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Designing routines: On the folly of designing artifacts, while hoping for patterns of action

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ABSTRACT

Using the example of a failed software implementation, we discuss the role of artifacts in shaping organizational routines. We argue that artifact-centered assumptions about design are not well suited to designing organizational routines, which are generative systems that produce recognizable, repetitive patterns of interdependent actions, carried out by multiple actors. Artifact-centered assumptions about design not only reinforce a widespread misunderstanding of routines as things, they implicitly embody a rather strong form of technological determinism. As an alternative perspective, we discuss the use of narrative networks as a way to conceptualize the role of human and non-human actants, and to represent the variable patterns of action that are characteristic of "live" routines. Using this perspective, we conclude with some suggestions on how to design organizational routines that are more consistent with their nature as generative systems.

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1. Introduction

Some organizational routines may simply emerge, but a great many routines are the product of explicit attempts to design efficient, effective work practices. In a typical scenario, managers assemble a team to design or redesign a work process. The team produces a variety of artifacts, such as diagrams, checklists, forms, and procedures, some of which may be subsequently embedded into a software artifact. Sometimes they get the results they want, but often they do not.

In this paper, we argue that the frequent disconnect between goals and results arises, at least in part, because people design artifacts when they want patterns of action. We paraphrase the classic

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paper by Kerr (1975) in our title because, like the folly of rewarding one thing while hoping for another, we believe that designing things while hoping for patterns of action is a mistake. The problem begins with a failure to understand the nature of organizational routines, which are the foundation of any work process that involves coordination among multiple actors. Cohen (2007) argues that, even today, organizational routines are widely misunderstood as rigid, mundane, mindless, and explicitly stored somewhere. With these mistaken assumptions as a starting point, designing new work routines would seem to be a simple matter of creating new checklists, rules, procedures, and software. Once in place, these material artifacts will determine patterns of action: software will be used, checklists will get checked, and rules will be followed.

Stated in more theoretical terms, these assumptions embody a rather strong form of technical or material determinism (Berg, 1998; Leonardi & Barley, 2008).[1] While research on technology and organization has largely discredited this perspective, the world of information systems design and "design science" still focuses on artifacts (Hevner, March, Park, & Ram, 2004). Alternative design frameworks, such as "interaction design" (Buxton, 2007; Cooper, Reimann, & Cronin, 2007; Moggridge, 2007), are limited to interactions between individual humans and artifacts, rather than patterns of action among a set of humans. Artifact-centered design is valuable, of course, but when applied to organizational routines, we believe it leaves a critical gap. Thus, ontological questions about material versus social determinism are not just esoteric matters for social theory. They have practical implications for anyone who wants to create or change a work process.

Our goal in this paper is to explore the practical problem of designing routines. We start from the premise that routines are generative systems that produce repetitive, recognizable patterns of interdependent action carried out by multiple participants (Feldman & Pentland, 2003; Pentland & Feldman, 2005). Given this definition, we ask what guidance current theory offers for the design of such systems. By design, we mean: "to do or plan (something) with a specific purpose in mind" (Concise Oxford English Dictionary, 2004, p. 388).[2] This line of inquiry provides an opportunity to consider the role of material artifacts in relation to organizational routines, and to articulate some principles for design that take into account the nature of organizational routines. In doing so, we challenge some traditional assumptions about the distinction between design and use, or design and improvisation. We begin with an example, followed by theory and discussion.

2. An example

This example concerns the administration of two "outreach" programs at a university somewhere in the USA.[3] These two outreach programs offer practical seminars on topics in labor relations and human resource management. In contrast to traditional academic courses, these seminars are not part of a degree program. The people who attend them do not have to be students at the university, and the people who teach them are not necessarily regular faculty. Outreach programs are sometimes called "continuing education" or "adult education."

2.1. Two separate programs

The Department of Labor Studies hosted two different outreach programs, each of which had a different mission and different audience. One program focused on traditional labor education, such as

[1] In an even more extreme form, one might even assert that the routines are artifacts, so the whole question of determinism would become moot. Needless to say, this is an even worse mistake, but if Cohen (2007) is right, we have not yet succeeded in stamping it out.

[2] In our title, and in this definition, "design" is a transitive verb: to design something. "Design" can also be used as a noun, as in "a plan or drawing produced to show the look and function of something before it is produced" (Concise Oxford English Dictionary, 2004, p. 388). In this and many other definitions we encountered, the verb form of "design" is defined as the act of producing the noun form, which is typically defined as a drawing, graphical representation, or some other artifact. Further, most definitions presuppose that the ultimate product is itself an artifact.

[3] One of the authors participated in this design effort as a member of the department's "technology committee." The example is lightly disguised and described only in general terms, without quotations or individual names. For our purposes, this is sufficient, because the basic phenomena are so commonplace. Many readers will undoubtedly be able to supply their own parallel examples.

seminars for union stewards. It was targeted at "labor" (union members), so we will refer to it here as the "Labor" program. Another program focused on general topics in personnel administration, such as hiring, firing, and performance appraisal. It was targeted at "human resource professionals" (i.e., management), so we will refer to it here as the "HR" program. These two outreach programs existed side-by-side, in the same building, on the same hallway. They operated out of a single budget, using common resources. For example, they all used the same photocopier.

Nevertheless, the two operations were completely separate, in the sense that they had different staff, different programs, different instructors, different databases, different sections on the departmental web site, and so on. The two programs were using different procedures and technology for scheduling, billing, and accounting. The Labor program used custom-written software that ran on the university's mainframe computer. This software kept track of everyone who had ever taken one of the labor outreach courses. It did not have any functionality to support accounting, scheduling, or billing, so these functions were done by hand. The HR program used off-the-shelf PC-based software designed for the purpose of running seminars. It also kept track of participants, but included additional functionality for scheduling, billing, accounts receivable, and expenses. Both the Labor and HR programs had to contend with a University accounting system that was cumbersome and rather primitive. Both groups found it difficult to keep track of revenues and expenses.

