Digital networks and Organizational Change:

The Evolutionary Deployment of Corporate Information Infrastructure

François Bar, Neil Kane, Caroline Simard

Stanford University

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Abstract

This paper presents a model of digital network evolution based on early research findings on Intranet implementation in American corporations. This evolution process is described as a three-step, cyclical model: automation, experimentation, and re-configuration. These steps are rooted in the existing literature on the study of technology and organizations. The suggested co-evolution model builds upon existing theories and models, and goes one step further by suggesting a cyclical pattern of co-evolution and the simultaneous reconfiguration of technology and organization.

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I. Corporate networks: the magic rod?

IT-enabled corporate networks have become a crucial part of American businesses’ strategy. No longer considered a "utility", like water or electrical networks, they instead serve to define and articulate the transformation of business processes and economic relationships. A vibrant industry of hardware vendors, software providers, and consultants vie for the attention and dollars of organizations racing to upgrade their corporate IT networks. Impressive claims fuel this frenzy: corporate networks, we are told, have begun to revolutionize the organization of work and economic activity. These changes take place at several levels.

At the individual level, corporate networks permit new work arrangements through the shrinking of time and space constraints (Morton, 1991; Sproull & Kiesler, 1991; Wigand, Picot, & Reichwald, 1997), allowing firms to cut costs associated with coordinating dispersed geographical facilities. These network-enabled work arrangements are said to result in increased job satisfaction and empowerment (Sproull & Kiesler, 1991), and provide access to a wider pool of potential employees, unlimited by geographical constraints (Cash, Eccles, Nohria, & Nolan, 1994).

At the firm level, corporate networks make multiple kinds of re-organization possible. They are said to yield faster response time to market changes (Lucas, 1996), better maintenance and access to organizational memory (Morton, 1991), improved leverage of organizational knowledge (Carayannis, 1998), speedier and more efficient information flows, better coordination of group communication, greater employee participation, rapid scheduling, efficient task assignment and reporting, enhanced communication across hierarchical levels, and enhanced coordination of communication within dispersed groups (Sproull & Kiesler, 1991). Corporate networks also improve dispersed employees' organizational commitment by acting as a "window on the corporation" and enabling better socialization of new organizational members.

In addition to improving existing organizations, claims are that corporate networks permit entirely new organizational forms. First among such IT-enabled organizational forms is the networked organization (Rockart & Short, 1991) where all participants are linked (Rockart & Short, 1991) and the organization firms flexibly re-organizes itself around each new task (Baker, 1992). Corporate networks also play a crucial role in the establishment and maintenance of internal and external linkages, transforming hierarchies and markets. The network organization thus extends beyond the boundaries of individual firms to form a wider network of multiple organizations (Malone & Laubacher, 1998), increasing interdependence within industries (Rockart & Short, 1991). This state of increased communication between suppliers, distributors, and business partners (Cash et al., 1994; Lucas, 1996) supports improved interorganizational arrangements such as strategic networks and the Japanese keiretsu, and timely cooperation forms such as joint ventures and consortia (Wigand et al., 1997).

At the extreme, the network model can be applied to a market of networked "organizations of one" (Malone & Laubacher, 1998), a virtual organization (Davidow &

Malone, 1992). The virtual organization is composed of a set of loosely coupled, self-organizing networked individuals in geographically dispersed locations. Individuals come together around a specific task or project and dissolve the group upon task completion, leading to the emergence of an “e-lance” economy (Malone & Laubacher, 1998). This organizational form is said to go beyond the limitations imposed by the boundaries of the firm and tap into a boundaryless pool of resources, knowledge, and skills.

A vast literature examines multiple facets of this transformation. Its primary focus however is the analysis of the organizational implications of information technology networks. In that effort, it largely treats networking technology as exogenous, assuming it changes little while its deployment is studied. Further, it treats end users as passive adopters of networking technology rather than actors in its development configuration and deployment. As a result, we still know little about the mechanisms through which corporate networks evolve jointly with the organizations that use them.

