MIS Quarterly

RESEARCH ARTICLE

ORGANIZATIONAL PATH CONSTITUTION IN TECHNOLOGICAL INNOVATION: EVIDENCE FROM RURAL TELEHEALTH[1]

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Path constitution theory has emerged as a promising combination of two contrasting perspectives on technological innovation: path dependence, which focuses on historically embedded, contingent processes that are more or less beyond the control of actors, and path creation, which emphasizes mindful contributions from powerful actors. However, the current path constitution literature focuses on macro- and multi-level inquiry without addressing the specific processes, opportunities, and challenges related to organizational (micro-level) technological innovation. Against this backdrop, we draw on the innovation and path literature as well as a case study of telehealth innovation in a public health organization to theorize how technological innovation paths constitute in organizational contexts. The proposed theory distinguishes between innovation path status and innovation path trajectory to help researchers understand and explain how organizations transform and reinforce path constitution patterns, how innovation paths may merge with or separate from other paths, and how organizations may arrive at a lock-in that challenges them to break out from dominant and seemingly irreversible action patterns.

Keywords: Technological innovation, innovation path constitution, path creation, path dependence, rural telehealth, social construction of technology, public health

Introduction

Technological innovations are important drivers of economic progress, productivity growth, and long-term performance (Burgelman et al. 2004; Dodgson et al. 2008; Sorescu et al. 2003; Tornatzky and Fleischer 1990; Xiao et al. 2013). Researchers and practitioners have therefore been interested in understanding the processes through which these innovations evolve over time (Yoo et al. 2012; Yoo et al. 2010). In recent years, the technology and innovation management literature has increasingly drawn on path theory to examine technological innovations in different contexts (Garud et al. 2010; Sydow et al. 2012a; Vergne and Durand 2010). In particular, path constitution has emerged as a rich and promising

[1]Suprateek Sarker was the accepting senior editor for this paper. John Mingers served as the associate editor.

perspective to make sense of these complex change processes (Meyer and Schubert 2007; Sydow et al. 2012a; Sydow et al. 2012b).

The path constitution concept draws upon the more general idea of social construction, which emphasizes the dualism between agency and structure. Organizational researchers have used this lens to investigate both continuity and change in the ongoing constitution of social processes (Sydow et al. 2012b) and, in particular, to examine technological and organizational changes (Barrett and Walsham 1999; DeSanctis and Poole 1994; Orlikowski 2000; Orlikowski and Barley 2001). An important finding in this literature is that human agency and technological structures are interdependent, and that specific change processes constitute through recursive intertwining between them. The literature also examines how organizational inertia and historical imprinting of decision making, on one hand, and human agency and mindful decision making, on the other, play key roles in shaping innovation trajectories (Sydow et al. 2012b), thus laying the foundation for theorizing path constitution.

Path constitution theory explains the evolution of technological innovations as a process shaped by emergent processes that are beyond the control of actors as well as by active engagement and mindful contribution of powerful actors (Meyer and Schubert 2007). Thus, it integrates the concepts of path dependence (Arthur 1989; David 1985, 2001; Sydow et al. 2009) and path creation (Garud and Karnøe 2001, 2003; Garud et al. 2010) into a more general notion of social constitution (Sydow et al. 2012b). Much of the current technological innovation literature portrays path dependence and path creation as two contrasting perspectives, despite the fact they relate theoretically as two ends of a spectrum (Meyer and Schubert 2007). Hence, a core idea of path constitution theory is to apply constructivist thinking to integrate path dependence and path creation approaches to understand and explain the shaping of technological innovations over time (Sydow et al. 2012a; Sydow et al. 2012b).

Although path constitution theory has taken important steps to draw on the complementarity between path dependence and path creation, it is limited in two important ways. First, the theory has not been developed or applied to investigate organizational (micro-level) technological innovation. This may be reflective of the traditional applications of path theory at macro- and multi-levels such as a nation's economy, industries, and organizational fields. Second, studies that have attempted to combine path dependence and path creation focus broadly on organizational and institutional phenomena, without a particular concern for the role of technology (Sydow et al. 2009; Sydow et al. 2012a). As a result, we have limited understanding of how technological innovation paths change over time in organizations (Vergne and Durand 2010).

To address this gap in the literature, we build on the notion of path constitution (Meyer and Schubert 2007; Sydow et al. 2012a; Sydow et al. 2012b) to theorize technological innovations in organizational contexts. Our theorizing occurs in three steps. First, we draw on existing innovation path theory to present foundational concepts and related abstractions that describe the key characteristics of technological innovation paths, identify paths at select moments in time, and explain how paths may unfold over a considered period. This foundational conceptualization represents our pre-understanding of how technological innovation paths constitute in organizational contexts. Importantly, it provides us with an approach to interrogate our empirical material in the second step. In the final step, we draw on the empirical analyses to develop the foundational conceptualization further and present propositions that theorize technological path constitution in organizational contexts.

Background Literature

Our path constitution theorizing aims to combine the complementary strengths of path dependence and path creation theories (Van de Ven and Poole 1995). The path dependence literature builds on the influential work of Arthur (1989), David (1985), and others to explain the persistence of (suboptimal) technological designs, industrial evolution, and organizational decisions (Garud et al. 2010; Sydow et al. 2009; Vergne and Durand 2010). Path dependence refers to processes that are "unable to shake free of their history" (David 2001, p. 19), thereby providing a historical, systems view to the economic explanation of technological innovations (Boland et al. 2007). It contends that an organization's innovation path is shaped by the path it has traveled, because the initial conditions, prior events, and repertoire of routines enable some and constrain other future options (Teece et al. 1997; Van de Ven 2005). Furthermore, innovation paths emerge from contingent, probabilistic events that are unpredictable and, over time, stabilize through mechanisms such as increasing returns, switching barriers, and lock-in (Arthur 1989). A lock-in occurs when actors are unable to move to a new state despite their preferences to do so (Garud et al. 2010) or as a result of measured actions and responses by managers. Once a path is locked-in, only a significant shock can dislodge it and create a new path (David 2001; Vergne and Durand 2010). Several IS researchers have used this perspective to explain technological innovation. In the case of information technology (IT) platform adoption, Fichman

(2004) suggests path dependence arises from high learning and adaptation costs during deployment and high switching costs later. Other researchers have found evidence of such dependencies in post-adoptive behavior with IT-enabled work systems (Jasperson et al. 2005), development and diffusion of technological standards in interorganizational systems (Gogan 2005; Weitzel et al. 2006; Zhu et al. 2006), differences in mobile service innovation across countries (Knutsen and Lyytinen 2008), and use of IT-based health infrastructures (Braa et al. 2007; Sahay et al. 2009).

The concept of path creation (Garud and Karnøe 2001, 2003; Garud et al. 2010) shares with path dependence the view that technological development is historically entrenched, and if this development stabilizes, it is almost irreversible (Meyer and Schubert 2007). However, path creation differs in its emphasis on human agency. Garud et al. (2010) and other researchers conceptualize agency as an emergent property of an ongoing process in which actors continuously probe their worlds to reconfigure a web of heterogeneous elements (Boland and Collopy 2004; Karnøe and Buchhorn 2008; Pandza and Thorpe 2010). Further, David (2001) argues that triggers of technological innovation are not always historically contingent, that is, a particular state has been reached only because certain states had occurred earlier. Therefore, the ensuing technological paths are not as deterministic as suggested by path dependence. In fact, actors may spearhead paths by setting in motion processes that actively shape social practices and artifacts and by mindfully deviating from existing routines and practices to sample new experiences, explore new practices, and create new resources (Garud and Karnøe 2001; Swanson and Ramiller 2004). These deviations emerge from, and result in, a lasting process of continual path creation and stabilization that involves contextually sensitive actions (Meyer and Schubert 2007). Researchers have used the path creation perspective to explain a variety of phenomena. For example, Garud and Rappa (1994) investigate path creation processes in the evolution of cochlear implants; Garud et al. (2002) explore the case of Sun Microsystems and Java to explain how sponsors of technological standards can affect their development and adoption; and Boland et al. (2007) examine the adoption of digital three-dimensional representations in a large construction project.

The literature reveals variations in the levels of analysis in path dependence and path creation studies. The majority of the path dependence literature is at the organizational field, market, or industry levels (Schienstock 2007; Sydow et al. 2009). As a result, it is nontrivial to translate path dependence theory to the organizational level. The difficulty arises because researchers have been unclear about how to establish evidence of path dependence. Additionally, some key concepts, such as the role of small or random events as well as lock-in, acquire different meanings in the organizational context, and depend on whether researchers take a sufficiently long-term view to reveal systemic path fluctuations (Garud et al. 2010). Sydow et al. (2009) attempt to address these concerns by examining the conditions and dynamics under which organizations become path dependent. They suggest three developmental phases of path dependence: the pre-formation phase, the formation phase, and the lock-in phase. In the pre-formation phase, the organization can choose from a variety of possible actions; in the formation phase, the scope of actions significantly reduces as an organizational path emerges; and in the lock-in phase, the path is locked-in and the organization has little or no choice in actions until a shock occurs. Thus, Sydow et al. (2009) provide an organizational-level framework to explain how an organization may become increasingly path dependent in its technological structuring, eventually attaining a lock-in, and possibly breaking away from the path. The path creation literature is, in contrast, more readily applicable to organizational-level analyses. Garud et al. (2010) suggest path creation requires actors to experience and enact complex emergent processes through discussion, debate, and experimentation. Arguably, micro- and meso-level analyses will more likely reveal evidence of such behaviors compared to macro-level analyses of organizational fields, industries, and societies.