While the operations were separate, the basic work processes were very similar. Although the participants did not use these labels, we can break the work into familiar categories that mirror, in microcosm, most of the functions of any business:

- *Planning and budgeting*: To run an outreach seminar, they needed to get a location (i.e., a hotel conference room), and schedule an instructor. Budgeting consisted mainly of allocating resources (such as instructors) to seminars and projecting expenses for mailing, travel, and photocopying.
- *Marketing*: Once a calendar of seminars has been set, each program needed to advertise the seminars, typically via direct mailings to established clients and former students.
- *Sales*: For each seminar, they needed to process the enrollment (including payment), send out confirmations, deal with cancellations, make refunds, and so on.
- *Seminar administration (production)*: When the actual date of the seminar approached, they needed to prepare handouts for the participants, arrange for meals (if necessary) and so on. "Certificates of completion" were prepared for people who attend the seminars, as well.
- *Accounting*: Throughout the process, they needed to track expenses and revenues. This was not so much for the purpose of computing profit or loss, but to make sure that charges were appropriate (no errors or fraud) and that all money received was properly credited.
- *Reporting*: Reports were needed for a variety of purposes, such as program and instructor evaluation. The university required an annual report that summarized the number of sessions, number of people who attended, and so on, for all outreach programs in the department.

In accordance with the mission of the university, their goal was dissemination of knowledge. Still, one can think of these programs as a simple business – they offered seminars (also called workshops, classes, training sessions, etc.), for which they charged money. Gross revenues were several hundred thousand dollars per year. They did not necessarily plan on making profits, but they needed to collect fees and account for expenses.

2.2. The need for change

While the participants were relatively content with the status quo, various factors prompted a need for change. Above all, the university was planning to pull the plug on the centralized mainframe system used by the Labor program. The Labor program had to find a new way to keep track of their work, because the old way was about to be shut down. Also, there was growing pressure from the Dean's office to manage costs, as well as pressure from users for better service (billing, refunds, etc.). While the loss of the mainframe was definitely problematic, it seemed like an obvious opportunity to "get everyone on the same page," improve operations, create uniform accounting, respond to the Dean's office, and so on.

2.3. The solution: a standard software package

The department investigated writing custom software to replace the mainframe software, and extend its functionality. They quickly realized that this was expensive, time-consuming, and difficult to maintain over time. Furthermore, there was no need for custom software, because several commercial software packages were available for purchase. Software packages were available because training and seminar administration is a very common problem. Lots of organizations host seminars, training sessions, workshops, and conferences.

The department chose a package called "SeminarPro." The choice was simple because the HR program was already using an earlier, single-user version of the product from the same vendor. They were happy with the support and functionality of the old product. The new product looked even better, with lots of standard features – reports, billing, scheduling, registration, accounting, course evaluations – integrated into a common database. All the data resided on a server, so many different users could access the data at the same time. It had different levels of access and security for different kinds of users. Faculty could get reports and set up new events, while the staff could enter new registrations, and so on. SeminarPro also had features that were intended to support operations. For example, whenever a seminar was scheduled, SeminarPro could place a customized series of key tasks and milestones on the calendar leading up to the date of the seminar (e.g., hotel booked, registration open, materials printed, attendee list confirmed, etc.). In short, SeminarPro seemed to have everything the department needed to run both of the outreach programs.

SeminarPro was expected to have several obvious benefits. First, it would consolidate all of the accounting information into a single database, making it possible to track revenue and expenses more accurately for the outreach programs as a whole. This was a critical issue for the Dean's office. Second, because it would consolidate all of the enrollment and registration information, it would allow the department to produce significant parts of their annual report automatically (e.g., the total number of seminars, participants, and so on). These reports were a huge sore spot for staff, who perceived them as an annoying waste of time. Third, because it was a network-based product, it would allow staff to share work and cover for each other more easily. Traditionally, each seminar "belonged" to a particular staff person; with SeminarPro, staff could fill in for each other more easily. Fourth, the "to-do" lists would allow staff to schedule work and provided a way to plan around "rush" periods and bottlenecks, if several seminars were scheduled close together. And finally, the shared, networked environment would allow faculty and administrators to get up-to-the minute reports on each program.

Adopting SeminarPro would not alter the list of functions outlined above, but it would change the specific actions needed to perform these functions. And just as important, it would change who could perform certain tasks. These changes in the way the routines are accomplished would potentially influence the effect of the routines, indeed the meaning of the routines, in the organizational units. For instance, in the existing way of working, each unit had been doing accounts and producing reports in ways that were idiosyncratic to that unit and that supported an identity of separateness between the two units. With SeminarPro, the HR staff could register people for the Labor seminars, and vice versa. As a result, changing to the same computer package and producing unified accounting and reporting would support an identity of unity. Sharing work would move even further in that direction.

2.4. The design was a success, but the implementation failed

A cross-functional team was established with staff from both the Labor and HR programs. They met regularly for several months to gather requirements and decide what needed to be done. After reviewing the alternatives, this group selected SeminarPro. Once they had selected it, they set about deciding how to use it and trying to design the routines surrounding the software artifact.

Most aspects of the design effort were quite successful. The team worked out a common chart of accounts, so that different categories of revenue and expense could be tracked. They also defined a system for naming seminars (e.g., "L-yy-mm-dd" for Labor, and "H-yy-mm-dd" for HR), and so on. By embedding the date into the code in this way, the list of seminars could be sorted to show all of the Labor seminars and HR seminars, in order. If there was more than one seminar on a given day,

additional characters could be added ("-a," "-b," etc.). Putting "L" and "H" first would keep the seminars from each program grouped together.

