Narrative Networks: Patterns of technology and organization[1]

Brian T. Pentland
Michigan State University

Martha S. Feldman
University of California, Irvine

Abstract

This paper introduces the *narrative network* as a device for representing patterns of technology-in-use. The narrative network offers a novel conceptual vocabulary for the description of information and communication technologies (ICTs) and their relationship to organizational forms. The narrative network is a constructive synthesis of concepts from actor network theory, adaptive structuration theory, the theory of organizational routines, and narrative theory. A narrative network expresses the set of specific patterns (performances) that have been, or could be, generated by combining and recombining the elements of the system. This paper discusses how thinking of technology and organizations as narrative networks influences our understanding of design. The concept of narrative networks helps us understand the relationship between specific actions and abstract patterns, a fundamental factor in understanding the simultaneity of change and stability.

[1] This paper is the result of a co-equal collaboration.

Introduction

To see how technology and organization are intertwined, we need to study people going about their work: *people* using *tools* to do *tasks*. The interconnected nature of people, tools, tasks and organizational form is a well-known phenomenon, demonstrated by decades of research (Trist and Bamforth, 1951; Woodward, 1958; Emery, 1959; Perrow, 1967; Thompson, 1967). With modern information and communication technologies (ICTs), people, tools and tasks are more vividly interconnected than ever. ICTs are enabling new kinds of work processes and organizational forms, reshaping industries, and shifting the competitive balance in inter-organizational relationships. Unfortunately, our ability to theorize (or even adequately describe) these phenomena is hampered by a conceptual vocabulary that has its roots in an era dominated by mass production and the material transformation of physical goods.

We believe the core theoretical problem confronting the study of ICTs in organizations arises from the reification of the categories in the familiar trope -- "people," "tools" and "tasks." A trope is a figurative use of an expression, such as a metaphor. This expression is an example of metonymy, a trope in which one entity is used to stand for another associated entity. The question we address in this paper is, simply put, what do each of these entities stand for? There has been a steady stream of scholarship aimed at dissolving these categories Latour, 1987, 1991; Grint and Woolgar, 1997; Atkinson and Brooks, 2005), but efforts at rebuilding have not met with mainstream acceptance. In the absence of a workable alternative, the scholarly conversation has continued to conceptualize ICTs as "tools," or with "proxies" such as cost or user perception (Orlikoswki and Iacono, 2001; Weber, 2003).

In this paper, we offer a constructive synthesis of several current theories of technology and organization: actor-networks (Law, 1992; Latour, 1999a), adaptive structuration (DeSanctis

and Poole, 1994) and organizational routines (Feldman and Pentland, 2003; Pentland and Feldman, 2005). Each perspective has strengths and limitations; in our synthesis, we strive to preserve and extend the key insights of each. We introduce the concept of a *narrative network* to describe our new model of ICTs and organizational forms. We use the term "narrative" to emphasize a connected set of actions and actors that embodies what Aristotle called "unity of purpose" (Bal, 1985). We use the term "network" to emphasize that these actions and actors can be interconnected in many different ways. There isn't just one narrative that describes "e-commerce" or "vendor managed inventory." There are usually many such narratives, and they may be competing or contradictory (Swanson and Ramiller, 1997). The combination of terms – narrative network – is meant to suggest that ICTs and the organizational forms in which they are used can be conceptualized and empirically summarized as patterns of narrative fragments connected into narratives. In Orlikowski and Iacono's (2001, p. 126) terms, a narrative network is an "ensemble view," where technology is "enmeshed within the conditions of its use."

The paper begins by describing the phenomena we hope to encompass. We offer two concrete examples: purchasing an airline ticket, and watching television. We have deliberately selected two very mundane, well-established domains, each of which has been undergoing considerable transformation. Through these examples, we identify the distinctive features of ICTs. Like Orlikowski and Iacono (2001), we argue that ICTs consist of recombinable, distributed fragments that communicate with one another. We argue that the "technology" exists not in the pieces, but in the patterns of interconnections and use. We introduce the concept of a narrative network as an analytical device for describing and comparing these patterns. It provides a novel theoretical perspective on structure, power and the relation between design and use of

technology. We conclude the paper by considering the implications of narrative networks for the design of ICTs and organizations.

The Phenomena

When organizational scholars describe technology in terms of abstract categories or properties, the details and features of specific technologies are often lost. These omissions are worrisome because research and practical experience have shown that when it comes to ICTs, the details matter. In order to make our discussion as concrete as possible, we have selected relatively examples with which our readers may be familiar: purchasing an airline ticket and watching a television show. For convenience, the examples are written in the first person, present tense. For each example, we present some data and a brief comment. We will return to these examples throughout the paper.

Example: Purchasing an airline ticket

Data. I need to fly to Denmark, so I have to buy a ticket. Before I pick the specific dates and buy my ticket, I need to figure out if I can afford to make a side trip to the original Legoland in Billilund with my family. If it looks workable, I will get tickets for my spouse and child, who are big Lego fans. This requires checking maps, train schedules, hotels, and so on. I also have to coordinate schedules with the rest of the family to make sure the trip won't conflict with other plans, and figure out the budget.

Once the plans are settled, I use my laptop computer to buy the ticket. When I turn the computer on, the built-in WIFI interface negotiates a connection with the nearest access point it can find (in my house or my neighbor's house). Once the computer is finished booting up and connecting to the network, I launch my web browser.

Now I can begin shopping for my flight. I am not sure what airline will offer the best deal, or the best itinerary. So I start by visiting sites like Expedia, Orbitz and Travelocity to see what the market is like. The best itineraries seem to connect through Amsterdam, since there are no non-stop flights to Denmark from my home town. Luckily, it looks like my usual airline, Northwest Airlines, has a good flight at a reasonable flight.

I go to nwa.com and login by entering my name, frequent flier number and personal identification number (PIN). After entering my itinerary and choosing my flights, the web site asks me if I want to select seats. It presents me with a map of available seats, and I pick the ones I want. To complete my purchase, I enter my credit card number, including the three digit security code. The web site checks with VISA to authenticate my credit card. It gives me a confirmation number and suggests that I print the confirmation page. I print the confirmation page so I have a record of the transaction. The web site also sends me an email confirming the transaction.

Comment. We have told this story as it appears from one particular point of view: a "user", sitting at a computer inside my house. Of course, this is a partial, fragmentary view of what really happened. Each time the user hits return or clicks on a link in the web browser, the storyline jumps to the nwa.com data center. Even if we skip the long and circuitous trip along the information superhighway, with miles of fiber optics, possible trips to satellites in space, and so on, there is plenty to tell. The web server will examine the details of each request (origination, destination, dates, number of passengers, and so on), and send back an appropriate HTML page. To do this, the web server must make requests to an "application server." The application server's job is to create itineraries that meet user preferences (for example, for lowest price, or non-stop only, etc.) And of course, to do this job, the application server must query the

flight database to see what flight segments are available.[2] From the point of view of the system architects and administrators who work in the airline data center, "purchasing an airline ticket" would be an entirely different story.

Example: Watching a television show

Data. In our rush to get to the airport, my 10 year old didn't have time to watch his favorite show. Fortunately, digital video recorder (DVR) in our living room recorded it for us. When we arrive at the airport in Amsterdam, I locate a wireless "hotspot" and turn on my laptop (the same one that I used to purchase the airplane ticket). I launch the application that allows me to connect to a device in my living room that will "stream" the video over the internet. In turn, that device asks the DVR in my living room to play the show. The image quality isn't great, but we can watch a show that we recorded at home while we are waiting to change planes in Amsterdam.

Comment. In this example, there is no device that we would recognize as a "television," yet we are still "watching television." Until fairly recently, recording, playback and distribution of audio and video content were restricted to organizations with studios and distribution networks. Today, large corporations no longer have a monopoly on the means of production in this industry. We can record our own digital audio or video tracks. We can edit our work using the same laptops we use to buy airplane tickets. We can "burn" shows to DVD, or distribute the finished product via the Internet for others to download. And because of the growing speed and

[2] This arrangement of servers (a web server, an application server, and a database server) is often called an "N-tier architecture." By separating different functions into different layers, this widely used configuration provides a great deal of flexibility and security. The application layer that serves Internet users can be programmed to show a restricted or simplified subset of possible itineraries. If I were to book the ticket by telephone, the reservation agent would be connected to the same flight database, but they would use a different application server that allows them to construct itineraries and flight options that are not available through the Internet.

connectivity of the Internet, we can enjoy these creative products on an increasingly wide array of portable playback devices, including cell phones.

