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NETWORKS, PEOPLE, AND PLACE: A MODEL FOR NETWORKING COMMUNITIES

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ABSTRACT

NETWORKS, PEOPLE, AND PLACE
A MODEL FOR NETWORKING COMMUNITIES

By

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Communities and enterprises are both complex social systems. Enterprises use communication technologies in the form of computer local- and wide-area networks to support their operations. Networks optimize accessibility, distribute processing, and facilitate sharing and coordination. They help decentralized, flat organizations to identify opportunities, make decisions, resolve conflicts, and solve problems. Enterprise networks provide a catalyst for innovating organizational objectives and processes, as well as a means to improve operations.

Communities have information flows and needs that are similar to those of enterprises, though they tend to be much less hierarchical, centralized and structured than traditional organizations. They are social networks that function to integrate their members, to help them grow and prosper through processes of recruitment, socialization and social control. Community information systems should parallel the structure of communities and support their processes.

Contemporary technologies such as groupware, hypertext, remote connectivity, and client/server architecture could be effectively adapted to facilitate community processes. Networks require a critical mass of services and usage in order to be economical and effective. The practicality of adapting enterprise networking to a community is dependent on willingness of it constituents to adopt technological means of improving their situations.

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INTRODUCTION

Humans are social creatures. We work well in groups and rely on interpersonal bonds of intimacy and commitment to meet shared needs: food, shelter, belonging, self-esteem, education, etc. It is this shared dependency that gives rise to community, the phenomenon of people living and working together within a geographic area. Communities are complex, multidimensional "meta-organizations" that encompass the range of human endeavors. They are the context in which we judge our welfare, our quality of life and cost of living. It has always been fashionable to decry the demise of community and to cite the resulting social ills (Claude Fischer 190-192), but regardless of the state of a particular community, few of its members would pass up an opportunity to improve their quality of life or lower their cost of living.

In the context of commercial and institutional enterprise, quality of life and cost of living translate into income and expense, and are called "the bottom line": what you gain and what you lose. Over the last two decades, enterprises have developed a number of technological models for improving their bottom lines. The primary components of these models are task-specific software, computers, and links between the computers. One such model, the enterprise network, creates a particular form of information system that is well-suited to highly integrated yet diverse and decentralized organizations. Networked organizations are able to respond rapidly to changes in the environment, to effectively identify needs and to fulfill them cost-effectively.

Can the enterprise network model be applied outside the focused context of commercial and institutional enterprise, into the larger context of the community? It has been recognized by progressive thinkers that there is a technological—communication technologies in particular—component in the improvement of communities (Park Dixon Goist 42; Making Cities Work 12). Could an information system enhance the functionality of a community similar to the way in which it would contribute to an organization that is more goal-oriented? Nearly forty communities across the United States and Canada have active community network projects. How do community networks compare and contrast with enterprise networks? What can we learn through a critical analysis of community networks using the enterprise networks as a model? This thesis examines these questions, seeks to identify opportunities for community networking, and offers practical recommendations on the creation of community networks that will have positive impacts on communities' "bottom lines."

METHODOLOGY

This thesis is a synthesis of research in a number of fields, including urban design, organizational communication, sociology and management science. In order to understand how a computer network might benefit a community, we must understand what a community is, how it works, and how it can be strengthened. There has been a vast amount of work done in sociology, anthropology, urban design, political science, and other disciplines on the subject of community. The most prominent and persuasive of these provide an excellent understanding of the structure, form, and function of communities.

If anything has been examined as thoroughly as community, it is information technology (IT). The hows and whys of implementing IT are exhaustively debated in the popular press, professional publications, and the world-wide Internet. To build a model of networking, we must identify the features of certain information technologies, the characteristics of organizations that apply IT successfully, and how the two are related. A review of the literature of organizational communication and of current information technology applications will provide the parts of the network model, as well as an understanding of the dynamics of the model, and its impact on organizations.

In comparison to the more general phenomena of community and information technology, community networks have evolved almost completely unnoticed. They have come about in a number of different ways, using a variety of technological models, and with varying levels of success. By visiting community networks through the Internet, examining surveys that have been conducted on the Internet, and reviewing the literature on community networking we can perform an analysis of the state of community networking today.

The conclusion of this thesis is a synthesis of the whys and hows of communities, the functions of information technology in organizations, and existing efforts towards networking communities. The results of this synthesis are a broader and deeper understanding of what community networking is and how communities might benefit from it, a model for economical and equitable community networking, identification of opportunities in community networking, and recommendations on the design, implementation and operation of a community network.

COMMUNITY

As a complex, multidimensional phenomenon, community is difficult to precisely define and is generally informal, i.e., changes form across space and time, and may have indefinite characteristics. A definition is necessary in order to discuss community, but it is necessarily a vastly simplified, generalized, and abstract definition. For our purpose, community is a social system in which persons with overlapping and conflicting agendas interact with the environment and each other within a geographically definable area in order to achieve shared and personal goals. Our challenge is to fully develop this definition in order to understand the costs and benefits of community networking. To answer this challenge we will move along a course from generalizations and abstractions to bottom-line, real world implications and recommendations. To help us stay on that course, we will apply concepts to a specific community: Chattanooga, Tennessee. Our discussion of this particular community will provide a subjective foil for the more objective, academic discussion of community as a phenomenon.

In its broadest sense community can be understood as a social system (Terry Clark; Irwin Sanders; Fischer; Making Cities Work, et. al.). A system is a group of interrelated, interacting, or interdependent constituents forming a complex whole, a functionally related group of elements (Webster's II New Riverside University Dictionary). Stephen Littlejohn provides an excellent overview of the development of general systems theory, and related studies of cybernetics and information theory. He notes that open systems have several characteristics:

- Wholeness and interdependence
- Hierarchy
- Self-regulation and control
- Interchange with the environment
- Balance
- Change and adaptability
- Equifinality (35-38)

The general elements of a system include:

- an environment
- processes
- components
- inputs from the environment
- outputs to the environment.

The general function of a system is to process inputs into outputs. A system achieves and maintains the characteristics described above through the persistence of interactions between components, acting upon inputs. These actions and interactions make up the system's processes and result in the transformation of the inputs into outputs. The system persists because its outputs have a greater value than its inputs. The value of inputs and outputs are determined by the transactions involving those items that take place in the environment. Through a number of transactions over time the environment sets value and thereby affects the outputs and inputs of a system. A system will tend to produce what it can with the greatest positive difference between the value of the inputs and the value of the outputs. In this way the function of a system is determined by its environment.

Community and its environment

The environment in which a system operates is the primary determinant of its function, form and structure. Richard Farace, Peter Monge and Hamish Russell delineate general types of environments along a continuum from "placid-randomized," in which a person [system] can wander without direction, learning to achieve goals and avoid danger by trial and error, through "placid-clustered" and "distributive-reactive" to "turbulent," in which a system must be ready to change its basic nature in order to adapt (36-37). Arensberg and Kimball see community as the link between society, culture, and the environment (2). Sanders turns this linkage around, saying that community "is part of and acted upon by complex environmental factors" (44). This "setting" includes a community's:

- Ecology
- Demography

- Culture
- Personality
- Time
- Society at large (Sanders 44-47)

Rather than delving into inconsequential details, let's restrict the description of our referent city to a brief overview of Sander's components:

> Contemporary Chattanooga exists, of course, in the United States of the nineteen nineties. It is part of, and exists within, that particular larger social setting. More specifically, Chattanooga exists in a society that sees itself as fragmented and out of touch with tradition, dealing with constant change and uncertainty, yet dedicated to the ideals of "rugged individualism" and pursuit of the "American dream." Overall, it exists in what would be characterized as a placid-clustered environment.
>
> Chattanooga is a city and surrounding metropolitan area in southeastern Tennessee, where the state borders Georgia and Alabama, just east of the central time zone, just west of the Smoky Mountains, and within a two hour drive of four major metropolitan areas. It sits up against the eastern flank of the Cumberland Plateau and straddles the Tennessee River. The center of the city is its Downtown area, which has recently undergone significant revitalization. Downtown is surrounded by industry, especially to the south, and lower income neighborhoods.
>
> There are several smaller centers in non-annexed towns and shopping areas to the north and east of the city. The smaller centers are surrounded by suburban middle-class neighborhoods. Upper-class neighborhoods are located on the ridges and plateaus that rise up around the center of the city.
>
> The weather is temperate, the soil is fertile, and there are abundant natural resources. The community is surrounded by rural areas, which support farms, extraction operations, and semi-wilderness, and numerous smaller cities and towns. Chattanooga is a center for ground and water transportation in the southeast, and supports diverse tourism and light manufacturing. Much of Chattanooga's heavy industry faded in the nineteen seventies, although there has been a steady—if slow—in-migration of heavy manufacturing over the last decade. It has made a recovery from being one of the country's most polluted cities, to being trumpeted as the "Scenic City."
>
> The people of Chattanooga are generally conservative, predominantly white, middle- and lower-class, with strong upper-class and minority components. They tend to be religious, with strong beliefs about personal freedom and moral commitment that are popularly characterized as "family values." Regardless of the social conservatism professed by much of the population, Chattanooga has a vibrant cultural life, even a hint of an "underground" culture. The city has numerous museums—including an aquarium, train museum, and several art museums—and is rarely without a cultural event occurring near the city center.
>
> Chattanooga has had—and still has—its share of social problems. And, like many communities, it has a tendency to try to ignore them. The community does benefit from a healthy grass-roots tradition, and the capital to fund such efforts. In particular, the community created an opportunity for self-appraisal and goal-setting—referred to as "visioning"—that has spawned significant amounts of civic activity and investment.

Beyond this general description, the community fits Sander's characterization in that it is a place with a population that exhibits general cultural and particular personal traits, and fills a range of social roles. It is important to note that the community and its environment are intermingled. While the community of Chattanooga, as a system, has boundaries that might be delineated in a number of ways—geographically, socially, economically, pyschographically and demographically—those boundaries tend to be vague and dynamic. As a small example, if an individual lives in Chattanooga but works in Dalton thirty minutes away, does that extend the boundaries of the community or compromise them? The elements of Sanders' setting are not singular or static measures; there may be only a vague and shifting delineation between where Chattanooga's cultural milieu ends and Dalton's begins. Not only is a community, or any system, affected by external factors in the environment, it has an effect upon itself. For instance, Chattanooga's culture and ecology are both components of community, but they are also parts of its environment. Culture transforms ecology. Ecology impacts culture.

Community processes

Systems encompass a range of general processes: procurement, allocation, production, consumption, transformation, innovation and change, maintenance, communication, etc. As a particular type of system, a community has specific processes, which Sanders identifies as recruitment, socialization, and social control. He states that, in order for a community to prosper it must:

1. Recruit new members either through birth, in-migration, or annexation, and maintain existing members;
2. Train the new members to play the appropriate roles as they take their places and achieve status in the community;
3. Exert some form of control over individuals who deviate too far from the norm (192).

These specific processes are carried forward, Sanders suggests, by two particular general processes: allocation and communication (219-240). The allocation of resources, roles, power and prestige to members of the community provides incentives and disincentives for becoming, staying, or bringing in a member of the community. Similarly, allocation provides rewards or punishments for filling certain roles or behaving in certain ways.

Communication is the process by which members or potential members of a community come to know how the community performs allocation—how much of what resources are assigned to which components of the community—as well as how efficiently, effectively and equitably the community performs its more specific processes of recruitment, socialization and control. Communication is an especially important process because of the function it provides for individuals. Frank Dance identifies the functions of communication as:

- Integration of an entity and its milieu;
- Development of mental functions;
- Control of behavior. (285)

The general process of communication allows the community to carry out its specific processes—recruitment, socialization, and control—by bringing individuals within its boundaries, enhancing their ability to deal with diversity and to prosper.

Beyond allocation and communication, as identified by Sanders, another general process that is significant to this thesis is innovation, as examined <u>Making Cities Work</u>. The editors of this book identify innovation as "not just a response to pressure but structural or system-wide effects on cities" (11). Innovation is not invention, but the process by which new ideas or technologies diffuse into use within a community (11-12). It is a process of re-structuring the social perspective in order to create long-term, sustainable improvements in the community. More particularly, innovation is the process by which a community not only responds to changes in its environment, but exploits them. Schon 56-65).

In Chattanooga, the specific processes of community are realized in numerous ways:

- An economic development board recruits businesses, encouraging them to move to the Chattanooga area, possibly even arranging tax breaks for them. [allocation]
- The Big Brothers/Big Sisters program provides positive role models and friends for children from disadvantaged or broken homes.

- The police and sheriff's department regularly set up sobriety check points along major roads on the weekends, reminding people to stay sober when driving and incarcerating those who don't pass the test.
- Through its visioning process, the community is attempting to proactively re-structure the ways in which it carries out recruitment, socialization, and social control.

The Components of Community

Arensberg and Kimball assert that the community is actually a "series of independent systems", suggesting that community is a master-model of other social systems linking, as already noted, society, culture and environment. They go on to build a taxonomy of these systems based on their categorization as relational, customary, or value systems. Relational systems are the primary components of a community. They are enumerated as:

- Family
- Economic
- Religious
- Political
- Educational
- Associational
- Informal

Each of these relational systems has customary and value systems associated with it, and is made up of numerous components itself. When one of the relational systems changes, the change affects its components, its associated system of customs and values, and the other relational systems (269).

The major components of relational systems can be categorized as actors, such as persons, families/households, institutions, enterprises, associations, and resources, such as capital, real estate, public goods, private goods, and time. These actors may be part of and resources available to several relational systems, fulfilling a similar number of roles. Logically, any particular actor has limited resources with which to act. This fact is reflected in problems of allocation, and particularly in the problem of role strain (Sanders 108-11). Actors allocate their own resources within a relational system based on the associated system of values, and use the associated system of customs as a guide for their actions. As they move between relational systems—and roles—they must adjust how they allocate their resources and conduct themselves. The process of this adjustment, and the process of communication required for knowing when and how to change, exert a strain on the actors resources, over and above what has been allocated to each role. Role strain accrues from the actor having limited resources for allocation to a practically unlimited number of roles, and from having to change roles.