Observing that researchers traditionally have examined path dependence and path creation largely in isolation (Garud et al. 2010; Stack and Gartland 2003; Sydow et al. 2005), the recent path constitution literature draws upon both perspectives to explain how history and human agency may intertwine during technological innovations (Meyer and Schubert 2007). Researchers have followed two approaches to examine path constitution (Meyer and Schubert 2007; Sydow et al. 2012b). Both approaches emphasize non-ergodicity, lock-in, and triggering events, but they differ on a number of important dimensions. Meyer and Schubert (2007) conceptualize two analytic dimensions: modes and phases of path constitution. The first dimension draws on Mintzberg and Waters (1985) to differentiate between unplanned, emergent processes and planned, deliberate processes. This distinction outlines a spectrum in which the processes involved in path constitution may also be partially controlled. The second dimension establishes a temporal order of observed processes that progress through three phases of path emergence or creation (generation); path persistence or extension (continuation); and path dissolution or breaking (termination). Hence, Meyer and Schubert rely on a life-cycle model (Van de Ven and Poole 1995) of path constitution commonly used in the path dependence literature, and focus on organizational field-level analysis. In contrast, Sydow et al. (2012b) propose a flexible

structuring of path constitution without assuming a life-cycle model. Although they examine path processes from a longitudinal perspective, they view constitution of the path organically without relying on preconceived temporal phases. Additionally, with their focus on organizational fields and their member organizations, Sydow et al. (2012b) employ multi-level thinking to support path constitution analysis. Further, they discuss a research methodology that can capture the process features necessary to analyze and demonstrate path constitution. Although they ground the proposed framework in the theory of technological, institutional, and organizational path dependence and creation, Sydow and his colleagues focus on the processual methodology to analyze path constitution, not to develop new theory. In fact, the authors mention explicitly their twofold objectives are to introduce a novel methodology to conduct path constitution analysis and to offer a detailed processual procedure that can aid future research (Sydow et al. 2012b, p. 156).

In summary, a significant amount of literature exists on path dependence and path creation, and researchers have recently begun to focus on path constitution. Although the current developments in path constitution theory address the limitations of path dependence and path creation research, we lack knowledge about how innovation characteristics interact with organizational contexts to shape technological paths (Mahoney 2000; Schreyögg and Sydow 2010). Few studies have focused on theory building related to path constitution and, as a result, conceptual development related to technological innovation paths at the organizational level—and their evolution over time—have suffered (Lamberg and Parvinen 2003). Our study addresses this gap in the current literature.

Organizational Path Constitution: Foundational Concepts

We share with existing path constitution theory the idea of integrating path dependence and path creation perspectives, but our focus is different. Meyer and Schubert (2007) examine the constitution of technological innovation paths across fields of interacting organizations, and Sydow et al. (2012b) emphasize path constitution analysis across a focal level and surrounding levels that are both micro and macro. In contrast, we focus on the particular processes, opportunities, and challenges involved in organization-level path constitution. Sydow et al. generalize their approach to all levels of analysis and do not take into account the particular characteristics of organization-level analyses. To develop path constitution theory for such contexts, we follow Garud et al. (2002) and view the technological structuring of an organization as constituted through multiple, interrelated paths where each represents a "phenomenon in the making," thereby relegating the idea of path as an outcome into the background and instead emphasizing path as an ongoing process. Viewing paths as evolving (Sydow et al. 2005) and organizations as fluid (Weick 1995), we define an *innovation path* as the progression over time of a technological innovation, embedded into particular organizational practices and arrangements. This conceptualization is consistent with structuration theory (Giddens 1984) and its application to understand the ongoing technological structuring of organizational practices (Orlikowski 1992; Orlikowski and Robey 1991). It affords identification of specific paths by focusing on the core technological innovations that drive them. Further, it accommodates an understanding of the interdependencies between multiple paths by focusing on how they entangle through specific organizational practices and arrangements.

To investigate technological innovation paths in an organizational context with sufficient detail and specificity, our theorizing must help researchers adequately describe the status of a technological innovation at select points in time as well as the progression of the innovation over a considered period. We must understand the characteristics of the specific innovation, as well as how the innovation started, how it included new functionalities, how the organization used these functionalities, and what conditions facilitated or inhibited the progress of the innovation within the organization. In order to provide such details and to ground our work in prior literature, we draw upon Dosi's (1982) seminal work in which he focused on two facets of technological innovation: technological paradigms and technological trajectories. According to Dosi, technological paradigm refers to a *pattern* of solution of selected technological problems based on selected material technologies. It includes the specific technology (or *cluster of technologies*), the generic tasks (or *problems*) to which it is applied, as well as the resources and properties involved in its development and application. Technological trajectory refers to the set of possible directions in which the technology may develop (*progress*) based on the technological paradigm. We draw on these general, macro-level constructs about technological innovations to propose corresponding micro-level constructs that capture an organizational technological innovation path based on its status and trajectory. Innovation *path status* signifies the characteristics of a selected technological innovation embedded into organizational practices and arrangements at a specific moment in time, and innovation *path trajectory* signifies the sequence or patterns through which the innovation path develops over a considered period. Path status analysis can help examine the innovation-in-use at particular points in time, whereas path trajectory analysis can help investigate how the innovation

progresses over time. Together, innovation path status and trajectory afford us both static and dynamic perspectives about a technological innovation in an organizational context. We present this synthesis as follows:

> ***Abstraction 1:*** *Technological innovation paths can be identified and adequately described based on their status at select points in time and their trajectory over specified periods.*

Organizational innovation paths involve adoption, assimilation, extended use, and continued development of a technological innovation; they may unfold over shorter or longer periods; and they may continue or discontinue. A key question in the study of innovation paths is how they constitute through deliberate processes orchestrated by the involved actors and through emergent processes beyond their control. Sydow et al. (2012a) suggest a path constitutes through a variety of processes in response to particular triggering events. These triggering events constitute imminent crossroads, critical incidents, and key turning points, and they have the potential to substantially impact the way in which the technological innovation unfolds in response to new organizational requirements. It is important to note the triggering events that shape the technological innovation paths in an organization may occur inside or outside the organization. Accordingly, we conceptualize both internal and external innovation triggers. *Internal innovation triggers* are events occurring inside an organization (such as employee dissatisfaction with an existing technology or demands to extend its usage) that challenge the trajectory of an innovation path and prompt the search for alternatives to the current path. Further, *external innovation triggers* are events taking place outside an organization (such as changes in available platform technologies) that challenge the trajectory of an innovation path and prompt the search for alternative paths. These internal and external triggers may challenge organizational practices and arrangements relating to a particular path status and, over time, lead to a new path status and a possible change in path trajectory. Therefore, to reveal changes in path status and trajectory, it is important to focus on an organization's processes during the period from when an innovation trigger occurs until the consequential changes in path status and trajectory have become manifest. We conceptualize such temporal brackets in an organization's innovation journey as *path constitution episodes* (Table 1). An episode may unfold over shorter or longer periods depending on the nature of the defining innovation trigger and the processes through which the organization responds. In order to understand differences in how an organization responds to innovation triggers, prior research draws on the concept of *response mode*, which may vary on a continuum from emergent to deliberate (Meyer and Schubert 2007; Mintzberg and Waters 1985). Our synthesis suggests the following:

> ***Abstraction 2:*** *Analyses of the episodes during which an organization responds to internal and external innovation triggers can reveal the status and trajectory of a technological innovation path.*

Abstractions 1 and 2 offer a practical approach to make sense of the complex process data involved in understanding how a specific organizational path constitutes (Langley 1999; Newman and Robey 1992). Still, at the heart of path dependency and path creation thinking is the issue of whether a path is moving the organization toward a lock-in or whether powerful collectives of actors may successfully guide its trajectory toward sustained innovation (Garud and Karnøe 2001; Sydow et al. 2012a). To help reveal such patterns, it is necessary to assess the *impact* each episode has on the trajectory of the innovation path (Table 1). When organizations become increasingly path dependent, it is because organizational processes during the observed episode *reinforce* the current trajectory in ways that progressively reduce available innovation options (Sydow et al. 2009). Unless the involved actors are able to break away from such patterns, the organization would, driven by increasing returns and switching barriers, eventually enter into a lock-in phase in which it loses flexibility. Alternatively, path constitution episodes may *transform* the current trajectory as organizational processes add innovation options that are not only available in principle, but also developed into actionable options that managers can realize to support sustained innovation (Sandberg et al. 2014; Sydow et al. 2009). These reinforcing and transforming episodes can occur in any sequence and jointly contribute to the unfolding of the innovation path. Thus:

> ***Abstraction 3:*** *The trajectory of a technological innovation path is shaped through reinforcing episodes that progressively reduce available innovation options and transforming episodes that make additional innovation options actionable.*