There are many other examples we could mention, including email, instant messaging, video conferencing, electronic auctions, chat rooms, blogs and wikis (McAfee, 2006). The collection of artifacts is sometimes referred to as "Web 2.0" (O'Reilly, 2005). The list is long, and it is growing. As one commentator noted in the *New York Times*:

> The Internet is entering its Lego era. Indeed, blocks of interchangeable software components are proliferating on the Web and developers are joining them together to create a potentially infinite array of useful new programs." (Markoff, 2006, p. E1).

While Internet-based software technologies exemplify the phenomena most clearly, other ICTs (such as cell phones and PDAs) also provide compelling examples.

These technological innovations have been paralleled by a huge array of organizational innovations (McAfee, 2006). In financial services, we have on-line banking and investing; mortgage application, approval, and origination. In education, we have distance learning and adaptive testing. In daily life, we have shopping, entertainment, getting directions, finding a mate. Even in Woodward's (1958) original domain of manufacturing technology, we have mass customization, flexible specialization and third party logistics. While organizational scholars have long recognized the linkages between ICTs and organizational form (Fulk and Desanctis, 1995; Baskerville and Smithson, 1995), our conceptual frameworks are still rooted in the world of relatively fixed, monolithic technologies of the 1960s.

Analytical properties of modern ICTs

These examples illustrate some important properties of modern ICTs. These features have been identified elsewhere (e.g., Orlikowski and Iacono, 2001; Coyle, 2002; Markoff, 2006). We reiterate them here to underscore the ways in which the technological landscape has changed since the 1960s. We consider these properties "basic" in the sense that they are an essential aspect of any technology that we currently recognize as an ICT. Anything lacking one or more of these properties is probably not an ICT.

Modular

ICTs consist of small pieces or modules that tend to be useless in isolation (Orlikowski and Iacono, 2001). For example, HTML (HyperText Markup Language) was an integral part of our story about the airline ticket, but it would have been useless without HTTP (HyperText Transport Protocol), plus a myriad of servers, routers, and network protocols that together form what we take for granted as "the Web." Similarly, a digital video recorder (DVR) is just an expensive doorstop, unless it is properly connected.

This is a familiar aspect of many kinds of technology. For example, anything that runs on electricity requires a power source (maybe just a battery, but typically a vast network of power plants, transformers and distribution lines known as "the power grid"). With ICTs, as with Legos, the modular nature of the artifacts is particularly evident. Modularity, layering and standardization have been used as conscious strategies to increase the potential for interoperability and reusability of the pieces (Coyle, 2002; Markoff, 2006). So an ICT is almost never just one thing; it is an ensemble.

Recombinable

People can recombine ICTs in many different ways, to serve many different purposes. The same laptop one uses to purchase an airline ticket can be used to view a TV show, edit a video, or place a phone call. ICTs are not just interchangeable, like mass produced parts, where there is an equivalency between standardized parts for a given purpose. Rather, by creating different connections between them, they can serve different purposes. For example, one can add new components to a computer network that transform the network into a medium for television or telephone. One can often substitute ICTs quite easily. If one has trouble purchasing an airline ticket over the Internet, one can pick up the telephone and talk to a travel agent, thereby substituting one ICT for another.

Distributed

It has been widely observed that ICTs bridge time and space (Cairncross, 1997). Returning to our basic trope, "people use tools to do tasks," ICTs allow people, tools and tasks to be separated by both time and space. I can choose a seat on an airplane that will not take off for weeks. While sitting in the Amsterdam airport, I can use the DVR in my living room to watch a show that was broadcast last week.

The spatial and temporal distribution of the parts of a technical system has a variety of implications, only some of which we will touch on here. In particular, the spatial and temporal distribution makes it impossible to observe the entire pattern of activity (Feldman and Pentland, 2003). In the airline ticket example, we never see what goes on at the data center, and the people at the data center cannot see us. The distributed nature of ICTs guarantees that observations of any given technology will be partial, and will depend on one's point of view (Pentland, 2003).

Communicative

ICTs facilitate communication between people, and they also communicate with one another. We deliberately use the phrase "information and communication technologies" (ICTs) and not just "information technologies", or "advanced information technologies" (DeSanctis and Poole, 1994). The ability to communicate relies on even more basic properties, such as the inscription of symbols, encoding of rules, and so on. But it is their communicative nature *per se* that makes ICTs particularly significant to organizational scholars. Communication is central to, and constitutive of, social organization. For this reason, ICTs would be important even if they only mediated communication between people. Their ability to communicate with each other, and mediate communication between one another, simply reinforces this importance.

Because they support communication, ICTs facilitate basic organizational processes such as decision-making, coordination, sense-making, learning, social interactions between members of an organization, and transactions between organizations. This is quite different from the technologies studied by Woodward (1958) – small batch, mass production, and continuous flow. These were manufacturing technologies that supported the transformation of material goods. The communicative quality of these technological systems enables and encourages us to think of them as semiotic - the technology carries meaning.

Summary

When people use ICTs to do tasks, it is not like using a hammer to drive a nail. The modular, recombinable nature of ICTs guarantees that, to accomplish meaningful functions, they must be organized into ensembles (Orlikoski and Iacono, 2001). The distributed and communicative nature of ICTs allows these ensembles to span time and space. Unlike a hammer (or a factory), ICTs are not necessarily visible or tangible. Indeed, many ICTs are non-material

entities, such as HTML or HTTP. Standards, protocols and languages are not "things" in any normal sense of the word, and they are certainly not "people," yet they play a crucial role in any ensemble of ICTs.

Thus, to conceptualize information and communication technologies as "things" is to misrecognize the phenomena in which they participate. This is not a question of subjectivity or social construction. It is a simple, practical fact that there is no single, specific "technology" for buying airplane tickets or even for watching a television show. One can buy an airline ticket or watch a television show or do most anything involving ICTs in many different ways. The pieces do not function in isolation, they are not single purpose, and their function/purpose is not determined by their designers. All of this is rather different from the technology in described by Woodward (1958) or Thompson (1967).

ICTs involve complex patterns of association between people, machines and ideas. These patterns of association embody what many scholars and practitioners consider to be new organizational forms, creating a new competitive landscape for business (Andal-Ancion, Cartwright and Yip, 2003). These patterns are (re)produced by designers, who envision certain patterns of use, and by regular people like you and me, buying airline tickets and watching TV. In the choices we make, we selectively (re)produce these patterns. We use some tools and resources more than others. We use DVRs to skip commercials and watch "television" shows wherever and whenever we want. We use web sites to select our own seats. If enough of us enact these patterns, TV stations and travel agents will dramatically alter the mix of things they do or go out of business entirely. In short, by combining and recombining various fragments, we (re)create our world.

Narrative Networks: A constructive synthesis

Organizational scholars have a variety of theoretical frameworks and vocabularies to talk about these phenomena. In this section, we draw on concepts from structuration, actor-networks and organizational routines, each of which bring an important perspective to the phenomenon, but none of which adequately captures the analytical properties we have identified. The result of this synthesis is the "narrative network," a conceptual device that incorporates concepts from the other theoretical traditions.

Adaptive Structuration Theory

Even though the original formulation made little mention of technology, Gidden's (1984) theory of structuration has been highly influential in the literature on organizations and information systems (Barley, 1986; Orlikowski, 1992). Orlikowski (1992) and DeSanctis and Poole (1994) extended Giddens' ideas explicitly to include technology. These frameworks emphasize the importance of technology-in-use. In adaptive structuration theory (AST), this is referred to as appropriation (DeSanctis and Poole, 1994). A PC can be used as a plant stand, if that serves the needs of the user.

The basic idea is that technology embodies an important aspect of structure because it incorporates constraints and affordances that are changed through use, as users appropriate the technology to their particular needs. In AST, technology is conceptualized as a carrier or vehicle for social and organizational structure: "Advanced information technologies bring social structures which enable and constrain interaction to the workplace." (DeSanctis and Poole, 1994, p. 125). In some formulations, technological constraints and affordances are treated as a direct aspect of structure (e.g., Barley, 1990; Pentland, 1995).