Relational systems and their associated values and customs are quite apparent in Chattanooga. An individual may have a role in an economic system as an employee, in a family system as a child, in an educational system as a student, in an associational system as a darts enthusiast, etc. There are complex patterns of interaction in the form of general processes such as allocation, communication, transportation, etc., taking place among the people of Chattanooga as they fill their various roles. They give up their time, energy, and knowledge in return for money, and give up their money for education, entertainment, and domestic tranquility. Participation in these processes fulfills basic social, institutional, and personal needs for the actors. This concept applies to institutions such as mental hospitals and schools, and enterprises such as barbecue stands and banks, as well as for individuals and families.

Community inputs and outputs

Each of Chattanooga's relational systems—and the systems of which they're composed—have identifiable inputs and outputs. There are a set of items that each one takes in, transforms, and then returns to its environs. The foundry takes in ore and power, and produces pipes. The City Commission takes in facts, figures, public opinion and taxes, and produces budgets and policies. Churches bring in sinners and send out saints. The family takes in food and energy, and outputs children who are well-adjusted, intelligent, and healthy. But what about the community itself, the meta-system of social systems, what are its inputs and outputs? Well, if we consider its processes—recruitment, socialization, and social control—we can see that those processes exist to benefit the constituents of the community, which is to say its components: persons, families, enterprises, and institutions. What is it that a community provides to these constituents? It provides roles in relational systems that give the actor value over and above the value of the resources the actor gives up in order to participate in the community, its relational systems and processes. In other words, a community synthesizes the outputs of all of its components in order to produce a standard of living.

If the output of a community is an abstract standard, then its input can be characterized just as abstractly as a "cost," more specifically the cost of living. This cost is paid by each constituent of the community, each actor that benefits from acting within the context of the community. The community maintains itself, grows or declines, based on the ratio of quality of life to cost of living. The higher the quality of life and the lower the cost of living, the more benefit (or excess profits) for constituents of the community, and the more wealthy the constituency becomes.

To bring this back to our referent community, we can see that the interaction of relational systems results in the creation of such things as industrial parks, police forces, and the renovation of historic sites. These items and activities provide the benefits of jobs, safety, and culture to individuals and families, which improves their quality of life. A couple may take advantage of these benefits to start a family, bring their parents to live with them, and/or encourage friends to move to Chattanooga. In essence, by these actions the couple "outputs" new members of their community. If Chattanooga as a community is able to output a sufficiently high quality of life while requiring sufficiently low inputs to the cost of living it will attract industrial executives, farm kids, unfulfilled professionals, and new babies.

Community function, form and structure

We now begin to see the complex form of the community emerging from the indefinite haze of society. As we simultaneously open up a broad abstraction and zoom in on a focused application of community, the function, form and structure of our social meta-system becomes more fully articulated.

What is the function of community? Clark suggests that communities provide these functions for their component actors:

- Adaption, which is accomplished through the economy;

- Goal-attainment, which is supported by the polity;
- Integration, which is performed by law, political parties and social groups;
- Latent pattern-maintenance and tension management, which he associates with the family, education and cultural organizations. (47)

He maintains that each function may be fulfilled differently by any one community and that the functions may be fulfilled by various communities for a given actor. The characteristics of a community are determined by patterns of functionality that emerge across its constituents. One way of analyzing the functionality of a community, he suggests, is by the ratio of occupations in the various professions associated with the services through which each function is fulfilled (53). This analysis points out that the community functions to empower its constituents. It empowers them to fulfill their physical, social, and personal needs, sheltering its members from dangers in the environment and drawing in resources for them. As noted above, persons and organizations may have to deal with environments ranging from placid to turbulent. Community makes its constituents prosperous. It provides a context in which they can find food and shelter, gain acceptance, and build self-esteem.

How does community fulfill these functions? The formal characteristics of a system are what determines how it interacts with its environments. So what is the form of community? Well, let's step back and look at the components and subsystems of community as they take up their roles in the process of community and see what form emerges.

Within each relational system, general and specific processes tie together components and subsystem. A high school student eats a hamburger (consumption), the fry cook gets paid (allocation), the manager does payroll and inventory (maintenance), the assistant manager calls in an order for more lettuce and tomato (communication), the supply truck pulls away from the warehouse and out onto the road (transportation), all within a microcosm of the community. Each interaction branches out from the last. Each individual moves from relation to relation, role to role, process to process. Each resource is transformed, the new resource is redistributed, and is in turn transformed again. What emerges is a web of activities and actors within space and time. If we put an individual or organization at the center of this web, it becomes apparent that we all exist within a "social network." Fischer (1977), points out that,

> "[s]ocial networks are important in all our lives, often finding jobs, more often for finding a helping hand, companionship, or a shoulder to cry on. Our networks do more than just support us; they also place demands upon us—for assistance, advice, to help a friend of a friend—and they influence our values, attitudes, and decisions." (19)

By moving within and through our social network we find sustenance and meaning, and through the network we make our contribution towards the cost of living.

So, a community takes the general form of a network, but a social network is a rather vague abstraction. If we define form as the sum of the characteristics that determine the nature of interactions, we see that these networks take the form of relational systems and, more specifically, the form of specific relational subsystems such as businesses, churches, schools, governments, and households. The specific form of a relational subsystem determines the processes it may take part in, the roles it can play. Those processes, roles, and the subsystems themselves define the structure of the larger relational system, e. g. economics, politics, religion, etc. These relational systems, the concomitant custom and value system, and their interactions define the form of the community, much as Clark suggests, above, and the form of the community determines its functionality. The numbers of individuals fulfilling roles within the various relational systems is one means of mapping the form of a specific community, of estimating to what extent it provides its constituents with a high quality of life for a reasonable cost.

In contrast to form, which describes the external, subjective characteristics, structure describes the internal, objective characteristics that support form. Not to detract from the work of the distinguished scientists who study social networks, but they confuse the terms form and structure. Form defines how a system interacts with its environment, while structure defines how the components of a system relate to each other. Beyond this semantic point, social network analysis provides excellent definitions of the structural variables of social systems:

Range—number of actors connected in a network

Density—the extent of interlinkage among the actors, usually expressed as the ratio of the number of existing links to the number of possible links.

Reachability—the average number of links needed to connect any two actors by the shortest route.

Clustering—the extent to which the total network is divided into distinguishable cliques. (Fischer 36)

The general attributes of relationships between actors/components are listed as:

Multiplexity—the number of relations in a given link [relationship]

Symmetry—the balance of power or profit

Intensity—degree of commitment to the link [relationship] (36)

Analyzed within the general framework of structure, form and function, we see that a community will tend to alter its components through processes of recruitment, socialization, and control in order to achieve a form that most optimally helps its constituents fulfill their needs, avoid danger, achieve their goals, grow and prosper.

ENTERPRISES

The analysis of social networks, of actors, roles and relations was developed as much in management science as in social science. Everett M. Rogers and Rekha Agarwala-Rogers stress the interrelatedness of organizational structure and communication. They begin—like most who write on this topic—with the accepted model of communication as a linear, dyadic phenomenon, but they develop this model into complex communication networks, with individuals or groups as nodes and communications as links. As with others in the systems school of organization, they place a great deal of emphasis on the significance of the environment as an element of organizations and as a determinant of organizational function, form and structure. Communication networks not only operate within the organization but also link the organization with other entities and its environment, which Rogers and Rogers see as crucial to the ability of organizations to adapt and innovate (70). Farace, Monge and Russell add to and elaborate on the link attribute identified above:

- Symmetry is the balance of control and effort that the communicating entities contribute to the link. Symmetrical communication has equitable flows between all participants; each node does equal duty as source and sink. Asymmetrical communication flows in only one direction; the nodes have fixed functionality as source or sink.
- Strength is determined by the periodic qualities of the link. Stronger links are used more frequently and/or for greater lengths of time.
- Reciprocity is the amount of awareness or agreement between participants as to the existence or characteristics of the link.
- Content is, of course, the messages that flow across the link.
- Mode is the means of communication. (181-2)

There are four variables that may be used to formally define communication networks:

- Flexibility of the network determines "who may communicate with whom" and "what specific pathways messages are to take."

- Directionality of information flows describes how communication spans the organization horizontally and vertically, as well as whether the flows are symmetrical or asymmetrical.
- Initiation or sequencing of messages may be imposed from the top of the organization regardless of the actions on lower levels, or sought by members of the organization, with communication in general encouraged throughout the organization.
- Load of information processing is characterized by the amount of resources being applied to communication. (76)

Communication is universally seen as a vital general process for organizations (Rogers and Rogers, Farace, Monge and Russell; Peter Manning; Lee Thayer). It has even been suggested that organizations are nothing more than complex information processing systems (Pamela Shockley-Zalabak 7; Rogers and Rogers 57; Jay R. Galbraith 179-89). For organizations as systems, communication functions to make them more effective in garnering resources and creating products; to increase their efficiency through innovation; and to maintain or change their form and structure in response to internal and external strains. These functions are facilitated by communication systems, which are subsystems of the organization. Overall, communication allows organizations to achieve their goals by supporting processes of production, planning, coordination, control, etc. Communication provides the information, commands and instruction, influence and persuasion, and integration (Thayer 187-249) that makes organizations cohesive wholes.

Farace, Monge and Russell parallel the functions of organizational communication with the general processes in organizations—production, innovation and maintenance:

1. Production. Communication involving the work being done, the work waiting to be done, problems in the work (such as errors), and problem detection and correction.
2. Innovation. Communication involving the elicitation of new ideas for doing work, new ways to do work, new types of work that might be done, and new procedures and policies that would improve the operation of the organization or the overall environment.
3. Maintenance. Communication that improves or enhances the individual's concept of self, or the nature and quality of interpersonal relations, or the identification with and loyalty to the company; in addition, maintenance includes communication that supports the production and innovation functions as well. (76-7)

—and relate them to three forms of communication:

> Environmental communication provides descriptions of actions, events or processes that observers detect in the world in which they live....
>
> Motivational communication refers to statements that assert specific goal or values....
>
> Instructional communication consists of assertions that provide courses of action which link the motivational and environmental statements together. (1977, 30-1)

Thayer states that the likelihood of an entity engaging in communicative behavior—either being communicated with or communicating to—are dependent on the anticipated result of that behavior. In the goal- and task-oriented environs of the organization, motivation to be communicative is founded on the need to solve problems or make decisions, to achieve some productive result (78). On an operational level, Thayer points out four preconditions to communicative behavior:

- A Relationship - Communication between entities requires that they be able to relate to one another in some way, on some level.
- A Need - At least one of the entities to be involved in the communication must require information or have some purpose for communicating.
- Roles and Rules - Rules involve the time and location of communication, as well as the medium, language, etc. to be utilized. Entities "play" roles when they make use of certain rules in order to communicate.
- A Language - the entities must share a means of representing meaning. (77-81)

The dynamics of communicative behavior are defined by the translation of informational needs into some form of symbiosis through which power, control and regulation are exerted and exchanged between the communicating parties, which Thayer terms "gaming" (82-9). For communication to be effective in organizations, its dynamics must be managed. The questions which must be answered in the process of managing communication are:

> a) *who* acquires or transmits *what* "information,"
> b) *from* or *to whom*,
> c) *when*, and
> d) with *what consequences*? (102-3; emphasis in the original)

Farace, Monge and Russell see this as a problem of control and coordination. Any organization, they argue, can have only a limited amount of information (bounded rationality). This information exists in two forms:

- Absolute information is a single "piece of knowledge" which can be possessed by a member of the organization. This is a measure of the amount of information that exists in the organization.
- Distributed information is the dispersion of a piece of knowledge through the organization. This is a measure of the penetration of the information that exists in the organization into its social structure. (26)

Absolute information either exists in the environment or in the organization's memory, and must be located, either actively or passively, through a search. Organizational memory consists of short-term and long-term storage, in the form of documents or knowledgeable members of the organization. The cost of storage and the cost of access are inversely related: while short-term memory can be easily searched, it is more expensive. The environment "stores" information without cost, yet it may be difficult to locate that information when it is needed. There is an economic trade off between using information, retrieving it from storage and reprocessing it from the environment. If the revenue potential of information is less than the cost of storing and retrieving it—particularly if the information is of use only in the near term—it should be discarded. Farace, Monge and Russell outline the general strategy for garnering information from the environment and incorporating it into organizational memory:

1. "[T]he total information available to an organization first goes through a processing step as it reaches the organization's members by any of several different channels" Channels may be systematically designed and used by the organization.
2. Information processed into the organization must be stored for future use. There must be rules for deciding what is usable and should be kept, and what should be discarded immediately, as well as methods for establishing and periodically evaluating those rules.
3. Information that is highly perishable, loses value quickly or is needed to resolve issues in ongoing activities should be put into short-term storage where it can be retrieved with little effort.
4. Less immediate information can be put into long-term storage.

5. Information must be disseminated through the organization (absolute vs. distributed information).

   Rules and procedures must be established to manage the distribution of information. (39-41)

Once information has been incorporated into organizational memory it can contribute to production, innovation or maintenance by facilitating tasks such as:

- Diagnosing quality problems or equipment malfunctions;
- Learning the identities of extra-organizational experts, influence peddlers, resource providers, or other useful non-members;
- Locating information or resources that cannot be located using official, standard sources (George P. Huber 256-58).

The information required to accomplish these tasks must be distributed in such a way that it is available when and where it is needed. Distributed information results from communicative behaviors. The forms of communication—environmental, motivational and instructional—serve to make sure their concomitant forms of information are distributed economically, in short-term and long-term memory, throughout the organization. In order to accomplish this, organizations utilize functional—but not necessarily formally or structurally—different communication systems:

> 1. The operational communication system, which "conveys" data about task-related activities and operations within the organization…
> 2. The regulatory communication system, which "conveys" to the organization's members those orders, rules, and instructions which are intended to regulate their material- and/or information-processing functions.…
> 3. …the maintenance and development communication system serves…the purposes of providing feedback as to the condition of the people or the communication channels upon which the organization is dependent… (Thayer 103-4)

Thayer also notes that these systems facilitate the management of communication as well as the process of communication itself.

