Information Infrastructure Development and Governance as Collective Action

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In this paper, we examine the challenges around the development and scalability of information infrastructures. We identify two possible solutions proposed in the literature, one emphasizing more top-down control and the need for a clear IT governance framework, and a second arguing for a more flexible approach since absolute control is impossible and only leads to drift and unintended outcomes. We suggest that there is a clear gap in the literature in better understanding how to govern the development of information infrastructures using a bottom-up approach. We build on research that approaches IS development as a collective action problem and focus on how different actors frame the infrastructure as a public and private good, and how the framing process is underpinned by actors' different ideologies. We use our theoretical approach to examine the framing of the development of a regional health information infrastructure in Crete. Our analysis examines how different actors frame the infrastructure as a collective action good and explore their ideological positioning. We explore the struggle around meanings attributed to the good over time as being a public or private one in establishing or sustaining relations of power, and how legitimacy is challenged or reinforced. Finally, we develop contributions on the collective action challenges in infrastructure development and suggest how a polycentric approach to governance might be further developed to promote the ongoing cultivation of information infrastructures from the bottom up.

Keywords: information infrastructure; collective action; longitudinal research; healthcare; polycentric governance; framing; ideology

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Introduction

Information infrastructures such as national health information networks and global online social networks have long been distinguished from information systems as being integrators of widely dispersed information spaces (Constantinides 2012, Hanseth and Monteiro 1998). In integrating information spaces, information infrastructures become established through complex processes that involve a number of challenges. Among others, a key challenge concerns the development of an infrastructure across an ever expanding base of users, who are heterogeneous in their interests and resources, thus requiring extensive standardization efforts (Bowker and Star 1999, Hanseth 2001, Monteiro 1998, Star and Ruhleder 1996). Another important challenge concerns the tension involved in “designing” the infrastructure (Hanseth and Monteiro 1998, Hanseth and Lytinen 2010) and seeking to control its scalability (Weill and Broadbent 1998, Weill and Aral 2006) versus acknowledging the processes of drift and of unintended consequences (Ciborra 2001, Hanseth et al. 2006, Sahay et al. 2009).

To address these challenges, research has proposed both a top-down and a bottom-up approach. First, proponents of the top-down approach have argued that infrastructure development is best approached through a clear IT governance framework, which will provide guidelines as to what decisions must be made to ensure effective IT governance, and who should make those decisions (Weill and Ross 2004). Arguably, this body of research offers a lot of insights into implementing effective governance of infrastructure development. However, such frameworks and similar suggestions (also see Dean and Sharfman 1996, Devaraj and Kohli 2003, Sambamurthy and Zmud 1999) have been developed with top executives or unit managers in mind, and, thus, seem to work in a top-down flow toward more control, which is not always possible or effective—especially for public sector infrastructures. Evidence of the problems and failures of centralized control in public sector infrastructure development
abound in the literature (e.g., Adler-Milstein et al. 2008, Currie and Guah 2007).

A contrasting body of research argues that an information infrastructure cannot be governed in a top-down fashion (Hanseth and Lyytinen 2010, Sahay et al. 2009). Rather, because of the dynamic complexity involved, including the expanding users’ increasingly varying needs, we can only aim to influence infrastructure development through its design (Hanseth and Lyytinen 2010). Researchers have proposed a set of “design principles” and associated “design rules,” while “observing pivotal relationships between technical and social elements, and their dynamic interactions” (Hanseth and Lyytinen 2010, p. 15). The design principles and associated design rules are drawn from complex adaptive systems theory, and bottom-up adaptations are put center stage with IT designers and users striving to create a self-reinforcing installed base.

Proponents argue that through careful design choices the infrastructure would self-organize while giving room to a set of generative mechanisms that ensure its scalability. Although these and similar suggestions (see, for example, Yoo et al. 2012, Henfridsson and Bygstad 2013) offer significant insights for the bottom-up design of infrastructure development, we know much less about how to govern such bottom-up design.

In this paper, we acknowledge the importance of bottom-up design, but argue that we need to better understand how information infrastructure development can be effectively governed toward its scalability. Our key research question is How can a bottom-up governance approach mediate the successful development and scalability of an information infrastructure?

We adopt a collective action approach to understand the challenges of infrastructure development and scalability by starting with a reconceptualization of the type of good under focus. Specifically, we suggest that, rather than placing emphasis on whether an information infrastructure is a public or private good, we should focus on the multiple and interdependent dimensions of collective action that generates both private and public good properties (see Hess and Ostrom 2007, Ostrom 2003). In turn, rather than approach infrastructure development and scalability as problems of resource allocation based on heterogeneous interests (see Markus et al. 2006, Monge et al. 1998), we seek to explain the complex dynamics of development and scalability as they unfold in practice.

In this paper, we build on earlier literature (Hanseth and Monteiro 1998), which has noted, without further theorization, the importance of ideologies—as systems of meaning that serve to sustain relations of domination (Thompson 1984, 1990)—underlying infrastructure development and scalability. Specifically, we propose that the development of information infrastructures is a dynamic process, which is underpinned by actors’ different ideologies (Nickerson and zur Muehlen 2006, Sahay et al. 2009, Barrett et al. 2013), which are constructed in collective action frames. By building on an ideological-framing approach (Barrett et al. 2013), we are able to make sense of the configurable politics (Sahay et al. 2009), which influence the development and scalability of information infrastructures.

We use our theoretical approach to examine the framing of the development of a regional health information infrastructure in Crete. Our analysis examines how different actors frame the infrastructure as a collective action good and explore their ideological positioning in understanding the process of development and scalability. We explore the struggle around meanings attributed to the information infrastructure over time as being a public or private good, and how this leads to relations of power being established or sustained, and legitimacy being challenged or reinforced.

We conclude by outlining practical implications for implementing a polycentric approach for governing infrastructure development. This type of governance has roots in collective action research (Ostrom 1990, 2010) and places emphasis on bottom-up adaptations, where multiple governing units at differing scales can exercise considerable independence to make norms and rules within a specific domain (e.g., primary care). While establishing links with our ideological-framing approach we explore ways by which polycentric governance can be implemented so as to enable the successful development and scalability of information infrastructures.

The rest of the paper is structured as follows. In the next section, we develop our collective action framing approach to infrastructure development. This is followed by a discussion of the methodology we employed for conducting the empirical study. We then draw on our theoretical approach in presenting our analysis of the development and attempted scalability of the regional health information infrastructure in Crete. Finally, we develop contributions on the
collective action challenges in infrastructure development and suggest how a polycentric approach to governance might be further developed to promote the ongoing cultivation of information infrastructures from the bottom up.

