: Narrative network of front-desk operations and its issues

Alpha's front-desk operations involved various organizational tasks that support the overall clinical care of the patients. These tasks, as ranked according to their frequency, are a) check-in of patients, b) dealing with patient's pick-up requests (forms, letters, referrals, prescriptions), c) scheduling patients for future appointment after their visit, d) providing patients with forms, slips and letters, and other administrative duties such as clearing receipt logs or finding missing charts for patients who have arrived. The main task of the front-desk operations is to check-in patients. This involved various steps as illustrated by the narrative network (as described below). The front-desk staff ("FDS") used an array of technology and artifacts to support their check-in task: they used an existing computer system (Check-In or "CI"), paper charts, photocopying machine, receipt logs, sign-in clipboard, and existing phone system.

The CI formed the core infrastructure for this line of work as it informs the FDS of today's scheduled patients. When a patient presents at the front-desk, the FDS verifies the patient with the schedule and "arrives" the patient into the system. This step generates the form that the medical provider uses to document the clinical visit. The FDS then takes all other relevant paperwork from the patient e.g. a copy of insurance card, signed HIPAA form or signed consent form (if it is a first visit) and files them into the patient's paper medical record. The FDS collects any co-payment that might be required for the visit and notes it down in the receipt logs. Patients are called based on the time they arrive in the clinic and that is reflected on the sign-in sheets on the clipboard. The task is completed and a patient considered checked-in when the FDS places the patient's paper medical record with the CI generated form and other paperwork in a clinical provider's metal rack.

While the Check-in task is fairly routine, it is one of the main "bottleneck" of the clinic's operation. The problems that the management had with the check-in process included patient experiencing long wait time before they were attended, frequently overlooked patients, and patients not checked-in according to their appointment time (Meeting minutes Aug. 24, 2007).

The reasons for the problems can be partly explicated by the production narrative network of the check-in task. The production narrative network is built on top of the narrative network of the check-in process in that the narrative network of the check-in from the FDS view forms one of the nodes of the production narrative network. It then links up the FDS node with other key producer/consumer nodes who "receives critical computing-related resources" from the focal FDS node. See Appendix A Figure 2 top graph. From our analysis of the observations and interview data, the reasons for this bottleneck can be traced to the infrastructure and macrostructure surrounding the patient node as well as infrastructure breakdown between the front-desk and the medical records nodes.

Patient Node and Macrostructure: From our data, the patients at the Alpha site were typically Medicaid patients (these are basically patients whose medical needs are subsidized by the US Federal government) and as such are mostly from a low social economic status and comprise of a significant number of elderly patients (Field Memo, Sept. 4, 2007). The patient flow is also typically high (averaging about 80 to 100 patients visits during a typical workday). Alpha also sees around 3-4 new patients every day. The characteristic of the patient node can be linked to various macrostructural issues – firstly, Alpha clinic's charter is to reach out to the community and provide quality healthcare to their surrounding area. Alpha was physically located in a low-income part of the city. However, over the last few years, several clinics within this particular MATH's initiative had been closed due to financial constraints. Most, if not all, of the patients from those closed clinics had been diverted to Alpha. These two macrostructural issues partly accounts for the character and condition of the patient node. Furthermore, Alpha had adopted a policy of open panel so that the providers continue to accept new patients (Interview with Medical Director, Aug. 1, 2007).

Because patient flow is high, FDS at Alpha are under pressure to arrive patients as they sign into the sign-in sheet without reviewing the actual schedule for the day. This resulted in patients being arrived not according to their scheduled appointment as some of them do come in earlier than their appointment time. Because a majority of the patients are Medicaid patients, FDS have to verify their insurance validity for every visit in accordance to existing Medicaid and MATH policy. This verification process is conducted via the telephone and may take between 2-5 minutes, depending on how complicated the case is. New patient check-in is also a longer check-in process as it includes insurance verification as well as requirement to get signed consent forms from patients. As a result of all these mentioned macrostructural issues, patients normally experienced a longer wait time during the check-in process.