There is an apparently recursive relationship between the functions of communication and the structure of organization in which it takes place. Communication is crucial for defining an organization: it is the means by which division of labor and delegation of authority take place. Yet, those are the very constructs which determine how who communicates what to whom, when, and with what results. Bounded rationality constrains the information processing capacity of organizations. In part, the structure of an organization serves to distribute processing capacity, just as it guides and limits flows of information. Farace, Monge and Russell suggest that there are number of factors which determine how effectively a system processes information:

- Load is the amount of information that the system must process. Information overload may compromise the operation of the system, but so—particularly if the node is a human who is wont to get bored—may underload. Overload of one component may have a domino affect, leading to the overload of other components when the first fails.
- Rules or norms about how information should and may be processed must be known by the node, agreed upon by other components in the system and must be accurate. For example, Rogers and Rogers note that the active discouragement of the practice of "going over the boss's head" not only reinforces chain of command and delegation of authority, but also prevents information overload of the boss's boss (90-92).
- Attention—or processing capacity—must be applied to the task of processing the information. There is also somewhat of a domino effect here, in that the more capacity a component has, the more it gets used, increasing the likelihood of its failure. (10-12)

When the amount of information available outweighs processing capacity, organizations have several mechanisms for dealing with the overload: successive—rather than simultaneous—judgements, memory, varying the precision of judgements, and chunking (Farace, Monge and Russell 115). Unfortunately, utilization of these techniques may result in important information not getting through—omission—or changes in the meaning of the message—distortion. These failures can be compensated for by a number of methods:

> 1. *Redundancy* is the repeating of a message in different forms, over different channels, or over time....
> 2. *Verification* is insuring the accuracy of a previous message....
> 3. *Bypassing* is the elimination of intermediaries in a communication flow. (92-94, emphasis in original)

Unfortunately again, all of these remedies may contribute to information overload. The soundest tactics for dealing with overload involve adding capacity or spreading the load out over time: increase the channels, filter the information more, allow queues to form during peak periods. Beyond these tactics, the organization must accept a trade off between the quantity of information processed and the quality of the processing (Farace, Monge and Russell 117-24).

Rogers and Rogers offer these general observations about horizontal and vertical flows through organizations:

- "Horizontal communication flows in an organization are more frequent than vertical flows." Rogers and Rogers hold that peers in an organization have similar views of the organization and their place in it and do not hold sway over each other, consequently they are more open to interaction. Horizontal flows usually serve to coordinate activities, "whereas downward flows are mainly authoritative and upward flows chiefly provide feedback on operational performance; so vertical flows carry messages that are potentially more threatening." Horizontal flows are more informal and move over channels that are more flexible and rapid.
- "Downward communication flows in an organization are more frequent than upward flows." Superiors naturally control communicative situations, so subordinates are less likely to initiate upward communications. Communication between superiors and subordinates are more likely at the upper level of organizations. Upward flows are also more susceptible to distortions which encourage a positive image of the subordinate. (96)

Rogers and Rogers also note that there is a relationship between the physical structure of an organization and its information flows:

> Usually, the physical structure (walls, corridors, and floors) of an organization is established according to the organizational structure, and the physical structure in turn largely determines the communication flows.…Physical proximity plays an especially important role in who interacts with whom at the early stages of social acquaintance. (102)
>
> Communication networks operate on three social levels:
>
> 1. *Total system network*—comprising the communication patterns among all of the individuals in a system, such as an organization.…
> 2. *Clique*—defined as a subsystem whose elements interact with each other relatively more frequently than with other members of the communication system.…
> 3. *Personal network*—defined as those interconnected individuals who are linked by patterned communication flows to any given individual. (Rogers and Rogers 113-14)

These networks consist of primary links between the entity and the other entities with whom it directly and frequently communicates and "weak ties" to entities with whom it communicates infrequently or indirectly, yet from whom it receives a significant amount of information. Weak ties can extend out several iterations and may have significant effects on the subject at the "center" of the network (115). Rogers and Rogers discuss the structure of interpersonal communication networks and note that open, radial networks are more effective at gathering information than closed, interlocking networks (116). They note a number of structures—circle, wheel, chain and all-channel—based on experiments by Leavitt with small groups in a laboratory setting. These conclusions are offered as results from those studies:

1. Network centralization…contributes to rapid performance…, but the error rate is high, presumably because two-way communication and feedback is discouraged.
2. Low centralization or high independence…is associated with member satisfaction.
3. The network structure served to elevate certain individuals into leadership positions.
4. Being in a key position in a network, however, also led to information overload for the leader, through whom all the messages had to pass. (121)

While these studies offer some useful generalizations about how information flows through and people interact in simple networks, Rogers and Rogers point out that they must be seen as only that—generalizations—and used only abstractly. Most notably, they cite criticisms of the studies for not considering independent variables such as opportunity, personality, noise, distortion, and distance (122). Taking these criticisms into account, Rogers and Rogers offer a number insights into analyzing networks. They suggest that analysis requires:

1. identifying cliques within the total system, and determining how these structural sub-groupings affect communication behavior in the organization;
2. identifying certain specialized communication roles such as liaisons, bridges and isolates…
3. measuring various structural indexes (like communication integration or connectedness, and system openness) for individuals, cliques, or entire systems. (125)

Farace, Monge and Russell identify the general structural characteristics of nodes in a communication networks:

- Isolates do not participate in any group.
- Group members participate primarily in a single group.
- Intergroup linkers participate equally in multiple groups. (185)

These roles are identified more formally as gatekeeper, liaison, opinion leader and cosmopolite by Rogers and Rogers (133). Ronald E. Rice characterizes various communication roles as routing and distributing, summarizing without changing meaning, delaying and storing based on priority, and modifying, editing or distorting content (67). Robert W. Zmud considers the functions that nodes may perform and offers a much greater characterization:

> Sensor nodes detect environmental *signals* and transform these into messages. Sensor nodes can exhibit distinct types of behavior: as scanners (gathering information that has no immediate use), as trackers (routine monitoring of issues, events and entities), and as probers (one-time exploration of a specific issue, event, or entity).
>
> Filter nodes operate on input messages in order to screen out those which are irrelevant. Relevant messages are maintained within the [system]; irrelevant messages are lost.
>
> Router nodes distribute an input message to particular nodes and to particular information buffers.
>
> Carrier nodes move, or "carry," messages to and from processing nodes and information buffers.
>
> Interpreter nodes apply existent guides-for-action and contexts-for action to input messages to enhance the information value of a message. As a result, uncertain or equivocal messages are interpreted, i.e. made more meaningful.
>
> Learner nodes apply existent guides-for-action and contexts-for-action to uncertain or equivocal messages in order to create new score-cards, triggers-for-action, guides-for-action, or contexts-for-action. Without these new schema, the input message would remain uncertain or equivocal....
>
> Modifier nodes transform input messages but do not add value to these messages. The information potential of an output message is at best equivalent to that of its associated input message. (99-100)

Based on previous discussions, Zmud's characterizations might be made more consistent by eliminating the carrier node—that function is fulfilled by links—and adding a storage node, which Zmud would identify as an "information buffer."

Zmud characterizes the messages that might flow through communication systems as facts, observations, projections, beliefs, opinions, as well as:

- "Guides-for-action represent norms, policies, plans, instructions, rules, or procedures indicating 'what to do' and 'how to do it.'"
- "Score-cards represent measures of task performance—what was accomplished and how well it was accomplished."
- "Triggers-for-action represent signals to commence a certain action."

- "Contexts-for-action represent the provision of data on the nature, history, and objectives that invoke a particular schema for a work situation." (99-100)

Communication technologies in organizations

Everett M. Rogers defines communication technology as:

> ...the hardware equipment, organizational structures, and social values by which individuals collect, process, and exchange information with other individuals. (2)

Further, he quotes McLuhan:

> All communication technology extends the human senses of touching, smelling, tasting, and (especially) hearing and seeing. Such extensions allow an individual to reach out in space and time, and thus obtain information that would not otherwise be available. (Rogers 2)

Rogers recognizes the "digital revolution" that is taking place in communication technology and goes on to enumerate the impacts of inexpensive digital technologies on human communication:

- Communication media allow for greater interaction than has ever before been possible, with the debatable exception of face to face communication. A prime example of this interactivity is the increased flexibility of many-to-many communication. Interaction relies to a great extent on the apparent "human-ness," or behavioral variations resulting from self-knowledge, of participants in the exchange. Increasingly, machines facilitate interaction or have a certain amount of human-ness themselves.
- Control of information flows through communication systems is moving from the producers of messages to the consumers, a process Rogers calls "de-massification." This is a result both of the implementation of different architectures and the declining price of computer technologies.
- New communication technologies allow communication to be asynchronous. The necessity of participants to be proximate to each other—or conversational referents—in time is being eliminated by devices which can "store and forward" large amounts of information at the whim of the user. (4-5)

All media may be described using a set a four characteristics, according to Rice:

- Constraints are inherent characteristics that limit, hinder, or obstruct the freedom of interaction between users.

- [Richness]...is the diversity of cues that a particular medium can transmit.
- Interactivity is the degree to which participants in a communication process have control over, can exchange roles in, their mutual discourse.
- Network factors concern the effect that the pattern of communication has upon the input, conversion, and output of interactions. (66-7)

William R. Johnson, Jr. envisions systems that might be used to move any information, anywhere, at any time. This type of system must provide:

- connectivity
- interoperability
- manageability
- distributed applications and connective services (152).

In light of the capabilities of new communication technologies, the question suggested by Thayer, above, "Who communicates what to whom, when and with what affects," must be amended to include "how." This addition makes the question circular because the answer to "how" will change the answers to the other parts of the question. In order to effectively and efficiently use new communication technologies, organizations must consider:

- The goals they wish to achieve;
- The strategies and tactics that may be used to achieve their goals;
- The tools and means applicable to their strategies and tactics.
- The impact of the technologies on goals and strategies.

The selection and implementation of a communication system requires the organization to understand what needs to be done and what the technology can do. Ronald E. Rice states that,

> [e]stablishing a good fit between media and communication activities requires an understanding of the characteristics of different media, possible interactions among characteristics and activities, and the media usage patterns of information workers. (66)

This requires consideration of technical, economic, satisfaction, political, cultural and cognitive criteria (Rice 70).

Peter Keen maintains that communication technologies were originally implemented to fulfill a basic function—conversation over a distance—and not to achieve any specific goals. At this stage, telephone technology was utilized to support business operations with little or no consideration of the various types of criteria for their implementation—they simply evolved. The technology was not viewed as a strategic factor to the success of an organization. In the next stage, communication technologies evolved to be an internal utility. This was fostered by increasing phone costs, growing competition in communications markets, and the emerging strategic significance of data processing. Today, communication technologies represent a coordinated business resource that is characterized not only by converging systems and distributed processing power, but also by the emergence of communication systems as a key strategic factor. They are increasingly seen as sources of revenue for the organization, rather than operational expenses (Keen 15-20). Browning notes that information systems can be used to boost productivity, gain competitive advantage and improve responsiveness. But, he says these are the ideals, of which the realities often fall short (5). Keen cites four general reasons for contemporary organizations to integrate new communication technologies into their business strategies:

- Operational necessity—to keep up with the basic level of service in one's industry
- Defensive necessity—to protect one's market
- Competitive opportunity—to steal an edge
- Breakaways and preemptive strikes—to change the rules of the games for competitors. (3)

A similar list is offered by Browning, with a slightly more functional perspective. He quotes Venkatraman in describing five stages of adoption:

1. Automating existing jobs…typically to boost productivity…[l]ittle changes but the number of people and the capital costs of doing business.
2. Electronic infrastructure. Islands of functional automation are linked together…. [but] without change there is usually little economic incentive to overcome the inevitable technical incompatibilities and to battle over who does what….
3. Business-process redesign….computers enable things to be done in new and more efficient ways.
4. Business-network redesign. Creating links with suppliers and customers not only creates new opportunities for changing business processes, it also changes the balance of competition.
5. Business-scope redesign. As part of the process of self-improvement, information technology enables some companies to move into new businesses. (1990, 7-8)

The strategic value of information technologies is determined in part by the operations they support. Traditionally, IT has been used tactically, to automate the "back office," tasks such as accounting, payroll and inventory, corresponding to Venkatraman's stages one and two or Keen's "operatational necessity" and "defensive necessity." Much of the emphasis in the re-engineering of corporations has focused on

Venkatraman's stage three and Keen's "competitive opportunity." In these cases, systems that support the "front office," executive decision making, product design, market research. The next step, which is already being taken by a number of innovative companies, is to incorporate information systems into the product itself. Margaret E. Guerin-Calvert and Steven S. Wildman note that this entails using information systems for processing of transactions, facilitating consumer search and evaluation, and product delivery (27). Only in rare cases are these functions, which correspond to Keen's "breakaways and pre-emptive strikes" and Venkatraman's stages four and five, provided by information systems, all three are not.

Another perspective on the functionality of information systems is offered by John Browning, who suggests that information technologies are most effective when they support humans rather then replace them. He suggests that IT best fulfills the functions of:

- Assistants that coordinate activities and control devices or processes;
- Advisers based on artificial intelligence such as expert systems that can provide guidance in making decisions, diagnosing problems, and identifying opportunities;
- Communicators that link together individuals in flexible information flows. (5-6)

More generally, Rice contends that computer-mediated communication systems can serve both as a medium and as content. Communication systems are an innovation that organizations must process, as well as systems which process information about innovation (73). Based on this concept, Rice offers a bi-dimensional model, which correlates processes of input, conversion and output with the two roles of medium and content, as a means of identifying possible uses of computer systems in communication. Under this model, as an example, computer-mediated communication provides information for making decisions more effectively and a means of transforming the organization to operate more effectively (74).

Applying information systems to any segment of an organization's operation may have significant benefits, but possibly the greatest benefits will be had from total integration of all units via information systems. The result of maximizing the strategic potential of communication technologies is a basic transformation in how the organization operates, a process Stan Davis and Bill Davidson call "informationalization." The tactical characteristics of this process are:

- Customized products + rapid response;
- Manufacture at the point of delivery;
- Shrinking overhead, inventory and working capital;
- High service standards;
- Inter-organization bonding;
- Globalization. (13)

Lois R. Bruss and Helene T. Roos offer a strategic triangle as the context for re-engineering business to capture the full benefit of information systems. The triangle "consists of clearly articulated and tightly linked technology strategy, business strategy and organizational change strategy."