**Collective Action Framing of Information Infrastructure**

We start by introducing and critiquing existing collective action in IS research, and then discuss how recent developments on framing in IS research can inform a collective action framing approach to infrastructure development.

**IS Research in Collective Action**

To begin to understand the dilemmas of collective action in infrastructure development and scalability, we argue that we first need to understand the type of good under focus. IS research employing a collective action perspective has argued that we need to move away from a pure classification of goods as either public or private (Monge et al. 1998). In this view, the good is not the information system itself, but the functionalities that it affords, and the willingness (interests) and capabilities (resources) of the users to take advantage of those affordances. Thus, unlike natural collective action goods (e.g., a forest, an ocean), IS goods are more sociotechnically interdependent on the heterogeneity of interests and resources of a distributed user base (Markus et al. 2006).

This research has argued that without countervailing incentives, the collective action good will not be developed as long as potential contributors act in terms of their separate self-interests (e.g., free riding while expecting others to contribute) (Oliver et al. 1985, Oliver and Marwell 2001). This is a typical “prisoner’s dilemma” observed in research on the development of industry-wide technology standards (David and Greenstein 1990, Foray 1994). There is also an “assurance game,” where early adopters get few benefits, because there are few other adopters with whom to interconnect via the standards; therefore, the tendency is for organizations to wait until others adopt (Greenstein 1992, Weiss and Cargill 1992).

Evidently, in the context of IS research there are a multitude of different scenarios that could unfold, many of which could lead to negative outcomes. For example, the greatest interests may be confined to a portion of the community that may also have the most resources. This high-interest, resource-rich subset of community members might elect to share information among themselves rather than provide a communal good for the broader benefit of all (Monge et al. 1998).

In such cases, the tendency will be for the development effort to fragment, in which case the goods developed are likely to be incomplete and fail to meet the practical importance of integration and standardization (Axelrod et al. 1995, Foray 1994).

Because of the complexity of IS goods (i.e., their distributed nature and associated interdependencies), it is argued that these goods depend on sustained contributions so that the level of the good at any given time will depend on the average rate of collective resources contributed (Monge et al. 1998). By keeping to an average rate of collective resources contributed, there are higher possibilities that participant groups will benefit from the good (ibid). Beyond such normative propositions, it has also been argued that, unless there are clear governance structures (including membership and IP rights protection)—usually imposed centrally by external agencies—for resolving conflicts of interests and resources supplied, the tendency would be for IT systems to fragment (Bekkers et al. 2002, Markus et al. 2006, Vincent and Camp 2004).

Although we acknowledge the importance of implementing such governance structures, we argue that it tends to emphasize top-down control, which can alienate participants and lead to fragmentation of the development process. Even in cases whereby a common forum is established, it is impossible to agree on governance structures that would be acceptable to all parties because of the heterogeneity of interests and resources involved (West 2007).

Research into collective action problems in natural resources (e.g., Dietz et al. 2003, McGinnis 1999) has argued that it is a common mistake of governments and other policy makers (e.g., corporations) to underestimate the capacities of subunits at any level to self-organize governance arrangements for which they are currently “too small.” It can sometimes be possible for subunits to deal with higher-level (i.e., spatially broader) problems by reconstituting themselves to represent all key interests at that higher level. Ostrom (1990, 2010) offered a way forward toward this direction by proposing a polycentric governance approach to collective action problems. Polycentric governance offers opportunities to organize not one, but many governing units, with each of those units being able to exercise independent authority to make and enforce rules within a specified area (see McGinnis 1999). The key advantage of polycentric governance is that, rules can be written in a general form that can then be tailored to local circumstances. In other words, many more actions tailored to local arenas can be authorized in a polycentric governance structure than in a monocentric structure that tries to establish uniform rules for all settings (Ostrom 1996).

We ascribe to such a polycentric approach to governance, but argue that, in order to better understand the heterogeneity of interests and resources involved in information infrastructure development, we need...
to examine the ideological goals of each party and how they are connected to diverse collective action framings. Our focus on ideological framings extends current collective action research, which is largely informed by economic perspectives, in that, it helps us to better understand how rights, responsibilities, and resources can be more effectively allocated—a key aim of polycentric governance.

Collective Action Framing for Information Infrastructure Development

Framing has long been recognized as a sense-making practice (Goffman 1974) that generates meaning for diverse collective movements. Research on social movements has highlighted that key actors engage in the framing of collective action beliefs that legitimate the activities of a collective (Benford and Snow 2000).

The IS literature has also developed the concepts of frames and framing. For instance, the work on computerization movements, whose advocates are concerned with how computerization can bring about a new social order (Kling and Iacono 1995), highlights the way in which competing frames of diverse movements influence the diffusion of IT innovations (Elliott and Kraemer 2008). The different framings emanate from the key ideological beliefs held by actors, and these can serve to legitimize or oppose investments in computerization.

More recent research has highlighted how (re)framing shapes collective action around a focal technology, by mobilizing individuals to promote the diffusion of technology. Through this process, a dominant frame may develop and as the computerization movement continues, a competing frame of collective action (Elliott and Kraemer 2008) may challenge and, if successful, potentially replace the dominant frame, thereby influencing the diffusion of IT related innovations. This dynamic perspective of the framing process has been recognized as an important development in the IS literature (Davidson 2006) involving the intertwining of interpretation and power (Davidson 2002, Lin and Silva 2005) and the imposition of meanings on different groups (Azad and Faraj 2011). Framing contests (Hargrave and Van De Ven 2006) evolve as actors try to influence the ongoing construction of meanings. These contests occur in a contentious framing phase (Benford and Snow 2000), and often manifest conflict before an enacted frame emerges.

To effectively account for these struggles around meanings that establish and sustain power relations in the development and diffusion of IT, Barrett et al. (2013) highlight the need to explicitly recognize the relationship between framing and ideology. Although ideologies are commonly understood to be a set of ideas or deeply rooted beliefs, the most widely accepted definition of ideology (Eagleton 1991) is how “meaning serves to sustain relations of domination” (Thompson 1984, p. 146). Of particular importance is how diverse movements (both dominant and counter-hegemonic ideologies) function through different strategies of legitimation in achieving collective action. These ideologies can function as frames for collective action, as manifested in the discourse of key stakeholder groups, which serve to (re)produce power relations by representing them as being in everyone’s interest (Thompson 1984, 1990). The ensuing power struggles that play out over time involve reframing strategies, which are also important for creating legitimacy for the innovation (Greenwood et al. 2002, Markus et al. 2008).