This paper proposes a model for the co-evolution of IT networks and their user organizations. It suggests that, in addition to the increasingly well-documented effects of IT networking technology on organizations, user organizations conversely shape IT network technologies and their deployment. It further shows how this results in an iterative, evolutionary cycle where networks and organizations cumulatively shape each other. The first part of this paper describes the three stages of our cyclical model, automation, experimentation and re-configuration. The second part shows how this cycle builds upon existing models of network impact on organizations. Our analysis draws upon research within twenty US organizations combining in-depth interviews and broad-based surveys [1].

II. A cyclical model of co-evolution

Digital networks are proving enormously malleable. Indeed, they begin to change as soon as they are adopted, and unforeseen uses emerge beyond those that initially justified network adoption. New functions are created, new patterns of communications supported, and new uses for the technology quickly appear. In this evolution, any period's applications become the building blocks upon which the next period's applications will be built. Therefore, we need a model that can describe the evolution of the underlying communication infrastructure over time, not simply from adoption to obsolescence, but through its successive transformations.

Previous analysis described how the introduction of a new communication technology affects organizations at three levels (Malone & Rockart, 1991). First level effects come from the anticipated efficiency and productivity gains that justify an investment in new technology. When introducing new information technologies, organizations first apply the new application as a solution to an existing task requirement – to do to old things in a new ways – to automate existing work processes. However, the most important effects of a new technology may be not to let people do old things more efficiently, but to accomplish new tasks that were impossible or infeasible with the old technology (Kiesler & Sproull, 1992). These unanticipated second level effects give rise to

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[1] Including Adaptec, American President Lines, Charles Schwab, Cisco Systems, Handsnet, Levi Strauss

new behaviors enabled by the technology. They reflect end-users' influence as their appropriation of technology interacts with, shapes, and is shaped by the technological, social, and policy environment (Sproull & Kiesler, 1986). Third level effects involve the emergence of new social structures around the technology (Malone & Rockart, 1991).

Reciprocally, organizations influence the network infrastructure and applications they use. Two distinct types of networks flexibility, make this possible. Application flexibility enables users to deploy multiple applications over an essentially stable network configuration. Configuration flexibility allows them simultaneously to change the network configuration to provide new applications and to invent new ones by taking advantage of new configuration possibilities. Users are thus empowered by the technology's characteristics which allow its end users to create new applications, and shape the configuration of the underlying communication infrastructure to serve their needs. This represents a fundamental shift from the past: with digital technology, the ability to control and configure networks through software has become flexibly separable from network ownership. In the past, only the network owners (e.g. the phone company) could configure the network. Today, the networks' end users can control the configuration of the networks. As a result, we need to study not only the effects of the technology on the organization using it, but also the effect of the organization and its users on the technology, as the two co-evolve.

Understanding this critical feature of the deployment of digital networks calls for a cyclical model of network deployment. Our research suggests that corporate network

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& Co., Microsoft, PeopleSoft, Silicon Graphics and Sun MicroSystems deployment follows an iterative, cumulative, path-dependent learning cycle. Throughout this evolutionary cycle, corporate networks constitute both the support and the object of innovation. They help companies articulate organizational change and the experimentation they support often results in the development of new network technology and applications. This results in co-evolution of the network infrastructure and the organization. Building upon the three level effects identified by Malone (Malone & Rockart, 1991), we describe this process as a three-step cycle: automation, experimentation, and re-configuration.

Stage One: Automation

Typically, an organization's initial wave of network deployment can be characterized as "automation" (Bar, 1991; Bar & Borrus, 1992): the corporate network serves as a tool to perform previously existing tasks in a new way. This stage has also been called “initiation”, where the rationale for technology deployment is the automation of existing organizational processes (Cash et al., 1994). A typical example stemming from our research is the use of Intranets to automate document dissemination, where the Intranet serves to distribute electronically documents that were previously sent physically. These are essentially the same documents as in the pre-Intranet era, prepared in similar ways, distributed to similar groups of people, and integrated in similar tasks. Cost reductions provide a straightforward justification for such Intranet-based automation and the return on investment for this initial wave is easily documented.