Many other details were worked out in the design process. The team identified some "custom fields" that needed to be added to the input forms, and the fields were added. The vendor designed and implemented a preliminary version of the departmental annual report. The report was a success, and everyone agreed that generating this report automatically would be a huge time savings. The system included the capability of setting different levels of access for different kinds of users. Permission levels were worked out so that faculty would have "read-only" access, so they could get reports they needed but not "mess things up."

In addition to these design decisions, the committee took care of data conversion and training. Old data were exported from the mainframe (for the Labor program) and from the PC (for the HR program), ready for import into the SeminarPro system. This involved carefully mapping from fields in the old database to fields in the new database, and getting data in the correct format for import. Training sessions were held on-site in the departmental computer lab. In anticipation of the difficulties of transitioning to the new software, the committee arranged for additional user support and created special procedures for getting help, reporting, and resolving problems. The software was installed, and everything seemed ready to go.

As the launch date grew nearer, however, obstacles emerged. The implementation met resistance and stalled. After dragging their feet for weeks, the Labor program eventually moved their data from the mainframe to a stand-alone PC and avoided SeminarPro entirely. The HR program eventually moved over to SeminarPro, but used only a subset of the features. Neither group utilized any of the functionality for accounting or reporting, relying instead on their familiar routines (using standalone spreadsheets) for these parts of the work. The carefully designed vision of unified accounting and reporting did not materialize.

We cannot draw firm conclusions about the reasons for this outcome, but we can safely rule out technical failure. SeminarPro was fully capable of meeting the functional requirements of both programs. With an installed base of hundreds of successful clients, there is no question that SeminarPro "works." So why did this design fail so miserably in this organization? We can find some clues in the issues that emerged (quotations are paraphrased):

- "These are my seminars – I don't want other people messing with them."
- "I don't want to see all those other seminars on the screen – I just want to see mine."
- "We don't want our people in your database."

These quotes suggest that people did object to creating a pattern that supported a unified identity for the two parts of the organization. They were especially concerned with who would perform which actions. Enrolling a new participant was not a generic action that anyone could perform. Each program wanted to control their own seminars, their own data and their own work practices, which was exactly the opposite of what SeminarPro would have facilitated.

These concerns made sense, because historically the programs had been entirely separate entities, with different target audiences, different subject matter, and so on. These issues were raised during the selection and design process. As a result, the SeminarPro system was configured to support the appearance of separation. In particular, the chart of accounts and the seminar codes "L-yy-mm-dd" and "H-yy-mm-dd" would allow reports to be filtered and sorted, so the Labor people would see the Labor data, and HR people would see the HR data. The data would be stored centrally (to facilitate accounting, reporting, and other administrative functions), but each group would continue to plan, schedule, and deliver their seminars more or less independently.

In retrospect, there was apparently a rather serious disconnect between the technical design (the artifacts) and the work process as understood and enacted by the participants. A shared database was a good idea, in principle, and it was necessary to achieve the department's objective of common accounting and reporting. The SeminarPro package was built around the idea that an organization could run many seminars, and that many different people would be involved in planning, staffing, and administering them. Like many network-based applications, it capitalized on the opportunity (and genuine need) for distributed access to a common database.

While we do not know specifically why the idea of a common database for labor and management (putting "our people in your database") was not a pattern that the staff in this case enacted, other studies with similar outcomes provide us with possible explanations. Studies based on longitudinal ethnographic research show that participants in organizational routines are aware that their actions contribute to and are constrained by many patterns simultaneously and that when changing a routine would threaten patterns that might be, for any number of reasons, seen as more important, the organizational routine either does not change or changes in ways that will not threaten the other patterns (Feldman, 2003; Howard-Grenville, 2005). This is sometimes considered to be resistance to change, but a closer look suggests that it may not be change that is resisted but the specific patterns that the change would promote.

In this case, we see people changing their performances but not so much that it will jeopardize the separate identities of the two units. In addition to this issue of identity, there may also be a variety of other patterns that are important to the observed outcome. What is important here is our recognition that, despite the considerable efforts to design routines for using SeminarPro to produce their seminars, the participants were able to take actions that maintained previous patterns, patterns that would have changed had they taken the actions envisioned by the designers.

3. Theory

Failures like the SeminarPro implementation are commonplace: software artifacts that seem ideally suited to solving problems frequently fail to do so. It is easy to design artifacts like a chart of accounts, a list of database codes, input forms, checklists, and so on. But these artifacts – no matter how carefully designed – do not necessarily result in changes in the patterns of action. Such problems are not found only in the arena of software, but more broadly in the field of organizational routines (Feldman, 2003; Howard-Grenville, 2005; Naduzzo, Rocco, & Warglien, 2000). An effort to change a budget routine analyzed by Feldman (2003) has very similar outlines to our current example. Artifacts created by management designed to produce more collaboration among participants in the budget routine had remarkably little effect on the overall pattern that the actions produced. People filled out the forms (changed their specific performances), but did not produce the collaboration desired by management. The frequency of this problem leads us to reflect on the difference between artifacts and routines and its implications for design. In the sections that follow, we work our way through a succession of theoretical perspectives that offer guidance on this matter.

3.1. Live routines

Building on the insights of the pragmatist philosopher, John Dewey, Cohen (2007) offers a distinction that helps frame our inquiry: dead routines versus live routines.[4] Dead routines are artifacts; they are rigid, mindless, and can be explicitly stored. The classic example is the sequential list of actions that is developed by people who do not enact the routine and is largely if not totally ignored by those who do enact the routine. If we were to restrict our inquiry to the design of dead routines, we could end the paper here. Dead routines can be designed by whatever means seems convenient and adequate.