Drawing on Suchman (1995), three types of legitimacy¹ can be delineated (Markus et al. 2008, Barrett et al. 2013), namely, pragmatic legitimacy, based on audience self-interest; cognitive legitimacy, as comprehensibility or taken-for-grantedness; and moral or normative legitimacy, as “the right thing to do” or normative approval.

We draw from the above to develop our understanding of collective action framing in information infrastructure development. These developments highlight the importance of recognizing the various ideological beliefs held by actors that underpin their framing strategies and function through strategies of legitimation to achieve a preferred social order (Kling and Iacono 1995). As discussed earlier, these ideological beliefs may not be a simple binary distinction of public versus private goods (Monge et al. 1998), but rather are intimately connected in a dynamic manner to different framing strategies. These inevitably lead to framing contests, through which actors seek to create different forms of legitimacy around the infrastructure, whether they be pragmatic, moral, or cognitive, as the infrastructure develops over time. Finally, as we discuss later, since the collective action framing of an information infrastructure necessarily goes beyond the organizational “box” (Davidson 2006) to the interorganizational level, framing strategies connected to underlying ideologies develop at different levels, and have important implications for implementing polycentric governance structures for infrastructure development. We explore these implications after we present our empirical findings.

¹ The links to Suchman’s (1995) three types of legitimacy, namely, pragmatic, cognitive, and normative, are in connection to our definition of ideology and not to institutional theory. Thus, although legitimacy is a central tenet of institutional theory we are not focused on their interrelationship in this paper.
Research Approach and Methods

Research Site
Following a number of European IT initiatives in the 1990s (European Commission 1993, 1994, 2000), the Greek government proceeded with a series of relevant actions that sought to reduce the gap between Greece and other European Union (EU) countries in the use of advanced information infrastructures for electronic transactions and access to new products and services for both firms and households (Hellenic Republic 1995, 1999). In this context, the Greek government proposed an operational program for the Information Society. The objectives of this program were to provide better services to the citizen and improve the quality of life through the deployment of IT in public administration, health, and welfare (Caloghirou et al. 2006). These actions were to be implemented through corresponding shares of the total national and EU funding (Greek Ministry of National Economy 2000).

In 1997, in the context of these developments, CreteTech, a private research and development (R&D) institute based in Crete, formed a working group to discuss and begin to develop an integrated, electronic healthcare record (I-EHR) module. The working group for the I-EHR module involved a team of software engineers from CreteTech and a team of three general practitioners. These healthcare professionals were pioneers in introducing electronic patient records in the region and also held senior positions (two of them were directors of their respective primary healthcare centers). They were selected for their keen interest in new technological developments and their capability to promote the initiative across the 17 primary healthcare centers and eight hospitals in the region. With the help of this working group, CreteTech began to develop HEALTHnet, the first pilot health information infrastructure in Crete.

Access and Data Collection
In the summer of 2002, we met the director of CreteTech to discuss the overall strategy for developing HEALTHnet. In our initial discussion, we expressed our interest to understand the institutional (e.g., funding and political support) and technological (e.g., network and application architecture) landscape within which HEALTHnet was developed, as well as the ways by which different actors sought to establish their own agendas by negotiating compromises in the new infrastructure. We were interested to explore the ways by which HEALTHnet was evolving in the midst of this dynamic, in line with the control versus drift debate found in the literature (Ciborra 2001). In our second meeting, the director of CreteTech agreed to facilitate access to the research site.

A critical question that had to be addressed concerned our access to sites across the region—a question that would lead us to a better understanding of the various framing strategies of different stakeholders involved in the development of HEALTHnet. In the end we carried out five field trips during the period 2003–2006 (January 2003, July 2003, January 2004, September 2005, July 2006), each lasting between two and four weeks. Initially, the director of CreteTech introduced us to his assistant who scheduled interviews with key individuals within the R&D Institute. The same person also arranged an interview with the director of IT services at the Regional Health Authorities. Then seven interviews with general practitioners from seven primary care centers were set up by the head of implementation from CreteTech. At the end of each of those interviews, interviewees were asked who else in their organization and across the region should be interviewed. These same interviewees were interviewed in subsequent trips and snowball sampling was again used to gain access to more people. In total, 65 interviews were conducted with senior management and IT professionals at CreteTech, healthcare professionals and administrators at nine primary healthcare centers and three hospitals, and senior officials at the Regional Health Authorities.

The main focus of the interviews concerned the meaning of the information infrastructure being introduced to the different groups and their expectations around its use, particularly with respect to their work contexts. In addition, the semistructured design of the interviews allowed for questions to be adapted to the characteristics and position of each group of interviewees. For example, the questions put to individuals at CreteTech primarily revolved around the strategy behind HEALTHnet. So, when we met with the director of CreteTech, we started the interview by asking, “What was the strategy of developing HEALTHnet and how did you drive that strategy across the region?” We then followed up with more specific questions concerned with points raised by interviewees regarding the development of a community around the infrastructure such as, “What were some of the interventions and approaches in building and sustaining a community to promote the scaling up and further development of HEALTHnet?” The questions we asked to participating healthcare professionals concerned the nature of their work in relation to the use of new information technologies introduced. So, when we met with primary care general practitioners we started the interview by asking, “Can you describe your everyday work and explain how the health information infrastructure has helped to support it?” Depending on the answer, we would follow with more specific questions around the positive and negative implications of new technology use.

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and what were these practitioners’ expectations (if any). Finally, the questions we asked individuals at the Regional Health Authorities focused on their relationship with CreteTech and the evolution of a health information infrastructure within the Greek public health sector. For instance, when we first met with the director of IT services at the Regional Health Authorities, we started the interview by asking, “How has HEALTHnet helped to meet the technological needs of the region?” We then followed with questions such as, “How will HEALTHnet be utilized in the Information Society initiative,” and “What are some constraints in building on the installed base?”

By repeating interviews with the same interviewees over a long period of time we enabled the expression of different views on how interpretations and actions changed over time, thus socially triangulating (or validating via the respondents) the data collection process (Gomm 2004). Furthermore, demonstrations of different IT applications were set up for the benefit of the research study at various sites. Direct observations of the use of different IT applications between different healthcare professionals were also permitted on occasions such as the use of a telecardiology application between a primary care center and a regional hospital (see Constantinides and Barrett 2006).