Stage Two: Experimentation

The network infrastructure deployed to support the initial phase of automation enables second order effects through a phase of "experimentation" (Bar, 1991). Once the network is in place, it becomes a laboratory for learning by using (Rosenberg, 1982): individuals and organizations begin to explore the possibilities it creates. This ranges from extensions of the initial automation applications (on-demand, targeted publishing is a good example of such experimentation to extend automated document dissemination), to more complex applications made possible by the existence of a digital network infrastructure (e.g. web-based transactions allowing employees to order supplies or modify their retirement plans). It involves the re-combination of individual application elements into new arrangements, a process of "bricolage" (Ciborra, 1993; Levi-Strauss, 1962) leading to the invention of new applications riding the existing infrastructure. This experimentation is often accompanied by partial reorganization of the underlying work processes. Its benefits go beyond strict cost-reduction, and begin to include more systemic gains such as rapid response to changing market conditions or cycle time reduction.

Through experimentation, the communication technology becomes more integral to the work process of the organization using it. However, the life of corporate networks doesn’t end here. Experimentation merely sets the stage for a third stage of network evolution.

Stage Three: Reconfiguration

Intranet-based experimentation typically runs into the limitations imposed by the infrastructure deployed during the automation phase, provoking the need for a third phase of "reconfiguration". Once the limits of the old network have been reached through learning by using, the network’s architecture itself needs to be re-configured. Several of the work processes it has come to support need to be re-organized to take full advantage of the technology's possibilities, leading to simultaneous network and organizational change, a process of co-evolution.

The process usually involves an extensive re-design of the corporate network (e.g. transformation of an Intranet's navigation, content, applications), a thorough transformation of the network's governance (e.g. who controls it, how it can be changed, how content and features can be contributed), and significant re-organization of the work processes supported by the network. Examples of processes undergoing such re-organization in the companies we studied ranged from the assimilation of newly hired employees, to requisitions, and sales-team management. As a result of this re-organization, companies find themselves with a new network infrastructure, upon which they can start automating and experimenting anew, embarking on successive network learning cycles, as illustrated by Figure One. The resulting co-evolution of network infrastructure and organization process is iterative, cumulative, path dependent, characterized by structured learning, and results in embedded knowledge. (FIGURE ONE HERE)

This cycle of successive Intranet generations is a result of corporate networks enabling learning by doing (Arrow, 1962; Ciborra, 1993) and by using (Rosenberg, 1982). Learning by doing involves increasing embedded knowledge of the processes supported by the technology and how those two elements interact, resulting in increased production efficiency and small design improvements. Learning by using involves learning from experience with the technology leading to incremental design improvements (embodied knowledge) and increased performance work practices (disembodied knowledge).

These observations regarding network evolution contribute to the existing literature by integrating various models of the relationship between IT and organizations. Indeed, most current models do not encompass all three stages and do not recognize the existence of a cyclic pattern. They do not identify the impact of user organizations on network technology that result in co-evolution. Nonetheless, the model proposed here builds upon many segments of the existing literature and recognizes the contribution of each model as a necessary component of a more comprehensive picture of the evolution of corporate networks and organizations. The next part of this paper articulates these relationships.

III. The three stages in the literature

Automation

The magic-bullet model

Many studies have looked at the impact of information technology on numerous organizational features: structure (Carter, 1984; Foster & Flynn, 1984) size (Brynjolfsson, Malone, Gurbaxani, & Kambil, 1994), performance (Byrd & Marshall;, 1997; Mahmood, 1993), productivity (Mukhopadhyay, Lerch, & Mangal, 1997) and profitability (Nault, 1998), communication patterns (Sproull & Kiesler, 1986), coordination (Argyres, 1999), work environment (Joshi & Lauer, 1998), personnel management (Straus, Weisband, &

Wilson, 1998) and user attitude (Teo, Lim, & Wai, 1998). Other studies, issued from a contingency perspective, focus on the matching of fixed technology attributes and aspects of organizational structure (Fiedler, Grover, & Teng, 1996; Raymond, Pare, & Bergeron, 1995). This literature is characterized by a focus on the effects of technology on organizations and users, portraying technology as a causal agent. It tends to portray the effects of technology as beneficial, resulting in organizational improvements such as cost reduction and enhanced performance. Research on the immediate effects of technology portrays benefits realized at the automation stage of our cycle. It pertains to changes brought about by the technology to the organization, without looking at how the organization might have changed the technology. This paradigm therefore focuses on unidirectional effects of a static technology on a relatively passive organization, which led to the label of the magic-bullet theory of technological transformation (Markus & Benjamin, 1997). In this model, technology is assumed to have some determined impact across all organizations (Crowston & Treacy, 1986).