Table 1 summarizes these foundational concepts as a vocabulary that can help us understand and examine technological innovation path constitution in an organizational context. Next, we draw on this conceptualization to analyze data covering 20 years of telehealth innovation at South East Health District (SEHD), a rural public health organization in the U.S. state of Georgia. Telehealth encompasses the distant delivery of health-related clinical and nonclinical services through the transfer of audio, video, and graphical information via telecommunication (Paul and McDaniel 2004; Perednia and Allen 1995). It facilitates knowledge sharing and

Table 1. Foundational Conceptualization of Organizational Path Constitution

Construct	Definition	Variable	Definition	References
Technological innovation path	The progression over time of a technological innovation, embedded into organizational practices and arrangements	Path status	The characteristics of a selected technological innovation and how it is embedded into organizational practices and arrangements at a specific moment in time	Dosi 1982; Garud et al. 2002; Meyer and Schubert 2007; Sydow et al. 2012a
		Path trajectory	The sequence or patterns through which the innovation path develops over a considered period	
Innovation path constitution	The formation of a technological innovation path through historically determined as well as human agency influences	Reinforcing impact	The stabilization of the current path trajectory through progressive reduction of available innovation options	Meyer and Schubert 2007; Sydow et al. 2009; Sydow et al. 2012a
		Transforming impact	The destabilization of the current path trajectory through the introduction of actionable innovation options	
Path constitution episode	The period from when an innovation trigger occurs until the consequential changes in path status and trajectory have become manifest	Innovation trigger	The internal and external events that challenge the trajectory of an innovation path at key moments in time and prompt the search for alternatives to the current innovation path	Meyer and Schubert 2007; Mintzberg and Waters 1985; Sydow et al. 2012a
		Response mode	The continuum of organizational responses—varying from emergent to deliberate—to an innovation trigger	

distributes complex diagnostic processes and medical decision-making across healthcare organizations (Paul 2006). Although medical care was initially the only justification for telehealth (hence the term *telemedicine* is also used), the scope has expanded to include supporting care-related processes, such as planning, coordination, and education (Bashshur 2000; Bennet et al. 1978). Several studies have reported that telehealth innovations can help rural healthcare institutions provide access to underserved populations by enabling effective management and coordination of health services, by engaging specialists from distant hospitals, and by expanding the geographical area they serve without corresponding increase in costs (Chiasson and Davidson 2004; Singh et al. 2010).

Method

Based on a retrospective analysis of events related to SEHD's telehealth innovation, we interpret organizational practices and arrangements as the cumulative result of how actors responded to internal and external events over a 20-year period. The appendix discusses some of the methodological challenges in conducting a retrospective analysis. Following Yin (2003), we use a case study approach to provide a rich description of events that may help us understand how outcomes evolved over time and how content and context interacted as SEHD underwent several iterations of technology selection, adoption, and integration. We used purposive sampling (Kuzel 1992; Miles and Huberman 1994, p. 27) to select SEHD as our research subject because it represents a rare example of a successful rural telehealth implementation. In fact, out of five pilot sites that started in the early 1990s in the Georgia Statewide Telemedicine Program (GSTP), only SEHD became financially sustainable after the initial subsidies ended. Despite technological, financial, and human resource challenges, SEHD successfully integrated telehealth into its day-to-day operations in innovative ways to sustain and expand health service delivery. As such, the SEHD case provides a unique opportunity to study the constitution of a technological innovation path over time.

Data collection occurred between December 2007 and March 2008, beginning with a visit to SEHD headquarters in southeast Georgia. Over four months, we interviewed key actors associated with the telehealth initiative: administrators, managers, physicians from Medical College of Georgia (MCG), nurses, and IT specialists. We used snowball sampling (Lincoln and Guba 1985, p. 233; Miles and Huberman

Table 2. Data Sources

Semi-Structured Interviews (In-person, unless indicated by "T" which were telephonic) (Total = 25)			
#	**Key Informants**	**Position and duration of engagement with SEHD**	**# Interviews**
1	Ted Holloway	Public health director, SEHD (1972-2005)	1(T)
2	Curtis Brantley	Director, Ware County Children's Initiative (since 1974)	2
3	Manager 1	Public health director, SEHD (since 2005)	2
4	Manager 2	Telehealth program manager, SEHD (2000-2005)	1(T)
5	Manager 3	Telehealth program manager, SEHD (since 2005)	2 + 1(T)
6	Manager 4	Nurse manager, SEHD (since 2002)	1
7	Manager 5	Human resource manager, SEHD (since 2006)	1
8	Physician 1	Chair, Department of Pediatrics, MCG (since 1986)	1
9	Physician 2	Pediatric geneticist, MCG (since 1988)	1
10	Physician 3	Sickle cell anemia specialist, MCG (since 1988)	1
11	Physician 4	Pediatric pulmonology specialist, MCG (since 1988)	1(T)
12	Physician 5	Director, Center for Telehealth, MCG (since 2000)	3
13	Nurse 1	Pediatric pulmonology, SEHD (since 1995)	1
14	Nurse 2	Pediatric genetics, SEHD (since 1995)	1
15	Nurse 3	Pediatric nutrition, SEHD (since 1993)	1
16	Nurse 4	Telehealth service coordinator, SEHD (since 1990)	1
17	Technician 1	Telecommunication network consultant (2000-2005)	1(T)
18	Technician 2	IT specialist, SEHD (since 2006)	1
19	Technician 3	Videoconferencing scheduler, SEHD (since 2007)	1
Field Observations (Total = 4)			
#	***Observation***	***Detail***	***# Observations***
1	Childhood obesity workshop	Nutrition workshop for a small group of obese children at an outreach clinic in SEHD by a remotely located nutritionist	1
2	Pediatric genetics clinic	Genetic counseling for a pediatric patient at an outreach clinic in SEHD by a specialist located at MCG using telehealth	1
3	Staff training session	Continuing medical education for staff nurses located in SEHD's 24 health offices via videoconference	1
4	Session scheduling	Scheduling of videoconferencing sessions for users at any of the 24 health offices	1
Internal and Published Documents (Total = 18)			
#	***Type***	***Details***	***# Documents***
1	Grant applications	HRSA.gov / Office for the Advancement of Telehealth, 2001 (#1H2ATM00293-01)	1
2	Technical specifications	Telehealth network diagrams – 2002, 2005, 2008	3
3	Journal publications	Adams and Grigsby (1995), Karp et al. (2000), Keenan (1999), Sanders et al. (1996), Singh et al. (2010), Stachura (2001), Vought et al. (2000)	7
4	Other documents	Spell et al. (2000), Stachura and Adams (2000), strategic financial plan (2001), personal communications, newsletters, annual reports (2006, 2007)	7

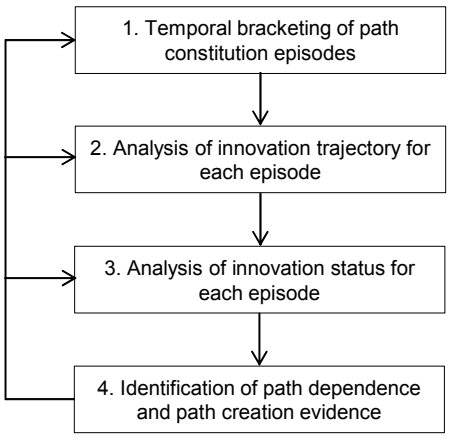

Figure 1. Iterative Steps in Data Analysis

1994, p. 28) to identify key actors who had considerable knowledge of the initiative. In all, we conducted 25 semi-structured interviews (20 in-person and 5 via telephone) with 19 informants (see Table 2). We also conducted direct, non-participant observations of how managers, nurses, nutritionists, and physicians used telehealth in their day-to-day operations. Finally, we reviewed secondary data sources, including grant proposals, technical specifications, published papers, annual reports, and internal communications to triangulate information obtained through interviews. The appendix elaborates our triangulation strategy further.

Following Spradley (1979), we asked open-ended questions about informants' roles and responsibilities, the history and status of the telehealth implementation, and informants' typical interactions with the system. We tailored our semi-structured interview protocol for specific interviewees. For example, we asked the IT specialist about network configurations, telecommunication capabilities, current and planned projects, security risks, and day-to-day technical and other challenges. With consent, we recorded each interview, which typically lasted about one hour. We transcribed the interviews, compiled researchers' notes, verified the transcripts for correctness, and subsequently analyzed the data.

We followed an iterative approach to data analysis (Figure 1). First, we examined SEHD's innovation path trajectory based on a general time-line of events spanning the 20 years. This path examination followed the well-established approach of historical analysis in organizations (Glick et al. 1990; Kieser 1994; Van de Ven and Huber 1990). A description of the resulting chronology, the relevant antecedent conditions and outcomes, and implications for management are discussed elsewhere (Singh et al. 2010). This temporal bracketing provided an initial understanding of how the trajectory unfolded, which was then iteratively refined through discussions and careful re-reading of interview transcripts and researchers' notes. Eventually, we identified seven episodes that reflect how SEHD's innovation path constituted in response to triggering events (Table 3). We then conducted a trajectory analysis for each episode by identifying the innovation trigger (internal or external), analyzing SEHD's response mode (deliberate, emergent, or mixed), and considering the impact on path constitution (reinforcing or transforming). Next, we examined SEHD's innovation path status by iteratively reflecting on the case data and identifying important innovation characteristics related to each episode. This process revealed three attributes of SEHD's innovation path status: *core* (the nature and current configuration of the technological innovation); *scope* (how and where the innovation was used in day-to-day operations); and *resources* (the available knowledge, financial support, relationships, and management practices that shaped technology usage and sustained the overall innovation process).