In addition to these primary data, our data collection involved secondary sources. These included strategy plans and reports commissioned by CreteTech, the Greek Ministry of Health and Welfare, and the Regional Healthcare Authorities of Crete; journal publications and presentations referring to the developments of HEALTHnet; and articles from local newspapers and magazines describing the impact of HEALTHnet and the subsequent Information Society initiative for the region of Crete. These secondary data sources along with the diverse views of different informants helped to mitigate possible positive bias in retrospective interviews (Eisenhardt and Graebner 2007).

Data Analysis
In the analysis of our data we followed a process-based approach by paying attention to key events in the development of a regional information infrastructure for Crete over time (Langley 1999). We started with two broad events: the development of the HEALTHnet pilot and the implementation of the Information Society initiative. Each of these two events were then broken down into smaller events in relation to developing an understanding of what happened and who did what when—that is, activities ordered over time and across different stakeholders involved in the development and scalability of a regional information infrastructure for Crete. These activities included efforts to spread adoption in the HEALTHnet pilot, or to counter activities resisting it, as well as parallel efforts to implement alternative solutions.

Our sense-making strategy included a combination of “constructivist narrative” (Guba and Lincoln 1994) and theory, paying attention to “the contextual detail in the narrative...and presenting as completely as possible the different viewpoints on the process studied” (Langley 1999, p. 695). We used constructivist narrative because of our focus on the ideological goals and framings of collective action of different parties in the case, which are very much based on meaning-making activities (Denzin and Lincoln 2005).

During the first three field trips, the key focus was on the negotiations between different stakeholders in the development of HEALTHnet, while considering the technological and institutional landscape underpinning those negotiations. At that stage, the emphasis on information infrastructure development as a collective action problem was only implicitly evident in the categories generated by our analysis.

Specifically, we initially coded the data into three main groups of respondents, i.e., CreteTech members, users (healthcare professionals), and senior management at the Regional Health Authorities. From this initial coding, it became evident that the initial development of HEALTHnet was very much attributed to the entrepreneurial initiative of CreteTech to apply innovative technologies in the region while utilizing European funds, coupled with strong political support by the Regional Health Authorities of Crete and key healthcare professionals in the region. To this end, we explored the usefulness of such concepts as the inscription of specific programs of action in the technology (Monteiro 2001) and the path dependency of the installed base (Hanseth 2001).

By September 2005, when we conducted our fourth field trip, there had been new developments that brought issues traditionally associated with collective action problems to the surface, making their way into our process analytical framework (Langley 1999). From this point we utilized insights from collective action research to reformulate our analytical categories in comparison to the new data incidents. Specifically, by September 2005 there had been a series of political reforms in Greece that redistributed roles and intentions around the HEALTHnet project, while also influencing the decisions and choices of the users. In 2004, the Democratic Party was elected, appointing new officials for the 13 Regional Health Authorities of the Greek National Health System and restoring control back to the center, the Ministry of Health and Welfare in Athens. This meant that the relationships that CreteTech had created with key individuals at the Regional Health Authorities of Crete were dissolved, and, more importantly, the legitimacy of the HEALTHnet pilot was put into question.
In turn, our analysis placed less emphasis on the technological design of the information infrastructure and the mobilization of users, and more on the ideological goals driving different stakeholder groups, as well as their competing frames around the development of the infrastructure. The fifth field trip (in July 2006) shed further light on the most recent case developments and integrated our analytical directions. As summarized in Table 1, our final coded themes focus on the dynamic process by which these different groups frame the infrastructure as a public and/or private good, as underpinned by their different ideologies. We discuss these themes and the dynamic negotiations between stakeholder groups in detail in the next section.

### Research Findings

In this section, we will present an in-depth analysis of events that followed the early development of HEALTHnet in the years 2003–2004, and the subsequent development of a new information infrastructure for the region of Crete in the years 2005–2006. We conclude with some recent data on the development

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<th>Table 1</th>
<th>Summary of Key Themes</th>
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<td>CreteTech</td>
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<tr>
<td>Ideological goal</td>
<td>Integrate all healthcare services through a common information infrastructure (II)</td>
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<tr>
<td>Means</td>
<td>• Provide hardware and software installations and training free of charge initially to increase adoption levels. Then seek formal SLAs</td>
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<td></td>
<td>• Introduce standards to enable the II to scale up and “lock in” the installed base</td>
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<td>Frames</td>
<td>• Frame 1 (initial CreteTech frame): An II is a valuable public good and should be made available to all. “HEALTHnet is designed to provide uniform ways for accessing authentic, physician-generated, patient record information that is physically located in different clinical information systems. . . . Such an environment also aims to enable patients to become more actively involved in the monitoring and assessment of their own wellness.” —Senior Engineer, CreteTech</td>
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<td></td>
<td>• Frame 2 (revised CreteTech frame): An II has private IP rights that need to be protected. “IP issues are difficult issues to have, especially when you have an organization who develops technology and in our case it’s pretty clear that whatever R&amp;D project is done by [CreteTech], belongs to [CreteTech]” —Senior Applications Scientist and Assistant to the Director, CreteTech</td>
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<td>• Frame 5 (hospital directors’ frame): Hospitals should be responsible for their own technological needs, based primarily on administrative functions for patient management. “If by 2006, when the Information Society initiative is supposed to end, you see anything happening you can drill a hole in my ear . . . I’m going to pretend that the Information Society does not exist and move on with my own money . . . what I need is a system to manage patient accounts.” —Hospital Director 1</td>
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of this new infrastructure provided by the IT Director of the Regional Health Authorities in February 2011.

The Development of HEALTHnet (2003–2004)

HEALTHnet, the first pilot health information infrastructure in Crete, was developed as part of CreteTech’s ideological goal to integrate all healthcare services in the region. The HEALTHnet project was partly financed from a series of government controlled Community Support Frameworks for Health and Welfare (in relation to the first three European Framework Programmes), and partly financed from other R&D projects that CreteTech had secured on a competitive basis.

HEALTHnet was built with Microsoft and SAP components based on the conceptual architecture of the Technical Committee for Health Informatics of the European Committee for Standardization (CEN/TC 251, 1995) and the Reference Model of Open Distributed Processing (ISO/IEC 1995). The initial objective was to create an integrated electronic health record (I-EHR) module for primary healthcare centers based on open standards to address interoperability issues. The two major applications included a Primary Healthcare Information System (PHIS), and a Hospital Information System (HIS), both of which supported only patient and medical data, such as X-rays, CT scans, biopsies, etc. There were no modules for administrative tasks, such as dealing with patient accounts, or any other finance and accounting functions.