This framework has been criticized for being insufficiently specific about technology (Monteiro and Hanseth, 1996). In some respects, this is not an inherent limitation of AST; it is always possible to be more specific about a particular technology within the context of given study. DeSanctis and Poole (1994), for instance, studied the use of a group decision support system (GDSS), and they provided very detailed data and description of the technical features. Their research has proved to be a rich source of insight for the design of group decision support systems over the years. Orlikowski (1992) also offers a great deal of specific detail in her empirical descriptions. This line of research shows that different people used specific technology in different ways, thereby demonstrating the difference between the technology and the technology-in-use (Orlikowski, 1992).

Still, the AST framework lacks any explicit consideration of the fragmented, recombinable and distributed nature of ICTs. The technology has specific features, but within the timeframe of a particular study, those features are basically static. This is a reasonable way to conceptualize earlier generations of information systems, but the state of the art has moved forward. So, while Desanctis and Poole (1994) refer to the GDSS they studied as an "advanced information technology," it did not have the modular, recombinable, and distributed properties that typify current ICTs. The same is true for the computer aided software engineering (CASE) tools studied by Orliksowski (1992). Details are clearly important in AST, but technology is conceptualized as relatively monolithic.

Appropriation takes on much greater significance in the Lego-like world of modularity and recombinability. In 2006, appropriation can occur in ways that were not common in the 1990s, and completely unheard of in the 1960s. The ability to appropriate fragments means that participants can redesign technologies "on the fly" in unanticipated ways. Structures composed

of recombinable fragments might be more malleable, more fluid, and less "structural" than structuration theory would lead us to think.

In summary, adaptive structuration theory spells out the importance of technology-in-use, which continues to be a critical insight upon which we need to build. But AST tends to treat technology as relatively monolithic and fixed and it views technology as an aspect of structure distinct from agency located in the people (Rose and Jones, 2005). These features of AST need to be scrutinized and updated to take into account the properties of current ICTs.

Actor Network Theory

We believe that Actor-Network Theory (ANT) also offers a range of insights that are essential for describing ICTs and organizational forms. We are not alone in this assessment. As Mutch (2002) notes, ANT has become an increasingly popular way to analyze information systems (see also Walsham, 1997; Doolin and Lowe, 2002; Hanseth, Aanestad and Berg, 2004; Allen, 2004; Faraj, Kwon and Watts, 2004). There are many variants of ANT (Law and Hassard, 1999; Latour, 2005), and a full review is beyond the scope of this paper. Yet there are some core ideas we intend to enroll and translate for our purposes here, as follows.

First, we believe it is useful to define "actants" as a category that includes human and non-human members (Latour, 1991; Law, 1992). Regardless of one's stance on the more radical versions of ANT, which propose complete symmetry between humans and non-humans, any analysis of technology and organization needs to include both people and machines. Treating humans and non-humans as functionally similar reflects the empirical reality that in many situations, machines can substitute for people, and vice versa. For example, when shopping for an airline ticket, one can visit the web site of each different airline looking for the best deal. Alternatively, one can visit a web site like Orbitz that does the comparison shopping for you.

Similarly, one can plan an itinerary, select seats, and purchase the ticket with the help of a human, or with the help of a web site. From simple answering machines to the most sophisticated voice response systems ("What is your destination…?"), ICTs act as our agents. The substitutability is not perfect or complete, but it is a commonplace aspect of ICTs that should be reflected in our conceptual vocabulary.

Second, ANT offers the principle of translation, which is roughly analogous to the concept of appropriation in AST. Latour (1991, p. 105-6) identifies this as the "first principle" in studying technology: in spite of what its designers may intend, the fate of an artifact is "in the hands of others." Translation is used in ANT as an alternative to diffusion as a way of understanding how innovations spread (Latour, 1999; Czarniawska-Joerges and Joerges, 1998). Diffusion models suggest that the innovation is an entity that stays intact as it moves in ever-widening circles. Translation models suggest that innovations are altered as they move. In some cases, the extent of translation may be so minor it goes unnoticed (for example, when web browsers are used for browsing the web). In other examples, the translation is more striking (for example, when cell phones are used as bomb detonators). The point is simply that without being acted upon, there is no "technology-in-use." Because technology must be acted upon, "technology in use" can be *very* different than the "technology" the designer intended. The process of translation is fundamental to our ability to recombine artifacts in different ways.

Finally, ANT gives us the idea that organizational forms can be conceptualized as stabilized, heterogenous networks (Law, 1992). Law (1992, p. 381, emphasis in the original) argues that "the social is *nothing other than patterned networks of heterogeneous materials*." The heterogeneity refers to the inclusions of both human and non-human actants, as discussed above. Stabilized networks occur when patterns of actants appear together repeatedly (Latour et

al, 1992). If the pattern is sufficiently stable, it may become a "black box" (Latour, 1987). Black boxes are often political phenomena in that they constitute a dominant "program" that serves the interests of some group. By "black-boxing" a pattern of actants, the pattern is hidden; it is seen as an integral entity (Law, 1992).

While ANT brings a great deal of value to the analysis of ICTs, there are some limitations and gaps. First, Mutch (2002) notes that ANT has been criticized as being "flat." ANT encourages careful attention to detail, but everything is in the here and now. This is exemplified by Law's (1992) statement: "I refuse an analytical distinction between the macro- and the micro-social." In lieu of explanatory categories like structure, culture or history, ANT offers only the network of associations. Unfortunately, the network has no depth of history or context. Law's (1992) argues that structure should only be used as a verb, a process that produces precarious, contingent effects. This corresponds to Latour's position that ANT "was never a theory of what the social is made of, contrary to the reading of many sociologists who believed it was one more school trying to explain the behavior of social actors. " (1999, p. 19).

Second, while ANT offers many theoretical insights, it is difficult to operationalize and analyze an actor-network using the tools one might apply to other kinds of networks (e.g., density, centrality, etc.) (Wasserman and Faust, 1994). Latour (1999a) notes that the "network" aspect of ANT refers to "the *summing up* of interaction through various kinds of devices, inscriptions, forms and formulae, into a very local, very practical, very tiny locus" (1999a, p. 17, emphasis in original). This sounds good, but the resulting network is largely metaphorical. The first problem is the heterogeneity of the network. Even the nodes that appear to be the same cannot be treated that way, because they are temporally situated in the here-and-now and subject to "translation" (Latour, 1999a). Second, there is no consistent definition of the ties or

associations between the actants. In the theoretical vocabulary of ANT, actants may be enrolled, associated, substituted and translated, but nature of these associations somewhat vague and metaphorical.

Finally, because it lacks consistent operationalization, ANT is generally silent on the issue of how we identify a pattern of actants as a network and how we can recognize a network as being the "same" over time. ANT encourages us to summarize instances into a network, but this summarization forces a move away from the concrete, towards the abstract. And given the distributed nature of ICTs, and the many actants who may be involved in their use, a great deal of summing up may be required, from many different points of view. In spite of these empirical complexities, the network of associations is often described in simple, present-perfect language: "Customers return their keys because…" or "One buys an airline ticket on the internet by going to the web site…" When described this way, both agency and structure become ambiguous and somewhat hidden.

These are critical issues for organization theorists, because the network of associations (the "program" or the "pattern") is the closest ANT has to offer to a description of an organizational form (Law, 1992). The abstract summing up is what defines and constitutes the role of travel agents, of television broadcasters and advertisers, and every other organizational process or form that employs ITCs. ANT gives us the essential idea that organizational forms can be understood as stabilized patterns of heterogeneous actants. At the same time, its theoretical commitment to the primacy of the here-and-now aspects of the social world makes it difficult to operationalize in empirical research. Ironically, this limits our view of what stability means, or how specific patterns can be sustained and replicated over time.