Huber maintains that the emergence of such tactical implementations will be evolutionary, rather than resulting from strategic decisions. He feels information systems will most often be deployed to meet operational necessity, i.e. to reduce costs by increasing efficiency or reducing staff. But, in general, "for advancement of their own interests, organizational participants will use advanced information technologies in ways that increase their own effectiveness in fulfilling organizational goals" (244). Huber notes a number of characteristics of information systems that support strategic behavior by allowing users to:

- communicate more easily and less expensively across time and geographic location…
- communicate more rapidly and with greater precision to targeted groups…
- record and index more reliably and inexpensively the content and nature of communication events…
- more selectively control access and participation in a communication event or network…
- store and retrieve large amounts of information more quickly and inexpensively…
- more rapidly and selectively access information created outside the organization…
- more rapidly and accurately combine and reconfigure information so as to create new information…
- more compactly store and quickly use the judgement and decision models developed in the minds of experts, or in the mind of the decision maker, and stored as expert systems or decision models…
- more reliably and inexpensively record and retrieve information about the content and nature of organizational transactions. (241)

These capabilities can be applied to answering the questions Franz F. Selig and Jack T. Nipper lay out for defining business strategies which capitalize on information:

- What information do you have that might benefit your customer or supplier?
- What information does your customer or your supplier have that might benefit you?

- What information does one department of your company have that might benefit another.
- Can you make information more valuable by transforming it in time, format, and ease of use?
- Can you collect new data or aggregate old data in ways that make them more useful? (4)

Browning, quoting Jefferies, suggests the questions may need to be more basic. It is necessary to ask two questions:

> Why should the change be made?
> What is it that must be done to meet the new goals? (11)

Browning also suggests that an important function of information systems is not just to answer questions, but to help users ask better questions. Organizations should use information systems to constantly recreate the fabric of organizational memory. This will be done, he says, by implementing systems that unify all of an organizations functional units, serving as the organization's collective mind, learning as individual members learn, acting in unison with each member's actions (18).

There is some risk involved in deploying systems that are based on the answers to these questions. Sharing and manipulating information will have benefits, but it will also have effects, beneficial and otherwise, which cannot be easily foreseen by designers. First of all, it must be understood that successful implementation of strategic information systems—such as might make use of the Selig and Nippers questions—will have a profound effect on the organization. Therefore, any significant system deployment should be done either in conjunction with a general re-engineering of the organizations systems—as suggested by Bruss and Roos—or with some caution and an understanding of how the organization may be affected.

Sproull and Kiesler point out that communications technologies have both first- and second-level effects. First-level effects are those that are planned and which provide the impetus for implementing the technologies in the first place. These effects can be generalized as either reducing costs or adding value. "Second-level effects…come about primarily because new communication technology leads people to pay attention to different things, have contact with different people, and depend on one another differently" (4). Communication technologies also have a recursive relationship with their users, according to Contractor and Eisenberg: usage shapes functionality as functionality shapes usage. Perceptions of new media, patterns of usage and, by extension, the media themselves develop and are reformulated in sequences, cycles and simultaneously (147-49). This is a process that is profoundly social in nature, and rarely results in the fulfillment of rational expectations (143). Because of the unpredictable nature of how information technologies will function in a particular setting, it is necessary to move from specification and design, to implementation, to testing, usage and improving, back to specification and design, to implementation, etc., (Figure 4) in what Browning calls the "virtuous spiral" (11).

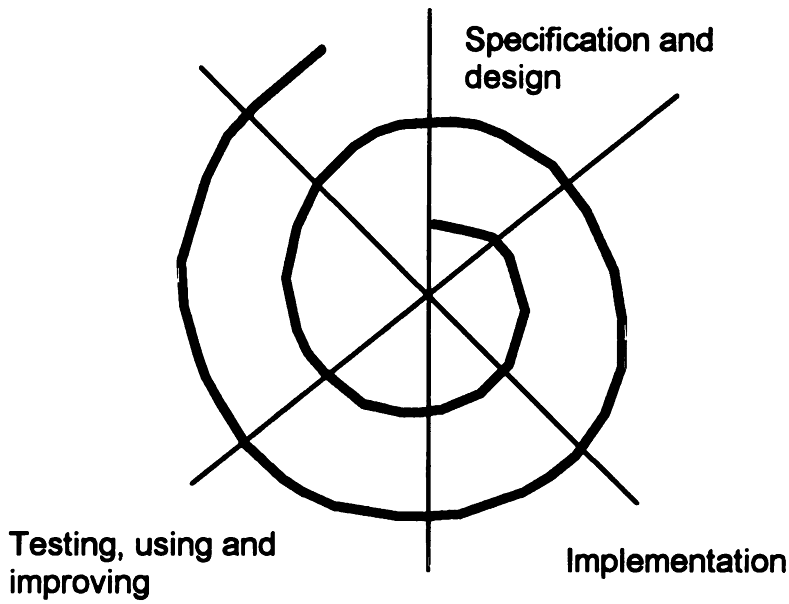

Figure 1. Browning's "Virtuous Spiral"

Huber offers a very powerful—although somewhat complex—model of the impacts of advanced communication technologies decision support systems on organizations. On a subunit level, Huber maintains that these technologies will lead to involving a larger number and variety of people in decision making, even while they reduce the time spent and the number of people involved in face-to-face meetings. Over the height of the organization, he predicts that distribution of authority will become more uniform. Decentralized organizations will become more centralized and the converse will occur in centralized organizations. Also, the number of levels involved in authorizations and message processing will be reduced, along with the number of intermediate human nodes in organizational networks (245-64).

Organizational intelligence and memory, according to Huber's model, will become more efficient and effective. Both short-term and long-term storage will become less expensive and more rapidly accessible, allowing problems and opportunities to be identified and solved or exploited in a much more timely, accurate and comprehensive fashion. In general, higher quality decisions will be made faster (Huber 245-64).

The chain of causality behind these events goes as follows:

- The availability of information technologies will lead to increased usage of those technologies.
- The increased usage of information technologies lead to greater information accessibility.
- Greater information accessibility will cause changes in the function, form and structure of organizations.
- Both the changes in organizations and the greater accessibility of information will drive improvements in the development of organizational intelligence and decision making. (264-5)

Even if the effects of technologies are taken into account, designers must understand that the effects will not be realized if the systems do not gain the general acceptance of the users. Bruss and Roos maintain that not only must the technology be available and the business operations redesigned, but is also necessary to have organizational culture and a level of readiness that will support the change. Senior level support and employee involvement are stressed by both Keen and Bruss an Roos. Both also underscoring the importance of user education, Keen in particular notes that there are three levels to education necessary for user buy-in:

1. Training: How do I use the system?
2. Support: How do I use the system in my work?
3. Education: How do I use it my way, in my job? (235)

An important factor that in both the acceptance of a system and its functionality for the organization is its performance. If the performance does not meet the expectation of the users, they simply will not utilize it to the extent envisioned, if at all. If the performance characteristics do not fully meet the needs of the organization, both initially and after the system is accepted and in full use, the results may range from disappointment to disaster. Then the general guidelines for the system must be set forth based upon the goals that it will be used to accomplished and how it will assist in accomplishing them. From those guidelines performance criteria can be set. Any configuration or system that falls outside of these factors would be immediately eliminated from consideration. Some of the factors that must be considered are:

- Reliability - If an information system is to be used for mission critical operations, it must be available and operating when it is needed. Some applications have sporadic or constant usage patterns that require the system to be up and running always. Getting this level of reliability may be very expensive.
- Capacity - Transmission, processing and storage capacity are vital considerations for any system. Once the system has been implemented even marginal performance gains over previous systems may result in unprecedented amounts of usage. The capacity of the system must be carefully considered, and there should be contingency or upgrade plans in the event of over utilization.
- Ease of operation - The system should be well-suited to the task. Factors in the work environment and those dictated by the type and amount of use must be considered. Also, the operational literacy of the user must be taken into account, especially if the customer will be the operator. Educating users can be very expensive and is of paramount importance to system acceptance.
- Flexibility - The system may need to support a variety of tasks or applications. Typically, a system that does many things, does not do any of them as well as a system that performs only limited functions.
- Interoperability - Communication and information systems may add the most value through the ability to share tasks and data. This is especially true when considering several dedicated systems rather than a single, flexible system.

Any system will need to be managed and maintained. While this may seem like a foregone conclusion, compromises in the manageability of the system can adversely impact its performance and contribution to the bottom line.

- Maintenance - If the system fails it must be easily repairable, ideally without any noticeable effects on the users. Maintenance features include automated fault management and correction, operator notification, multi-level alarms and fault diagnosis.

- Management - Changes, upgrades and moves should be able to be made with minimal impact on performance.
- Accounting - System usage must be tracked. This may only serve the purpose of verifying service provider billing, but it may also be used to monitor productivity, charge usage back to subunits or individuals, or to bill customers.
- Modularity - A system which is composed of well engineered modules is more flexible, expandable, reliable and economic. Upgrades and repairs can be accomplished by switching out components. The components may be sold competitively by several vendors, giving the manager greater choice in both component quality and cost.

ENTERPRISE NETWORKS

Enterprise-wide computer networks—or simply enterprise networks—are the result of on-going efforts by organizations to integrate the various, often dissimilar information systems of their functional units. The impetuses for this trend are to:

- share resources such as programs, data and equipment regardless of geographic location;
- increase information system reliability with duplicate files and redundant processors;
- Save money with the better price/performance ratio of small computers. (Tanenbaum 3)

Enterprise networking is not a "technology" or type of information system, rather it is a general term for the complex form of communication system that emerges when all of the information resources used by an organization are combined as a greater whole. We have seen how information systems influence and interact with goal-oriented social systems. By examining the components, processes, and operation of an enterprise network, we will develop a network model that might be applied on a larger scale, to community, the "social meta-system."

The Function of Networks

In the average office, the computer network functions on numerous levels. It connects the computers together, it carries e-mail messages, it allows the CEO to track production and sales. Networks are complex and dynamic systems which are closely linked to the culture and economy of an organization. A computer network can reveal a lot about an organization just as Rogers and Rogers, quoted above, say an organizational chart can. How hardware and software resources are allocated says nearly as much about organizational goals and values as the use of real estate, personnel, or fuel. When organizational functions are automated, eliminated, or created using information technology, that organization is making a statement about and selecting a determinant of its structure, form, and function. The classic challenge for implementers of computer networks has been to build a system that is both true to and positive for the organization.

So what basic function is both true about and positive for all businesses? Cost reduction. Organizations must maintain a positive difference between inputs and outputs, i. e., income must exceed expense. Not maintaining this excess value will eventually (the U. S. national debt notwithstanding) lead to system failure. Networked micro-computers have provided the greatest cost saving by allowing organizations to move away from monolithic, "legacy" information systems—mini- and mainframe computers.

The first generation of business computer applications eliminated armies of bookkeepers and clerks, by performing accounting functions much faster and with greater accuracy than a human could. Ironically, the centralized computing paradigm, and the mainframe/mini with it, was replaced in much the same way by networks. Beginning in the late nineteen-eighties, firms began to realize that the personal computers (PC) that they were using for clerical functions such as typing letters or creating simple spreadsheets, could be interconnected and used for enterprise-wide accounting and coordination, eliminating the need for a mainframe (Herb Brody; Bill Musgrave; G. Hunter Jones; Bill Machrone; Marc Kustoff, et. al.). The process of replacing mainframe applications with network services, which is generally known as "downsizing," allows organizations to eliminate regular software fees and hardware payments, high-paid technology specialist positions, and exorbitant power bills (Machrone; Jim Seymour; John Gantz). During the early nineteen-nineties large organizations in finance (Evan I. Schwartz; Alice LaPlante; Jean S. Bozman, "Mainframe-to-PC LAN shift taking hold"), law (Kim S. Nash), government (Christopher Lindquist), medical (Kirk Johnson), utility (W. E. Delcomyn), retail (Kathleen O'Malley) and manufacturing (Michael Fitzgerald, Susan R. Nykamp) made the transition from closed, proprietary legacy systems to integrated, networked, enterprise-wide systems (Paul Pinella; Gantz; Laurie Flynn; Bozman, "Bank of America tests downsizing: moves host apps to PC LANs across 11 states").

Micro-computers can save costs in the same way as their larger counterparts do—by replacing human workers—but in the smaller organizations that were unable to justify a mainframe, the micro-computer did not supplant secretaries, clerks, and bookkeepers, it supplemented them: thus the term "personal computer." Networking saved costs for personal computers by allowing the sharing of expensive resources such as printers and disk drives (Cheryl Spencer; Donald J. Little). Networking had one other important cost function: just as it distributes processing in a technical sense, it also distributes costs. The cost of personal computer networks can be easily assigned to specific departments, business processes, and individual personnel (Musgrave, Kustoff).

This is not to say that personal computing and enterprise networking are inexpensive or easy. Achieving ideals for an information system laid out in the previous chapter will be costly no matter what form the system takes. It took some three or four years for the networking technology to mature in the late nineteen-eighties and early nineties, building a LAN could be an expensive and problematic proposition (Musgrave; Seymour; Frank Blau; Mark Schlack). In general, PCs and networks provided a much better price/performance point than mainframes (Pinella; Gantz; Flynn; Bozman, "Mainframe-to-PC LAN shift taking hold"), and the performance and prices of network systems are continually improving. Networks have also become a means of synergistically combining personal and mainframe computers, preserving the value of the legacy (Joe Vincent; David Hughes), and proving to be very cost-effective overall (Lynda Radosevich).

In general terms, information systems function to reduce the costs of searches and transactions. Locating resources is in itself a process that uses other resources. By making resources more available, easier to locate and identify, information systems reduce search costs. Capturing the value of resources is also a process that uses other resources. By facilitating the coordination, tracking, and control of activities, information systems reduce transaction costs. Network systems also facilitate cost control because they can be implemented in phases or incrementally, and costs can be distributed or imputed to more fully. Because network functionality comes in smaller units (i. e., *micro*-computers), and these smaller units can be flexibly combined, the scale and scope of a network system are easier to alter than in legacy systems. Usage of network resouces can be completely logged and charged to user, department, or project accounts. This level of cost control keeps networks tied very closely to demand for an organization's product, the cost of production, and cost justification, i. e., if a car parts distributor has seen steadily, but slowly increasing business, its management can flexibly add workstations, printers, etc., as needed, for a resonably modest cost. If business suddenly booms, the entire system can be supplemented just as easily.