To achieve their ideological goal and increase adoption levels, during the early development of HEALTHnet between 1997–2002, CreteTech provided hardware and software installations and training free of charge according to the interest exhibited by healthcare professionals. CreteTech hoped to finance the pilot by seeking funding from various sources while building a community of users around what they thought was a public good. In January 2003, the director of CreteTech told us the following,

By acknowledging that there are a number of different services being offered in the health sector, we began to think of ways to integrate these services under a uniform infrastructure for accessing them and providing them to the public. . . . So, we developed strong alliances with key stakeholders that supported our efforts and also began to look for funding for the various projects that we would undertake.

In June 2003, a senior applications scientist at CreteTech added in an interview the following statement,

…a lot of things depend on the personal contact and being able to develop a community of users around a given concept. . . . at least in the beginning, you make sure the system is utilized hoping that during that time they are motivated and convinced regarding the benefits of the system.

This initial framing of CreteTech’s ideological goal was shared by a number of primary care general practitioners (GP), who saw benefits in the clinical solutions and the state-of-the-art infrastructure provided by CreteTech. In January 2004, one GP told us the following,

[CreteTech] came and told us “we will give you hardware and software on EU expenses and you will help us to substantiate our work and research.” We accepted their offer after we had reached a consensus on two important principles: that nothing would be accepted unless we could import all our existing files to the new system; and that we would tell them which fields we want to be included . . . . The functionality we find most useful regarding the patient record system is the fast classification and statistical analysis of our patient data . . . . With this system we were able to create a database of approximately 6,500 patient records of patients who had already had paper records.

These users largely shared the framing of HEALTHnet as a public good but had specific demands from the technology to satisfy their own clinical needs.

Other users, however, were distant and did not participate in the pilot. The main reason for this nonparticipation was the fact that HEALTHnet was an R&D project initiated by CreteTech that never received the formal support from the Greek government. In turn, many users were skeptical as to the sustainability and ongoing use of HEALTHnet; many believing that this was just a passing “pilot” project, and that soon the Greek government would announce a new initiative. This collective action frame was influenced by the repeated changes in the Greek government, with the latter playing a key role as a policymaker in the delivery of healthcare services in the public healthcare sector. According to these users, any public sector IT project should be state controlled and owned to give a clear direction and objectives. In July 2003, one radiologist at a district hospital told us the following,

They haven’t made a decision to develop a standard, which would be followed by all hospitals, and this is not [CreteTech’s] job, this concerns the political initiatives of the Ministry of Health.

These competing frames around the value and objectives of HEALTHnet led to conflict in 2002. After the reforms introduced by the Socialist party, one of the general practitioners—and a professor at the medical school—(who collaborated with the CreteTech team in the initiation of the project) was promoted to vice president of the new Regional Health Authorities. In his new position, this founding participant challenged CreteTech over intellectual property (IP) rights emanating from the development of the I-EHR.
In July 2003, a senior applications scientist from CreteTech told us the following.

One of the reasons that we have some problems with a professor at the medical school, with whom we worked together regarding the I-EHR, was the fact that at some stage he felt that he had intellectual property rights from the technology.... So a lesson learned is that, in multidisciplinary collaborative efforts, it is very important to very clearly resolve IP rights beforehand.

Notably, this IP rights dispute was the consequence of a strong engagement between founding members involved in the development of the I-EHR. The dispute was not entirely surprising, given the lack of formal contractual agreements and the bottom-up approach employed for developing HEALTHnet. However, none of the parties expected such rivalry when they jointly initiated the project as suggested in the quote above. At this stage, CreteTech was increasingly being viewed as having revised its original framing of HEALTHnet as a public good to one that carried private ownership. These actions fueled ideological contestations in the region.

In 2003, the Greek government—through the European Information Society program—directed the newly established Regional Health Authorities to announce competitions for regional IT solutions. Three of the key requirements imposed by the Information Society program were for open architectures, flexible standards, and lifelong integrated electronic health records, all of which had already been introduced by CreteTech in the HEALTHnet project. In late 2003, in the midst of these developments, CreteTech attempted to mobilize support around HEALTHnet through clearly defined contractual agreements. However, CreteTech’s attempts had minimal success primarily because the Ministry of Health refused to offer funding for such support because of the upcoming Information Society program.

By January 2004, a number of hospital directors in Crete, having completely lost faith in HEALTHnet and unwilling to wait for the Information Society program to materialize, had decided to self-fund their own projects. Their efforts were primarily directed toward establishing hospital-wide networks for intra-organizational support of administrative-financial systems for managing patient accounts—a service not offered by HEALTHnet. The consequence of these efforts was that, by 2005, even though parts of the HEALTHnet project were still functional, the region was saturated with multiple inter- and intra-organizational networks (i.e., hospital-wide and hospital-to-hospital networks as opposed to region-wide networks). In January 2004, a hospital director of a district hospital told us the following.

I've been working as a hospital director for the last 14 years and I have no false expectations that any government will deliver any solutions....each regional hospital is in a better position to understand local needs and to propose solutions....the Ministry [of Health] cannot know whether I use any applications or not....all success stories are based on the self-motivation of a few key stakeholders, who are willing to improve their work and to provide more benefits to the patients.

Essentially, these hospital directors contested CreteTech’s collective action frame on the development of HEALTHnet, arguing instead that, they had the right to choose their own technologies based on their local needs.

These contestations resurfaced after the reelection of the Democratic party in 2004. Soon after his appointment, the new president of the Regional Health Authorities of Crete questioned the ownership of all of the different applications installed in the region’s healthcare centers and hospitals. He felt that since the various applications installed as part of the HEALTHnet pilot were being used (by different healthcare centers) under the jurisdiction of the Regional Health Authorities, they belonged to that authority. He argued that these applications were resources de jure owned by the regional public healthcare sector of Crete.

A key outcome of these contested frames and ideologies was that the region was now saturated with fragmented healthcare systems provided by different IT vendors. Thus, it was unclear as to who was in control and if indeed there was a regional information infrastructure. In consequence, usage of the various HEALTHnet applications began to drop significantly. For instance, by 2004, the I-EHR system was used by only a handful of general practitioners. An illustrative example of such decline in use was noted by the head of CreteTech’s implementation team in 2004.