Theory of organizational routines

The relationship between specific performances and stable patterns is the central theme in Feldman and Pentland's (2003) theory of organizational routines. They define organizational routines as "repetitive, recognizable patterns of interdependent actions, carried out by multiple actors." (p. 95). Like most social science theorizing, this definition fails to include non-human actants. But it does include an important theme that AST and ANT do not emphasize: patterns of interdependent actions. In terms of our guiding trope, while ANT and AST have focused on the "people" and "tools", the theory of organizational routines has focused more on the "tasks." Organizational routines are defined by patterns of interdependent actions that are assembled into a (more or less) coherent whole, to accomplish some recognizable organizational function, such as hiring. In our constructive synthesis, patterns of actions are a key element.

The theory of routines also provides a way of thinking about how we identify a set of associations as a network and how we can recognize a network as being the "same" over time. The "stabilized patterns" of the actor-network are likely to be repetitive, recognizable and carried out by multiple actants. In organizations, when people use tools to do tasks, they most often do so as part of an organizational routine. Feldman and Pentland (2003) argue that any social system that satisfies the definition of organizational routines must consist of two complementary aspects: the ostensive and the performative. Thus, the stabilized patterns we recognize as "buying an airplane ticket" or "watching TV" must also embody ostensive and performative aspects.

The performative aspect consists of the concrete, specific performances of the routine. In terms of our example, the performative is the purchase of a particular ticket to Denmark by a specific person. In contrast, the "ostensive" aspects consist of the abstract, generalized

understandings of the participants. In terms of our example, it is the general idea of "buying an airplane ticket" and the generalized steps involved in accomplishing this task. The ostensive is a generative resource – participants draw on their understandings of a routine to reproduce it, to plan, guide and account for their actions with respect to the routine (Feldman and Pentland, 2003). The ostensive includes normative expectations, as well as intentions, designs, and imagination.

It is important to emphasize that the ostensive aspects of an organizational routine are not unitary or monolithic (Pentland and Feldman, 2005). Even when there is some degree of shared understanding, different participants will have different points of view, and may have different or contradictory understandings. The extent of this diversity is an empirical question. Performances are even more diverse, because performances of a routine vary from one iteration to the next. For example, the next time I buy an airline ticket, I am likely to have a different destination, I may choose a different airline, I may use a different search engine and other associated technologies and I may even incorporate a travel agent with whatever technologies accompany that actant.

The theory of organizational routines is consistent with the ensemble view (Orlikowski and Iacono, 2001), which emphasizes the participation of multiple actants. The involvement of multiple actants is what distinguishes a routine as organizational, rather than individual. Also, it accounts for the theoretical importance of routines as a means for coordination (Stene, 1940). The involvement of multiple actants insures, however, that there will be multiple points of view, multiple understandings and potentially multiple goals.

The multiplicity of participants and understandings makes it difficult to identify clear boundaries on ICTs or the activities in which they are employed. For example, does the airline

ticket purchase process include shopping at Orbitz.com, and researching the side trip to Legoland? Or is it limited to the actual transaction at nwa.com? These fragments could be parts of other, entirely different stories. This is especially true of the smaller technical fragments, like "I launch my web browser." They appear as part of a particular story – purchasing this particular airline ticket -- because we told that story from a point of view that provided coherence. We do not mean to suggest that boundaries do not exist. Rather, there are multiple, different boundaries that depend on the point of view of the observer (Pentland, 2003).

Table 1: Summary of ideas and opportunities

Source	Ideas we adopt	Opportunities for improvement
Adaptive Structuration Theory	• Appropriation/translation • Duality of structure and agency	• Recognition of basic properties of ICTs: modularity, recombinability, etc. • Better representation of patterns of ICT use • Richer understanding of organizational form and function
Actor-Network Theory	• Generalized actants & heterogeneous networks • Appropriation/translation • Organizational forms as stabilized patterns of actants	
Theory of Organizational routines	• Organizational functions as stabilized patterns of action • Duality of abstract/specific • Multiple points of view & boundaries	

Table 1 summarizes the specific strengths upon which we build, and the opportunities for improvement. To account for the properties of ICTs, we need better ways to conceptualize and represent the patterns of use. These opportunities are not ends in themselves; rather, they are stepping stones towards a better understanding of the inter-relationships of ICTs, organizational form and function. To accomplish this theoretical synthesis, we need a new framework that integrates the key elements from each perspective.

The narrative network

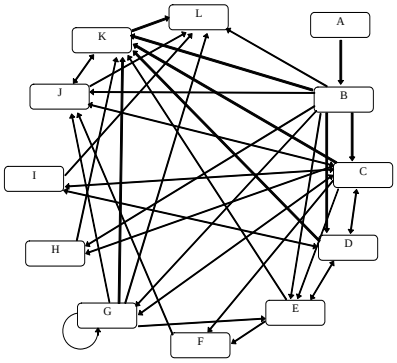
In this section we introduce the narrative network and show how it creates the theoretical synthesis of the elements that the previous theories provides. As Latour argues:

> The main difficulty of integrating technology into social theory is the lack of a narrative resource. We know how to describe human relations, we know how to describe mechanisms, we often try to alternate between context and content to talk about the influence of technology on society or vice versa, but we are not yet expert at weaving the two resources together into an integrated whole. (Latour, 1991, p. 111)

The narrative network is intended to provide the theoretical resource Latour is describing. Table 2 summarizes the hierarchy of concepts and their definitions, from concrete to abstract. In an effort to minimize the number of different terms and concepts, we will stay close to our introductory examples.

Table 2: From actants & actions to narrative networks

Concept	Description	Example
Actants and actions	• Like atoms or elements	"the user" "the web browser"
Narrative fragments = combination of actants and actions	• Like molecules • Can fit into many different narratives	"the user launched the web browser"
Narrative = Particular sequence of functional events that cohere	• Like polymers or proteins • Beginning, middle, end depends on point of view of narrator • Coherence from unity of purpose	"I launched the browser and typed in the URL of the airline web site. I logged in to the site…" in order to buy an airplane ticket.

Narrative Network = Actants and actions coupled into fragments or potential fragments and connected into narratives and potential narratives	• Narrative fragments and the connections between them • Empirically: Fragments that are part of a narrative, or could be used to create a narrative • Theoretically: generative resource from which narratives can be created	

Note: Example narrative network depicts the sequential relationship between twelve categories of events in technical support process (adapted from Pentland, 1999).

Actants and actions

Actants are the human and non-human actors. In our case the human actants can be thought of as designers, users and observers. The non-human actants include a broad range of things including hardware and software, the physical locations of these things, the wires, the waves, the satellites, the protocols, etc. The actions connect the actants to one another. With ICTs, the action is frequently something like "using," "communicating," "authenticating" or "connecting."

Narrative fragments

Narrative fragments are the basic "nodes" within a narrative network. Narrative fragments consist of at least two actants and some kind of action that occurs with them or between them. For example, "I log onto my computer." More famous examples do not necessarily include technology: "the Princess kisses the frog" and "Cinderella dances with the Prince." Narrative fragments build directly on Hendricks' (1972) concept of a "functional event" in a narrative (Bal, 1985). Basically, narrative fragments advance the plot. Each fragment answers the question, "What happens next?", but the fragment contains more than just the action or event. Events do not happen in isolation; they occur with or between actants. It may be

helpful to think of narrative fragments as little chunks of technology-in-use, as long as you recognize that they do not necessarily need to include non-human actants.

Hendrick's (1972) use of the adjective "functional" does not imply that every event is well-adapted in some rational or normative sense. Functional events simply advance the plot, which can be dysfunctional for the characters (e.g., "Snow White bites the apple"). We prefer the term "narrative fragment" partly because it does not carry the connotation of being "functional" in a normative sense. Typical ICT narrative fragments involve human and non-human actants: "the user visits the web site," "the web server authenticates the user" and "the firewall blocks the protocol."

Narratives

While there are many forms of narrative, we are using the term here in a fairly mundane way, as a progression or sequence of events (Rimmon-Kenan, 1985). Hendricks (1972) argued that a narrative can be modeled as a sequence of "functional events" of the kind we have just described. The sequence will generally have a distinct beginning, middle, and end (Barthes, 1977), although these boundaries will depend on the point of view of the narrator (Bal, 1985). For example, does the story end with the purchase of the ticket, or does it include the flight and the trip to Legoland?