Production is, of course, a general process that is vital to any organization. One of the major reasons for deploying LANs is the boost in productivity that can be accomplished through an effective implementation of information technology. As networking emerged in the late eighties, professional publications and pundits evangelized the technonology (Latamore, Little). And as the business world began climbing up the networking learning curve, many specific examples of impressive gains appeared. Firms such as K-Mart (O'Malley), Allen-Bradley (Nykamp), Lloyd's of London (Boris Sedacca), and Celestial Seasonings, Inc (Michael Fitzgerald) found that networking allowed for better coordination and control. Similar results have been identified by academic researchers such as Sproull and Kiesler, Peters, Drucker, and Keen.[1] What this range of sources shows is that the productive benefits of networked computer systems are, not surprisingly, primarily captured by knowledge workers: managers, clerks, secretaries, agents, designers, authors, etc. But we also see second level contributions to the less ethereal forms of production. Manufacturing processes can be tuned or completely redesigned to improve economy or quality based upon accounting and analysis performed by using information systems. Production can be better tracked and coordinated in order to reduce duplication or unproductive time.

The general function of supporting productivity has most recently spawned two market trends: groupware and remote connectivity. Groupware is a form of computing that is focused on supporting the operation of teams or "flat" organizations. It is particularly well-suited to synthesizing inputs from and coordinating the activities of disparate (either physically or logically) organizations. It functions to allow users to manipulate the components, processes and relations of a software environment that is analogous to their organization's memory, sources, sinks, and processes. The goal is for the participants/users to become highly integrated with the organization, to develop an in-depth familiarity with the organization's form, and to be able to react effectively and quickly to changes such as new opportunities or dangers (Paul Bernstein; Michael Miley).

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[1] See the third chapter, "Enterprises," above

The same concept underlies remote connectivity, which may be seen as the structural component that underlays groupware and similar forms of information systems. Remote connectivity is simply the ability to extend the reach, or the scale, of a computer network, and points out the contribution networking makes to distributive processes. It allows geographically separate LANs or individual users to be linked together as a wide-area network, or WAN. Remote connectivity boosts productivity in two ways, both of which increase the availability and the flexible allocation of resources. First of all, it makes information available where it is needed—on a construction site, sales meeting, car wreck, or battlefield—when it is needed. Secondly, it allows personnel to remain closely linked to the organization even when they are in different locations for extended periods.

Networks generally function to make an organization more productive through coordination based on highly accurate and timely information, by handling a greater amount of information that can be used to tailor a product or service to more fully defined markets, and by pooling knowledge resources—e. g., people—regardless of geographic location. Information systems allow organizations to respond more quickly and fully to their environment by:

1. facilitating the collection of data,
2. the compilation of data into information,
3. the synthesis of information into knowledge, and
4. the application of knowledge through action.

Implicit in the function of processing of data into action are "networks of causal relations, including closed-loop 'feedbacks,'" that are so vital to goal-orientation. In contrast with mainframes, networking realizes this concept in distributed structure, which can be flexibly reformulated and applied to opportunities or problems, at any one of these four stages, and then can be quickly re-allocated to another aspect or different problem. As a result, networks are well-suited to informal or unstructured processes, and for allowing those processes to become more or less defined as required by any particular situation.

In turbulent environments reactive strategies are typically ineffective because, by the time a system can react, what it was reacting to has gone or been transformed. Environments which undergo frequent, rapid or chaotic change call for a proactive strategy, a strategy that is exemplified by innovative behavior. It is this type of behavior that is best facilitated by flexible, informal, and relatively unstructured communication processes and relationships. If we remember our discussion of the enterprise social networks in chapter three—particularly the examination of communication technology's significance for organizations—we see how information technology provided the greatest value when used to integrate the various departments, operations or constituencies in an organization. A highly integrated organization will involve more people in decision making, distribute authority more uniformly, reduce the resources needed to turn information into action, and be generally efficient and effective in identifying problems and opportunties, and at resolving or exploiting the situation. To restate Huber's assertion: a well-implemented enterprise-wide network will allow higher quality decisions to be made faster (245-64).

The contemporary concept of innovation as verbalized by progressive businesspersons and academics can be metaphorically—and sometimes literally—characterized as a process of "changing the rules" (Changin the Rules; Keen; Drucker; Peters). At the heart of this process is empowering an organization to drive the market, rather than being driven by it, not through monopoly or cartel, but through continual re-invention and strategic redefinition of the organization itself. While such an organizational state may be undesirable in all but the most turbulent of environments, organizational innovation is an important process. Whether a hospital needs to redefine its operations to provide medical services in the suburbs (Kirk Johnson), a university is attempting to change where and how students can work on their degrees (Jon Nordheimer; Denis Newman), or a publication wishes to find new ways to reach its readers (Hugh Morgan; Deirdre Carmody), networking functions to support innovation.

Innovation is associated with computer networks in multiple, intermeshed ways. First of all, as discussed above, computer networks lend themselves to the specific innovations in production and distribution, such as on-line shopping, distance learning, or mass-customization. More generally, networks support the types of organizations that are best at being innovative, well-suited to operating in turbulent environments: diverse, team-based, flat and unhindered by geography. Lastly, networking is itself an innovation with which organizations must deal. Building an effective network necessarily means formalizing organizational information flows; adopting new work habits, new customs and conventions, and even new personnel and roles.

Network forms

Networking has four forms, or technology paradigms, including "sneaker net." These forms dictate the ways in which information may be processed and applied. They are:

Stand-alone, or sneaker-net - Even if a group of computer users are not physically interconnected, they can still share information by writing it onto some interchange media such as diskettes, or paper, or by spoken word. In this form, individual performance and functions are defined by each user, but the ability to capture benefits from rapid or flexible interaction is rather limited because there is no network through which they might arise.

Terminal/host - All processing and storage is performed by a central computer, or host. Information is entered and displayed on terminals or printers. In this form, the capacity, performance, and functions of the system are centrally defined. There is no need for processing or storage at the periphery. Individual users have little or no control over what what the system does or how it does it. This form captures network economies to a limited extent, because it does not allow for process or functional change to be initiated quickly or flexibly: it must occur system-wide and all at once, or not at all. Terminal/host are not strictly speaking "networked" and do not provide all the functionality of a network, but they do represent the precursor to networking and can operate over a network infrastructure.

Client/server - All components of the network provide processing, storage, and input/output, but do so within two general roles. A server provides specific, well-defined services that may be applied to a range of processes or types of information. Clients on the other hand, may flexibly use these services either by using multiple services or using a single service for several purposes. In this form, processes and units of information are located on particular servers and client computers. Major changes in or new forms of services must be initiated at the center of the network, but new ways of using services and the adoption of new services are defined at the periphery.

Peer-to-peer - In this form there is no center or periphery of the network. As in a sneaker-net, performance and functionality are defined by each user, but local definitions are intimately interrelated with system-wide definitions. Processes and storage may be fully distributed across the network, e. g., when you access a body of information, the data from which it is composed may exist on various computers and the process of creating it may be flexibly carried out similarly.

What this taxonomy of network forms shows is a progression in the integration of the devices on a network and the network itself. On the lower end of network functionality, under the standalone or terminal/host forms, changes in the needs of the end-user have little effect on the overall system. Indeed, the host/terminal form is designed to meet very specific needs of a meta-user: the organization. This form can be effective for organizations because all of their personnel are working—consciously or otherwise—

toward a set of well-defined goals, within a set a well-defined roles. Mainframe-based host systems can process large amounts of data, but also run complex programs that cannot be easily or flexibly changed to meet the needs of organizational subunits.

Networks, on the other hand, because they are made up of relatively small, standardized components and tie together systems that are on average of much more modest means than a mainframe, can be built incrementally, flexibly and minimal corporate oversight. Many LANs have evolved in this way: a department hooks its computers together to share a printer and to facilitate moving files between computers, a division ties all of its departments together so its managers can better track and coordinate the activities of the various departments, corporate executives see that all the littles LANs are getting out of hand both technically and financially, and that they can better control costs and capture additional benefits by interconnecting all of the divisional and departmental LANs as well as stand-alone computers.

As much as network form is conceptually defined by the processing power and interconnection of a network's components, so is it practically defined by the types of software that run across it or make use of resources through it. There are numerous forms of software, including:

- Operating system (OS) - The OS defines the basic processes that go on inside a computer. They also include higher level functions for identifying and accessing units of information.

- Network operating system (NOS) - Much as an OS defines the information process within a computer, a NOS defines how a computer takes part in information processes that occur across the network.

- Applications or programs - Applications are units of information that interpret other units—called files or documents—of information, and what operations or processes might be carried on those files. There are both general and specific types of applications; examples of these are listed in table x. It should be noted that such a typology is deceiving because specific applications often have the characteristics of various general types.

- Documents or files - Files are units of information that are recognized by an operating system, and documents are files that are associated with a specific application.

Table 1. Examples of general types and specific computer applications.

Type of application	Specific applications
Word processor	Microsoft Word, WordPerfect, Claris MacWrite, Lotus AmiPro
Spreadsheet	Lotus 1-2-3, Microsoft Excel, Quattro Pro
Desktop publishing	Quark Xpress, Aldus PageMaker, TypeStyler, Print Shop
Computer-aided Design	Autodesk AutoCAD, Microstation, MicroCAD
Database management	Sybase, Paradox, Microsoft Access

Software facilitates various processes: filing, data management, production, viewing, development, messaging, and recreation. Filing functions are typically integrated with a computer's operating system (OS), and the specific operation and the syntax of the filing system is determined by the OS. Today, OSs typically include the ability to use the network as an extension of the filing system. More and more OSs are opening their filing systems to provide hooks into other OSs and their filing systems, so that computers running Macintosh, Windows, or Unix operating systems may share storage space through the network. A network directory is evolving into a list of the network's users and resources in a structure that is similar to that of a computer filing system. While the OS takes care of things like computer and file locations and names, the specific funtionality of a system—the tasks for which it can be used or how it might be applied—are determined by programs and applications.

Data processing applications support the data entry into, processing and storage of, and information retrieval from databases. Data processing software, including database managers, spreadsheets, accounting packages, etc., is used primarily for structuring and inter-relating data so that it may be interpreted, and used to guide actions. Computer-based production processes pieces of information into files which will be converted into real products: a report, newspaper, letter, or blueprint. Production as a general form encompasses word processing, desktop publishing, report generation and other specific forms of production. The logical counterpart to the production of files is the viewing of those files.

Typically, files and documents are viewed with the same application with which they were created. A new class of software is evolving that allows users to view files regardless of the application that was used to make them. Development is similar to production, except that the development process produces interactive computer programs. Until the late eighties, "development software" was synonymous with "programming language." A trend towards more open, comprehensible, and useable development tools has resulted in the development of multimedia authoring programs, many of which can be practically used by a novice. Recreation is not a process that is typically important to the organization as a whole, but with the tendency of some workers to goof off, either by playing a game of Solitare or with a mult-user Doom session, it is a process that can have a significant impact on an organization. By definition, recreation software doesn't have any productive result other than the amusement of its users, which may be counter-productive for the organization as a whole.

Messaging allows for writing, sending and receiving messages, including files and programs, and is the only computing process that requires a network. As a matter of fact, low level messaging is a central process in NOSs. The functioning e-mail, file transfers, and other types of higher level messaging is dependent on the lower level messaging operations carried out by the network. Of course, other forms of applications can make use of the network in much the same way as filing systems do. Client/server and peer-to-peer networks allow applications to have hooks into data on, or the processing capacity of, other computers.

A relatively new type of software called groupware is further defining the form of network systems. Groupware emerged in the early nineties. Like messaging groupware is necessarily linked with networks, but unlike messaging it provides a synthesis of higher level functionality that enables an enterprise to flexibly access and allocate its knowledge resources. Rather than focus on processes such as production, development, or data processing, groupware integrates some of the functional characteristics of these processes into the process of coordination, and focuses on supporting, automating and innovating the internal workings of the organization as well as its external functions (Miley, Zmud, Srpoull and Kiesler).

The final, and possibly most significant, formal aspect of computer systems—and networks by extension—is the user interface, which determines how information is displayed on, and how a user may interact with, the computer. It is through the interface that the user builds a concept or cognitive picture of an information system. The major innovation in user interfaces has been the move away from text-only displays and command lines interfaces toward graphical interfaces and WYSIWYG (what-you-see-is-what-you-get) displays. This innovation also included the introduction of pointing devices, such as the mouse, that allow users to physically select and manipulate information. The graphical user interface (GUI) has revolutionized computer applications by revolutionizing how users understand and interact with the information system. Typically, GUIs use real-world metaphors for the computing environment, relating applications to tools, and files to things. Another strength of GUIs is that they can guide user interaction with on-screen prompts that have both implicit and explicit meaning: a storage device may be represented as a filing cabinet, and may even have a sign attached to it saying, "put your files here."

The users of a network and the organization itself are aspects of a network's form. More than any other aspect, how people use an information system determines its functionality. Even if a system is designed to operate a certain way, users may well use it in other ways, for different functions. This fact takes us back to a number of the points made above, about how enterprises use information systems. Systems cannot simply be dropped into an organization, design and implementation must be followed by assessment, redesign, modification, and reassessment as needed to most effectively meet organizational goals and capitalize on user habits. One way to facilitate the "virtuous spiral" of system implementation is to make it flexible and scalable, creating a system architecture that responds to the demands, interests or needs of its constituents and components. User education is also an important part of implementing a network. The entire premise of a computer network is to empower an organization to interact more efficiently and effectively with its environment. The members of an organization must be able to use the system optimally, must be able to make it conform to their way of doing their jobs, in order to fully capture the benefits of networking. The form of a network, like that of any system, must change to fit its environment, and users are a major element in the network's environment

Network structure

Enterprise networking has been evolving incrementally ever since micro-computers made their way into the corporate environment. But it can be an emergent phenomenon, can coalesce out of several unrelated devices simply by adding a resource that they all need. One of the primary characteristics of enterprise networking is that it can be, and often is, developed from the bottom up. Two workers in the same office may need to share resources so they connect their machines together. Then others in the office add connections, until the whole office can share the resources via a LAN. A gateway to the mainframe or mini-computer is added to the LAN. Other offices or departments that have also been internally networked, might then interconnect with the first. And so an enterprise network grows. This is a generalization of the situation, but that is in part due to a second characteristic of enterprise networks: they evolve along many different paths and take many different forms. Indeed, enterprise networks are nearly as varied as the situations in which they are implemented. Each organization has different communication needs, technology strategies and different mixes of information systems.