Live routines are another matter entirely. Any organizational routine that involves people, who are capable of learning from experience, is at least partially a "live" routine. The key distinguishing factor, following Dewey, is that the experience of the participants naturally and inevitably gives rise to learning. In our terms, live routines are generative: enacting them naturally and inevitably gives rise to new actions (performances) and sometimes new patterns of action. Managers may or may not want to capitalize on this inherent capability of routines, but they cannot erase it unless they are willing and able to "kill" the routine through total automation.

[4] For the purposes of this paper, the live-dead distinction is useful. As with most distinctions, there are some ambiguous cases. It is always possible, for instance, for the artifact to be used by participants in various ways in the creation and recreation of the live routine (D'Adderio, 2008; Szulanski & Jensen, 2006; Winter & Szulanski, 2001; Zbaracki & Bergen, 2008). We take up this possibility to a limited extent in our discussion of actor-network theory later in this paper.

3.2. Routines as generative systems

Live routines are best conceptualized as generative systems that can produce a wide variety of performances depending on the circumstances. Fig. 1 illustrates a simple way of visualizing the parts of an organizational routine. On one hand, routines consist of abstract regularities and expectations that enable participants to guide, account for, and refer to specific performances of a routine. We refer to these as the "ostensive" aspects (Feldman & Pentland, 2003). Others may refer to this aspect as a "disposition" (Becker, 2004). The ostensive aspects are not the written rules or procedures, which for many routines do not even exist. They consist of the understandings (embodied as well as cognitive) of the participants, and since these typically vary across an organization, we refer to the ostensive aspects in the plural. On the other hand, routines also consist of actual performances by specific people, at specific times, in specific places. We refer to this as the "performative" aspect (Feldman & Pentland, 2003). These two aspects are mutually constitutive; without these two aspects, the recognizable, repetitive patterns of action that characterize organizational routines cannot be produced or reproduced.

These generative systems can produce performances over a wide variety of time scales, from very fast (a few minutes or seconds) to rather long (weeks or months). At one end of the spectrum, the routines of sports teams can be very fast. At the other end of the spectrum, the technology roadmapping routine analyzed by Howard-Grenville (2005) is a good example of a routine that extends over a long period of time. In the SeminarPro case, the routine of "putting on a seminar" generally extended over a period of several months, from initial planning, advertising, registration, to teaching the class. Whether long or short, each performance of a routine is a progression of events in time. This progression is not the same every time, but it is similar enough to be recognizable, like a folk song. The parallel to jazz improvisation is helpful here, as well – within the basic progression and rhythm of the piece, there can be enormous variations (Barrett, 1998; Hatch, 1999; Moorman & Miner, 1998).

3.3. Artifacts and routines

Artifacts take many different forms, from written rules, procedures and forms to the general physical setting (e.g., a factory or an office). Software and computers are very common kinds of artifacts. In an organizational routine, artifacts are often used to try to ensure the reproduction of particular patterns of action. The to-do lists in SeminarPro make an excellent example of this. Following them would tend to narrow the range of actions taken and produce an appearance of consistency.

Artifacts such as rules and written procedures are sometimes mistaken for the ostensive aspects of a routine. Artifacts such as work logs and databases can also provide a convenient archival trace of the

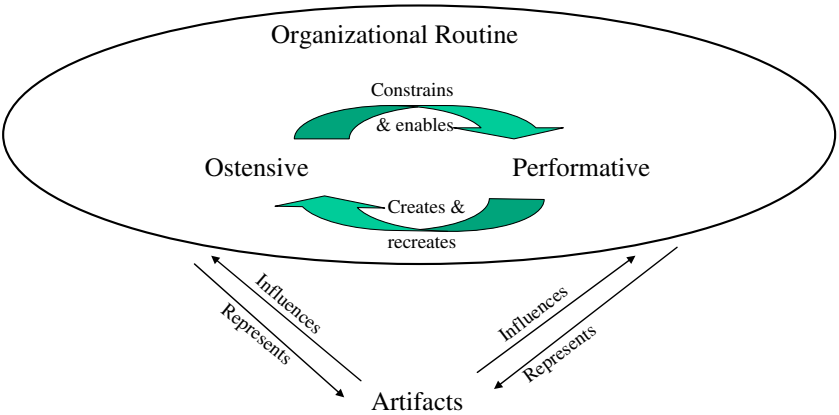

Fig. 1. Organizational routines are generative systems.

performative aspect (Pentland & Rueter, 1994). But as shown in Fig. 1, the ostensive and performative aspects of routines are recursively related while the artifacts are distinct from the routine as constituted through this recursive relationship (Pentland & Feldman, 2005).

Artifacts may reflect either the ostensive aspects of a routine (as in the case of a written procedure or a policy statement that describes the overall pattern of the routine) or the performative aspects of a routine (as in the case of a transaction history or tracking database). Artifacts may also influence either the ostensive aspects of a routine or the performative aspects. Influence, however, is not a foregone conclusion and even artifacts that influence the specific actions taken do not necessarily change the overall pattern. While artifacts may serve as a guide for action, the manner of use and interpretation leaves open a lot of possibilities (D'Adderio, 2008). In the budgeting routine Feldman (2003) examined, for instance, new actions were taken (forms were filled out) but the collaborative decisions that they were supposed to encourage (the new pattern) did not emerge. Likewise, in planning scenarios analyzed by Wright and Starkey (2008), some actions conformed to the lists of proposed actions as a way of legitimizing an overall pattern that was markedly different from the lists.