To qualify as a narrative (rather than a "chronicle" or just a set of disconnected events), the fragments need coherence (White, 1981; Abell, 2004). White (1981) emphasized the importance of moral context or purpose, but coherence can come from a variety of sources. In his Poetics, Aristotle identified unity of time, place and purpose as three key elements in a narrative (Walker, 2004). Thus, the classic Greek drama had to occur in one day, in one place,

with a single dramatic point. Burke expanded this list to include five elements that help define the boundary of the narrative: scene, act, agent, agency and purpose (1969).

For organizational narrative, unity of action or purpose provides the most valid form of coherence (Czarniawska, 1997, 1998). As our simple examples illustrate, narratives involving ICTs are often widely distributed in time and space, which limits the utility of these dimensions in establishing coherence. Unity of action defines the "function" that one might ascribe to the narrative – it is the "purpose" in Burke's (1968) pentad. In the theory of organizational routines, this unity of purpose is what makes the pattern of actions recognizable and coherent. It represents the organizational function of the routine (e.g., selling tickets, hiring, etc.).

Of course, what one sees as the function or point of a narrative may differ depending on one's point of view. For example, the difference between "sharing music" and "violating copyright" depends, in part, on whose point of view we adopt. The same combination of narrative fragments can create different narratives when they are assembled for different purposes and understood from different points of view.

Narratives can be actual, typical, hypothetical or fictional. They can be first person, second person (imperative), or third person. They can be past, present or future tense. Each of these ways of narrating the pattern of fragments has a very different empirical and theoretical status. Designers often narrate in the second person (imperative), in an effort to dictate or control what "users" should do. Their narratives are future tense, and basically fictional: they describe associations between actants that may never exist. On the other hand, we can make detailed observations, and record those observations as actual events, in the past tense. This would be typical of ethnographic field notes, for example. In the grey area between fact and fiction, we find a large array of documents and descriptions, such as standard operating

procedures and process maps. These documents contain narratives, some of which are "actual" or "typical", and some of which are not. The map is not the terrain (Suchman, 1995).

Narrative network

A narrative network is a tool for representing the actual and potential narratives that can be created within some sphere of activity. We use the term "network" to evoke the image of many interconnected elements, a maze of potential pathways from which particular performances can be identified. Actants are connected through actions into narrative fragments and narrative fragments are connected with one another in the construction of narratives.

Nodes are narrative fragments. The "nodes" in a narrative network are fragments (analogous to what Hendricks (1972) called functional events) rather than actants. In this respect, a narrative network is similar to what Czarniawska (1997) and Pentland (1999) have called "action nets." The nodes represent parts of stories – things that have happened or could happen. The shift in terminology from "action net" to "narrative net" is more than just a difference in labels – it is meant to convey the theoretical position that actions and actants together form meaningful, integrated units.

The choice to focus on fragments rather than actions or actants at this stage of the theorizing has some implications worth considering. First, each node consists of a little network of two or more related actants (human and non-human). While it would be possible to make a network of actants, doing so would focus attention on how actants become connected rather than on how fragments become connected. How actants become connected is a very important issue and is at the heart of actor-network theory (Czarniawska and Hernes, 2005). How fragments become connected is one of the questions that ANT leaves unanswered and for which we need to turn to a theory of narratives.

Second, by focusing on fragments the composition of the fragments can become taken for granted entities or "black boxes" in the ANT parlance. Therefore, it is important to recognize that the fragments are constructed through the actions of human and non-human actants and that the fragments that are created reflect different possibilities represented in the network. The boundaries on the fragments depend, to some extent, on the point of view of some observer. Unlike individual people, narrative fragments are not a "natural kind" (Quine, 1969); they do not appear to be "given" by some natural law.

Third, each enactment of a particular fragment (each chunk of technology-in-use) can entail a different translation (appropriation) of the underlying pieces. Latour (1992) makes a similar point in his criticism of the way the "network" aspect of actor-networks has been misunderstood. For example, "I launch my web browser" can be part of an airline or part of a television network. Third, because the fragments could be further decomposed, using them as nodes tends to give narrative networks a "boxes-within-boxes" feel. This reflects an important characteristic of the phenomenon: ICTs are built in layers, and so are the processes and organizations that use ICTs. Thus, the nodes in a narrative-network cannot be isolated and identified like individual people in a social network.

Kinds of ties. The use of fragments as nodes forces attention to the connections between fragments or the kinds of ties in a narrative network. Because fragments are arranged sequentially to form a narrative (Hendricks, 1972, Czarniawska, 1997), sequence is the most basic relation between fragments in a narrative network. This relation answers the question: what happens next? This relation implies chronology, but also coherence (e.g., unity of purpose). In other words, just knowing that fragment A occurred before fragment B does not

establish a relation between them. They must occur sequentially as part of the same, coherent story.

Interdependence of the elements is another part of the relationship between narrative fragments. Interdependence may arise from the flow of information or materials (Malone and Crowston, 1994). For example, I have to launch a web browser before I can visit a web site. Interdependence may also arise from the unity of purpose or the kind of story being told. For instance, the fragments I need to use my computer to buy an airplane ticket are different from the fragments I need to use my computer to watch a "television" show. Interdependence can constrain sequence, which makes it an important source of structure in patterns of action (Salancik and Leblebici, 1988).

Figure 1 contains an example of a narrative network for our story of the airline ticket. The left hand side of the figure includes a set of narrative fragments from the story as it was told. Note that each fragment is a functional event (Hendricks, 1972); two or more actants and some action. In that narrative, the fragments flow sequentially, in a straight line from beginning to end. The right hand side contains fragments from another narrative about purchasing an airline ticket using a different ICT: the telephone. In these fragments the telephone and the reservation agent are actants that take the place of many of the actants in the narrative on the left hand side. They can also form a straight line sequence, but there are many points along the way where one could jump between these stories. The ability to choose between narratives generates variety. Figure 1 includes some typical examples, but readers are probably familiar with still others:

- You can research and reserve a flight on line, then telephone the airline to pay.
- You can purchase tickets on-line, then telephone to get seat assignments.

- If you want to sit next to someone who has already purchased a ticket, you can telephone the airline to ask.

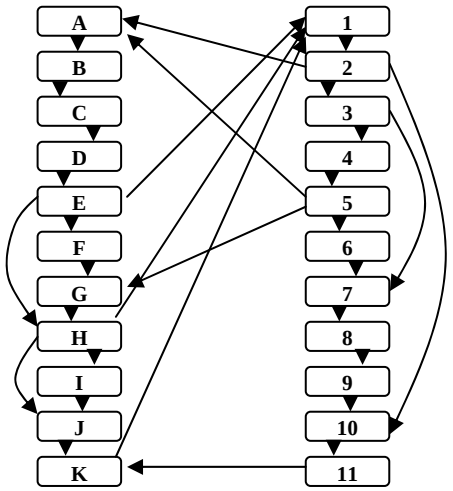
Narrative fragments ("I bought my ticket on the web…")	**Narrative network**	**Narrative fragments** ("I called the airline to get my ticket…")
A. I turn on the computer B. The computer connects to the network C. I launch the web browser D. I visit the web site of a travel agent to compare prices E. The web site advises me about price and itineraries F. I go to a different web site to purchase the ticket G. I log in to the web site H. I select my itinerary I. I select my seats J. I enter my credit card number K. The web site sends me confirmation via email		1. I pick up the phone 2. I call my airline 3. I tell the agent my dates and destination 4. Agent checks the database 5. The agent suggest some flights 6. I select my flight 7. Agent checks database for seats 8. Agent suggests seats 9. I agree to the seats 10. I give my CC 11. Agent gives me the confirmation number

Figure 1: Narrative network for purchasing an airline ticket

As we add technologies or participants, the possibilities multiply. For example, what if the traveler is *invited* to Denmark, so that *someone else* books and pays for the ticket? The traveler might still research the flight and select an itinerary, then send that itinerary to the person who actually books the flight. When the arrangements are complete, the confirmation information is sent back. In that scenario, the tasks and technologies are similar, but there would be additional characters and different fragments, arranged in a different sequence. And if the traveler is the narrator, the actual booking of the ticket becomes invisible. Likewise, from the point of view of the person booking the ticket, researching the flight becomes invisible.

We could add fragments from narratives where we need to change a flight; or use frequent flier miles; or your credit card is rejected; or you book on-line with your PDA; and so on. The more fragments we add, the more connections become possible. Participants can

arrange the fragments in a multitude of ways. We clearly see that "buying an airplane ticket" is not necessarily a simple, straight-line story. It is a complex network of possibilities.