Diffusion theory

Another way to conceptualize the automation process is in terms of the gradual adoption of a new technology by organizational members. Here, the benefits of automation are realized as the number of adopters increases. Diffusion of innovation theory (Rogers, 1962) suggests that early adopters do so because they will gain the greatest utility. Then, as other members of the social system communicate with early adopters to reduce uncertainty linked to the innovation, the diffusion rate takes off, resulting in an S-shaped curve of diffusion (Rogers, 1983). Diffusion processes are evidently present during all the stages proposed by our model: automation, experimentation, and reconfiguration. However, the initial formulation of diffusion theory portrayed it as a finite process, where user influence was limited to adoption or non-adoption of the technology, a process that pertains to the automation stage of our cycle. Only later did diffusion researchers recognize the potential influence of users by introducing the concept of reinvention (Rice & Robers, 1980). Critical mass theory (Markus, 1990) is an adaptation of diffusion of innovation theory to interactive technologies. Here, the adoption of a technology needs to achieve critical mass for benefits to be realized. Diffusion of innovation and critical mass theory suggest a linear view of the deployment of communication technology. They view technology deployment as a finite process, with a progressive succession of steps leading from beginning (selection) to end (replacement), from invention to diffusion (Silverberg, 1991), from individual adoption to critical mass (Markus, 1990).

Assumptions of automation models

Models pertaining to the automation stage assume relatively stable communication technologies, regardless of the users (Fulk, Schmitz, & Steinfield, 1990; Silverberg, 1991). Diffusion theory has been criticized for not applying well to complex technologies (Attewell, 1992), ignoring the characteristics of the technology as an important determinant of diffusion (Cooper & Zmud, 1990), and assuming static technologies: “the technology itself, however, remains more or less the same […] it is simply passed along this pipeline […] until its innovative strength has been exhausted like a squeezed-out lemon” (Silverberg, 1991, p.67). These models have also widely assumed that static technologies would be the driver of organizational structural change, without considering the possibility that the organization's structure could also change the technology (Burkhardt & Brass, 1990). They tend to view adopters as homogeneous and passive in their relationship with the technology, failing to recognize human action as a possible predictive factor (Barley, 1990). However, these models effectively describe and document technology adoption at the automation stage.

Experimentation

Experimentation, as proposed by our model, represents a stage of learning by doing and using. As users begin experimenting with the possibilities of the technology, new uses for the technology begin to emerge within the organization, beyond the initial justification for implementation. Ciborra (1993) describes experimentation as *bricolage* (Levi-Strauss, 1962), a process of tinkering where known tools of the technology are used to solve new problems, whereas automation applied new tools to old problems. In order to benefit from the possibilities of this stage, firms must focus on the odd practices of user experience (Ciborra, 1993). Several authors have recognized the innovative potential of users as they discover and shape new ways of using a technology.

Users as innovators

Von Hippel (1988) has recognized the existence of the experimentation process by suggesting users as a source of innovation. End users need not be technological experts to find innovative ways of using a technology. Indeed, end users who are closest to the task at hand tend to use technology in a creative way when faced with challenges that a traditional use of the technology cannot meet. Therefore, once automation is in place, users can begin experimenting to solve new problems.

Reinvention

Diffusion researchers came to acknowledge the influence of users with the concept of reinvention (Rice & Rogers, 1980; Rogers, 1983): “Instead of simply accepting or rejecting an innovation as a fixed idea, potential adopters on many occasions are active participants in the adoption and diffusion process, struggling to give their own unique meaning to the innovation” (Rogers, 1983, p.179). In doing so, users are shaping the use and implementation of the technology to meet organizational needs, as well as modifying organizational processes to adjust them to the innovation. This corresponds to the stage of experimentation suggested by our model: users learn by using the technology and start discovering new possibilities specific to their own organizational environment. Reinvention occurs throughout the stages of adoption of a technology (Johnson & Rice, 1984), although it happens mostly at the implementation stage. It can lead to successive generations of the same technology (Johnson & Rice, 1984), resulting in a modification of technology and the modification of work practices to accommodate to the technology (Johnson & Rice, 1984).