Artifacts have instrumental, aesthetic, and symbolic dimensions (Rafaeli & Vilnai-Yavetz, 2004; Vilnai-Yavetz & Rafaeli, 2006). Instrumentality relates to the effects on related tasks and goals, aesthetics relates to the sensory reactions and symbolism relates to the associations elicited by the artifact (Rafaeli & Vilnai-Yavetz, 2004, p. 673). The symbolic dimension of artifacts relies on interpretation for their impact. Consider the difference between a sign that says "Employees only – Do not enter" and a locked door. While each of these has all three dimensions, the sign relies much more on the interpretation than does the locked door. Some of the artifacts that surround organizational routines are more like locked doors in that they truly constrain action. But the vast majority, such as rules, forms, diagrams and procedures, are more like the sign in that their meaning is open to a variety of interpretations. Artifacts with a strong symbolic dimension influence action to the extent that they are incorporated into the ostensive aspects of the routine. While certainly important, these artifacts should not be mistaken for the ostensive aspects of routines as they do not capture the complexity of the embodied and cognitive understandings that guide actions taken in the enactment of routines.

Still, we need to consider the role of artifacts in routines quite carefully, because artifacts are at the center of design processes like the one described here. Artifacts are implicated in at least two ways. First, as the SeminarPro example shows, they are the immediate object of the design activity. A "design" is an artifact, usually consisting of diagrams and text. Second, artifacts are embedded throughout a typical work process. This is especially true of computer-based artifacts (like SeminarPro) that are used to coordinate inter-dependent activities. And of course, from a theoretical standpoint, artifacts are crucial because of their role in debates about materialism and agency.

3.4. Materialism and agency

The relative importance of materialism and agency has been a longstanding problem in the study of technology and organizations (Leonardi & Barley, 2008; Orlikowski & Barley, 2001; Rose & Jones, 2005). In many studies, there is a distinct tendency to "tilt" one way or the other (Leonardi & Barley, 2008). The materialist view leans towards technological determinism (Berg, 1998), arguing that technology embodies structures that enable and constrain particular kinds of behavior. In other words, structure is built into the technology. The "agency" view leans towards social determinism, arguing that people are more or less free to choose the ways in which they use technology.

Obviously, material objects matter (Orlikowski, 2007). Equally clear is the importance of human agency at all stages in their design and use (Orlikowski, 1992; Orlikowski & Barley, 2001). The information systems literature recognizes many versions of this interplay between objects and agency, such as interpretive flexibility (Doherty, Coombs, & Loan-Clarke, 2006) and adaptive structuration (DeSanctis & Poole, 1994).

Routines exist within a multiplicity of material and ideological structures that influence the patterns of action that participants create and recreate (Feldman, 2003; Howard-Grenville, 2005). In the SeminarPro case the software artifact embodied specific ideas about the routines required for seminar administration. Nonetheless, it was possible for the members of the Labor program simply to ignore it, and for the members of the HR program to ignore most of it. By selectively using (or choosing

not to use) the technology, they continued to enact their existing social structure ("I don't want my people in your database"). When designing routines, what guidance do the major theoretical positions seem to offer?

3.5. Technology as enabling and constraining

Technology can be seen as enabling and constraining action (Orlikowski, 2000), and this view provides important guidance for design. For example, SeminarPro would have enabled a single, departmental report showing the number of outreach participants at all seminars. It could do this at the touch of a button, so to speak. Further, SeminarPro contained a large number of features that would tend to constrain or prevent unwanted actions – by requiring certain fields to be filled in, by limiting access to certain kinds of data without authorization, and so on. These are familiar functions in many kinds of computer software. So, while the enable/constrain view is clearly true in some respects, and intuitively very useful, it has limits.

First, this view does not account for the question of whether the technology in question will be enrolled (used) at all. This has been an enormous issue in IS research, spawning research streams such as the technology acceptance model (Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). In the SeminarPro case, this turned out to be the core issue, much to the surprise of the design team. Although the HR programs did use SeminarPro, they did so selectively, for keeping track of registrations, printing name badges and attendance lists, and so on. One can use a computer program and not necessarily use all of the features.

Second, will the technology be used as intended? Adaptive structuration theory introduced the concept of faithful (versus unfaithful) appropriation of features (DeSanctis & Poole, 1994). The literature is filled with examples of unexpected or unintended uses. Even if we leave aside the most extreme cases, such as the use of cell phones for bomb detonators, or email for spam, it is clear that when technology enables and constrains action, it can do so in ways that the designers do not intend.

Third, it does not account for the presence or absence of alternatives. In the SeminarPro case, the photocopier and printer were interchangeable for certain tasks. Likewise, one does not need a telephone to make a phone call. One can use a voice-over-IP application, such as Skype, on a computer. Even when participants are following rules, the interchangeability of tools and sequences of action is a prime mechanism for generating variety in a routine.

Finally, the enabling/constraining perspective is limited to particular, unitary actions – pieces of routines, or subsets of routines. Actions get constrained or enabled one at a time. It would rarely apply to the whole pattern of action, unless the routine is fully automated and therefore dead. Even the to-do lists on the SeminarPro calendar would not have constrained them to specific sequences, since the calendar and the lists are symbolic artifacts. So, while the enable/constrain view contains important insights, and integrates materialism without implying determinism, it falls short on key areas of concern to anyone designing an organizational routine. In particular, while technology may effectively enable or constrain particular actions, it may be less effective with entire patterns of action.

3.6. Actor-network theory: enrolling the artifact

Many of the issues addressed above can be restated and reinforced in the language of actor-network theory (ANT) (Latour, 2005; Law, 1992). Among other things, ANT addresses the question of how technical artifacts are integral to the social world. There are many variations of ANT, but the core idea that concerns us here is the role of non-human actants or artifacts in structuring the social world. Artifacts have a stabilizing effect on the multiple configurations of human activity that are possible, but to have this effect, they must be "enrolled" and "translated" into the social world. Latour (1991, pp. 105–106) identifies translation 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." Thus, a personal computer can be translated as a plant stand. Of course, the technical capabilities of the artifact place limits on the range of possible translations; no amount of translation will turn a toaster into a cell phone. An additional insight from ANT is that actor-networks are "stable-for-now" – the pattern of associations among the actants can

change (Czarniawska, 2004). This is an important insight that is particularly relevant to the question at hand. Routines have a temporal dimension – both within a performance, and between performances. ANT helps reinforce the view that the associations we observe are not permanent.