Narrative networks as epistemology and ontology. We can think of the narrative network as an epistemological construct or an ontological construct. As an epistemological construct, it becomes a way of organizing and analyzing data that we collect about ICTs and organizational forms. For example, we might do a study where we collect a sample of process descriptions (narratives) of people purchasing airline tickets. We could summarize these narratives into a network in the manner just described, by identifying common fragments and the relations between them. A variety of event-based methods are available to operationalize such patterns, such as event structure analysis (Heise, 1989; Corsaro and Heise, 1990; see also Abbott, 1990, 1995). A full review of these methods is beyond the scope of this paper. Based on the theoretical synthesis presented here, the patterns of connections in a narrative network would offer an excellent representation of the ensemble of ICTs and the patterns of action they produce (in other words, their organizational form and function).

One can also treat narrative networks as an ontological construct, in which case ICTs and organizational forms literally *are* narrative networks. In this view, the narrative network would play the theoretical role of "structure" the way this term is used in Adaptive Structuration Theory, as a noun. Instead of being rigid and monolithic, however, the narrative network provides a model of structure that is filled with possibilities and alternatives. In the following section, we begin to explore the implications of this perspective.

Narrative Networks as Theoretical Synthesis

The narrative network allows us to combine many of the useful ideas from AST, ANT and the theory of organizational routines to create a new understanding of structure. We can see

a progressive integration of the three features of our basic trope: *people* use *tools* to do *tasks*. AST brought our attention to the importance of the ability of people to appropriate features of tools in relation to their interactions (DeSanctis and Poole, 1994) and the production of institutional properties (Orlikowski, 1992). In this view the structures of technology are different from the structures of interaction or institutional properties. As a result *tools* are separated from, though not inconsequential for, the structuring of *people* and *tasks*. The structures of technology are generally fixed in this view. Technology tends to be monolithic and relatively unchangeable. In their re-creation of institutional properties and structures of interaction, people appropriate and even subvert features of the technology to serve their own interests, but the basic technological structure is laid down by the designers and enforced by the designed artifact.

In ANT, people and tools are explicitly connected. Technology is the result of what people do; tools are nothing without the actions that people take with them. Tools cannot be used without translation. Every use of a technology is a re-creation of it with smaller or larger deviations from how it was used before. ANT locates structure in the patterns (the actor-networks). ANT does not really attempt to explain why these patterns occur or what it is that makes them cohere (hence the "flatness" of ANT). *People* and *tools* are connected but *tasks* are still not integrated.

Attention to organizational routines adds tasks to this trope. In their theory of organizational routines, Feldman and Pentland (2003) provide a way of thinking about the integration of *people* and *tasks*. A disconnected set of individual actions or tasks becomes an organizational routine when people begin to recognize it as such; the ostensive aspects of the routine supply the unity of purpose. In terms of our framework here, it supplies the connections that make the pattern of action recognizable as the routine. In turn, through their actions, people

create, maintain and modify these connections. Thus, what appears to be structure exists in the pattern of *tasks* and the ways that actants, including *people*, are connected. This theory, however, leaves out *tools*.

Narrative networks allows us to complete the integration between people, tools and tasks by providing a more refined concept of structure that incorporates technology more explicitly and extends the quest for balance between agency and structure. It locates structure in the connections between fragments – chunks of socio-technical potential that actors can arrange and re-arrange to suit their current interests. To some extent, the fragments are "given," and may even have a black-box quality. The ways that fragments can be arranged may also be somewhat constrained, but this is an empirical question that provides an avenue for comparing the structure of alternative networks. The arrangement of fragments into narratives – actual work processes – is a matter of choice (agency).

The narrative network improves on AST and ANT because it opens a continuum of empirical possibilities. At one end, the structure is relatively rigid. At the other end, it is flexible. For any particular situation, the degree of structure is an empirical question. The concept of structure we propose here suggests that both ends of the continuum are theoretically possible. Narrative networks provide a way of comparing whether an organizational form has "more" or "less" structure. Similarly, the duration of structures over time is also an empirical question. This contrasts with the ANT perspective that patterns are always precarious and contingent (Law, 1992), while acknowledging that they are always potentially subject to change. The narrative network includes a straightforward way to describe organizational change, as well. Patterns can be changed by adding or removing fragments, and adding or removing connections.

Understanding structure is important for understanding the nature of power. In AST, designers embed rules into the technology – they exercise power by enabling and constraining the actions they want to see. Technology can be a means of domination, which has been a central theme in labor process theory and other critical perspectives on technology (Braverman, 1973; Noble, 1984; Kelley, 1986; Rosen and Baroudi, 1992; Berg, 1998; Orlikowski and Barley, 2001). Some appropriation is possible, but the idea that technology carries structure (and power) is the baseline against which that appropriation takes place. Designers have power; their power is embedded in technology; and through that technology, designers *cause* users to engage in certain patterns of behavior. Users' power is often limited to ignoring the technology or altering the institutional context in which it is embedded.

ANT takes the opposite position. ANT's signature claim is that power is an *effect*, not a cause (Latour, 1986; Law, 1992). This view offers a welcome antidote to the simplistic reification of social structure, hierarchy and power. Designers may *try* to exercise power by embedding rules into their artifacts, but ultimately, according to Latour's first principle, the fate of the artifact rests with the users. Technology enters the world through translation by its users. To the extent that it exists at all, power is an effect of the way that users translate the technology. The intentions of the designers are remote.

In the framework we propose here, both of these stories are possible. In a narrative network, the balance of power between designers and users is an empirical question. Sometimes designers can effectively constrain or enable certain patterns of action, but sometimes they cannot. Sometimes users can assemble their fragments as they please, but sometimes they cannot. Theoretically, a narrative network can allow lots of variations, or very few. The possibility for user-initiated variations depends on array of available fragments and the richness

of connections between them. Certainly, the world of ICTs seems to be providing more and more such possibilities. The extent to which users avail themselves of those possibilities (exercising their agency) is a separate question.

Narrative Networks: Implications for Design

Conceptualizing "people using tools to do tasks" in terms of a narrative network presents a direct challenge to the idea that design is separate from, and prior to, use. Orlikowski and Barley (2001) have noted that technology is shaped by designers and by users. Our perspective suggests that there is potentially considerable fluidity between these roles. We claim that the construction of particular narratives out of the fragments that join agents, tools and tasks in various combinations *is* an act of designing whether it is done by designers or users or some blend of these. Choosing and executing a narrative is creating structure and exercising power. The modular, recombinable nature of ICTs both increases the number of choices and puts more of the power to execute in the hands of the user. From this perspective, then, using *is* designing and design is emergent.

Designing ICT artifacts

This view has some implications for the growing interest in the design of ICT artifacts (Hevner, March, Park and Ram, 2004). Current research on the "designed artifact" generally builds on the intellectual tradition established by Herbert Simon in *The Sciences of the Artificial.* Designers are concerned "with how things *ought* to be – how they ought to be in order to *attain goals* and to *function*" (Simon, 1969, p.5-6). Simon defined artifacts in terms of their boundaries:

> An artifact can be thought of as a meeting point – an interface in today's terms – between an "inner" environment, the substance and organization of the artifact

> itself, and an "outer" environment, the surroundings in which it operates. If the inner environment is appropriate to the outer environment, or vice versa, the artifact will serve its intended purpose (1969, p. 6).

In this view, artifacts are the quintessential black boxes, with clear boundaries. Designers work inside the boundary, so that users can stay outside. This classic division of labor between design and use is reinforced in the ubiquitous warning, "No user serviceable parts inside." Like AST (DeSanctis and Poole, 1994), design science is predicated on the existence of well defined, well bounded artifacts.

The narrative network undermines this perspective in several ways. First, the narrative network blurs the distinction between "inner" and "outer." Each participant has his/her/its own point of view (the traveler, the travel agent, the web site, etc.), and each point of view introduces a potentially different boundary. The distinction between "inner" and "outer" works well when applied to devices that have physical covers that conceal their inner workings, reinforced with warnings about voiding the warranty if the cover is opened. But the distinction does not work so well when users are combining narrative fragments into the patterns needed to accomplish meaningful tasks. Everyone is potentially on the inside. In a very concrete sense, users *design* their own collection of fragments, and deploy them as they see fit. I choose my laptop, my browser, my airline, and so on, and I use this configuration of resources as I please.