Local Infrastructure around FDS: The local infrastructure also contributed to the issues faced at Alpha's front-desk. First, the current CI system did not have a default day schedule view and the FDS relied solely on the sign-in sheet to view patient's appointment and arrive time. Patients however frequently do not fill in the appointment time and so the FDS check-in each case in the order that patients sign-in. Secondly, the two FDS counters worked off one common sign-in sheet. A FDS will remove the name of the patient that they are working on from the sign-in sheet so as to reduce confusion. But in order to be efficient, some FDS would take a couple of patient names to work on. However, the one-sign in sheet also caters to patients who are here for paperwork pickup or scheduling appointment. So there are cases where a FDS may be dealing with a patient schedule but have another patient sign-in who is here for an appointment in their working sheet. The other FDS would not know about this case and carry on working from names that are still on the sign-in sheet. This infrastructural arrangement contributed to patient overlook, patient wait-time and patient arrival issues.

Infrastructure Breakdown: While the local infrastructure design contributed to part of the issues and the nature of the Patient node was a significant pressure point causing the issues, another key issue with the infrastructure that disrupted the flow of FDS work was the case of "missing" paper charts. As one can see from the production narrative network, once the phone operators schedule a patient (or the front-desk if it was a follow-up appointment), the CI system will reflect the patient information and appointment schedule. The Medical Records staff ("MRS") would usually retrieve (or in their terminology "pull") the patient's paper medical chart using the schedule one day prior to their appointment. MRS then arranges these scheduled patient's paper medical charts in the trolley located at the front-desk. However, due to issues surrounding the Medical Records operations, missing paper medical charts often occurs. As a result, FDS often engage in articulation work (Strauss 1988) – this may involve a simple call to the medical records room to request for a chart or when MRS fail to find the chart, FDS may have to also go to the backoffice to assist in finding the chart. When that occurs, the front-desk operation is severely impacted as the number of available FDS is reduced (As there are only two FDS, when one leaves to go to the medical records room, only one FDS is left to deal with the patients). Either situation exacerbates the existing macrostructure and infrastructure stresses that exist around the entire production narrative network of Alpha's front-desk check-in process.

Planned Work & Technology: Idealized network of front-desk operations

The configuration of the EMR-Front-Desk operations involved four key groups (see Figure 1): the project team, the vendor, the MATH ambulatory care operational leadership and the Alpha site management. While some research may consider this a relatively straightforward exercise (e.g. Volkoff et al. 2007), we adopt the view that the configuration exercise is problematic and highly political. From our data, we observed that each organizational

group brings with them their own set of interests that are shaped by the infrastructure and macrostructure that they are embedded in. With respect to the front-desk operations, the entire team had to work on specifying, designing and configuring a variety of front-desk procedures. The final set of procedures that were specified, designed and configured in the EMR system included: a) Check-in procedure, b) Check Out procedure, c) Triage Visit procedure, d) Forms request, e) Walk In or Lost Prescription Refill Encounter, f) Insurance Verification, g) Appointment Confirmation and h) Beginning of day and End of day processes (Ambulatory Service Workflow Documentation).

Political interests of major groups: For Alpha site management, their interest in the configuration process was to use the EMR system to revamp their front-desk operations and resolve some of the issues that have been discussed above. This would improve its overall efficiency, improve its current poor satisfaction rates among its patients and in the long term provide better healthcare for its patients (Interview with Alpha Practice Manager, Sept. 5, 2007). For the MATH ambulatory care operational leadership, their agenda was wider than Alpha's in that they wanted to tackle the lack of documentation of operational policies across their community clinic sites. The EMR project served as an opportunity to document their operations and use it as a template to systematize and standardize the front-desk operations across all its on-campus and off-campus clinics. Moreover, they were interested to use the new EMR system as a first step towards a full integration of their back-end billing system that is currently highly fragmented (Interview with VP Ambulatory Care, Oct. 18, 2007). The EMR project team's main interest was to build legitimacy for the system and by extension the project's existence. The EMR project at that time had hit various major organizational roadblock in rolling out the system to the main MATH hospital campus as well as other MATH-owned hospitals (Interview with Project Director, Jul. 31, 2007). As such, it was imperative for them to be able to provide a basic build of the EMR system for the Alpha site and use that "successful rollout" as a major "proof-of-concept" for the team. Given that the EMR project team lacked real experience, they relied heavily on the vendor best practices arrangements that have been deployed in the vendor's existing client sites.