Finally, we analyzed the episodes for evidence of path creation and path dependence. For these analyses, we drew on Garud and Karnøe (2001) to consider the role of human agency in transforming existing practices and arrangements, and on Sydow et al. (2009) to consider increasing returns from existing practices and arrangements, switching barriers, and possible lock-ins.

Case Analysis

Based on the initial conceptualization, we now present our case analysis of telehealth constitution at SEHD. First, we briefly describe the relevant antecedent conditions at SEHD

Table 3. Key Episodes in SEHD's Telehealth Innovation (1988–2007)

Key Episodes	Innovation Trigger	Response Mode	Constitution Impact
1. *Establishing outreach clinics in collaboration with MCG to provide specialty medical access in 1988*	• Lack of physicians to address the unmet demand for specialty pediatric consultations in rural Georgia (external) • Patients had to travel up to four hours to see specialists at MCG (external)	Deliberate	Transforming
2. *Joining GSTP, the statewide telehealth network in 1993*	• In 1992, Georgia mandated a statewide telecommunications network to support telehealth (external) • Some specialists were reluctant to travel frequently for in-person consultations at SEHD clinics (external) • Long wait times at SEHD clinics for patients to meet specialists (internal)	Mixed	Transforming
3. *Limited expansion of telehealth-based medical services in 1995*	• GSTP network expanded to connect three SEHD offices; still, other health offices within SEHD had no access to MCG specialists (internal)	Emergent	Reinforcing
4. *Breaking from GSTP and creating independent telehealth network (STP) in 2000*	• Subsidy for GSTP network expired, doubling SEHD's telecommunications costs (external) • GSTP network was ineligible for federal telecommunication subsidies (external) • GSTP network architecture limited SEHD's connection with all its health offices and with regional hospitals other than MCG (external)	Mixed	Transforming
5. *Expansion of telehealth-based medical services in 2002*	• Growing demand to provide specialty services across SEHD's health offices (internal) • Need to connect with other regional hospitals for specialty consultations (internal) • SEHD was locked-in to the existing technology configuration (internal)	Deliberate	Reinforcing
6. *Connecting all health offices via telehealth after Hurricane Katrina in 2005*	• Hurricane Katrina caused sudden spike in gas prices (external) • High travel costs restricted visits by nurses and nutritionists to distant patients (internal)	Emergent	Reinforcing
7. *Moving beyond telehealth-based medical services in 2007*	• Opportunity to improve service delivery across all health offices by using the STP infrastructure in new and innovative ways (internal)	Deliberate	Transforming

that acted as a precursor to the innovation path. Next, we provide a comprehensive account of how the innovation path constituted through seven episodes over two decades (from 1988 to 2007) as SEHD implemented telehealth as an integral part of its health services delivery. Subsequently, we provide evidence of how path dependence and path creation manifested along SEHD's innovation path.

In the 1970s, southeast Georgia had limited access to clinical specialists, including neurologists and pediatricians. As a result, patients often had to travel up to four hours to tertiary hospitals, such as MCG. Emphasizing the need for local access to specialists, Dr. Holloway, SEHD's public health director, said:

> In SEHD, we had very few specialists and subspecialists. Our early intervention program needed a multidisciplinary team with a pediatric nutritionist, occupational therapist, a speech therapist, neurologist, pediatrician and we didn't have those folks in the community.

To improve public health delivery in the region, Dr. Holloway collaborated with Mr. Brantley, a local business leader.

In the late 1970s, Holloway visited Alaska to meet his physician brother and had the opportunity to see firsthand how telehealth benefitted remote communities. This fortuitous experience encouraged Holloway and Brantley to consider using telehealth to provide local access to specialists. However, at this point, SEHD did not have the resources or expertise to do so.

Innovation Path Constitution at SEHD

Table 3 summarizes the key episodes in SEHD's innovation path constitution. These episodes reveal how SEHD responded to various innovation triggers, the particular response modes involved, and the impacts of these responses on the constitution of the innovation path over time.

Episode 1: Establishing Outreach Clinics to Provide Specialty Medical Access

To address the unmet demand for pediatric specialties in rural Georgia (Karp et al. 2000), Holloway and Brantley established the Diversified Agencies Involved in Serving Youth (DAISY) Clinic in 1988. The Clinic provided school-based health services in the region. Brantley helped build alliances with community partners who provided financial and infrastructural support for the Clinic beyond an initial grant from the Robert Wood Johnson Foundation. Once the physical infrastructure was ready, Holloway and Brantley created a formal collaboration arrangement with MCG specialists to conduct in-person outreach clinics. To begin, they established two outreach clinics for pediatric specialties: one for pulmonology (primarily to treat acute asthma cases) and another for genetics (primarily to treat sickle cell anemia cases). The outreach clinics transformed SEHD's innovation path, allowing it to deliver specialty consultations locally without the patients needing to travel to MCG. Although the clinics were not telehealth-based (hence the link to MCG in Figure 2 shown by dotted line), they had a significant impact on the innovation path's core and scope by transforming the existing model of health service delivery. The innovation's core enabled telehealth as an extension and improvement of SEHD's service delivery arrangement with MCG specialists, and the buildup of financial, community, and staff resources supported the innovation. However, the MCG specialists, who now had to drive up to 185 miles to the clinics, were reluctant to travel frequently for in-person consultations. Consequently, the wait times increased significantly, with patients having to wait up to three to four months to get an appointment. The circumstances forced Holloway and Brantley to consider telehealth seriously.

Episode 2: Joining GSTP, the Statewide Telehealth Network

In March 1992, the state of Georgia passed a law that mandated a statewide telecommunications network to support telehealth, leading to the creation of GSTP in collaboration with MCG. Remembering his brief exposure to telehealth in Alaska, Holloway responded immediately to this unexpected opportunity. He attended a planning conference for the GSTP program in Atlanta in late 1992, which firmed up his resolve to implement telehealth. Brantley reflected on their thinking:

> How can we get specialty care to people that really need it without them having to travel to consult with a specialist located far away? That was the thinking behind how it all started. Somebody at the conference mentioned—here is a new technology, and here is an opportunity. Dr. Holloway said, "I want it."

Holloway and Brantley negotiated for SEHD to become one of five pilot sites. Telehealth service actually started when SEHD connected to the GSTP hub at MCG via a T-1 line in December 1993. Holloway and Brantley realized that by joining the network, SEHD could more efficiently provide care to patients. Hence, SEHD's service delivery transformed by allowing patients to interact with remote specialists on a regular basis through the addition of requisite technology to SEHD's innovation core (including diagnostic cameras, videoconferencing and networking equipment, personal computers, as well as specialized adapters for equipment such as telephonic stethoscopes used for pediatric pulmonary examination). SEHD also expanded its innovation scope with new specialty consultations (initially pediatrics) while continuing outreach clinics at regular, albeit reduced, intervals. Consequently, SEHD started to build important innovation resources: the staff got first-hand experience in using the telehealth system; a state subsidy reduced monthly telecommunication costs by 50 percent; and although the GSTP network connected to only one node (at SEHD headquarters), the technical and infrastructural support from GSTP afforded SEHD increased access to telehealth-based medical services.

Episode 3: Limited Expansion of Telehealth-Based Medical Services

In 1995, the GSTP network expanded to connect three health offices within SEHD (Figure 2). This helped SEHD intensify its collaboration with MCG and expand its innovation scope to provide consultations more frequently. Karp et al. (2000) reported 333 telehealth consultations between December 1995

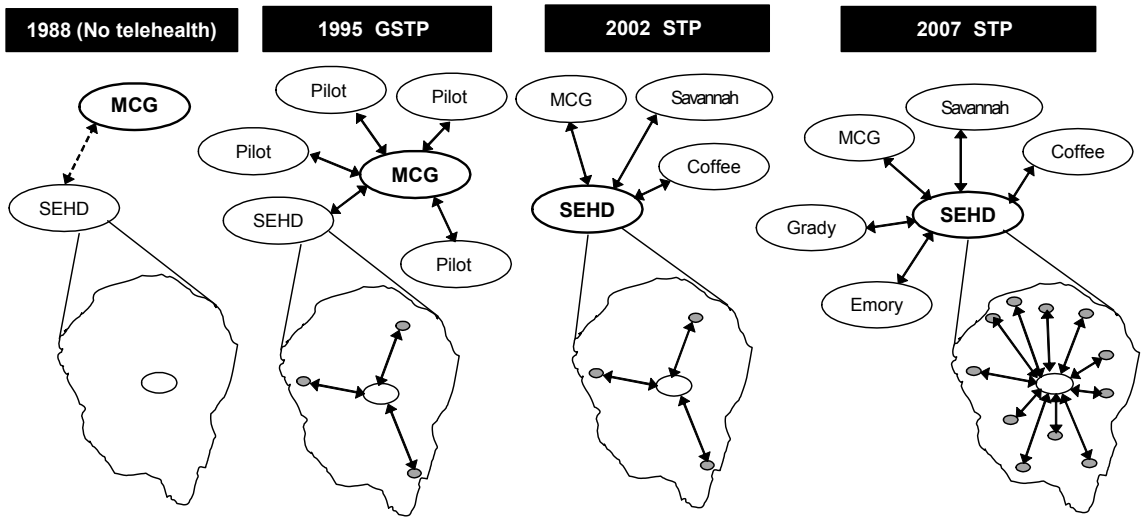

Figure 2. Evolution of SEHD's Telehealth Network

and May 1997, as compared to about one consultation per month previously. As SEHD increasingly relied on MCG specialists to provide the consultations, it also utilized these relationships to improve the clinical skills of its nursing staff and local physicians, thereby continuing to strengthen its innovation resources. A pediatric pulmonologist at MCG noted the impact of this development:

> The local therapy has improved over the years. In the first five years of telehealth implementation, ER visits by children with asthma attacks reduced by over 30 percent.