Second, the idea of a singular goal or purpose is undermined. Multiple participants, with points of view and potentially divergent goals are the root of the difficulty. Simon (1969) makes no distinction between clients and users, and assumes that designers serve those interests. Chuchman (1971) introduced the notion of a "client", whose interests may be different from the designer or the user. For example, a manager (the client) might hire a programmer (the designer)

to implement help desk software for his staff (the users). In his analysis of a failed public transportation system, Latour (1999) opened the field even further, noting that every participant (including the technology itself) had potentially divergent interests and goals. In recognition of this potential diversity, the narrative network makes no assumption about shared understanding or shared goals. A particular sequence of events is connected by unity of purpose, but the "purpose" is always localized to the individual adding the next fragment to the story.

Designing organizational processes and routines

The narrative network tends to undermine traditional assumptions about roles, boundaries and goals in the design and use of technical artifacts. The same can be said of the components of organizational processes and routines. Organizational routines are not naturally occurring phenomena that can only be executed in one way. Instead, they consist of modular, recombinable fragments that organizational designers, participants and observers combine to create patterns that cohere through sequence, interdependence and purpose. They, too, are narrative networks.

The question, "Who gets to choose the narrative?" takes on additional significance in the organizational arena. The traditional assumptions about design imply a single narrator, with a single point of view, who determines how events should and will unfold. The designer may also determine what happens if there are exceptions or problems. This traditional perspective on design fits well with an emphasis on standard operating procedures and other material artifacts. While standard operating procedures are certainly important to organizational routines, they are distinct from both the specific actions people take in performing a routine and the abstract patterns that emerge from these performances (Feldman and Pentland, 2003; Pentland and Feldman, 2005). These performative and ostensive aspects of organizational routines have not

one but many narrators. The choice of what pieces belong together as a routine varies from different organizational perspectives and as the performances unfold over time, everybody gets a choice of what happens next.

Conclusion

Our goal in this paper has been to introduce a new approach to ICTs and organizations. If we think in terms of narrative networks, we can restate some of our familiar questions about technology and organizational change. For example, one general line of research concerns the impact of technology on stability and change. In terms of narrative networks, one might ask why some patterns get stabilized in particular forms. Why are some patterns flexible, while others are rigid and resistant to change? What are the connections that stabilize a particular pattern and what would disrupt these connections? In the closely related areas of adoption and diffusion of technology, the narrative network provides an alternative vocabulary for the micro-dynamics of change. For example, one might investigate the conditions under which one fragment gets associated with (or substituted for) another fragment.

It may also be possible to study the properties of the narrative network itself. For example, higher density implies more possible associations, which may afford more flexibility and more room for improvisation. Lower density implies fewer connections that could be made, which may afford less flexibility and less room for improvisation. It is beyond the scope of this paper to explore all of these possibilities, but it seems clear that the narrative networks offers an alternative framework for exploring a wide range of phenomena.

Explaining how we summarize specific performances into generalized patterns is an important problem for understanding organizations (Birnholtz, Cohen and Hoch, 2006; Feldman and Pentland, 2003; 2005; Tsoukas and Chia, 2002; Weick, 1979; Whitehead, 1929/1978).

Much of social science has simply taken for granted the abstraction and missed the processes that create it (Latour, 1986; 2005). As a result, Bourdieu (1990) claims that through recognizing, we misrecognize. For instance, by focusing on stability, we miss change (Tsoukas and Chia, 2002). In this paper we show that by focusing on technology as a structured thing that somebody (designers) control, we miss the fungible nature of tools, tasks and agents and the power embedded in and released through use by ordinary users. Narrative networks provide a way of breaking open these black boxes. They provide a way of thinking about the process of abstracting patterns from specific performances that keeps the multiplicity of the specific performances available at the same time that we see the process through which a pattern emerges.

References

Abbott, A. 1992. From Causes to Events: Notes on Narrative Positivism. *Sociological Methods and Research*, 20(4): 428-455.

_____. 1995a. Things of boundaries. *Social Research,* 62: 857-82.

_____. 1995b. Sequence Analysis: New methods for old ideas. *Annual Review of Sociology* 21 93-113.

Abell, P. 2004. Narrative Explanation: An Alternative to Variable-Centered Explanation? *Annual Review of Sociology*. 30:287–310.

Allen, J. 2004. Redefining the network: enrollment strategies in the PDA industry, *Information Technology & People*, 17(2), 171-185.

Andal-Ancion, Angela, Phillip A. Cartwright and George S. Yip (2003). The Digital Transformation of Traditional Businesses, Sloan Management Review, Vol 44(4), pp. 34–41.

Atkinson, Christopher and Laurence Brooks 2005. In the Age of the Humanchine., in David E. Avison, Dennis F. Galletta (Eds.), *Proceedings of the International Conference on Information Systems, ICIS 2005*, December 11-14, 2005, Las Vegas, NV, USA. Association for Information Systems.

Bal, M. 1985. *Narratology: Introduction to the theory of narrative*. Toronto: University of Toronto Press.

Barley, S. R. 1986. Technology as an Occasion for Structuring: Evidence from the Observation of CT Scanners and the Social Order of Radiology Departments, *Administrative Science Quarterly*, 31, 78-108.

Barley, S. R. 1990. The Alignment of Technology and Structure through roles and networks. *Administrative Science Quarterly* 35(March): 61-103.

Baskerville, R.and S. Smithson, 1995. Information Technology and New Organizational Forms: Choosing Chaos over Panaceas, *European Journal of Information Systems*, 4 (2), 66- 73

Berg, M. 1998. The politics of Technology: On Bringing Social Theory into Technological Design, *Science, Technology and Human Value*, 23(4): 456-490.

Birnholtz, J., M.D. Cohen and S. Hoch. 2006. Organizational Character: On The Regeneration Of Camp Poplar Grove. Unpublished ms.

Bourdieu, Pierre. 1990. *The logic of practice.* Stanford, CA: Stanford University Press.

Braverman, H. 1973. *Labor and Monopoly Capital*. New York: Monthly Labor Review Press.

Burke, K. 1969. *A Grammar of Motives*. Berkeley: University of California Press.

Cairncross F., 1997, *The Death of Distance: How the Communications Revolution Will Change Our Lives* Boston, MA: Harvard Business School Press.

Churchman, C. W., 1971. *Design of Inquiring Systems: Basic Concepts of Systems and Organization*, New York: Basic Books.

Corsaro, W. A. & Heise, D. R. 1990. Event Structure Models From Ethnographic Data. In C. C. Clogg (Ed.), *Sociological Methodology: 1990*, Vol. 20: 1-57. Oxford: Basil Blackwell.

Coyle, F. P. 2002. *XML, Web services, and the data revolution*. Reading, MA: Addison-Wesley.

Czarniawska, B. 1997. Narrating the Organization: Dramas of Institutional Identity. Chicago: University of Chicago Press.

_____. 1998. *A Narrative Approach to Organization Studies*. Thousand Oaks, CA: Sage.

_____. 2004. On time, space and action nets. *Organization*, 11(6): 777-795.

_____ and T. Hernes, 2005. Introduction. In Czarniawska, B and T. Hernes (eds) *Actor Network Theory and Organizing.* Stockholm: Liber and CBS Press.

_____ and B. Joerges. 1998. "Winds of Organizational Change: How Ideas Translate into Objects and Actions." In Nils Brunsson and Johan P. Olsen (eds.) *Organizing organizations.* Bergen: Fakbokforlaget.

DeSanctis, G., & Poole, M. S. 1994. Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science*, 5, 121-147

Doolin, B. and A. Lowe, 2002. To reveal is to critique: actor-network theory and critical information systems research, *Journal of Information Technology*, 17(2), 269 – 78.

Emery, F., 1959. Characteristics of Socio-Technical Systems: Introduction to the Concept of Socio-Technical Systems: in *Design of Jobs*, Davis, L.E. and Taylor, J.C. (Eds.), Penguin Books, Harmondsworth, UK

Faraj, S., Kwon, D. and Watts, S. (2004) Contested artifact: technology sensemaking, actor networks, and the shaping of the Web browser, Information Technology & People, 17(2), 186-209.