Artifacts can be "enrolled" in the performance of a routine to varying degrees, at the discretion of the participants (D'Adderio, 2008; Feldman & Pentland, 2005; Feldman & Pentland, 2008). As significant as this incorporation may be in specific cases, it is nonetheless important to distinguish it from the routine as a generative system. We place artifacts outside of the routine itself in Fig. 1 to indicate that artifacts are different from either the specific performance or the abstract patterns and that the artifact can be incorporated into the routine in a variety of ways. This discretion is limited both by features of the artifact and by features of the social context in which the artifact is enrolled, as understood by the participants. We cannot discern the significance of an artifact by inspecting it from our own (etic) point of view. Researchers sometimes mistake their own (etic) understanding of an artifact for member (emic) understandings; designers are apparently prone to the same error.

In the SeminarPro case, the software offered the possibility of better reporting and accounting. The actual users of the software did not apparently regard reporting and accounting as problems, so they had no reason to enroll the software. Moreover, using the software would have produced some overall patterns (ostensive aspects) that they may have wanted to avoid such as greater transparency to the Dean's office and a more unified identity between the two units.

3.7. The narrative network

While ANT offers important insights about technology, it is important to remember that actor-networks do not describe patterns of actions. They describe the pattern of associations among a set of actants. Thus, they are the wrong conceptual tool for describing what Cohen (2007, p. 781) aptly calls the "pattern-in-variety" that is characteristic of any live routine. To address this problem, we need a way to describe patterns of action, as well as the actors.

A narrative network (Pentland & Feldman, 2007) allows us to express the actual and possible patterns of action that can be generated by an organizational routine. The narrative network is defined as a collection of functional events (Hendricks, 1972, 1973), related by their sequential occurrence in a story or set of stories. Thus, unlike an actor-network, a narrative network is an explicit representation of an organizational routine as a pattern of action. For live routines, each functional event in each performance provides an occasion for variation. Within a narrative network, technologies that allow for substitutions and variations can lead to entirely new paths (Pentland & Feldman, 2007).

The functional event will be the key unit of analysis in our discussion. As conceived by Hendricks (1972), a functional event is the building block of a narrative; it is a fragment that advances the story. A functional event consists of two actants connected by some action, so they are similar in structure to a simple sentence: "subject–verb–object." Functional events can include human or non-humans, such as a computer or a cell phone, so we prefer the more general term "actant," from actor-network theory. Typical functional events from the SeminarPro context would include:

- The director schedules the seminar.
- The staff person prints the list of attendees.
- The staff person photocopies the handouts.

Note that some functional events can include multiple actants, as in the case of photocopying or printing. Like "organizing moves" (Pentland, 1992), functional events provide convenient units of action, from which we can recognize the patterns of action that make up an organizational routine. Moreover, it includes important information about who does what – the identity of actants can be preserved. In this conceptualization, each part of a routine is a functional event.

Participants experience functional events as things that happen, or things "to-do," or things that need doing. Indeed, one of SeminarPro's functions was to allow users to create customized "to-do" lists – basically scripts for routines – that would be added to the calendar once a seminar was scheduled. Thus, if a seminar was scheduled for June, the software could automatically add "to-dos" for everything leading up to that date.

The narrative network explicitly allows for alternative pathways. If the copier is broken, we can go to Kinkos. If the information is not in the database, we look it up in the files. And so on. This is the essence of the live routine, filled with improvisation and occasions for learning. There are two basic ways that participants can introduce variety into a narrative network. First, within each functional event, there may be alternative ways to do it. In organizing seminars, the staff in the Department of Labor Studies had many choices about how to accomplish their work. For example, to produce handouts for a seminar, they might print one copy of an original document and then make copies on the photocopier. Alternatively, they could print multiple copies directly. Similarly, they could host the events at hotels, or at dedicated conference facilities on campus. Second, the sequence of events may be adjustable by the participants. While some events are logically constrained to occur in sequence, others are not. There may be choices about what to do next, what steps to skip. Also, if the sequence of events loops back on itself (due to error, or rescheduling, or revisions), that can add a lot of variability.

Participants, thus, have choices about how to carry out a particular action and about how to arrange the pattern of actions. We see these choices as examples of design, according to our earlier definition: "to do or plan with a specific purpose in mind." Because these choices occur as part of each performance of a routine, design is inter-mingled with improvisation in the context of each execution of the routine. Each performance is created by the participants, as they carry it out. It is partly (re)-enacted from past experience, partly improvised based on current circumstances and partly designed in their efforts to achieve visions of the future. This mirrors Emirbayer and Mische's (1998) concept of agency, and Weick's (1995) concept of sensemaking, which have retrospective, current and prospective components. Even if a particular action in the network is entirely determined by technology (e.g., getting money from an ATM), the overall pattern of activity is not (we can get money elsewhere, or just use a credit card).

4. Discussion

In most definitions, design is separate from "use" and is assumed to come first. Similarly, design is considered separate from improvisation. The perspective we offer here is intended to challenge that idea. The traditional ideas about design assume that someone, such as a manager, with a single point of view, will determine how a routine should work. The manager may also determine what happens if there are exceptions or problems. This view fits nicely with the assumptions about technological determinism discussed earlier. Sidney Winter has called this "Naïve top-down-ism."[5] The steps have a familiar, almost self-evident quality that comports well with traditional systems analysis and design methods:

- Step 1: Gather requirements.
- Step 2: Make up rules to implement those requirements (checklists, forms, SOPs).
- Step 3: Inscribe/embed the rules into artifacts (ideally, computer systems).
- Step 4 (optional): Provide people with skills, tools, and incentives to follow the rules.
- Step 5: Push the "GO" button!