From a high-level perspective, the political interests of all the key groups were highly aligned in that a successful and well designed EMR system would assist the project team to gain its legitimacy as well as satisfy MATH's and Alpha's management interests of systematizing and improving their workflow. Specifically, for the check-in process, these interests combined to configure an ideal production narrative network based on the new EMR system that aimed to streamline Alpha's check-in procedures. This configuration was proposed by the vendor and the project team using a template based on the vendor's set of best practices. In this new configuration, as captured in the new ideal production narrative network (figure available on request), the phone room schedistrar captures pertinent patient's insurance and demographic information (e.g. guarantor information, insurance information) prior to scheduling the patient. The capture of pertinent patient information will generate a workqueue for insurance verification. A FDS or Phone Operator will then work through the insurance verification workqueue one day before to patient's appointment. All these new inter-connections aim to reduce the check-in process to simply a verify-and-click procedure and they envisioned that check-in would take "only a few seconds". Moreover, with the EMR system in place, the project team envisioned that the link between the FDS and MRS for paper medical chart will be removed and that the FDS will simply focus on checking-in patient without disruption due to missing medical chart issue (Ambulatory Service Workflow Documentation).

Infrastructure and Macrostructure: However as this configuration and design process has to also satisfy the political interests of the other groups e.g. MATH's ambulatory care operational leadership and the project team, new infrastructural and macrostructural elements were inscribed into the new narrative networks. For example, this EMR system is no longer a stand-alone system like the old CI system. The MATH ambulatory care operational leadership wanted the EMR system to be integrated with its hospital billing system. The project team has the same agenda given that they have to rollout a centralized Electronic Medical Patient Index system for all eight hospitals within the MATH system. The need for integration meant that there additional data fields had to be captured by the schedistrar or the front-desk – some of which were not relevant to Alpha's own clinical operations. The MATH ambulatory care operational leadership also wanted to embed existing macrostructural elements that previously had been loosely enforced at Alpha site (Interview with Alpha Practice Manager, Oct. 4, 2007). For e.g. the Medicare Secondary Payor Questionnaire (MSPQ) was inscribed into the system such that FDS have to ask Medicare patients to answer the MSPQ every 90 days between their visits. This is a legal requirement that MATH has to comply with and is part of their annual audit. From the project team's perspective, they had negotiated with the Alpha and MATH groups on how integrated the EMR system will be when Alpha go live. Due various infrastructural and macrostructural concerns e.g. the urgency to get the system up and to ensure that the system build is stable, the project team decided to provide limited integration with the billing systems – enough for information exchange among the systems but not enough for Alpha and MATH groups to replace their existing paper-based insurance

claims processing processes (Interview with Project Director, Oct. 26, 2007). This meant that the FDS had to continue generating paper-based encounter forms for billing and claims processing and hence one more step in the ideal production narrative network (Interview with VP Ambulatory Care, Oct. 18, 2007).

Inscription: After a series of internal design and configuration meetings between all key groups (the vendor was present only at some meetings), the negotiated outcomes of the front-desk check-in process was inscribed into the EMR system as workqueue rules, data fields, screen navigation as well as system rules. One interesting negotiated inscription was the use of "soft stops" for collecting patient's insurance and demographic information. The MATH ambulatory care operational leadership had debated with the Alpha management and the project team whether the fields should be coded as "hard stops" i.e. the system will not move forward unless the user enter all required fields or as "soft stops" i.e. the system will move forward even though all required fields have not be entered. From the operational flow perspective, it made sense to make it a hard stop so that all data will be complete. The vendor however cautioned that phone conversation may be very fluid and the system should be flexible enough for cases where patient information is not complete (Meeting Minutes, Aug. 22, 2007). Alpha management also reflected the fact that their phone call volumes are high and that they may be issue of getting all the information at the time of a patient's call. The consensus at the end was to make it soft stops but that the schedistrars (phone operators) should be trained to collect all information and treat unavailable information as exceptions rather than the rule. However these "soft stops" would become "hard stops" when the FDS check-in a patient. In parallel with the project team's work of inscribing these narrative networks into the EMR system, the MATH ambulatory care operational team was also inscribing these narrative networks into an Operational Workflow document for the Alpha site.