Corporate networks are an example of a loosely-bundled innovation, which Rice & Rogers suggest is better suited to reinvention, as users can shape, mix, and match components (1980). However, the concept of reinvention, when applied to digital networks, needs some modification. First, the concept of reinvention as initially formulated pertained to an opportunity for the user to shape the use and implementation of the technology. However, digital networks enable the user not only to shape the use and implementation of the technology, but to shape the technology itself, as users directly manipulate the network's content and configuration. Second, Rice & Rogers mention several drivers of reinvention: problems with implementation, threat to political survival, pride of ownership, status, user's lack of knowledge, budget constraints, and problem definition (Rice & Rogers, 1980). Corporate networks do not need such specific conditions for reinvention to occur: as the diffusion of the network is contingent upon users shaping it, reinvention of the network is continuously taking place, leading to a continuous cycle of diffusion. Rice & Roger's discussion of reinvention takes place within a linear adoption process, whereas corporate networks are deployed, reinvented, and redeployed in a cyclic fashion. During technological diffusion, a process of "collective invention" (Allen, 1983) occurs, leading to a process of incremental innovation (Silverberg, 1991). For corporate networks, this process of "collective invention" is one of "continuous collective reinvention", as users shape and redesign the technology. This cyclical and continuous co-evolution process illustrates that the diffusion of network technologies is contingent upon their reinvention.

Reconfiguration

The reconfiguration stage is typically reflected in the literature in terms of the reconfiguration of the organizational structure. Our model suggests that this reconfiguration process is not limited to the organization but also pertains to the technology co-evolving with the organization. Furthermore, the reconfiguration processes proposed in the existing literature tend to be portrayed as a finite process, whereas out model suggests a continuous cycle of automation, experimentation, and reconfiguration.

Structuration theory

Structuration theory (Giddens, 1984) explores how technologies and organizations influence each other over time (Barley, 1986). It suggests a process of continuous interaction between users, organizational structure, and technology over time (Orlikowski, 1992). The premises of adaptative structuration theory, as formulated by DeSanctis and Poole (1994), are fourfold: 1) before the implementation of a new technology, structures exist in organizations; 2) some aspects of these structures become incorporated in the new technology as it is implemented and appropriated by users; 3) these organizational structures can become reinforced or modified through technology use, leading to new structures within the technology; 4) the technology therefore becomes a structure for social interaction, which then influences the organizational structure.

Orlikowski's (1992) application of structuration theory to technology is of particular relevance to corporate networks. She posits technology as interpretively flexible, meaning that it is physically and socially constructed by members of a social system. Technologies vary in their level of interpretive flexibility. The Intranet and digital corporate networks in general show a high level of interpretive flexibility, since they are physically (users publish information) and socially (users use it to communicate) shaped by their users. Applying Orlikowski's theory of structuration to digital networks, we would conclude that: 1) networks are the product of human action and are formed and shaped by organizational members, as they publish, manipulate, and exchange information; 2) networks are the medium of human action: they enable and constrain new ways of doing work and communicating; 3) human action cannot be understood outside its organizational context: when users are redesigning the network, they are influenced by their institutional setting (norms, rules of behavior, culture, etc.); 4) when using the network, users in turn influence the organizational structure: they reinforce or modify institutional structures by exploring new ways of doing work.

The application of structuration theory to corporate networks results in a dynamic view of influence between network, users, and institution, which is consistent with the foundation of our co-evolution model. It also recognizes the potential for these influences to lead to the reconfiguration of the organizational structure and the technology. However, structuration theory sees the reconfiguration process as linear, by predicting the institutionalization of technology over time (Orlikowski, 1992). Our model goes one step further by suggesting that corporate networks are continuously being reconstructed and reinstitutionalized by their users, and that the technology is continuously redefining the organization, as the organization is continuously redefining the technology.