Most primary health centres find it very hard to go against the will of the Regional Health Authorities, because they simply depend on them.... A general practitioner who initially used paper records later changed to using electronic records and he was actually one of the most enthusiastic users, but now he has switched back to using paper records.

With the change in government, most healthcare professionals in the region were aware that, at any given time, the Greek government could intervene and replace HEALTHnet with a completely new information infrastructure. In interviews with healthcare professionals in the region it became clear that there was great concern that the HEALTHnet project was potentially enclosing them in CreteTech’s ideological...
goal of producing commercial products, with which they were now hesitant to embrace. The repeated disputes between CreteTech’s senior management and officials at the Regional Health Authorities of Crete did not help to alleviate this situation. Thus, a key outcome was the illegitimacy of HEALTHnet and other technologies deployed in the region, especially in light of the then-upcoming Information Society initiative.

**The Development of a New Information Infrastructure for the Region of Crete (2005–2006)**

By late 2005, the competition for the regional health information infrastructure in Crete was completed and the contract went to CompeTech, a consortium of IT vendors that did not include CreteTech or any of the other companies that had previously implemented IT systems in Crete. As might be expected, this development caused a dramatic change in the negotiations by not only bringing new actors onto the stage but also a new information infrastructure.

The new information infrastructure proposed by CompeTech followed the strict guidelines of the Information Society, which called for distributed architectures, open standards, and integrated electronic healthcare records. Based on these guidelines, CompeTech proposed an Oracle-based system with three key applications, namely, a Primary Healthcare Information System, a Hospital Information System, and an application for the Regional Health Authorities, which would enable the latter to monitor levels of use and manage patient pathways across the region. All three of these applications included modules for managing both medical and administrative tasks and data, in contrast to what was offered by HEALTHnet in the past.

Also in contrast to the HEALTHnet pilot, the development of a new information infrastructure followed a top-down approach based on clearly formulated contractual agreements and rules. Under these formal governance rules, the Greek government, via the Information Society program, retained full ownership and control over the new information infrastructure. The Regional Health Authorities and staff at the primary healthcare centers and hospitals were users of the various applications offered by the new information infrastructure, but they had no rights to make any changes or to choose among alternative applications.

Thus, even though at the surface level, the Information Society shared the same ideology with CreteTech in that both sought a universal, integrated information infrastructure for the region, the two actors had different frames on what type of good they were developing. Unlike the Information Society, which was driven by state objectives toward developing a public good, CreteTech was increasingly pressured (for survival) to pursue a private good.

In fact, CreteTech had high expectations of winning the competition in Crete as that would give them enough justification (while building on the earlier HEALTHnet project) and funding to support their participation in other regional projects across Greece. When CompeTech was chosen, CreteTech claimed that there were political agendas behind the competition. The director of IT services at the Regional Health Authorities supported the Information Society’s choice by explaining that CompeTech was chosen under “transparent mechanisms.” This meant that each entry to the regional IT competition was evaluated by a third-party committee against three dimensions: the legal status of bidders (e.g., whether they had previously declared bankruptcy, etc.), the technical specifications of the solutions offered, and the financial dimension of each proposed entry. According to the third-party committee, CompeTech scored the highest on all three dimensions.

Thus, in a way, the Greek government working with the Information Society framed the development of the new information infrastructure as a private-public good with the need for transparency and public accountability to deliver healthcare services in an efficient and effective manner and involving private sector IT vendors. An Information Society officer speaking at a public conference in Crete in July 2006 explained the following.

This [Information Society] program will give to the regional authorities themselves the opportunity to develop a variety of tools under a common framework… this effort complies with the famous Lisbon Strategy:

**Despite this framing, however, there were concerns among officials at the Regional Health Authorities of Crete, and groups of users that the final selection was made not by those directly involved with the use of the new information infrastructure. In an interview in July 2006, the director of IT services at the Regional Health Authorities explained the dilemma faced in the vendor selection process,**

We have reached the point where the users are at least happy with some applications because they enable them to carry on with their work…. So we already have an existing base; we already have a bicycle. But we don’t know whether we are going to get just a wheel that we will spin around or whether we will get a car…. The only thing we know is that they have ticked all the boxes in our list of requirements. And this is true for all the consortia that participated in the competition…. If it’s just going to be a wheel then it would be better for us to keep the bicycle that we already have.

**2 This preceded the Lisbon Treaty of 2007 with similar aims for making the EU “the most competitive knowledge-based economy in the world” through a more centralized approach to governance.**
This quotation raises questions as to whether the “transparent mechanisms” applied by the Information Society were a democratic means of selecting the “best” infrastructural solutions, or whether those mechanisms, in fact, excluded interested parties from the decision-making process. According to the director of IT services, all the Regional Health Authorities could do was to negotiate—in the context of a project steering committee, which included two individuals from the Information Society (another transparent mechanism)—whether some of the existing systems could stay.

Through the project steering committee, CompeTech was required to evaluate the existing installed IT base and keep those components that fitted the original call for tenders. However, from CompeTech’s point of view, there were financial and technical issues at stake (i.e., noninteroperability of components). CreteTech also had similar concerns, as evident from the following quotation from an interview with a senior engineer in July 2006.

We would have to enter into a discussion around the logic behind making our systems interoperate, which is not the easiest thing…. The choice here was to have an Oracle-based system. Our system is Microsoft and SAP based. You can’t really say that you are going to open channels of communication between the two systems…. We want to do it but they’ll have to secure enough funding for us and also provide guarantees that we will not be risking the rest of our projects. Because if we were to only see the small picture of Crete and only Crete, then we would be myopic.

CreteTech felt that there were high risks involved in them negotiating a subcontract with the Information Society and CompeTech because it would have implications for their IP rights over the software code on which HEALTHnet was built. Entering such a negotiation would compromise the security and, thus, the control of CreteTech’s infrastructural solution in other projects that they were running in other regions of Greece.

The outcome of the negotiations between CompeTech, the Information Society, and the Regional Health Authorities was an agreement for CompeTech to evaluate the existing installed base with the help of senior management from the Regional Health Authorities. After that, CompeTech would have 15 months to pilot and deliver a new information infrastructure for Crete. In the event that the project collapsed for reasons related to user acceptance, loss of data, and/or application noninteroperability, the Information Society would then intervene and cancel the project. Evidently, as with the “transparent mechanisms” enforced during the evaluation of the tender offers, the implementation approach also followed a number of EU-wide standards set out to objectively evaluate the commissioning and outcome of the new infrastructure in Crete.