Implementation and Optimization of New Technology & Work: Tensions and Fitting

Once the EMR system went live at Alpha, several difficulties occurred immediately in the front-desk operations. The most obvious difficulty was the increased amount of time required by FDS to check-in a patient. From observations and interview data, we know that part of the increased time was due to the learning curve that the FDS underwent to get used to a new system. The other part is because many of the patients who arrived did not have the complete demographics and insurance information. As such the FDS had to enter all the information in during check-in as these data fields were mandatory or "hard stop" fields. To better understand these tensions, we refer to the production narrative network of the new check-in process (see Appendix A Figure 2 middle graph).

Tension at Phone Room: The assumption of the ideal narrative network had been that the phone room schedistrar would be able to capture all pertinent patient demographics and insurance information at the time of the appointment scheduling. However, several infrastructural and macrostructural factors violated that assumption. As discussed above, the patient volume at Alpha is relatively high. This also is manifested in the number of phone calls that Alpha handles each day. During the peak hours of 8:30 am to 11am (prior to system implementation), each phone operator has roughly half a call per minute (or one call every two minutes) requesting for an appointment. This is because Alpha practices an open-access system that allows patients to make same-day afternoon appointment during the morning and limits patients advance appointment scheduling to two weeks from the day of call (Interview with Alpha Lead Physician, Sept. 18, 2007). The result of these policies is the "morning rush" by patients to call the clinic for appointments. Furthermore, the Alpha management, in anticipation of the slowdown of work throughout its clinic, had taken steps to reduce the workload for the first two months of operations (i.e. they had reduced appointment schedules for clinical providers by half) (Interview with Medical Director, Nov. 30, 2007). Although it was intended to alleviate the overall patient flow, this reduction of workload ironically exacerbated the conditions for the phones as it meant less appointment slots and more people without appointments that in turn led to more calls for appointments. Previously using the old CI system, a schedistrar was able to handle the volume of calls as each scheduling event only took around 1-2 minutes. With the new EMR system, each scheduling event took around 5-8 minutes to complete (Observation Notes). Given these existing and new conditions, the phone room schedistrars found it difficult to stay on the line to take down all the new information that are required by the new EMR system.

Patients, on the other hand, also did not "cooperate" with the new ideal network. Many patients complained that the information requested were "too much" just so they could get an appointment (Field Memo, Oct. 30, 2007). Others were frustrated when after the "information gathering", they were unable to get an appointment as the slots have been taken up (Field Memo, Nov. 2, 2007).. Still there were frequent "exceptions" where the caller did not have the patient information requested (e.g. the caller was from a doctor's office and was making an appointment on behalf of the patient or the caller was a relative and did not know the relevant information at the tip of their tongue) (Field

Memo, Feb. 19, 2008). These issues at the patient node made the phone room workflow more tense and problematic and the result was that Alpha's phone system became extremely jammed.

Tension at Front-desk: Since work is all interconnected within this production network, the load and tension in the phone room flowed over to the front-desk. This resulted in the observations that we made above i.e. more patients presenting at the front-desk requiring data entry in mandatory fields. Moreover, the phone room operator's inability to complete the field entries also meant that the insurance verification workqueue did not materialize as there was not a significant list of patient information to work on. In any case, because a majority of the patients are Medicaid patients, the insurance verification could not be conducted the day before, so in effect, the insurance verification workqueue was not relevant to most of Alpha's front-desk operations. Another unintended consequence of the new narrative network's impact on the phone room was that FDS began seeing more patients coming to them to schedule appointments as they were not able to call into the phone room. So although they had planned for a reduced number of patients coming in due to the reduced appointment schedule, the FDS experienced relatively similar volume of patients due to the increased number of patients asking for appointments.

The tension at the front-desk was not just limited to the additional data requirements of the new production narrative network. The FDS also continued to have issues with "missing" paper charts. This was due partly to Alpha's management decision to "pull" paper medical charts for patient visits given that the EMR system may not be populated with the most updated patient clinical information. It was also partly due to Alpha's existing routine where medical assistants are alerted to patient's arrival by a physical paper medical chart on the provider's rack at the front-desk. All these meant that the FDS experienced greater challenges since the pressures and tensions generated by the new production narrative network were added on to their pre-existing problems with the existing production narrative network.