Another characteristic of all enterprise networks, associated with their incremental growth, is the distribution of processing and storage throughout the network. Rather than consisting of dumb terminals that rely on centralized processing facilities, enterprise networks are built in large part on powerful personal computers, workstations and numerous, small-scale input, output, routing and storage devices. All of these devices are segmented into either physical or logical zones that can—ideally—be managed, maintained or reconfigured separately, without affecting other parts of the network. These devices are software as much as hardware and the digital revolution is leading to new ways of defining and interconnecting software devices, i.e., distributed object computing.

One practical result of distributing processing power throughout the network is that costs are also distributed. The cost of the network is only marginally more than the computers and other hardware that it interconnects. Micro-computers are not only relatively inexpensive stand-alone appliances, but they may be purchased and configured independently and then integrated into the network when necessary. The common equipment that supports the network's operation is reasonably inexpensive, is becoming both less expensive and more powerful, and its cost may be shared among all network users. For instance, an application that is used by all members of a group may be centralized, saving the cost of licensing it for all workstations.

The defining concepts for enterprise networks are "openness" and "connectivity." The emergence of micro-computers and the need to share resources between disparate systems contributed to an on-going process of standardization in the computer industry. The ideal goal of this process is to define a standard for "open systems" that allows computer systems—even if they are based on proprietary technologies—to be easily interconnected and to share data input, output, storage and processing. To accomplish transparent connectivity, hardware and software functions are defined in suites of protocols (Figure 2). Each protocol layer in a suite is functionally separate from the other layers of the suite. A layer defines certain functions that may be fulfilled by any number of technologies. It sends data to and receives data from the layers immediately above and below it, but it "knows" nothing of those layers, it only knows how to process the data in very specific ways and then to pass it on. Just as the layers of a protocol stack don't need to be aware of each other, so it is that users, operating at the top of the suite, don't need to be aware of the protocols that make data available to them. Indeed, the whole idea of a protocol suite is to take low-level details such as bit sequencing and session naming off of the mind of the user, to totally eliminate any work that is external to the task they need to accomplish, to make the computer and the network disappear. The network provides either a shared set of protocols for all devices, or a means of translating one protocol into another.

	OSI	SNA (IBM)	TCP/IP (Internet)	NetWare (Novell)
	Application	End User	Application	Application
Operation	Presentation	NAU Service Management	Transport	Service Protocol
	Session	Data Flow Control		
Transmission	Transport	Transmission Control		Communication Protocol
	Network	Path Control	Internet	
Connection	Data Link	Data Link Control	Network Interface	Link Support Driver
	Physical	Physical	Physical	Hardware

Figure 2. A general comparison of network protocol suite reference models

The lowest level of a protocol suite defines the physical connection between the network and the devices it interconnects, the basic network infrastructure. Things such as cabling, connectors, voltage levels, data carrier encoding, etc. are defined by physical layer protocols. Often physical protocols are closely associated with data link or interface layer protocols, which set out the traffic laws for accessing the network. The data link layer is often subdivided into two layers. In particular, the Institute of Electronic and Electrical Engineers (IEEE), which publishes the most widely implemented physical and data link protocols, defines a lower level media access control (MAC) protocol and an upper portion, the logical link control (LLC) protocol. The physical and data link protocols are the primary determinants of the data carrying capacity of a network.

Local area networks (LANs) can be distinguished as either being shared access or switched. Additionally switched networks can be circuit switched or packet switched. In shared access MAC protocols such as ethernet and token ring, all devices on a segment of a network see all the data on that segment. They simply watch the traffic, waiting for a packet that is addressed to them and ignoring any that is not. LANs contain traffic on segments and subnets. Segments are interconnected through bridges, which can only process the MAC address information at the head of each data packet. A bridge knows what MAC addresses are on either side of it, simply forwards or stops packets from passing to each segment based on that information.

A recent development in data link protocols is the point-to-point protocol (PPP) for interconnecting devices through the telephone network. Before the development of PPP in the early nineties, serial connections between computers through modems and over the telephone network only allowed for character-based links. PPP defines packet-based serial connections, and can be used through analog or digital modems, across analog or digital lines. A character-based connection was fine for text-only applications, when linking a terminal to a host. Packetizing the data makes not only for more effective transimion of non-textual data, but it also makes transmission more efficient. Lastly, PPP is well integrated with network layer protocols, consequently its operation is almost transparent to the end user.

Routers understand network layer protocols, as well as data link information. Network protocols, the most common of which are internetwork packet exchange (IPX), internetwork protocol (IP), and LocalTalk,[2] define how the network is subdivided and how traffic moves between these subnetworks. Just as there are hardware addresses for the MAC layer, there are software addresses at the network layer. Unlike MAC addresses though, network addresses can be set dynamically and designate a logical grouping. Network protocols can operate over most any MAC protocol, e. g. IP works over ethernet, token ring, or PPP, as do IPX and AppleTalk. Routers are devices that move traffic based upon their network protocol information, and are used to create large, logical internetworks out of smaller, physical local networks. Often, the various physical networks are interconnected through a backbone. The actually

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[2]IPX and LocalTalk are proprietary protocols defined, respectively, by the Novell and Apple corporations.

backbone may be a high-speed LAN, a router or a packet switch, and functions as a center of the network in which traffic is concentrated on its way from one subnetwork to another.

Just as physical and MAC protocols are closely related, so are network and transport layer protocols. Transport protocols define the interconnection of processes between communicating devices, basically setting up and managing the flow of data between the devices. Typically, network services, which operate at the session layer, are closely linked to transport and internetwork protocols, too. The functions at the top of the suite, application and presentation, are standardized by operating system, and are typically totally independent of the lower layer protocols. Applications are the primary consumers of network bandwidth, and applications seldom use network capacity conservatively because they are not designed to be aware of or compensate for available capacity. The exception to this generalization is the TCP/IP protocol suite. This suite, which is commonly referred to as the Internet protocols, or just IP, extends the functionality of the network up to the application layer with protocols for messaging, file transfer, terminal emulation, and hypertext links.

The IP application protocols are notable in that they are standards for applications which are freely published and distributed, but they are not applications. The application protocols define how to implement and manage the formal aspects of the network, but they are not the programs that assume those aspects. They describe functions, but they don't actually perform them. This means that any one can write applications that adhere to the IP protocols, and all such applications will interoperate. It is also important to point out that many IP protocols implement a client/server architecture makes efficient use of network bandwidth.

In a true enterprise-wide network all personnel who have any type of information dependency in their job have access to a computer, even if it is just a shared workstation that they use to access e-mail. Although computer usage may be concentrated in management, clerical or creative professions, computers are distributed throughout the organization. Mission-critical and large-scale services are provided centrally, while lower-level services for printing or sharing files are usually provided departmentally or by geographic location.

The resources required to build, maintain, and operate the network infrastructure and central services come out of the organization general budget, or from a budget for information systems. Divisions of the organization that have their own information systems may purchase resources for them on the open market and/or through a corporate information services (IS) division. Likewise, the costs of the network infrastructure and central services may be imputed to divisions that use them by the IS department or chief financial officer. The costs of the network are recouped through the benefits provided by networking at corporate, departmental and personal levels.

Information services departments implement and operate the network, hosts, terminals, clients, and servers. The duties of corporate IS departments include, but are by no means limited to, installing operating system and application software, controlling access and security, training users, evaluating products and services, and troubleshootng network faults. Some organizaitons have departmental technical specialists or system administrators, especially if they have their own server, but major changes or improvements are handled by a centralized group of network engineers. While the functions, components, and costs of a network are distributed throughout the organization, the responsibility to designing, purchasing, building, running, and managing the network are generally centralized.

THE NETWORK MODEL

We have examined communities, enterprises, and enterprise networks as systems, as having functions for their constituents or users, forms through which they interact with the environment in order to meet their functions, and structures consisting of components and processes operating in support of form. Now our task is to use these concepts as guidelines for developing a model of a public information systems that are effective, efficient, and equitable. To demonstrate this model we will turn back to our referent city, Chattanooga.

A community is a social meta-system, which is composed relational systems such as commerce, education, and law. A business such as a bookstore or a school is also a social system. Commercial enterprises are systems that are nested within a larger economic system, which in turn overlaps with other relational systems. To extend this analysis, computers and networks are information systems that support the operation and facilitate the functioning of organizations. A clerk at the bookstore uses the cash register to record a purchase by a teacher for her class. The cash register is a computer that tracks the day's sales, sending the data to an inventory system, which consequently produces an order to replenish the stock books. While this accounting system simply automates transactions, it could be adapted to helping shoppers find the books they need, or to processing transactions automatically, both of which would make the store more productive. The store could set up a service that not only helps clients locate books and has the books delivered to them, but also allows local authors to distribute their work, provides reviews, and announces literary events. An electronic bulletin board system (BBS)—a dial-up terminal/host system—could provide these services inexpensively, but this change represents a significant innovation for the store.

An innovation is not simply an internal change such as cutting costs or boosting production, it changes the form of the organization and how it interacts with the its environment. In other words, the "virtual" bookstore functions in a way that is different from its real counterpart. If this form meets a need or serves a purpose in the community that generates more income for the bookstore than what it costs them to keep up the system, then it will most likely persist. But in order for the innovation to succeed the community must react positively to it and adopt it; the innovation must diffuse out into the environment, the community. The teacher would need to have a computer and a modem at home and/or at school, some training in using the software, and some willingness to use a computer in order to use the system.

Even if the bookstore is a wonderful store, with a great selection, and helpful staff, and even if they do an excellent job setting up, publicizing and running the BBS, few of its clients are likely to go out of their way to use the system. Customers that have and know how use the necessary hardware and software may use it some, but probably not enough to generate significant cash flow. Even if the BBS reduced the cost or improved the productivity of handling these clients, it probably wouldn't be a justifiable investment for the store.

The clientele can expand either by having more local users or by expanding its geographic scope. While the latter might be viable it would require more capital and a place the bookstore in a competitive market dominated by catalogs. Having more local users can only occur if the individuals, families and businesses change their information seeking behavior and begin to use computers more. Rationally, this will occur when the perceived benefits of using the computer exceeds the barriers to using it. And these barriers are more than buying the computer, setting it up, and learning to use it. Just turning it on and waiting for it to boot can be significant barriers to adoption. So, we see that basic economics hold true, and that in order to prosper the network model must:

- optimize the benefits provided to the community and constituents, and
- lower the barriers to and cost of usage.

An information system benefits an organization by lower its costs, boosting productivity, and facilitating innovation. I think its safe to say that most members of the Chattanooga community would like to be able to live for less, get more done, and make more opportunities for themselves. These are, of course, the very functions of an information system: reduce costs, boost productivity, and facilitate innovation. Organizations capture these benefits effectively because they are goal-oriented and are predicated on economically producing a good or service. This also holds true for both commercial and institutional organizations. Even relational systems such as education, religion, and politics must bring in at least as many resources as they expend in fulfilling their functions. Indeed, this even holds true for the family and individual. If families don't keep income above expense, they go into debt and eventually insolvency, just as an organization would. But, society cannot afford to let people die as it can with most organizations, so these people slip into poverty and the cost of supporting them is transferred to the community.

Clearly, a community network based upon our model must have a real impact of the cost of living and the quality of life in a community. Costs of living are attributable to food, clothing, health, housing, transportation, education, recreation, and entertainment. How can a network reduce these costs? Well, costs to the consumer are set in part by what it costs a firm or organization to provide a products and services. A network could lower what people pay for goods and services by reducing the cost of production, marketing and distribution for the retailer. The consumer also has search and transaction costs that are exemplified by such things as driving around town looking for a the right swim suit, or having to pay for a bounced check because a bank deposit wasn't made in time. A swim suit isn't something you'd want to purchase without trying on, but it would be nice to know which stores are most likely to have a swim suit you'd like. Descriptive listings of items such as bathing suits it something that is handle well by information systems, so in this way a computer network might reduce search costs.

An information system may allow a person to electronically make deposits and check an account balance, thereby avoiding fees of bouncing a check, but there are number of other transaction costs that networks might reduce. These are the costs that are caused by taking on roles in various systems or taking on multiple roles within a systems. These costs are exemplified by driving to work, participating in a PTA meeting, leaving the office to vote, heating and cooling the house, being burglarized, or moving to be near a better school. Networking minimizes these costs by supporting telecommuting, on-line conferencing, electronic voting, home telemetrics, computer-assisted surveillance, and distance learning. Any one of these services probably wouldn't prompt the widespread adoption of community networking.

These applications can also increase a family's "productivity." Under a functional implementation of the network model, a woman can meet with clients, check on the status of a project, schedule a dental appointment, coordinate preparations for her church's summer bible camp, participate in a lesson at her son's school, and automatically alert the gas company that there's a leak in the basement, all within the course of a day, while spending time at home with her infant daughter. The network supports these activities by providing access to distributed resources and multiple processes within a single system. The network allows the mother to interact more effectively and efficiently with her environment. Through the network she can participate in multiple relational systems, go from one role to another more rapidly and with less trouble, and even get guidance on the systems of values and customs associated with them.