Although these expansions improved medical services in the region, they reflected reinforcement of the existing innovation path, particularly as the GSTP network architecture only allowed connection to a small number of nodes (thereby limiting telehealth implementation to only three health offices) and did not allow connections to any other regional hospital (except MCG).

Episode 4: Breaking from GSTP and Creating Independent Telehealth Network (STP)

Although telehealth had allowed SEHD to expand its innovation scope and strengthen its innovation resources, the GSTP-based innovation core provided no flexibility in the choice of technology and expansion of the network. In 1999, the state subsidy expired, doubling the telecommunication costs for all five GSTP pilot sites in Georgia. Moreover, the Georgia Department of Administrative Services' ownership of the GSTP network made individual sites ineligible to receive telecommunication costs relief from the federal Universal Services Fund. In Brantley's words, this was the tipping point. The loss of the state subsidy and ineligibility for federal support made all GSTP pilot sites financially unviable. Therefore, although the GSTP network was a clinical and technical success, this external shock forced SEHD to reevaluate its current innovation path.

In 2000, with financial support from a federal grant, Holloway and Brantley established an independent telehealth network, Southeast Telehealth Partners (STP), a private, secure network based on Internet Protocol, Cisco routers and switches, and Polycom videoconferencing equipment (that relied on H.323 standard). The network used Integrated Services for Digital Network (ISDN) communication standards for simultaneous digital transmission of voice, video, and data. Although the STP network was not web-based, it was scalable and allowed SEHD to connect additional offices. This transformed the innovation core and allowed SEHD to become a hub in its own network, connecting to MCG and the same three offices as in the earlier Episode (Figure 2). Based on

the new arrangement and the increased control over infrastructure, SEHD expanded the innovation scope further by offering consultations for additional specialties, including pediatric immunology, pulmonology, neurology, and genetics. It added significant innovation resources by hiring a program manager and a telecommunication consultant to manage and customize the growing network. The STP network also gave SEHD greater access to financial resources for expansion through grants from the federal Office for the Advancement of Telehealth. Further, STP's independent structure and rural location made it eligible for Universal Services Fund subsidy. SEHD negotiated directly with its regional telecommunication services provider (which was not possible in the GSTP network) and reduced its telecommunication costs by 75 percent. Once the transition to the STP network was complete, SEHD severed ties to GSTP but maintained its relationship with MCG. Thus, increased control over its network allowed SEHD to expand its telehealth services.

Episode 5: Expansion of Telehealth-Based Medical Services

In 2002, Brantley and Holloway negotiated with two regional hospitals (Savannah Perinatology Associates in Savannah and Coffee Regional Medical Center in Douglas) to provide telehealth clinics for level-II (comprehensive and detailed) ultrasound evaluations. This move allowed SEHD to meet the increasing demand for high-risk obstetrics and perinatal care, resulting from a general trend of specialization in medicine (Cassel and Reuben 2011; Detsky et al. 2012) and a growing migrant population in the region. This network expansion enabled widening of the innovation scope through the inclusion of telehealth consultations for high-risk obstetrics and perinatal care. Still, expert consultations for some specialties were either not available to patients or the wait times were long. Hence, there was a need for additional services and network expansion:

> We had an infectious disease specialist position in our district that was funded by the State (of Georgia), but she could not be in sixteen places at one time. [Manager 2]

> We are a large rural health district, serving an area the size of New Jersey. In addition, we have a large Hispanic population. With a large migrant population, we also have high incidence of HIV cases. [Manager 3]

In 2003, SEHD received additional funding from the Office for the Advancement of Telehealth, which provided resources for network expansion, including adding telehealth links to Emory Hospital in Atlanta for HIV consultations and to Grady Hospital in Atlanta for infectious disease consultations. Thus, the telehealth connection to the four regional hospitals made it possible for STP to connect beyond MCG, which significantly enhanced the innovation scope. The network expansion also enabled telehealth-based HIV consultations through five wellness centers within SEHD, thereby fulfilling a growing need for HIV and infectious disease specialists in the region. A federal grant provided financial resources for these expansions. SEHD also added telehealth-based nutritional and lactation consulting at three health offices. By mid-2005, the STP network connected patients and staff at 16 of SEHD's offices. The telehealth program manager explained its impact:

> We added additional health offices into the network that enabled them to offer children's services and adult sickle cell, and it also enabled us to provide infectious disease services to those offices. [Manager 3]

Over time, the technical skills (e.g., learning how to operate the telehealth system) of the nurses and support staff improved, which further stimulated network usage for telehealth consultations. As a result, the number of such consultations increased four-fold: from 250/year in 2000 to 1000/year by 2005. Another important development was that SEHD enhanced its innovation core by integrating the telehealth network with its internal IT network, thus laying the foundation for experimenting with how the network could support nonmedical purposes.

Episode 6: Connecting All Health Offices Via Telehealth After Hurricane Katrina

After Holloway retired in early 2005, SEHD's new director hired additional staff, including a dedicated program manager, to explore and grow the potential of telehealth. In the fall of 2005, Hurricane Katrina struck, causing a sudden spike in gas prices. This external event led to almost doubling the travel costs for the nutritionists, nurses, and other medical staff. Since the state budget did not allocate any funds to cover this cost, SEHD had to bear the burden. The program manager stated:

> When Hurricane Katrina hit, it affected public health delivery in Georgia too. SEHD covers an area of 8,000 square miles. Earlier, nutritionists, nurse practitioners, and other medical staff doing follow-ups would travel about 2.5 hours each way to see a patient at a clinic. The increased cost of travel nearly crippled us.

The resulting financial pressures affected day-to-day activities such as staff education, training, and administrative meetings as well as essential services such as environmental health and infectious disease management and follow-up. In response, the new director reassessed SEHD's health delivery and decided to reduce travel costs and serve patients more efficiently by extending telehealth to of all its 24 health offices. She explained:

> We had to seek new ways to stay in business. It became clear that expanding the STP network to all counties would enable our staff to deliver health services without the travel and costs associated with it.

This expansion changed SEHD's innovation core once again and had some immediate impacts. For example, Manager 3 estimated that telehealth had saved more than 56,000 miles of travel in 2006–2007. The expansion allowed SEHD to increase the innovation scope by developing a portfolio of telehealth services (such as environmental health and infectious disease management) for patients near any of its health offices. Additional federal grants supported these developments. To manage the increased network usage, SEHD implemented a scheduling system and hired a dedicated scheduler to coordinate communication among the remotely located staff. SEHD could now focus on developing its telehealth operation and nurturing its relationships with all five partnering hospitals and their specialists.

Episode 7: Moving Beyond Telehealth-Based Medical Services

After SEHD completed the STP network expansion in early 2007, it began to focus on finding innovative ways to use the infrastructure for nonmedical purposes. As the following quotes suggest, the innovation scope increased as nurses, managers, and other staff began to use the network for day-to-day coordination, reporting, program updates, continuing medical education, protocol sharing, recruitment, and training:

> We use the telehealth network to do all kinds of emergency preparedness training, such as for flu epidemic, bio-terrorism, and emergency infection handling. We also use the system to provide educational resource for the community. [Manager 1]

> We also use the STP infrastructure for continuing education units for nursing staff. The meetings are mixed with educational programs, such as updates for Tuberculosis. [Manager 4]

> We used the telehealth system for coordination and communication during the wildfires last summer (2007) in southeast Georgia and northern Florida. [Manager 1]

Although SEHD's innovation core (the telehealth technology and network configuration) remained stable from 2007 onward, its innovation scope continued to widen as network utilization evolved. Nearly 85 percent of the network traffic in 2008 resulted from nonmedical services. However, the increase in nonmedical services did not imply a decrease in medical specialty consultations; instead, it reflected new ways in which SEHD used telehealth. For instance:

> We use the system to interview nurses located at remote locations. Now I can be at a nursing interview on the other end of the district. [Manager 4]

> We use the system for HR (human resources) training. [Manager 5]

The innovation resources continued to strengthen as managers and nurses became skilled telehealth users, and patients and specialists adjusted to telehealth-based service delivery. Further, an onsite IT team (consisting of a manager and three technicians) conducted routine network maintenance and an Ohio-based vendor provided remote network support. Table 4 summarizes the innovation path status (core, scope, and resources) related to the seven episodes identified above.