One can see these steps in the SeminarPro example: the team made up forms, checklists and procedures. They selected a software system that allowed them to embed these rules and more. They provided the staff with skills and support, tools and even some modest incentives. When the "GO" button is pushed, however, there is more room for variety and innovation then naïve top-downism envisions.

4.1. Artifacts and actions: a familiar category mistake

Naïve top-downism assumes that good artifacts (such as SOPs and software) will result in good performances. This failure to understand the difference between artifacts and actions is not new.

[5] At the Second International Conference on Organizational Routines, Nice, France, 2005.

In drawing the distinction between plans and situated action, Suchman (1987) noted that people are people and not like machines. We do not simply follow programs or plans. Berg (1998) argues that the failure to distinguish the social (or human) from the technical is what he calls a "category mistake." Mistakenly treating people like machines (rule-following automata) results in a wide range of undesirable, but not entirely surprising, outcomes. This category difference has been amply demonstrated for individuals, but it applies equally (if not more so) to organizational routines. This is because members' embodied and cognitive understandings (the ostensive aspects of the organizational routines) are often diverse, multiple, and conflicting. Even if the individuals in an organization (such as the Department of Labor Studies) were somehow transformed into rule-following automata, their day-to-day interactions would not necessarily produce automatic, predictable results, because they are not following the same rules.

4.2. How narrative networks help us understand artifacts and routines

The narrative network draws attention to the functional events that make up the patterns of action in a routine. Within each functional event, there are various possibilities for the combinations of actants. For clarity, let us start with the simplest case (two actants and one action), and physical artifacts. The actants may be human, or they may be artifacts. There are three basic combinations: human–human, human–artifact, and artifact–artifact. We can express these combinations in a simple 2×2.

Table 1 suggests that events that occur between two humans are most "alive." They are most subject to agency and improvisation, learning by experience, and also to the private intentions of the participants. Each time the event occurs, the participants have the opportunity to (re)enact it according to their preferences at that moment.

At the other extreme, events that transpire between two material artifacts, such as two computers on a network, are most nearly dead. They are least subject to agency and improvisation. They can be fully scripted in advance, and if any parameter fails to meet the expected value, the event simply will not occur. Credit card authorizations make a familiar example; a human swipes a card (human–artifact–artifact), but then the point of sale terminal contacts the credit vendor for authorization (artifact–artifact). If the card is not approved, the sale will not go through.

On the diagonals, we have the mixed-mode examples – human and artifact. This is the domain that has received considerable attention lately under the name of "interaction design" (Buxton, 2007; Cooper et al., 2007; Moggridge, 2007). Some artifacts may provide very strong constraints and affordances to encourage specific actions, but the human participant is often free simply to use a different artifact. So, for example, if one is unable to log into a web site to accomplish a transaction (human–artifact), one can often just pick up the phone and call (human–artifact–human), or perhaps send a FAX. If successful, these "workarounds" become part of the repertoire of the savvy users. Still, it is quite possible to design processes such that the human–artifact interaction is very strongly controlled (as in the case of the automated teller machine).

The differences between the quadrants in Table 1 may be especially relevant for the growing areas of business process management ("BPM") and service oriented architecture ("SOA"). The technologies offer the promise of easily reconfigured processes and a new "revolution in productivity" (Merrifield, Calhoun, & Stevens, 2008). Merrifield et al. (2008, p. 72) argue that:

Table 1
Degree of control afforded by various kinds of functional events

		Actant one	
		Human	Artifact
Actant two	Human	Most "alive" Weakest control by designer	Some control by designer, depending on kind of artifact
	Artifact	Some control by designer, depending on kind of artifact	Most "dead" Strongest control by designer

> It is becoming possible to design many business activities as Lego-like software components that can be easily put together and taken apart . . . The beauty of SOA is that it allows activities – or processes built from such activities – to be accessed using the now-ubiquitous Internet in a standardized fashion. Whether the capabilities that make up an activity are manual, fully automated, or somewhere in between, the SOA-based design of their underlying software or electronic user interface allows the activity to be turned into a de facto web service.

Business process management offers a similar vision of software-enabled process agility (Leymann, Roller, & Schmidt, 2002; van der Aalst, ter Hofstede, & Weske, 2003). This idea of Lego-like software components is appealing, but it depends on all the blocks fitting together neatly. The framework in Table 1 suggests that blocks from the artifact–artifact quadrant will fit neatly, but blocks from the other quadrants may not fit as reliably. And even if they fit well at first, they will tend to grow and change over time.

4.3. Design methodologies produce artifacts, not routines

Traditional definitions of design emphasize artifacts as the output of the design process. And there are lots of methodologies for representing, designing and mapping routines, such as flow charts and data flow diagrams. These representations are symbolic artifacts, not routines. These representations encourage users to mistake procedures for organizational routines. The problem is deeper than the common observation that "the map is not the terrain" (Suchman, 1995). The very idea of "terrain" suggests organizational routines are fixed/solid, like the ground. This is part of the conceptual error we are attempting to remedy here. Because routines are generative systems, they are not like "terrain." As in the SeminarPro case, attempts to pretend otherwise are likely to fail.

4.4. The appearance of inertia

Routines have often been described as inertial (Becker, 2004; Nelson & Winter, 1982). Yet recent research shows a great deal of flexibility, adaptability and change (Adler, Goldoftas, & Levine, 1999; Feldman, 2000; Howard-Grenville, 2005). The recent research emphasizes endogenous processes or ways that routines change as they are enacted; in other words, it emphasizes the living aspects of the routine, as it grows and changes.