From localized exploitation to business scope redefinition

Venkatraman (1994) describes five levels of IT implementation. In the first level, localized exploitation, IT is used solely to respond to localized challenges. The second level involves internal integration, where IT is integrated with an entire business process. These first stages are consistent with the automation process. They are evolutionary, in that they are coherent with the existing organizational structure, whereas the last three are revolutionary, in that they entail organizational transformation. The third level, business scope redesign, involves the redesign of business processes to match the possibilities of IT, reflecting our experimentation stage. The fourth level, business network redesign, involves transforming interfirm cooperation from transaction processing to knowledge networks. Finally, the last level and highest in benefits realized from IT, business scope redefinition, occurs, where the entire organization is redefined, consistent with our reconfiguration stage. However, this model still assumes a static technology and a linear, finite evolution of the technology from localized exploitation to business scope redefinition. The reconfiguration in this model concentrates on the organization, while our model suggests the simultaneous reconfiguration of the technology and a continuous cycle.

Substitution-extension-replacement

Malone and Rockart (1991) describe the transition path from existing to new technology as being one of ‘substitution-extension-replacement’. New technological innovation moves along an evolutionary path. Substitution begins when new technology is chosen in lieu of older, existent tools. In the extension phase, perceived enhanced usability and functionality compared to the older technology cause a demand shift. In the final phase, leading to full incorporation, older structures are removed and the new technology is left as the dominant paradigm. Hence, a given technology can give rise to new uses and structures beyond those originally intended. This is what Malone and Rockart call third level effects of technology, where entire organizational and social structures are redefined. Our reconfiguration stage adds to that third level effect the simultaneous reconfiguration of the network in conjunction with the organization.

Routinization

Yin (1979) has looked at the evolution of new practices and how they become integrated into organizations. The complete innovation ‘life cycle’ described by Yin has three phases: improvisation, expansion, and disappearance. During the improvisation period, governance policies and procedures necessary to embed the new innovation within the existing infrastructure are just beginning to be formulated. With expansion comes continued growth in the number and scope of applications being supported. The innovation receives formal recognition through incorporation in the organizational budgetary and resource allocation mechanisms. Standard operating procedures and policies begin to reference or depend upon the use of the innovation. In the final phase, disappearance, key personnel associated with innovation move on to new positions in the organization. There is considerable turnover and replacement of initial coordinating personnel as expansion to full organizational use is achieved. The technology is no longer considered new or innovative. It has been absorbed as a standard operating tool as new tasks become routinized and embedded in the organization. This entire process is called routinization. Yin therefore recognizes that the introduction of an innovation can result in organizational transformation through a process of increased embeddedness of the technology in the organization, which is consistent with the reconfiguration stage of our model. However, Yin's technology life cycle addresses the changes of a dynamic organization around a static innovation, and assumes a finite evolution process, ending with the disappearance of the innovation into the organizational structure.

Infusion

Going beyond Yin’s routinization, Zmud and Apple propose a state of “advanced incorporation” (Zmud & Apple, 1992) labeled “infusion” (Cooper & Zmud, 1990; Zmud & Apple, 1992). Infusion is the last stage of a wider implementation model developed by

Kwon and Zmud (1987), consisting of six stages: initiation, adoption, adaptation, acceptance, routinization, and infusion (Cooper & Zmud, 1990). Infusion recognizes that technologies mature and evolve through a series of redesigns and reconfiguration towards a new level of incorporation, going beyond adoption and routinization (Zmud & Apple, 1992). An infusion is represented by a sequence of configurations for the new technology, each one based upon the previous, with increasing levels of work related innovation, a process of experimentation. With each cycle the interconnectedness of workflow increases and becomes more dependent of the new technology. Zmud and Apple define routinization as a necessary but insufficient condition to produce high levels of infusion. Their discussion of infusion recognizes the dynamic evolution of technology and organization, while assuming a linear technological evolution pattern, with infusion marking the completion of technology diffusion.