Evidence of Path Dependence and Path Creation

This detailed account of innovation path constitution at SEHD reveals instances of path dependence and path creation. For path dependence, we looked across episodes to examine whether self-reinforcing mechanisms over the considered 20-year period led SEHD into a lock-in with limited options to transform established practices and arrangements (Sydow et al. 2009). For path creation, we examined whether the response mode of each episode involved deliberate actions and had a transforming impact on the constitution of the path (Table 3). We also examined whether the episode resulted in a path status with significant expansion in innovation core, scope, or resources (Table 4). These characteristics would signify that actors at SEHD had actively shaped the path by mindfully deviating from existing practices and arrangements to sample new experiences, explore new options, and create new resources (Garud and Karnøe 2001; Swanson and Ramiller 2004). Following this logic, our empirical analyses uncovered one instance where SEHD became path-dependent, that is, it experienced a lock-in from which it later managed to break out (period between Episodes 2 and 4). The analyses also revealed several instances of path creation (Episodes 1, 2, 4, and 7). Table 5 summarizes the observations on path dependence and path creation.

Table 4. Innovation Path Status Related to Key Episodes

Key Episodes	Innovation Core	Innovation Scope	Innovation Resources
1. *Establishing outreach clinics in collaboration with MCG to provide specialty medical access in 1988*	• Local patient access to MCG specialists (without telehealth)	• Monthly consultations for pediatric asthma and sickle cell anemia	• Financial support from Robert Wood Johnson Foundation grant • Long-standing relationship with MCG • Support of local schools, businesses, and churches • A pediatrician and operational staff
2. *Joining GSTP, the statewide telehealth network in 1993*	• Specialized hardware and software for remote consultations • Telehealth linkage added to one outreach clinic	• Patients consulted with specialists with reduced travel and wait times • Specialists provided remote and in-person consultations	• Financial support from the state • GSTP's infrastructure and technical support • Relationship with MCG specialists • Telehealth knowledge and practices
3. *Limited expansion of telehealth-based medical services in 1995*	• Telehealth services at three health offices (all connected to hub at MCG)	• More frequent telehealth consultations for pediatric asthma and sickle cell anemia	• GSTP's infrastructure and technical support • Expanded relationship with MCG specialists • Improved clinical skills of SEHD nursing staff and local physicians
4. *Breaking from GSTP and creating independent telehealth network in 2000*	• SEHD became a hub, connecting three health offices and MCG • Disconnected from GSTP network	• Telehealth consultations with MCG specialists for pediatric immunology, genetics, pulmonology, and neurology patients	• Financial support from federal grant • New STP telehealth infrastructure • Telehealth program manager and telecommunication consultant • Relationship with MCG specialists • Telehealth knowledge and practices
5. *Expansion of telehealth-based medical services in 2002*	• Telehealth linkages to four regional hospitals • 16 health offices connected via telehealth	• Telehealth consultations in additional specialties (high-risk obstetrics, perinatal care, HIV, infectious diseases, nutrition, and lactation)	• Financial support from federal grant • Relationship with specialists from MCG and four regional hospitals • Improved clinical and technical skills of SEHD nursing staff
6. *Connecting all health offices via telehealth after Hurricane Katrina in 2005*	• 24 health offices connected via telehealth	• Telehealth system used for environmental health and infectious disease management	• Financial support from federal grant • Relationship with specialists from partnering hospitals • A scheduler to manage increased telehealth interactions
7. *Moving beyond telehealth-based medical services in 2007*	• 52 computer terminals across 24 offices connected via telehealth	• SEHD staff used telehealth network for coordination, reporting, continuing medical education, recruitment and training	• Financial support from federal grant • IT manager and three technicians to manage routine network operations • Ohio-based vendor for remote network support • Improved telehealth-related skills of SEHD managers and nurses

Table 5. Path Dependence and Path Creation Observations at SEHD

Path Dependence	Path Creation
Limited expansion of telehealth-based medical services between 1993 and 2000 (period between episodes 2 and 4)	• Establishing outreach clinics in collaboration with MCG to provide specialty medical access in 1988 (episode 1) • Joining GSTP, the statewide telehealth network in 1993 (episode 2) • Breaking from GSTP and creating independent telehealth network in 2000 (episode 4) • Moving beyond telehealth-based medical services in 2007 (episode 7)

The constitution of telehealth innovation between episodes 2 and 4 reveals how SEHD became increasingly path dependent. Although SEHD initially benefitted by joining the GSTP network, the technical and organizational configuration of the state-sponsored network gradually led to decreased innovation options. Because SEHD had limited prior operational experience and independent technological infrastructure, and because there were few viable alternative options, it had to rely on the GSTP network for a considerable period (1993–2000). The GSTP network afforded SEHD little flexibility (for example, in choice of technology and available bandwidth, GSTP used legacy T-1 data circuits that limited transmission rates to 1.544 megabits per second) and scalability (it only allowed connections to three nodes, whereas SEHD had 24 health offices in need of telehealth services). Nonetheless, GSTP offered attractive and affordable access to telehealth expertise and connectivity to MCG, and these options allowed SEHD to provide telehealth-based services. However, as the range of innovation options narrowed and the process became increasingly irreversible, SEHD experienced a lock-in with a restricted innovation core that provided no opportunity for telehealth expansion. Later, the constitution of telehealth innovation during episodes 5, 6, and 7 also presented some limitations that could potentially have led to path dependence. For example, STP was not web-based and the switching barriers (including the cost and effort to transition to a new system) were high. Nevertheless, during episodes 5, 6, and 7, SEHD did not enter into a lock-in because it had control over the network configuration and operation, it could connect to (or disconnect from) partners at will, and it could exercise options to expand telehealth-based services according to changing requirements.

Four episodes (1, 2, 4, and 7) reflect path creation, as the involved actors took deliberate, mindful actions in response to internal or external events and continued to respond to local healthcare needs. The establishment of outreach clinics (episode 1) resulted in an innovation path status that significantly increased SEHD's options to provide specialty consultations locally without the patients having to travel to MCG. Although not yet technology-enabled, the outreach clinics made the adoption of telehealth a feasible next step. Similarly, joining the GSTP network (episode 2) increased SEHD's options to have patients interact with remote specialists regularly and make the specialists more readily available for consultations. Later, Holloway and Brantley created the STP network (episode 4), which significantly increased SEHD's options to provide telehealth-based clinical services. Having control over the technological infrastructure allowed SEHD to build new relationships with regional hospitals and to engage specialists as needed. The scalability of the STP network allowed SEHD to connect additional offices and develop routines for accomplishing tasks such as scheduling consultations, training, and recruitment. Finally, SEHD moved beyond telehealth-based clinical services by using the telehealth infrastructure to support collaboration and education (episode 7). This path creation enabled SEHD to expand its current scope of administrative and medical telehealth services.

Discussion and Theory Development

Whereas the foundational conceptualization helped us examine path constitution related to telehealth innovation at SEHD, the empirical analysis enabled us to elaborate the concepts and develop new theory. A comparison of our empirical findings and prior literature provides some immediate insights. First, consistent with prior work in path constitution, we found that both history and human agency entangled to shape technological innovation paths. Second, as observed in prior literature, we found that the interaction between technological characteristics and organizational dynamics shaped the progress of telehealth innovations at SEHD. Third, in contrast to Meyer and Schubert's (2007) conceptualization of path constitution as a continuum with emergent decisions on one end and deliberate decisions on the other, our analysis revealed that emergent and deliberate responses to innovation triggers intertwined to jointly constitute innovation paths. Fourth, as a new insight, we observed how internal as well as external triggers shaped the observed technological innovation path. Finally, our analysis suggests the constitution of technological innovation paths manifest as combinations of predetermined patterns consistent with life-cycle models of change as well as emergent patterns consistent with teleological models of change (Van de Ven and Poole 1995). In the following, we elaborate on these insights to advance a new theory on organizational path constitution in technological innovation.