"Fitting" in the Phone Room: Six months into the implementation, the project team, the Alpha management, and the MATH ambulatory care operational leadership met to discuss the situation of the "implemented" production narrative network. The teams concluded that the effect of all the macrostructural issues made it "challenging" to follow the ideal production narrative network. As part of the optimization process, they decided to revise their policy that the schedistrars must collect all patient demographics and insurance information to schedistrars collecting only patient demographics data where possible (Interview with Alpha Practice Manager, Apr. 25, 2008). This revised "narrative network" is a reflection of the fitting work that actual users had already enacted in their narrative network of work. The Alpha management had also enacted several changes to the organizational policies that contributed to lessening the tension in the phone room for example, they reverted the schedule back to 100 percent and extended the appointment schedule horizon from two to three weeks so that more appointment slots were available.

"Fitting" at the Front-desk: Given that the phone-room role in the production narrative network has been transferred effectively to the Front-desk, FDS had to get use to the requirement for more data entry during the check-in process. This meant that check-in process had effectively become longer in duration despite the intended goal of the EMR system to streamline the check-in process. The few upside for the FDS with the new production narrative network is that they can check-in repeat patients who have their updated information in the system much more efficiently than before (Interview with Front-desk staff #2, Apr. 24, 2008). The EMR system also has a more user-friendly display of patient schedule and appointments so that FDS can easily check-in patients according to their appointment time rather than their sign-in time. Moreover the issue of patient coming to make appointments have significantly alleviated with the easing of the bottleneck in the phone-room.

A major fitting work at the front-desk however is with the issue of missing paper medical chart. During the early period when the FDS had to deal with missing charts on top of the challenges of checking-in patients, they had resorted to using the EMR messaging system to request for missing charts and not go off to the medical records room to search for the chart. After the fourth month, the Alpha management and staff decided that with the more effective EMR arrival alert mechanism, they shouldn't need the paper medical charts up front to alert them of arrived patients. Alpha's management decided to rely solely on the EMR system for patient arrival status and that the paper medical records would be sent directly to the nursing stations instead of the front-desk (Interview with Alpha Practice Manager, Apr. 25, 2008). This resulted in an emergent production narrative network that "resolved" one of the issues affecting the front-desk operational effectiveness.

Other fitting work that were not part of the EMR system but occurred with the implementation of EMR occasion to improve the front-desk operations were: dedicated front-desk for specific providers – each with its own sign-in clipboard, installation of dedicated photocopiers at each front-desk to reduce amount of time moving around the front-desk area and deployment of an additional front-desk staff to handle check-out patients as well as verification

workqueues and check-in overflow. Because of these new "fitted" nodes in the overall front-desk production narrative network, issues of overlook and wait-time between sign-in and check-in were mostly resolved. (See Appendix A, Figure 2 bottom).

Discussion and Conclusions

Using grounded theory methods and data from an in-depth longitudinal case study of an EMR system implementation, we propose a different perspective on how technological innovations and organizational change are interwined. In essence, the Narrative Network Perspective sets its sight squarely on how IT innovation such as EMR is interconnected with the work that organizations do. Our perspective suggest that analyzing the process by which IT is interconnected to work and work to IT enables us to gain a better understanding of their relationship. Our analysis above shows us that even though it is important to recognize the role IT's materiality play in organizational change (Kallinikos 2004; Orlikowski and Yates 2006; Volkoff et al. 2007), it is equally important to understand how this materiality is designed by and constituted in the work practices of organizations (Berg 1999; Berg and Bowker 1997; Star and Griesemer 1989). We argue that it is not enough to only surface the materiality e.g. Volkoff et al.'s notion of embedded routines, roles, and data or Leonardi's (2007) informational capabilities in that they give us only one dimensional view of the change process – it is unable to explain fully why some material inscriptions are critical and why some aren't. This is similar to some scholar's critique of the Practice-view of technology in that they focus only at the single dimension of practice and situated concerns of organizational users to explain why and when change occur. We argue that the Narrative Network Perspective represents a more balanced focus on the work practices of the organization and materiality of the technology given that the production narrative network takes both into account. Using the production narrative network, we are therefore able to pinpoint a clearer and more precise relationship between the technological artifact and organizational work and by extension, the relationship between technological and organizational innovation.