Finally, a network should enable a community and its constituents to be able to innovate more easily. It is interesting to note that what we have described as a healthy community is structurally similar to enterprises that are good at innovating: diverse, organizationally flat, actively seeking opportunities for improvement. Networks support these organizations by capturing synergies among groups with different skills, experiences, and values, by automating the coordination and accounting functions performed by middle managers and bureaucrats, and by allowing the organizations to examine themselves and their environment from multiple vantage points and perspectives. Through a community network that fits our model, a barber who hears a rumor about a plan to widen the street outside his shop, can check its veracity through government records, assess its impact on his business, and express his support or opposition easily and effectively. Or a group that wishes to promote natural conservation by attracting eco-tourism can organize, publicize its views, recruit visitors, work with land owners, and document and share its activities, successes, and problems all through a network, and in theory without ever having a face to face meeting. This type of network will allow members of a community to locate persons with like interests, work and play together, and economically share resources. By no means would all of these activities take place on the network, rather it would add value to and formalize activities that already take place in the community, and facilitate the initiation of new activities. As noted above, a computer network does not function optimally by supplanting existing forms of interaction, but by supplementing and enhancing them.

†The key to the value of a network, even more so than many other technological innovations, is dependent on the number and type of persons or systems that have adopted it. Network economies are

derived from having easy access to multiple and varied resources, with the cost of access shared among numerous users. In other words, the cost per user and functionality of a network are directly correlated to the number of users it has: each user adds value and reduces cost for each other user. There is a critical mass of network users that must exist in order for the network to create more value than it consumes and for it to persist as a functional information system. It is the synergy of a whole range of dynamic services that can flexibly change to meet the needs of the market, the community, the users, that would take a network to the critical mass of usage required to make it a sustainable innovation.

Interestingly, in order for a community network to reach and maintain a critical mass of users it must use processes that parallel those of a community: recruitment, socialization and social control. In order for a community network to succeed it must operate as a relation system. A community network would be a particular form of relation system though. It would be one that formalizes the interaction of traditional relational systems. In order to be successful, a community network must supplement and enhance political, economic, and religious systems by providing linkages between them, rather than supplant and replace them. A community network can be generally defined as a relational system that reduces the cost and increases the benefit of interaction between other relational systems, their component organizations, and the individual constituents of a community.

So we see how a network could function to reduce costs, boost productivity and foster innovation for communities and their constituents. But what form of system, which applications and services must be available on a network in order for it to fulfill these functions? There are three general aspects of the form of a community network that can be identified immediately. First, it must have an intuitive interface and be easy to use. Second, because communities are composed of numerous constituents with conflicting and complementary agendas, a network must be applicable to various activities and needs. Lastly, the network must have a form that brings people together, emphasizes commonalities, minimizes the effects of conflict, and synthesizes divergent objectives into a shared agenda.

More specifically, a community network would need to be economical and provide some flexibility in how the network is used, therefore it should take the form of either a terminal/host or client/server system.

Peer-to-peer networking could be an excellent architecture for community networking, but it is more dynamic and less formal than the other forms. This points up an important point about the form of a community network: for it to be adopted it must have one. A network is a rather abstract thing, particularly when it is outside the familiar context of an enterprise. For people to get into the network, both actually and conceptually, it will have to provide them with a means of thinking and talking about the system as well as a physically accessing, using and benefiting from the it. Members of the Chattanooga community are like any other people, for them to make a decision about whether something could be of use to them, they have to know what that thing is, what it does and how to use it. Giving the network a form is not only a technical or practical consideration, but a marketing consideration as well.

On the other hand, the network must be informal enough to redefine itself as it evolves and as the community begins to learn about and really use the system. If we refer back to Browning and his "virtuous spiral" (page 39), we remember that the less information designers and implementers have about the application of an information system, the more it will need to be refined and redesigned during implementation. Such a mix of form and flexibility are best provided by client/server networking. Typical terminal/host systems are probably too monolithic to adapt to the dynamism and informality of a community, while peer-to-peer networking may not provide the form required in order to be adopted. Additionally, terminal/host systems do not provide the type of intuitive, attractive interface called for by contemporary aesthetics, and peer-to-peer systems don't make efficient use of network bandwidth. Client/server provides a set of general functions that may be applied to specific tasks, but also a level of formality that allows users to place it within a meaningful conceptual context. And it doesn't preclude either other form, so that terminals may be used to provide low cost access, and a peer-to-peer form can develop as the network and user sophistication evolves.

The form of a community dictates certain formal characteristics for network that will support its processes. Communities are composed of numerous actors operating multiple relational systems. Each of these systems are realized in specific instances as families, businesses, churches, schools, etc., each of which exist in a discrete location, physically separate from each other. In order to tie all of these locations into a network, there must be an infrastructure that can interconnect them. There are three alternatives:

- Make use of existing communications infrastructures such as cable and telephone physical plants, cellular services, or satellite links.
- Use wireless network technologies for point to point and/or multipoint connections.
- Deploy new infrastructure that meets the specifications of physical and data link protocols.

A new infrastructure would be rather expensive to deploy, and while it would provide the best overall performance there is no way to justify the investment without concrete evidence of the demand for the services it would provide. Wireless technologies are also rather expensive, are not fully mature technologies, and are designed for use within a space such as a building or for connecting such spaces to one another. While LAN standards may be adapted to community networking, and are valid for deploying portions of the network that may exist within a single location, it would be far more practical to use the existing infrastructure. In other words, a community network will not take the form of a local area network, which is limited to a floor or a building, but that of a WAN or dial-in network. Users would access the network through the same wires used to provide telephone and cable TV service. Organizations with their own LANs could tie those networks into the community network in the same way they interconnect their sites. As technologies and usage develop, access through wireless may become more practical, particularly for interconnecting specific points, and it may even prove feasible to deploy new physical infrastructure such as a high-speed backbone that is specifically for the community network.

In Chattanooga, the network model would suggest that the City and County governments, the Chamber of Commerce, the United Way and other public sector institutions would be interconnected. Each agency's member organizations would be connected through that agency. Non-profit or commercial organizations could provide access to the general public via terminals or dial-in connections. All of the oganizations using the network could work together to build a backbone for the network, to which they would connect directly, instead of having to cross-connect with each other. In this case, it is likely that a third party would have to be given responsibility for the backbone. This organization would be the community's version of the corporate IS department.

The central component of a dial-in remote access network is a router or communication server which brings data traffic in from phone lines and routes it onto a LAN or another phone line. The LAN provides a shared access medium that allows data to flow from one device to other devices. Individual workstations, terminals, or other LANs may be attached to the LAN through the router. Between the router and phone line is a device called a modem that dials the phone number of the destination LAN or workstation[3], and encodes digital information into the analog connection. On the other end, another modem answers the call, decodes the data and sends it on to the attached DTE (data terminal equipment)[4]. The interconnected agencies and network service providers in Chattanooga would each own and operate a router, as well as the communication equipment and phone lines that would interconnect them. If there was a backbone, each organization would need only one connection. If there was not, each agency would have to have and manage multiple physical connections to the network.

The function of each device on the network is determined by the software that it runs and the physical connections, or ports, it supports. A server, for instance, has a LAN port and runs service software ("daemons" in Unix, "modules" in NetWare, "services" in AppleShare), a router on the other hand has multiple LAN or WAN (wide-area network serial connections over phone lines) ports and runs routing software that moves data packets from a source port to the correct destination port. These functions can be combined so that a single device provides both routing and server functions. A communication server is just such a combination. It has multiple serial ports and a LAN port. Router software sends the data from one destination to others. Server software matches destinations to serial ports, sets up and manages connections. Each organization that wished to provide dial-in access to the community network would need a communication server, as well as software for managing usage and accounting. The hardware and software needed to effectively connect a LAN to a community network

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[3]Terminals do not have the intelligence to answer calls and provide a service, and so would not typically be a destination for a network link.

[4]The term terminal typically refers to a video-display terminal, but it technically refers to an input/output device at the end of a serial connection. A router is DTE because it terminates the serial transmission by moving the data to the LAN.

backbone can be purchased at retail for $1,500 to $3,000. A similar system that would interconnect a LAN, eight dial-in users, and a community network backbone costs around $7,000.

People who wish to use the network could do so from a public terminal or computer, a home computer, from a pay-per-use computer, or from a workstation on a LAN. Terminals would have serial connections to a host, and that host in turn would be attached to the community network. Most computers would need a modem and software—called "packet drivers"—in order to establish both a physical and logical connection to the network. They would dial an access provider, be assigned a port on the router and be connected to the network, all in a process that is transparent to the end user.

A communication server is just one type of server, and a relative simple one at that. Other services include:

- File server - shares files and data storage capacity;
- Application server - shares expensive or specialized software;
- Database server - shares large amounts of data and large-scale data processing;
- Mail server - shares electronic mail with private mailboxes;
- News server - shares "delayed response" or asynchronous discussion groups;
- Hypertext server - share text and multimedia documents and provides links to other servers;
- Directory server - shares structured lists of network resources, organizations and individuals;
- Chat server - shares real-time conferences;
- Print server - shares the use of a printer or other "hard-copy" output devices like film printers, CD-ROM recorders, digital audio or video recorders.

Servers can be set up independent of each other and by various organizations. The Chattanooga City government may want to set up an application server that provides access to public records on their host computer. The Chamber of Commerce could set up a hypertext server that features information about its members. A camera store may let customers use a photographic printer across the network. Interactive conferences may be run by local arts organizations to discuss aesthetics and culture. A computer company could set up some modems and phone lines, let people have free access to the community network, but charge to use use their file, mail and directory services. A bird-watcher could put her collection of photographers, recordings and observations onto her computer, run a file server program, and allow the general public to access the files. Each user of the network would need a physical connection to the network, network operating system extensions and client software in order to access services. The software can usually fit on a single floppy disk. The software and hardware needed to connect a DOS-based PC to a community network would cost about $200 and an hour to install.

The services do not dictate what kinds of information can be shared through them, they simply provide persons with a medium, giving the author somewhere to put her work and giving readers a way to find it. The service defines how, when and with whom information can be shared, but not what the information is, how it might be used or interpreted.

The types of services are determined by the network operating system, specific operational characteristics by the operating system, the server software, and client software. The NOS provides five things:

- Seamless integration with workstation operating systems;
- Unique "names" for network devices that can be mapped onto media-level address;
- Hardware and software platforms for network services;
- A means of managing interconnected networks and routing data between them;
- Accounting, security and auditing tools for controlling access and tracking usage.

Multiple NOSs can operate over a shared network infrastructure, and services from several NOSs can be simultaneously accessed from a networked computer.

There are several network operating systems (NOS) available today. For the sake of brevity we will examine the four industry leaders: Apple Computer's AppleShare, IP, Microsoft WindowsNT-Advanced Server, and Novell's NetWare. AppleShare provides a whole range of services on a single platform. The basic functionality of AppleShare is built into the Macintosh operating systems. The server software provides a wider range of more powerful services on a larger scale than the client software. AppleShare also supports third party applications for a range of network services, including access to the services provided by other operating systems. While Macintoshes can access the services of most any NOS, it can be difficult to make AppleShare services available to machines running a different NOS.

IP is unique. Because it is little more that a set of protocols recommendations, it can be integrated with relative ease into an operating system or application. Also, these protocols were created by their users, technologists and scientists, not manufacturers. The global Internet is based upon these protocols. The Internet makes IP valuable for two reasons, one is that it allows users to get at information and users all over the world. The other is that it is an excellent source of inexpensive “shareware” or “freeware” server and client software, which can be used to set up servers inexpensively, as well as access these services. There are implementations of IP service protocols—both client and server components for all major NOSs and OSs. Also, protocols for other operating systems can be “tunneled” through an IP network.

The Novell corporation publishes the most popular NOS for corporate environments. NetWare is a proprietary, multi-function software that runs on a standard PC-compatible computer. This software allows users to “attach” to the computer across the network. Network services are provided by software modules that load on top of the NOS. While only Novell publishes the core operating system, a wide variety of server modules are available from third party developers and Novell. There are modules that allow a NetWare server to provide IP and AppleShare services. Some of the most advanced network services are provided by Novell: video services, telephony services, and enterprise-wide directory services.

Microsoft WindowsNT is a “next generation” operating system which can be extended with the NT-AS (Advanced Server) software to provide network services. NT-AS operates at the session layer and above, and is totally independent of lower level protocols. Consequently, NT-AS services can be provided across most any network structure: IP, IPX, or AppleTalk. NT-AS has many server functions built into it, but as with the other NOSs, software that extends its functionality is available from Microsoft and third party developers.

In order to provide a service on the network, an organization or individual would have to have a network connection, a computer to use as the server “platform,” a network operating system and server software for each service and the number of users they plan to support. The users of these services—the people who actually put information into the system, use its applications, and get information out of it—would connect to the network using the appropriate network software by running the client for the type of service they wish to access, enter the name of the specific service, hit the 'enter' key, and they're in.

Even with hardware and software that are inexpensive and powerful, a network cannot run without the proper "wetware": the peolple who make any changes and improvements, keep systems running, and keep the users trained. There are two things that will stop any networking effort dead in its tracks: technologies that don't work, and users that don't care. It is the job of the IS department to mitigate each of these factors in enterprises, and there must be a similar group supporting the operation of any network. This function will be especially important in setting where the computer is a major innovation, such with underpriviledged or economically disenfranchised communities. It is the responsibility of the network operations group to make sure users are getting the optimal value out of the system, and often times the greatest value can be gained by the least empowered. In an enterprise setting these groups are relatively easy to spot and can usually be motivated by rewards in pay or position. In a community, groups that aren't contributing can be difficult to identify, and even if they can located it may be very difficult to get them to even attempt to find the benefit of networking: they don't have an interest in being integrated, and sure aren't going to get paid for it.

Corporate support and training professionals long ago learned that the basic truism of computers—"garbage in, garbage out"—also applies to users. You must understand how and why individuals do or not use computers, and then evaluate and re-evaluate how they might gain the most value from the information system. Pat answers and canned instruction may make everybody feel like they've done something, but have little value when you're back at the office trying to get something to work. Education and trouble-shooting efforts must suit the scale and scope of the user base, not the network. This means finding out what matters to the user as well as identifying technical problems, and resolving both issues at the same time. It means changing attitiudes as well as skills, recruiting users, building enthusiasm, and providing proactive, hands-on, personalized, real-world training.

Application of the model

The possible means of creating and supporting a community network can be considered in a continuum of available capital and technical expertise as follows:

1. individual hobbyists,
2. community cooperatives,
3. small entrepreneurs or institutions,
4. public computing consortiums,
5. local governments,
6. large entrepreneurs or institutions,
7. utility companies.