While it is beyond the scope of this paper to review the literature on resistance to change, the framework presented here may offer some possibilities that could be tested in future research. For example, perhaps routines (and the people who enact them) are most resistant to exogenous redesign or efforts by outsiders to influence familiar patterns of action. It is also possible that because artifacts have been confused with routines, efforts at exogenous change have simply missed the mark. We would also expect that resistance might emerge most strongly from functional events that involve human actants. Managers seeking software-enabled process agility should be mindful of the difference between the quadrants in Table 1; dead routines can simply be reprogrammed, but live routines cannot.

5. Some guidelines for designing live routines

One may wonder at this point whether it is at all possible to design routines. Understanding routines as generative systems allows us to see why efforts at design often go awry. It also allows us to suggest ways in which one can imagine a different approach to design that takes seriously the living systems that are being influenced.

First, invest in the ostensive. For a live routine, artifacts are not enough. Consider some examples where interdependent action is critical: sports teams, military operations, fire fighters, symphony orchestras, and so on. These people get training, they practice together, they get feedback on their collective performance, and they practice together some more. In this way, they build up patterns that they can recognize even from a variety of different perspectives – they build the ostensive aspects

of the routine. The ostensive aspects connect symbolic artifacts (such as sheet music) to the desired performances (the actual music). Job design, training, incentives, and other aspects of human resource policy will obviously influence the capability of an organization to reproduce successfully a desired pattern of action. But all of these will also fail if the pattern is conceptualized as something that stays the same or as something that is produced by the same actions.

Second, consider the point of view of each actor. What are the patterns that they are producing and responding to? Is the pattern of the new organizational routine consistent with other patterns in the organization or does it require changes in them? Also, consider the point of view of each actor at each functional event. What are the paths leading to the event (how did they get here)? What are the paths flowing out from the event (what typically happens next)? What are their interests and what are their alternatives? The idea here is to create an awareness of the space of possibilities from the perspective of the participants. After all, they will be designing the actual patterns of action, on the fly, day after day.

Third, think about the relationship between specific actions and abstract patterns. Are there many actions that can produce the same basic pattern or narrative? Do you care about the basic narrative or the specific actions? Use the narrative network to map out the different ways to move from one event to another and see if variations in the path matter.

Fourth, attempt to create "ruts in the road," so that the connections between functional events run along the lines you want. This may involve as much (or more) attention to incentives and training as it does to artifacts. In this respect, Kerr's classic advice stands more or less unchanged: create incentives for the behavior you want. If you want patterns of action, design patterns of action, but realize that the actors are the ones who will enact them (and re-enact them).

Fifth, think about design points in the process, rather than decision points. Traditionally, we ascribe a very narrow mindset to participants in an organizational routine. To the extent that the routine is "designed" by management, employees should not even think: they should just carry it out. This is the dead routine. Of course, many routines require some thought on the part of participants – they need to interpret rules and make decisions. If we think of this as a "decision" mindset, then we are basically locking the participants into a fixed set of alternatives (live, but just barely). Participants may have a generative, improvisational mindset, where they are empowered to make significant choices about how work gets done. To the extent this is true, users become designers.

Sixth, try to lock in the events you really care about. For events that are really required, use physical artifacts to enable and constrain that particular part of the performance. For example, in accounting procedures, and for any system involving financial reporting, there are mandatory control points. These obviously need to be monitored and enforced. Other aspects of a process might allow more flexibility. When auditors test for compliance with written procedures, they look for various kinds of evidence. This can include the extent to which employees are aware of written procedures. Ultimately, however, compliance auditing boils down to checking for material evidence that certain functional events have occurred consistently. It is generally not possible or necessary to audit the entire pattern of action, so auditors tend to focus on "key controls": specific actions or events that provide assurance that the essential parts of the process are being carried out as prescribed (Fox & Zonneveld, 2006).

Seventh, be prepared for continued engagement. Unless you can totally kill the routine, probably by completely automating it, change will be a part of the process. Longitudinal research on the development of patterns of action shows that even when the employees closest to the routine are involved in producing it, unintended patterns and consequences arise (Feldman, 2004). Paying attention to the emergence of these patterns and consequences enables those who would design routines either to take steps to keep the routine on track or to recognize that a different pattern or a different set of actions may be appropriate.

6. Conclusion

Routines are often treated like objects – like pieces of furniture, albeit complicated ones. To the extent that this is true, designers are implicitly adopting the view that routines are like things. This mistake is easy to make because designers tend to mistake the artifacts (forms, systems, rules, flow charts,

etc.) for the routine itself. Live organizational routines are not machines. They are not fixed programs or patterns. They are not like computer programs or film clips; they cannot simply be "played back." Rather, they are generative systems that can produce patterns of action based on local judgment and improvisation by actors.

To understand routines, we need to study and understand this variability. New technologies, such as workflow management systems and business activity monitoring create an opportunity to capture detailed data about the execution of particular routines (Pentland, Haerem, & Hillison, in press). These tools allow us to examine actual patterns of action that emerge from the living routines, not just the proposed or idealized patterns reflected in the process design. Efforts to create agile processes provide natural laboratories to study the factors that influence inertia and resistance, as well as flexibility and change. As processes of all kinds become increasingly digitized, these research opportunities will only grow larger.

Ultimately, it is important to realize that managers design artifacts, not routines. They hope that these artifacts will shape the ostensive aspect of a new routine, and also constrain the performances in some desirable way. But when the participants actually start producing performances, it is not necessarily what the designers had in mind. Some amount of improvisation is inherent in the execution of routines. For better or worse, organizational routines have a life of their own.

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