Despite the enforcement of these standards, however, in an interview with the IT director of the Regional Health Authorities in July 2006, we were told that some healthcare centers and hospitals were demanding that they be left alone to make decisions around which software suites should stay and which should be replaced. The resistance of these healthcare providers was primarily an outcome of their exclusion from participation in the decision-making process, and the ability to choose solutions that would address their local needs—a collective action frame that was also present during the HEALTHnet pilot. During this period the strength of this frame generated momentum for reviving parts of the HEALTHnet project as an alternative solution. In July 2006, a senior engineer from CreteTech told us the following.

Generally, a lot of people have put pressure on us to take action towards ensuring that our systems stay in Crete.

This reflects the comment by the director of IT services at the Regional Health Authorities, who said that the region might be better served with what already exists, whether that means HEALTHnet or any of the solutions previously installed by other IT providers. In a July 2006 interview, one general practitioner who was also the director of her primary health center expressed her concern to us.

How would I be able to search through 5,000 patient records if I didn’t have the [HEALTHnet] system? …I think that each region should be responsible for its own budget formation based on a needs analysis…. we should have more power to say that, for example, we don’t need a new system we have other needs…. we should have the freedom to allocate the money the way we want to, rather than following the plan of the Ministry of Health.

A follow-up interview with the new director of IT at the Regional Health Authorities in February 2011 provided valuable data and insights on the development of the new information infrastructure in Crete. Specifically, the electronic healthcare records module (the core of the infrastructure), although installed, was not being used in any of the hospitals (this included medical tests and laboratory data, with some exceptions). These data justify the concerns raised by various stakeholders during earlier field trips in the region and pose serious questions around the governance of the new information infrastructure in Crete.

Discussion

Our paper has sought to better understand the collective action challenges in information infrastructure development and to consider implications for
an appropriate governance approach to promote scalability. Our theoretical developments build on and integrate ideas from collective action theory (Hess and Ostrom 2007, Ostrom 2003) and recent developments of a dynamic ideological-framing perspective to understanding IT diffusion (Barrett et al. 2013). Applying this theoretical perspective to our empirical study we sought to better understand the governance of infrastructure development and scalability as a form of political configurability (Sahay et al. 2009). The objective has been to problematize the usual binary distinction of public-private goods adopted by actors, and alternatively to take account of various framing strategies including those that emerge from a similar ideology.

Ideological-Framing Strategies and the Evolution of Information Infrastructures

Our case findings demonstrated the dynamic emergence of competing ideologies and frames in the development of a regional information infrastructure for Crete and how these are closely connected with different types of legitimacy. To start with, CreteTech developed HEALTHnet based on the ideological goal of a universal socio-technical network, using state-of-the-art middleware and standards and addressing clinical user needs. They framed HEALTHnet as a public good and this was shared by a number of primary care GPs who accepted the clinical solutions offered by CreteTech. However, although CreteTech provided substantial free resources during the pilot to drive adoption, the hoped for “taken-for-grantedness” of the network was not realized. This had adverse implications for CreteTech in achieving high levels of cognitive legitimacy. Instead, hospital directors resisted this framing strategy as it was seen to be at odds with their frame of a more heterogeneous infrastructure, inclusive of administrative modules to support the management of patient accounts. These framing strategies challenged the pragmatic legitimacy of CreteTech’s HEALTHnet and its ability to support the management of healthcare in addition to clinical support.

In addition to these contestations around technical configurability (Henfridsson and Bygstad 2013), political configurability (cf. Sahay et al. 2009) was also apparent. Specifically, the framing of the Regional Health Authorities represented a struggle over whether HEALTHnet was a public or private good and not whether the infrastructure could be technically configured to account for the heterogeneity of the user base. In other words, the Regional Health Authorities’ framing sought to exercise control and governance over the infrastructure’s future development and directly challenged CreteTech’s moral legitimacy. They questioned whether it was appropriate for CreteTech to be a public sector infrastructure provider regardless of whether or not the infrastructure supported much needed areas of clinical practice.

These challenges of legitimacy adversely affected the potential sharing of HEALTHnet despite it being both enabling and open in architecture. The technopolitical configurability involving both clinicians’ need for heterogeneous applications (around administration modules) and new framing strategies by the Regional Health Authorities had negative consequences for HEALTHnet. Some end users subsequently reversed their IT adoption decision by halting or backtracking on their use of the infrastructure.

Our study also highlights how different framing strategies emerging out of a similar ideology can have important implications for information infrastructure development. For example, during the Information Society initiative, the Greek government shared a common ideology as CreteTech around the open, enabling, and shared nature of the new information infrastructure (cf. Hanseth 2001). However, whereas the newly stated architecture required by the Information Society offered a potential rebirth of HEALTHnet and a growth of its installed base, this was not the case. Despite sharing a similar ideology, the government’s framing of “designing” control and transparency mechanisms in the development process ultimately challenged CreteTech’s framing strategy to secure future universalized coverage and control of their infrastructure across other regions by pursuing a private good approach.

Drawing on our case insights, we argue that, for different framing strategies to coexist, different stakeholders have to be engaged in dynamic and adaptive governance processes. To support this, we conducted a case survey based on a sample of 10 cases on information infrastructure development and scalability identified in Henfridsson and Bygstad (2013). As summarized in Table 2, there is a wide variation in both successful and unsuccessful information infrastructure development and scalability in combinations of technical configurations and governance modes. As evident from our cursory analysis of sample cases, extant research places great emphasis on actors and their interests. We suggest, however, that it is important to examine the ideological framings of collective action of diverse actors to understand the dynamic (coevolving) relationship of the technical configuration of information infrastructures and their governance.

In light of the limitations of access to details of the cases from our case survey, we focus on our case findings to show the importance of ideological framings. We provide some first steps toward understanding how a polycentric approach to governance may support successful infrastructure development and scalability.
A Polycentric Approach for Governing Information Infrastructure Development

As discussed in previous sections, a polycentric approach is characterized by multiple governing units at differing scales rather than a monocentric unit. Each unit within a polycentric system exercises considerable independence to make norms and rules within a specific domain (such as a group of primary care centers, a regional government, or a national government). This translates into the nesting of governance into a broader network of institutions, in which governance is broken down into a series of layers. This distributes decision making across all stakeholders, with each layer dealing with similar types of issues but at a progressively larger scale and lesser level of detail (McGinnis 1999).

This nesting of governance helps smaller units become part of a more inclusive system without necessarily giving up distinct ideological goals and framing of their aspired (public/private) good. As larger units...
develop or get involved, problems associated with noncontributors, free riders, and local “dictators,” can be addressed through polycentric mechanisms for mutual monitoring, learning, and adaptation of better strategies over time (Ostrom 1990).