Our empirical analysis revealed three key attributes of technological innovation path status: the nature and configuration of the material technology (core); the use of the technology in day-to-day operations (scope); and the resources that enabled and sustained the use of the technology (resources). We found these attributes changed throughout the study period. For instance, SEHD's innovation core changed when it became a pilot site of the GSTP network, thereby extending the innovation scope to provide telehealth-based medical services in the region for the first time. SEHD's acquisition of innovation resources (financial support from the state, technological and infrastructural support from GSTP, and availability of telehealth knowledge and practices) enabled these changes to the innovation core and scope. These path status

attributes, adapted from Dosi's (1982) macro-level conceptualization of technological innovation paradigm, were helpful in revealing differences in the way the innovation path constituted over time (Table 4). Future research may verify whether these attributes are similarly helpful when applied to other technology innovations and organizational contexts, or whether other attributes may prove more salient under different conditions. In the context of this study, the three path status-related characteristics described the innovation adequately. Therefore, we posit:

> ***Proposition 1****: The status of a technological innovation path can be adequately described by the innovation core, the innovation scope, and the innovation resources at a specific point in time.*

This proposition raises the question of how the innovation core, scope, and resources may influence the innovation path trajectory. Focusing first on the reinforcement of the trajectory, we consider the unfolding of SEHD's innovation path from episode 2 to episode 3. As summarized in Table 4, the network connectivity to MCG made it possible to expand the innovation scope by providing more frequent telehealth consultations for pediatric asthma and sickle cell anemia. The access to innovation resources (financial support from grants, technological and organizational infrastructure support from GSTP, and existing relationships with MCG) made SEHD realize it could exploit the potential of the innovation core by connecting three health offices to the network and enhance the scope of its health services. Thus, unrealized innovation core and innovation scope options combined with the availability of requisite innovation resources allowed SEHD to reinforce its current innovation path trajectory. Next, consider the unfolding of SEHD's innovation path from episode 4 to episode 5 (Table 4). SEHD exploited the innovation core and innovation scope generated after the creation of the STP network during episode 4 by extending the technology to connect to 16 health offices during episode 5 and using the network to provide telehealth consultations for additional specialties such as high-risk obstetrics, perinatal care, HIV, infectious diseases, nutrition, and lactation. The availability of innovation resources (federal grants, relationships with MCG and regional hospitals, program manager and telecommunication consultant) reinforced SEHD's innovation trajectory during episode 5.

Turning to how the innovation core, scope, and resources may influence the transformation of the innovation path trajectory, we first consider the unfolding of the path from episode 1 to episode 2. The availability of MCG physicians at SEHD outreach clinics in episode 1 created an innovation core that expanded the scope of services (e.g., pediatric asthma and sickle cell anemia consultations). However, SEHD could not provide many types of health services because physicians from a number of specialties had not agreed to visit. Given its current infrastructure, SEHD had reached a limit for which services it could offer. Against that backdrop, telehealth afforded an immense opportunity to transform the current trajectory, enabling SEHD and MCG staff to provide services without being physically present and engaging additional physicians of different specialties. Such a move would radically increase SEHD's scope of services. Next, consider the unfolding of SEHD's path from episode 3 to episode 4 (Table 4). Because the GSTP network only allowed connection to a limited number of nodes (episode 3), SEHD could not implement telehealth at its remaining offices, nor could it access additional medical specialties through connections to other regional hospitals. Having realized and exhausted the innovation options afforded by the current innovation core and scope, and triggered by adverse changes in financial support, SEHD broke away from the current trajectory to develop the independent STP network (episode 4). This path transformation provided SEHD new options to connect its many health offices as well as to engage additional physicians of different specialties from MCG and other regional hospitals.

As Table 4 shows, SEHD's innovation path was triggered by a variety of events, sometimes requiring SEHD to mobilize additional innovation resources (e.g., episode 2) and at other times exploiting available resources (e.g., episode 7). These empirical patterns may be explained by drawing on options thinking in innovation and path theory: As organizations respond to internal and external events, the availability of actionable options (Sandberg et al. 2014; Sydow et al. 2009) for the current innovation path status influences whether the path trajectory is reinforced or transformed. Hence, we suggest the following propositions on how path status characteristics influence innovation path trajectory:

> ***Proposition 2:*** *The likelihood that the trajectory of a technological innovation path is reinforced increases when some innovation core or innovation scope options remain unrealized and the organization has slack innovation resources.*

> ***Proposition 3:*** *The likelihood that the trajectory of a technological innovation path is transformed increases when an organization has realized all of its innovation core and innovation scope options.*

Our analysis also revealed new insights into how different organizational paths interacted. There were several instances where distinct innovation paths merged into a consolidated path. For instance, Holloway and Brantley's decision to become a pilot site of the GSTP network (episode 2) effectively merged two paths—a state-wide path of telehealth innovation

(GSTP) and SEHD's own path of outreach clinics with MCG—which up to that point had unfolded independently. The merger led to enhanced innovation status in which SEHD gained access to the GSTP telehealth network (core) and the outreach clinics benefitted from available grant funding and established connectivity to MCG (resources). Furthermore, it became possible for SEHD to deliver specialty consultations (scope) that were not feasible earlier. Similarly, during episode 5, SEHD's new STP infrastructure made it possible to connect beyond MCG to four additional hospitals. The merger of SEHD's innovation path (with that of the four hospitals) created an innovation path status whereby it could access new and hitherto unavailable medical specialties. This merger also provided access to knowledge and infrastructure within these hospitals that could complement SEHD's existing resources to address local health needs. These examples suggest that, although different paths may not be entirely congruent, organizations may merge paths to gain access to complementary resources that will enable them to surmount current limitations and explore additional innovation options. Indeed, merging of disparate paths can lead to resource complementarities (Bianchi et al. 2014; King et al. 2003) that may enhance the value of an organization's existing resources and allow it to stimulate innovation by combining resources (such as technological, financial, human, and clinical) in novel ways.

At times, SEHD's innovation path also separated itself from other organizational paths. The GSTP pilot program required little financial investment, but offered SEHD no control over network configuration. In 1999, SEHD realized that, in addition to the inherited technological limitations of the GSTP network, it also faced negative financial implications (such as expiry of state subsidies and ineligibility for a federal telecommunication subsidy). These limitations forced SEHD to consider other options, including creating an independent telehealth network (episode 4). Staying with GSTP would have meant continuing with a network configuration that did not meet SEHD's growing needs and provide the same innovation opportunities as an open network structure. Therefore, SEHD separated from the GSTP path (which continued to unfold at other sites) and gradually expanded the STP network to all of its health offices and additional regional hospitals. This option was fraught with risk because SEHD had limited financial resources and no experience in managing a telehealth network. However, the STP network gave SEHD requisite control to choose an appropriate technology, select an established vendor for videoconferencing hardware, expand the network to other sites, link to new medical partners, and outsource network support.

These empirical observations are consistent with Garud et al.'s (2002) perspective on how technological structuring of an organization constitutes through multiple, interrelated paths. Our findings are also consistent with prior research elucidating how organizations seek complementary resources to facilitate innovation success based on collaboration (Harrison et al. 2001; King et al. 2003). Moreover, the findings are supported by widespread industrial practices related to outsourcing, in which organizations may have to separate their current technological innovation paths into distinct trajectories (Lacity and Hirschheim 1993), and to mergers and acquisitions, in which integration of separate technological paths is a major challenge (Alaranta and Mathiassen 2014; Robbins and Stylianou 1999). In fact, the continuous and frequent changes in the technology and business landscape in which organizations operate (Tanriverdi et al. 2010) makes it increasingly important to adopt a dynamic, multipath perspective on technological innovation. Hence, we propose the following:

> ***Proposition 4:*** *An organization will more likely merge its technological innovation path with another innovation path when strengths in the inherited path status offer innovation options that overcome current weaknesses.*
>
> ***Proposition 5:*** *An organization will more likely separate its technological innovation path from another innovation path when vulnerabilities in the inherited path status jeopardize available innovation options or increase the likelihood of a lock-in.*

Our analysis of path constitution at SEHD did not reveal a linear process with preconceived stages and predictable response patterns. However, life-cycle models have come to dominate the path literature (Mahoney 2001; Meyer and Schubert 2007; Sydow et al. 2009). For example, Meyer and Schubert (2007) focus on how paths constitute through different stages and modes (generation stage of emergence and creation, continuation stage of persistence and extension, and termination stage of dissolution and breaking). This conceptualization offers limited insights into how the changing state of an innovation conditions its continued path, making it more difficult to reveal the processes, opportunities, and challenges related to a particular technological innovation path, and, in turn, making it more difficult to explain observed innovation path trajectories. Moreover, Meyer and Schubert's conceptualization would imply that SEHD's technological innovation path terminated and a new and different path started at episode 4. Such an interpretation gives priority to discontinuities in technological configurations over continuity in the organizational arrangements that fueled the innovation at SEHD, in effect suggesting an unfortunate separation between the technological and social aspects of innovation.

Life-cycle models embed change into their basic structure, that is,

> the developing entity has within it an underlying form, logic, program, or code that regulates the process of change and moves the entity from a given point of departure toward a subsequent end that is prefigured in the present state (Van de Ven and Poole 1995, p. 515).

In contrast to such prescriptive theorizing, constructive theorizing relies on teleological models of how entities change through deliberate action (Van de Ven and Poole 1995). While SEHD arguably followed a staged process initially toward a lock-in (until episode 4), we did not find other evidence that SEHD followed a prescribed, linear process over the entire 20-year period. Thus, there are arguments both for prescriptive theorizing of organization-level path dependence based on life-cycle models (Sydow et al. 2009) as well as for constructive theorizing of path creation based on teleological models. To combine path dependence and path creation perspectives, path constitution theorizing should therefore rely on constructive theorizing—by keeping the door open for the engagement of powerful collectives of actors (Garud and Karnøe 2001)—while, at the same time, accommodating periods in which the organization becomes increasingly path dependent following a prescriptive life-cycle logic (Sydow et al. 2009). Accordingly, we posit:

> ***Proposition 6:*** *Technological innovation paths constitute as unpredictable and discontinuous trajectories that may follow prespecified life-cycle patterns during periods when they become increasingly path dependent.*

Conclusion

Our research makes important contributions by presenting a new theory of technological innovation paths based on a detailed investigation of 20 years of telehealth innovation at SEHD. Our theorizing extends the emerging literature on path constitution (Meyer and Schubert 2007; Sydow et al. 2012a) and follows Van de Ven's (2005) suggestion to integrate path dependence and path creation perspectives. Focusing on the organizational level of analysis and drawing attention to the context in which a path unfolds, we investigated how technological innovation paths constitute in response to triggering events. The proposed theory distinguishes between path trajectory and path status to help researchers understand and explain how organizations engage in transforming and reinforcing a path; how innovation paths may merge with or separate from other paths; and how organizations may arrive at a lock-in that challenges them to break out from dominant and seemingly irreversible action patterns.