In addition, the Narrative Network Perspective proposes that to fully understand this complex relationship, IS and organizational researchers have to reset their conceptual lens to include both the design/configuration phases and the implementation and use phases of the new technology's development (Leonardi 2005; Orlikowski et al. 1991). Theoretically, this subtle shift to extend our conceptual lens is important given that to understand the materiality of the IT artifact, we need to understand the "historicity" of the artifact (Kallinikos 2004). Within the organizational and IS context, we argue the relevant start point for tracing the artifact's "historicity" is the point when the organization comes in contact with the new technology, starts to open the technological black-box and explore ways to adopt and use the technology within its context i.e. the design and configuration phase (Leonardi 2005). Empirically, research has shown that the design and phase occur sequentially first but then continues in parallel (Markus et al. 2000). Hence, the Narrative Network Perspective brings together the design/configuration phase and the implementation and use phases. The combined view allows researchers to understand how the production narrative network, the infrastructure and the macrostructure in the real environment co-evolve with the idealized production narrative network inscribed in the new EMR artifact within and across each of the three phases of design, implementation and use. Analyzing the two structures within each phase reflects a synchronic analysis– in that interactions between the organizational and technological activities are considered – while tracing the co-evolution of the two structures over time constitutes the diachronic analysis (Barley 1990). This integrated and holistic view on the surface is similar to the temporal dimension of Volkoff et al.'s (2007) model. Their model's temporal dimension is based on the Critical Realist stages of structural conditioning, social interaction, and structural elaboration. However, we argue that we adopt a more critical stance towards the early stage i.e. the design and configuration phase as compared to Volkoff et al.'s (2007) structural conditioning stage. We do not assume that the process of "conditioning" the IT artifact as one that is straightforward explication of existing routine, roles or data and embedding that into the artifact. Instead, we find that the design and configuration phase involves political process of negotiation among varied interests and that routines, roles, data and in effect the work are contested (Bijker et al. 1987; Orlikowski and Gash 1994). Moreover, we also do not agree that the existing enacted routines have no impact on the configuration process. Instead, we find that the issues that surround existing enacted routines were carried into the configuration and design process as part of the interests of groups representing existing users.

Finally, by combining the above-mentioned aspects – the production narrative network built on local infrastructure and macrostructure as well as an integrated temporal perspective using both diachronic and synchronic analysis – the Narrative Network Perspective provides a potentially powerful tool to understand how technology-mediated organizational change occurs. Our paper shows that current narrative network of organizational work and how technology is designed and located in that network influences the design and configuration of a new technology.

However as the design and configuration phase is highly social and political, the final idealized production narrative network may not map directly to the local concerns (Berg 1998). When the technology is applied, apparent changes to the current flow without attending change to the other elements such as infrastructure and macrostructure will result in tensions. These tensions are relieved by either changing those elements that exert pressure or by changing the production narrative network or by changing the inscribed technology – i.e. the process of fitting. By tracing and taking into account all these key elements over the three phases, we are able to provide plausible answers to questions of when and why planned change occur or when and why emergent change occur with the introduction of IT innovations. And even though this analysis was generated based on the EMR system implementation, we believe that the Narrative Network Perspective has broad application to other package software implementation and use. Future research could adopt the Narrative Network Perspective and apply it to other package software and test the validity of the model. We also envision practitioners applying the Narrative Network Perspective to explicate current workflows and infrastructure/macrostructure elements. The value for practitioners would be to conduct comparative analysis between planned workflows and current workflows and allow managers, system designers and users to retool the workflows prior to implementation.

We started this paper considering how organizational and technological innovations are related and ask how that specifically applied in the healthcare and clinical context. We conclude that a holistic, temporal and balanced perspective that takes into account both the material aspect of technology and the work dynamics of organization may provide us with a firmer step towards understanding this complex relationship. We believe the Narrative Network Perspective comes closer to answering the call for a process theory that "conceptualize IT artifacts as embedded in specific social and historical contexts" and as "complex and changing technosocial processes existing in time and over time" (Orlikowski and Iacono 2001 p.g. 131).