The value of nesting follows from the horizontal and vertical assurance problems that arise as governance becomes multilayered. Introducing a higher layer assists lower-layer stakeholders (e.g., general practitioners in primary care centers) with their horizontal assurance problems only to the extent that they trust the higher layer (e.g., the Regional Health Authorities) not to fail them. Similarly, lower-layer stakeholders should be free to govern themselves as long as their self-governance does not affect others in the same or higher layers. Hence, governance is nested to higher layers until a layer is reached where all individuals with a substantive interest in a collective action problem are represented adequately.

Drawing on this polycentric approach we are able to go a step further and identify from our case findings a pattern for the successful nesting of different types of legitimacy that enables the governance of information infrastructures. Our case suggests that pragmatic legitimacy should be pursued first as a way of building support across diverse interests; cognitive legitimacy would follow as users begin using the infrastructure, making it part of their everyday practice, thus achieving taken-for-grantedness; and finally moral or normative legitimacy would be achieved as the infrastructure becomes “the right thing to do,” thus gaining the normative approval of stakeholders beyond those immediately concerned (e.g., the end users). We now demonstrate this pattern by drawing more explicitly from our case study.

First, if lower-layer units are denied opportunities of participation, they will cooperate less voluntarily with higher layer decisions than would otherwise be the case, something we observed in the case of infrastructure development in Crete. For instance, after the selection of CompeTech as the winning consortium for the Information Society competition, the director of IT at the Regional Health Authorities noted the possibility of resistance by end users since they were sidelined from the selection process, with implications for the pragmatic legitimacy of the new infrastructure. Second, drawing on the tenets of polycentric governance, we would suggest that cognitive legitimacy may be achieved by representing the collective action framings of diverse layers in the overall governance of the infrastructure. In effect, the nesting of governance across different layers may help to mesh larger belief systems and ideologies with the experienced reality of the different stakeholders’ everyday practices (cf. Suchman 1995). For instance, during the HEALTHnet pilot, many users felt that during the HEALTHnet pilot, many users felt that their collective action framings were not represented in CreteTech’s approach to governance. In this case, nesting could have helped to legitimate their participation in capacity-building activities (e.g., developing local electronic patient record databases). This could have helped facilitate the cognitive legitimacy of the infrastructure—i.e., its comprehensibility across different frames of collective action. Finally, in strengthening both the pragmatic and cognitive legitimacy of the infrastructure, the nesting of governance may help to diffuse the normative judgment that developing and scaling the infrastructure is the right thing to do, i.e., achieving moral legitimacy or normative approval. In sum, the nesting of governance across different layers can help to establish legitimate links across both horizontal and vertical axes, a key practice in developing sustainable information infrastructures, as evident from other large infrastructure developments such as the HIS project across different geographical locations (Braa et al. 2004).

Further, as is evident from our empirical findings, a significant challenge in implementing polycentric governance in infrastructure development is to address the problem of control while accounting for the diversity of ideological goals of collective action. Early on in the development of HEALTHnet, CreteTech adopted a flexible bottom-up governance approach, which supported knowledge and learning at the health service (provider) layer. However, the framing of the Regional Health Authorities with their diverse ideological goal generated contestation and a dynamic of control rather than stimulating an effective nesting of governance across different layers. This had adverse consequences for the scaling up of HEALTHnet. At the same time our case shows how, at a later date, the opportunities of nesting different layers of governance could have been made possible by the Greek government via the Information Society who shared a common ideology of technical configurability as CreteTech. However, rather than building on the existing installed base, their collective action framing was, once again, stymied by the configurable politics of control. Our study therefore emphasizes the need to appreciate the ideological and framing strategies at different layers of control in infrastructure development, and how this can significantly influence the potential for its polycentric governance.

An important implication is that prior to nesting governance across different layers, engagement with different stakeholders is critical to identify the framing strategies of key stakeholder groups and to understand their ideological goals as to how the infrastructure good may be most effectively appropriated. As our case study indicates, when the infrastructure good is imperfectly understood, it is easier for multiple and diverse ideological goals to emerge. Further, parties
with different ideological goals will typically construct polarized framing strategies around the infrastructure, and pose collective choice challenges to its development. For instance, challenges to infrastructure development may occur when, for example, it is being controlled by developers who adopt framing strategies around a private good that is not deemed legitimate by users as meeting their local needs. Thus, it is important to engage interested and affected parties in a well-structured dialogue (Prince et al. 2014) to provide credible information, build legitimacy, increase social capital, and provide a basis on which to politically configure the information infrastructure.

**Conclusion**

In this paper we contribute to the development of a bottom-up approach to governing infrastructure development. Our theoretical contribution develops a collective action framing approach to examine how different actors frame the infrastructure as a public and private good, and how the framing process is underpinned by actors’ different ideologies. Through our case study we demonstrate how this theoretical approach can deepen our understanding of the configurable politics of control among actors that influence the evolution and scalability of information infrastructures. In particular, our analysis allows us to explore the struggle around meanings attributed to the good over time as being either public or private in establishing or sustaining relations of power, and how legitimacy is challenged or reinforced.

We also provide contributions as to how a polycentric approach informed by our theoretical developments may allow the bottom-up governance of information infrastructures. Our findings highlight the importance of engaging different stakeholders to identify their framing strategies and understand their ideological goals as to how the infrastructure good is to be appropriated. Below, we provide some important practical implications for nesting governance decisions across different layers (McGinnis 1999, Ostrom 2010) and establishing the legitimacy of the information infrastructure.

During the earlier development of the information infrastructure, detailed governance rules should not be defined in advance, since that would immediately trigger resistance because of the perception that governance is imposed in a top-down manner. Instead, a key principle would be to give autonomy to all stakeholders to govern themselves as long as their self-governance does not affect others in the same or higher layers. Once there are “spillovers”—i.e., one’s self-organization impacts another’s—governance is nested to higher layers until a layer is reached where all individuals with a substantive interest in a collective action problem are represented adequately. Such progressive nesting would gradually enable the definition of more detailed governance rules, as long as the diversity of framing strategies and ideologies of collective action are taken into account. Doing so would help to establish the pragmatic, cognitive, and moral legitimacy of the information infrastructure.

In closing, we believe that future research could usefully build on our empirical findings and theoretical implications on collective action framing to further develop our proposed framework for polycentric governance.

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