Mutual adaptation

Leonard-Barton (1988) suggests a cyclical, spiral-shaped process of mutual adaptation between technology and organization. She suggests that managers should view implementation as a mutual adaptation process, involving technological reinvention and organizational adaptation. This mutual adaptation process is the result of misalignments between technology and organization. These misalignments can be technical, pertain to the delivery systems of the technology, or the result of a mismatch between technology and performance criteria (Leonard-Barton, 1988). The adaptation cycles can be large or small at the technological and organizational levels. For example, a small cycle can lead to a minor technological redefinition at the technology level, a task redefinition or the modification of a single element of delivery systems at the organizational level. A large cycle, on the other hand, would entail the complete redesign of the technology, or a redefinition of the corporation's core activities. Therefore, Leonard-Barton suggests the existence of reconfiguration cycles of technology and organization. However, the goal of achieving alignment implies that there might be an end to the adaptation process, and that reaching this end is a main managerial goal. On the other hand, our model maps out the possibility for a simultaneous, continuous co-evolution of technology and organization, bringing greater benefits to the organization as each cycle is deployed.

IV. Conclusion: Toward a cyclical model of network deployment

While a co-evolutionary framework has been applied to the study of organizations (Koza & Lewin, 1998; Koza & Lewin, 1999; Lewin, Long, & Carroll, 1999; Lewin & Volberda, 1999; Van den Bosch, Volberda, & de Boer, 1999), it had yet to be applied to the study of technology in organizations. This paper presented a model of corporate network evolution consisting of three stages: automation, experimentation, and reconfiguration. The model proposed here builds upon multiple models in the literature and combines them into a single framework. We propose that corporate networks follow a cyclical, path-dependent evolution process. During the automation phase, the network is used as a tool to automate essentially unchanged work processes. The second phase is one of experimentation, where users gradually learn by using the network, discovering its potential and limits and creating new applications. The third stage, reconfiguration, marks the attainment of the limitations imposed by the network, leading to a re-configuration of the network and of the work processes it has come to support. This re-configuration leads to the transformation of both technology and organization, upon which a new cycle of automation, experimentation, and re-configuration is started. This cyclical process is in constant dynamic evolution and sees no end, as the technology continuously co-evolves with the organization and its members. We agree with Leonard-Barton's (1988) suggestion that mutual adaptation between organization and technology follows a spiral pattern rather than a purely cyclical pattern, which would imply a return to the original point. Instead, each successive cycle builds on previous ones. Hence, the proposed model brings the properties of the co-evolution framework to the study of technology and organizational change: embeddedness, multidirectional and circular causalities, nonlinearity, mutual interaction feedback, and path dependence (Lewin & Volberda, 1999).

While we observe such a cyclical pattern in all the companies we have studied, there are however important differences. Companies show differing abilities to learn (about themselves and about the Intranet technologies) as they go through these cycles. They exhibit various levels of expertise in embedding the knowledge gained at each step within the Intranet infrastructure they deploy in successive steps. Our research traces these disparities to differences in the corporate governance of Intranets, including the organizational allocation of control over Intranet architecture and evolution, and the level of integration of the firm's various web-based efforts (Intranet, Extranet, and Internet). Further study of the evolution of corporate networks in these companies is necessary to document the continuous path of co-evolution resulting from mutual interaction of technology, users, and organization.

Figure One

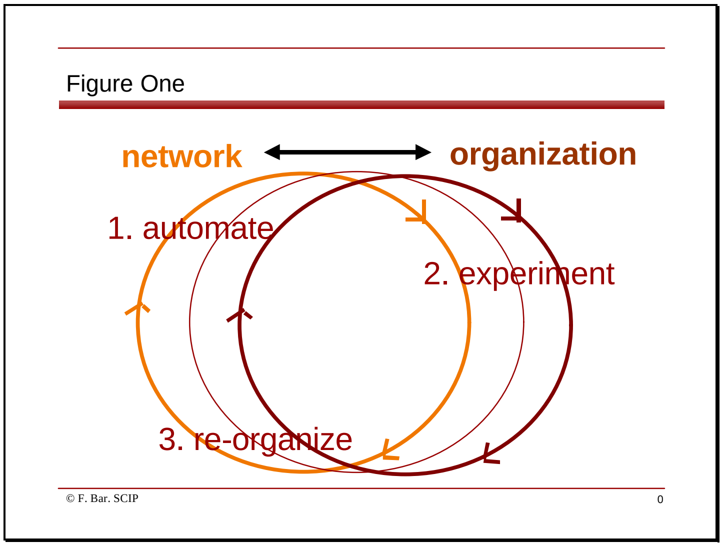
Figure One
network
organization
1. automate
2. experiment
3. re-organize
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