APPENDIX A

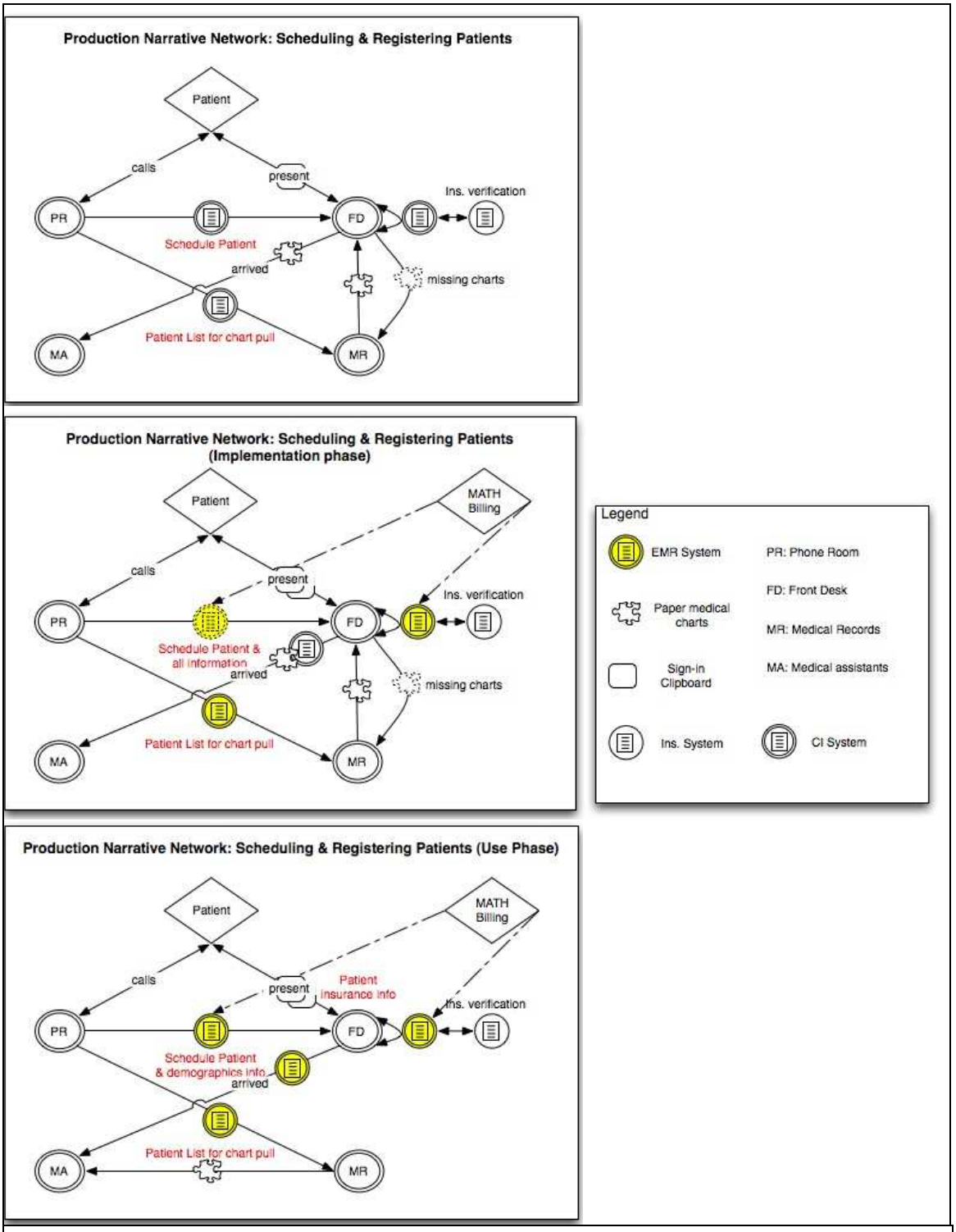

Figure 2. Production Narrative Network over the three phases

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