Feldman, M. S. and Pentland, B. T. 2003. Reconceptualizing Organizational Routines as a Source of Flexibility and Change. *Administrative Science Quarterly*, 48(1), 94-118.

Feldman, M. S. and Pentland B.T. 2005. Organizational Routines and the Macro-Actor. In B. Czarniawska and T. Hernes (Eds.) *Actor-Network theory and organizing*. Stockholm: Liber and CBS Press.

Fulk, J. and G. DeSanctis.1995. Electronic Communication and Changing Organizational Forms, *Organization Science*, Vol. 6, No. 4, 337-349

Giddens, A. 1984. *The Constitution of Society*, U of California Press, Berkeley

Grint, K. and Woolgar, S., 1997: The Machine at Work: Technology, Work, and Organization, Polity Press, Oxford, UK

Hanseth, O., Aanestad, M. and Berg, M. (2004) Guest editors' introduction:Actor-network theory and information systems. What's so special? *Information Technology & People*, 17(2), 116-123.

Hendricks, W.O. 1972. The structural study of narration: sample analyses *Poetics* 3(1972), 100-123. Reprinted in his: *Essays on semiolinguistics and verbal art* (The Hague, Mouton, 1973), 152-174

Heise, D. 1989. Modeling event structures. *Journal of Mathematical Sociology*, 14: 139-169.

Kelley, M. R. 1986. Programmable Automation and the Skill Question: A Reinterpretation of the Cross-National Evidence, *Human Systems Management* (6), 223-241.

Latour, B. 1986. The Powers of Association. In Law, John (Ed.) *Power, Action, and Belief.* London: Routledge.

_____. 1987. *Science in Action*. Cambridge: Harvard University Press.

_____. 1991. *Technology is society made durable*, In: A Sociology of Monsters. Essays on Power, Technology and Domination., (Ed, Law, J.), Routledge, London, pp. 103-131.

_____. 1999a. On Recalling ANT. In Law, J. and J. Hassard (Eds.) *Actor Network Theory and After*. Oxford: Blackwell, 15-25.

_____. 1999. *Aramis: the love of technology*. Cambridge: Harvard University Press.

_____. 2005. *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.

_____., P. Mauguin, Teil, G. 1992. A Note on Socio-Technical Graphs. *Social Studies of Science* **22**: 33-57.

Law, J. 1992. Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity. *Systems Practice* **5**: 379-393.

_____., and J. Hassard. 1999. (eds.), *Actor Network Theory and after*, Oxford: Blackwell.

Malone, T. W., K. Crowston 1994. The interdisciplinary study of coordination, *ACM Computing Surveys*, 26(1), 87-119.

Markoff, J. 2009. The software out there. New York Times, April 5, 2006, E1.

McAfee, A. P. 2006. Enterprise 2.0: The Dawn of Emergent Collaboration, *Sloan Management Review*, Vol. 47(3), 21-28.

Monteiro, E. and O. Hanseth 1995. Social Shaping of Information Infrastructure: On Being Specific About Technology. InW.J. Orlikowski, G.Walsham, M.R. Jones and J.I. DeGross (eds.): *Information Technology and Changes in Organisational Work*. Chapman & Hall, pp. 325–343.

Mutch, A. 2002. Actors and networks or agents and structures: Towards a realist view of information systems. *Organization*, 9, 513-532.

Noble, D. F. 1984. *Forces of Production: A Social History of Industrial Automation*, New York: Knopf.

O'Reilly, T. 2005. What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software, http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html, Downloaded April 17, 2006.

Orlikowski, W. J. (1992): The Duality of Technology: Rethinking the Concept of Technology in. Organizations, *Organization Science*, 3(3), pp. 398-427.

_____., & Barley, S. R. 2001. Technology and institutions: What can research on information technology and research on organizations learn from each other? *MIS Quarterly, 25*(2), 145–165.

_____. and Iacono, C. S. 2001. Research Commentary: Desperately Seeking the IT in IT Research - A Call to Theorizing the IT Artifact, *Information Systems Research*, Vol. 12, No. 2, pp. 121-134.

_____. 2000. "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations." *Organization* Science 11(4): 404-428.

Pentland, B. T. 1995. Grammatical Models of Organizational Processes. *Organization Science* **6**(5) 541-556.

_____. 1999. Organizations as Networks of Action, in J. Baum and B. McKelvey, (Eds.), *Variations in Organization Science: In Honor of Donald T. Campbell*, Thousand Oaks, CA: Sage., pp. 237-253.

_____. 2003. **"**Conceptualizing and Measuring Variety in Organizational Work Processes" *Management Science*. 49(7): 857 .870.

_____. and Feldman, M. S. 2005. "Organizational routines as a unit of analysis" *Industrial and Corporate Change*. 14(5), 793-815.

Perrow, C. 1967. A Framework for the Comparative Analysis of Organizations. *American Sociological Review* **32,** 194-208.

Quine, W. V. O. 1969. Natural kinds. In *Ontological relativity and other essays*, pages 114--138. Columbia University Press, New York, NY.

Ramiller, N. C., and Swanson, E. B., 2003.Organizing Visions for Information Technology and the I.S. Executive Response, *Journal of Management Information Systems*, 20, 1, 13-50.

Rimmon-Kenan, S. 1983. *Narrative Fiction: Contemporary Poetics.* London: Routledge.

Rose, J. and Jones, M. 2005. The Double Dance of Agency: A Socio-Theoretic Account of How Machines and Humans Interact, *Systems, Signs and Actions*, 1(1), pp. 19–37.

Rosen, M. and J. Baroudi 1992. Computer-based technology and the emergence of new forms of control. In A. Sturdy, D. Knights and H. Willmott (eds.) *Skill and Consent: Contemporary Studies in the Labour Process*., London: Routledge.

Salancik, G. and H. Leblebici 1988. Variety and Form in Organizing Transactions: A Generative Grammar of Organizations, In N. DiTomaso and S. B. Bacharach (Eds.), *Research in the Sociology of Organizations* Greenwich, CT: JAI Press.

Simon, H. 1969. *The Sciences of the Artificial.* Cambridge, MA: MIT Press.

Stene, E. 1940. An approach to the science of administration. *American Political Science Review*, 34: 1124-1137.

Suchman, L. 1995. Making work visible. *Communications of the ACM* 38:9 p. 56-64.

Swanson, E.B. and N. Ramiller 1997. The Organizing Vision in Information Systems Innovation, *Organization Science*, Vol 8 No 5

Thompson, J. D. 1967. *Organizations in Action.* New York: McGraw-Hill.

Trist, E. L. and K. W. Bamforth. 1951. Some Social and Psychological Consequences of the Longwall Method of Coal-Getting: An Examination of the Psychological Situation and

Defences of a Work Group in Relation to the Social Structure and Technological Content of the Work System, *Human Relations* 4: 3-38.

Tsoukas, H. and R. Chia 2002. On organizational becoming: rethinking organizational change. *Organization Science* 13(5):567-582.

Walsham, G. 1997. Actor-network theory and IS research: current status and future prospects, In *Proc. IFIP WG 8.2* , Philidelphia, USA.

Walker, J. 2004. Distributed Narrative: Telling Stories Across Networks Presented at Association of Internet Researchers 5.0, Brighton, September 21, 2004

Wasserman, S. and Faust, K. 1994. *Social Network Analysis: Methods and Applications*. New York: Cambridge University Press.

Weber, R. 2003. Editorial Comments: Still Desperately Seeking the IT Artifact, *Management Information Systems Quarterly*, (27)2,June, pp.iii-x.

Weick, Karl E. 1979. *The social psychology of organizing* (2nd ed.) New York: Random House.

Weick, K. E. 1995. *Sensemaking in Organizations*. Thousand Oaks, CA: Sage.

White, H. 1981. The Value of Narrativity in the Representation of Reality. In Mitchell, W. J. T. (Ed.) *On Narrative*. Chicago: University of Chicago Press. p. 1-24.

Whitehead, A. N. [1929]1978. *Process and reality*. New York: The Free Press.

Woodward, J. 1958. *Management and Technology*. London, HSMO.