In practical terms, our research can sensitize managers to understand how technological innovations develop based on past actions and contexts and the involved actors' mindful decisions to create new technologies and institutions. Managers can use this knowledge to develop and implement strategies that transform existing artifacts, structures, and practices through the assimilation of technological innovations. Specifically, by following the framework laid out in this research, managers will be able to analyze innovation paths in terms of path status characteristics, triggering events, and consequential reinforcing and transforming influences on organizational practices and arrangements. Linking path status attributes to consequential path constitution influences, managers may assess whether the organization's innovation characteristics are consistent with organizational needs; whether the organization is using the innovation to its fullest potential; and whether the organization is supporting the innovation with sufficient resources. Moreover, the theory allows mangers to consider when different innovation paths may separate and when they may merge to create a stronger innovation path.

Drawing on a single case limits our ability to conduct cross-case comparisons and account for institutional variations (Miles and Huberman 1994; Yin 2003). However, these limitations should be balanced against the advantages of attention to context, dynamics, and multiple stakeholder perspectives (Mason 2002). Our study provided a rich description of the context and process at SEHD to help researchers assess our findings and apply our theorizing to other social settings (Lee and Baskerville 2003; Lincoln and Guba 1985). As a retrospective case study, we based our identification of triggers and other aspects on hindsight. However, to limit the adverse effects of retrospective analyses, we adopted a comprehensive data triangulation strategy and combined it with stakeholder feedback (see the Appendix). Still, we recommend that in future longitudinal studies, researchers attempt to identify triggers as they occur.

Future researchers may apply multiple case study designs to develop the proposed theory of organizational path constitution in technological innovation further; they may implement our propositions in other contexts and empirically test path innovation hypotheses using quantitative data; and they may investigate how different technologies, contexts, and events could lead to disparate innovation trajectories and outcomes. We chose to present path status based on three

attributes: core, scope, and resources. These attributes were useful to our analysis, but other researchers may conceptualize this foundational concept differently. More broadly, researchers may explore the role industry, leadership, structure, and culture play in constituting technological innovation paths in organizational contexts.

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Appendix

Approach to Retrospective Analysis at SEHD

Economists, sociologists, and political scientists have used historical, retrospective analyses extensively, and they are particularly prevalent in the path dependence and path creation literature. Abbott (1988) suggested using historical narratives for the explanation of the temporal order and sequence in which discrete events occur in an organization. Mason et al. (1997) even called for developing a historical tradition in IS research, which can provide a "temporal and contextual meaning" to IS phenomenon (p. 258). As a consequence, many recent technology-related and IS studies have established a historical baseline of events to examine internal and external conditions, organizational actions, and consequent impacts (Berends et al. 2011; Cho et al. 2008; Garud and Rappa 1994; Hanseth et al. 2006; Leonardi 2011; Porra et al. 2005).

However, retrospective analysis has several challenges, including those related to identification and specification of events and to the introduction of recall errors (such as bias) and multiple interpretations during the historical reconstruction of events. It should be noted that events result from researcher interpretations of available empirical material and they are as such theoretical entities distinct from the incidents that actually occurred (Van de Ven and Poole 1990). In our study, we initially created a detailed time-line of events that unfolded over time at SEHD, from the mid-1970s when the earliest data was available to 2008 when we collected primary and secondary data. Once this initial set of events was available, the next challenge involved aggregation of these events into significant episodes that revealed how telehealth had constituted at SEHD during a given period. The final selection of episodes and their characteristics (Table 3 and 4) developed iteratively and by consensus among the three researchers. To address the effects of recall errors and multiple interpretations in these retrospective analyses, we adopted a robust triangulation strategy that improved the validity and credibility of the study (Creswell and Miller 2000; Jick 1979; Lincoln and Guba 1985). Following Denzin (1970), we conducted various types of triangulation:

1. *Data triangulation* refers to using multiple data sources that involve different times, places, and persons. As Table 2 suggests, we conducted 25 interviews (20 in-person and 5 via telephone) of 19 key decision-makers involved with telehealth at SEHD. These interviews took place between December 2007 and March 2008, and most of them occurred at SEHD's headquarters. We interviewed Physicians 1, 2, 3, and 5 in their offices at MCG in Augusta. Although none of the informants had been involved continuously from the mid-1970s when Holloway and Brantley first began to think about telehealth to 2008 when we collected data, we made sure to cover every period by interviewing multiple informants who had direct involvement in SEHD's telehealth innovation. In addition, we made sure the informants covered all of the key roles at SEHD: managers, nurses, staff, physicians, technical people, and dedicated telehealth staff. Triangulations between these different informants filled important details and they corroborated the sequence and effect of various events on SEHD's health service delivery. For example, the MCG specialists provided excellent validation of the events as many of them had

provided consultations at SEHD's outreach clinics even before the adoption of telehealth. All specialists had played a key role in developing and providing telehealth services throughout the considered period, and they were outsiders to the SEHD organization. Thus, getting the specialists' perspective helped us validate the account of SEHD's innovation path. For example, SEHD managers and staff had at times inconsistent views on when different medical services became available and we were able to resolve these by triangulating with data from the MCG specialists.

2. *Methodological triangulation* refers to the use of multiple data collection methods, including interviews, nonparticipant observations, and review of published and internal documents. We used all of these methods at SEHD. In addition to the interviews mentioned above, we conducted direct, nonparticipant observations of how managers, nurses, nutritionists, and physicians used telehealth in their day-to-day operations. These observations helped us understand the use of telehealth for different purposes and they confirmed the intensive use of telehealth technologies for collaboration and educational purposes in addition to supporting health delivery services. Further, many researchers have examined the SEHD case (Adams and Grigsby 1995; Karp et al. 2000; Keenan 1999; Sanders et al. 1996; Singh et al. 2010; Stachura 2001; Vought et al. 2000). We referred to these journal papers, as well as a comprehensive set of internal documents, technical specifications, and published reports to validate details relating to SEHD's innovation path. For example, when our interviews with SEHD managers and staff provided inconsistent data on the sequence and scope of certain telehealth initiatives, we reconciled it with data in SEHD's annual reports and in its grant applications to funding agencies.

3. *Investigator triangulation* refers to using multiple investigators to control or correct subjective bias from individuals. A related publication (Singh et al. 2010) involved four researchers who jointly developed an initial time-line of episodes at SEHD. The current research involves two of the original researchers and a new researcher, who independently and jointly examined the multiple sources of data, and identified and constructed the episodes, triggering events, path status, and path trajectory. Throughout, we discussed and resolved any differences in researcher interpretations by reviewing the multiple sources of available data systematically.

4. *Analytical triangulation* refers to conducting multiple analyses of the same data. We adopted this approach instead of Denzin's (1970) theoretical triangulation—that is, approaching data with multiple perspectives in mind, but which, as Mathison (1988) suggests, is "problematic at best, and likely impossible in reality" (p. 14). As discussed in the "Case Analysis" section, we iteratively conducted an analysis of the innovation path trajectory (to identify and characterize key episodes) and an analysis of innovation path status (to identify path-related characteristics resulting from each episode). These two analyses complemented and informed each other, and together they provided validity for our theorizing.

Finally, we sought feedback on our interpretations from key stakeholders (Miles and Huberman 1994; Yin 2003) to confirm our narrative account. This was an iterative process: as our understanding of SEHD's context and various events over the considered 20-year period improved, we kept going back to the informants for further clarification.

Overall, the four types of triangulation and the stakeholder feedback provided a portfolio of tactics that, often in combination, helped us improve the validity and credibility of the retrospective analysis. For example, we drew on data and methodological triangulation to develop the overall time-line of episodes, but the interpretation of which episode had significant impact on the innovation path was also based on investigator triangulation (i.e., individual examination of data and joint discussion between the three researchers) and analytical triangulation (i.e., iterations between trajectory and status analyses). We also sent a draft paper to SEHD's new leadership team (since 2005) for stakeholder feedback. They mentioned that the general time-line and details related to the episodes were all right, but the role of their predecessors and support staff appeared glorified whereas there was less emphasis on the role of current managers. We responded during a telephone discussion, in which two of the researchers participated, by stating that a large part of our narrative related to the period from the mid-1970s to 2005 and it was therefore natural to spotlight the decisions of earlier actors for a longer time. The new leadership team did not dispute that and, after a couple of other revisions, accepted our historical analysis.