Any and all of these actors may have a role in the implementation community networks. The enterprise network model would suggest that community networks would start on the lower end of the scale, with grass roots organizations, and involve higher- from those at the upper end.

Individual hobbyists would be motivated by the personal gratification of working with the technology and the social interaction that would result from working on a community network, as well as any modest network economies that would accrue. At this level the community network would necessarily be very modest. It would be implemented in much the same way as a BBS, except that:

- users would have packet-based connections that would support terminal emulation as well as more sophisticated applications that make use of the client systems processing and storage and,
- the system would be a server that could be interconnected to and share resources with other servers as well as clients, users connected to one server would be able to access services across the network.

The the system owner would have to purchase a computer, network operating system software, two or more modems, a multi-port serial device, and any software that might be used to provide services. The total cost of such a system, providing IP-based services independently of the Internet, would be around $5000, with monthly charges for phone lines and power.

A cooperative implementation of the network model in a be similar to that of the hobbyist, but with greater coordination and pooling of resources. It would be formally similar to other cooperative enterprises with a board of directors, a couple of paid employees, and a general membership. The public would be charged for use of the network or just given basic access, while members would have free and/or full access. All members would participate in fund raising, but a core group would be responsible for setting directions and policy, selecting technologies, building and operating the system, and training and supporting the general members. One possibility for a cooperatively deployed community network is a system that focuses primarily on interconnecting non-profit arts, environmental, and/or social groups that have some LAN infrastructure in place already and could benefit from interconnecting their information systems.

A municipal community network would be a combination of a community information system and an enterprise network, extending beyond the city departments to other community institutions and households. Part of the motivation for such a network would be to support the operation of the city government. The cost of the city enterprise network would be more justifiable if it could be shared with other community subunits. It could make for a more informed, involved populace. One of the sticky issues of community networking rears its head at this point: universal access. If the community network is provided by a government agency, all citizens must be given equal access to the network. Does that mean a jack on their wall, does it mean giving every citizen a computer, does it mean opening all government files for access on the network? On a computer network "access" can exist on multiple levels, across the breadth of services on the network. Even if only basic information services are provided by the government, excluding any provisioning of infrastructure, there will be a number of difficult questions that will need to be answer in defining "equal access" on a community network.

Entrepreneurial provision of community networks is a wide-open consideration. Many BBSs are operated for profit. There is a growing market and healthy competition for regional, national, and global network services. Local markets are being opened to competition for telephony and cable television, although there has been little movement into more sophisticated network services. For any entrepreneur there must be potential return commensurate with the risk of the investment. The only precedent for the types of service that a community network would offer, and the way in which it would benefit its constituency, is the Internet. The costs of a community network would be at least comparable to those of any small business, while the return is questionable: how much will users pay for what services? sign-up fees? usage-sensitive charges? service specific charges? flat rate? how do you set up a pricing structure? how do you track usage, maintain accounts and collect? do you interconnect with other network entrepreneurs? can you build enough of a user base to reach a critical mass?

Possibly the best way for a network to be provisioned by an entrepreneur is to focus on target markets. One such market would be organizations with shared agendas, with much the same specific functions as a cooperative community network, but providing services to commercial and semi-commercial ventures for a fee. This may mean providing services along industry lines, or vertically between suppliers and their customers. Another focused market would be apartment complexes. It would be reasonably economical to build high-speed LANs in apartment complexes, and even to tie the LANs together. A final entrepreneurial opportunity exists in provision of gateway services to the global Internet. A community network could easily operate as a secondary function of such a firm, but most access providers are national or regional in scope and not too terribly motivated to support community networking.

Utility companies—broadly meaning all companies that currently provide water, energy or communication services to the home under a functional local monopoly—could be the most viable implementers of community networks. They have the capital necessary for such investments, the infrastructure and technical expertise for the job, and community networking would not be far from their core businesses, which involve economically distributing resources to members of a community. Indeed, a community network may provide the utility itself with benefits such as more economical fulfillment of their core business, greater customer satisfaction, and enhanced social standing. A community network, as defined by our model, represents a significant innovation. Business considerations, regulations and corporate culture might all work against the possibility of utility companies from building community networks.

The network model doesn't preclude the involvement of several of these sectors in creating a community network. Rather, the model allows for various network structures and forms to be integrated into a single system. Involving several diverse groups in the creation of the network would actually contribute to the value of the system. Each sector could play a unique and significant part. If a single group or organization deploys the community network, it seems reasonable that they would insist on controlling it. On the other hand, bringing diverse groups into a project of this scope may result in conflicts that could compromise the functionality of the network.

The cash flow of a community network must be positive, but there are several ways to structure finances in order to achieve positive cash flow. One way of generating income is to ask. If the community network is operated by a non-profit organization, it could bring in funding in the form or donations. Similarly, the system could be at least initiated with a grant from a philanthropic or governmental agency. The system could have a membership, and membership fee, that would give a user access to special services or discounted usage fees. Fees are of course the most tried and true method of generating cash flow. Users could be charged a one-time membership fee, a reoccurring membership fee, per time or data unit, per service, etc. Commercial enterprises may pay for space on the community network and for services such as transaction processing, and the revenue they generate may be used to subsidize the system for the rest of the community. Rather than charging for access to the system, the network operators may charge to limit access to spaces users wish to keep private. Also fee structures may change over time, most significantly they may be correlated to the resources on the network or may be set by defined democratically by the users of the system.

Let's review the network model what it tells us about a community network. A community network would consist of home computers and public terminals connected to private and public local-area networks via modems and phone lines. Servers, personal computers, and workstations would be directly attached to the LANs, which would be interconnected by digital data cicuits. Constituents of the network would fill the following roles:

- User - uses the network as a means of coordinating activities, locating facts and figures, setting goals and solving problems,

- Access provider - operates and maintains a communication server or a router and provides physical access to the network,
- Service provider - operates and maintains a server platform and manages its services,
- Information provider - provides content for services,
- Network operations - defines the architecture and technologies used in the network, is responsible for operation and finance of shared portions of the network, and provides technical assistance and education to users.

Access to the network would be free or inexpensive. Each service—including those that supply network control and support—would have its own pricing structure and usage policies. Individuals or organizations may fill one or more of these roles.

The network would formalize interactions between the constituents of various relational systems, between the relational systems themselves, and between the community and its environment. Rather than wondering where to find a book, a person would run their directory client software, type in the name of the book, and the program would find any entries for the book in local bookstores inventories, library catalogs, and possibly even private collections. The network would facilitate the problem solving, conflict resolution, innovation, and strategic behavior. By its very nature, a community network would provide a broad context for the concerns and interests of its constituents, within which people might find commonalities and synergism.

Just as enterprise networking has been an innovation that caused conflict and change in the business world, networking will also be an innovation for communities. According to this model, a functional community network will have the same effects on its community as networking has had on organizations: more people will be involved in decision making, decision will be made more quickly, authority will be distributed more uniformly across the social strata and among relational systems, centralized social processes will become less so and vice versa, and the number of intermediaries between members of the community will decrease. Community memory and intelligence will be improved as building, storing and sharing information becomes easier and less expensive. Social problems and opportunities will be solved or exploited in a much more timely, accurate and comprehensive fashion. The network should allow the community formalize decision making processes that higher quality decisions will be made faster and more economically.

NETWORKING COMMUNITIES

It is beyond the scope of this thesis to apply the network model to a community. Such a project would necessarily require the participation of the members of a community, would take several years and significant amounts of capital to reach critical mass. Instead of building a network from the ground up, let's use the model to analyze some concepts behind community networking, some trends that may impact the evolution of community networks and some community networks that are operating or being created today.

Communities of interest and networks for social action

There are two conceptual approaches that use the ideas of community and networking together with somewhat different intent than what we have identified as community networking. One view of networking and communities sees computer networking as making community independent of place. Intellectual community is an ancient concept, and is at the center of the relational systems that we have identified and the primary components of a community. Computer networking formalizes intellectual interaction while eliminating burden of having a body, the baggage brought to a relationship by physical characteristics, such as age, weight, sex, physical ability, etc. The lack of a physical representation allows one to be a member of a group that is without space: what Howard Rheingould calls a "virtual" community, an "on-line community," or more generally, cyberspace. The only thing that ties such a community together is the shared interests of its members—and their concept of community. The Whole Earth 'Lectronic Link (WELL) and East Coast Hang Out (ECHO) are two such systems. While they are located in San Francisco and New York, respectively, many of their users are outside those areas.

The Internet is, of course, the other example of virtual community—or communities. MUDs, or multi-user dungeons (taken from the game "Dungeons and Dragons"), are particularly good examples of electronic communities. MUDs are shared applications, in which the users build a virtual world where interactions are described in text, and through which they type their ways. They have been noted for their overpowering sense of community: there are stories of professionals and students totally abandoning their work just to play in the MUD (Josh Quittner 138). These systems have distinct cultures, their own customs and values, their own means of recruiting, socializing and controlling members. Virtual communities have the form of community even if they don't have the substance. Their constituents think of themselves as part of a community. But, while the intellectual environment of a virtual community may be compelling, the physical environment is nonexistent. No matter how much you may get out of on-line culture, you still have to deal with what the denizens of cyberspace call "the meat world," physical existence.

The members of an intellectual community cannot benefit from network economies in the same way members of a physical community can: car pooling, baby-sitting, crime watches, cooperative cooking, etc. Most people can gain more value from interaction with their neighbors than with people with whom they share only intellectual interests. Members of a virtual community simply don't share material needs and stresses the way members of a physical community do (John Perry Barlow 55). There are a number of other inherent problems with on-line communities. Carolyn Schaffer and Kristin Anundsen point out some of the inherent social problems that go along with virtual anonymity: intentional deception and misperceptions, casual disparagement and "flaming," and dominance by white males (121). This last discrepancy has been pointed out by numerous observers. There have been concerns about who gets access and at what price ever since the first telephone networks were built a century ago, and the problem of access persists with the information superhighway. Barlow points out the general lack of women, minorities, children, and handicappers in virtual communities (54). Reginald Stuart characterizes the situation as the major civil rights issue of the next century, and foresees the rise of "electronic redlining," the systematic exclusion of minorities from cyberspace. Lack of diversity is not only inequitable, but the network model suggests that diverse communities will find the optimal synergies and greatest benefits of networking. Whether it happens intentionally or not, lack of diversity limits the resilience, flexibility, and innovativeness of a system.

The other view of networking has nothing in particular to do with computers. It has to do with social networks and the way people set and pursue their agendas in the context of their community. In this view, networking is purposive social interaction, sharing concerns and ideas among a diverse, richly interrelated group of people, a means of creating and reinforcing community. It is a definitely local phenomenon, one that may not even be amenable to discussion without a specific local context, because every community is unique in its character, richness and poverty (Making Cities Work 11-12). The sociologists who study social networks advocate a proactive approach that is similar to that of the management scientists and sociologists who study organizational networks. Peter Keen encourages business to "compete in time" by using communications technology as a "coordinated business resource" (15). Donald Schon sees networking as an innovative way to restructure social problems and put then in terms that express the interests of all members of a community (53). Schaffer and Anundsen enthusiastically encourage the use of social networks—personal, business, and activist—to build community.

There is a definite synergy here. While virtual communities powerfully link people but lack the profundity of physical existence, real-world communitarians are working diligently to provide linkage between diverse interests and struggling to cross the gulfs between relational systems. On-line communities are rather bland environments with technical and financial barriers that are too high for many minorities. In contrast, enterprises have driven a market for low cost yet powerful means of sharing information and are linking personnel throughout an organization. Management scientists have documented the power of networked computer systems to innovate the form and operation of organizations, allowing for greater participation (Selig and Nipper; Zmud; Rice; Manning; et. al.). Communities seem to be searching for the kind of equitable, efficient, and effective interaction that network systems have been able to facilitate in enterprises.

The network model for communities is an innovative application of computer and communications technology, an innovation that must be adopted by the community, and an innovation that makes a community more economical and innovative in its own right. By bringing virtual community and social networking together in the form of a community network, a community should be able to reduce the cost of living and improve the quality of life for its constituency.

Community Networks[5]

The first community networks were, by todays standards, rather modest systems. The first two systems shared this modesty, but beyond that were very different. The Community Memory project in Berkley, California began in the early eighties, with its first test system going into operation in 1984. It provided little more than indexed files that a person could view, respond to, or create their own. The creator of a message chose keywords to be associated with the file. Files could be browsed or selected by keyword. The system focused on recording the opinions of the members of the community, on putting the people in touch with their community through computer-mediated many-to-many communication.

Case Western Reserve University (CWRU) started a small BBS in 1984 to test the feasibility of disseminating medical information electronically. The system allowed members of the Cleveland community to leave medical questions and retrieve the answer within 24 hours. It was so successful that it was moved to a larger system, and the areas were expanded to include law, education, arts, sciences and government, as well as interpersonal electronic mail. The system, called the Cleveland Free-Net, is available for free, 24 hours a day to anyone with a computer, modem and phone line. It became the model for community network pioneers, and the production and distribution of it operating system was spun off as the National Public Telecomputing Network (NPTN) in September of 1989. NPTN is a non-profit corporation that sell a turnkey community network solution, including software, operating guidelines, and a funding structure ("Community Computing" 2, 6-7).

Today, the nearly 50 Free-Nets and 30 plus other community networks consider unstructured interpersonal messaging and expert assistance to be two of their most valuable services. Conferences on a range of community issues use the functions of both messaging and expert advice. Most community networks have databases of local, regional, and national social resources available, and provide some type of Internet access. Democracy is emerging as an important application of community networks, and exemplifies the application of computer networking to social networking: people use the systems to

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[5]Much of the information for this chapter was culled from a series of electronic survey responses that are available through the Internet: ftp//

become more involved in their governments. The Santa Monica Public Electronic Network (PEN) was set up by the City of Santa Monica in order to remove some of the barriers to communication that separated the local government from its citizens. The use of community networking to formalize political processes is a realization of social networking, and seems to be reasonably successful. On the other hand, the systems are not deemed secure enough for the next logical step in electronic democracy: on-line voting. At least one system, Santa Cruz County WAN (scruznet), exists solely to tie together local BBSs.

The demographics of community networks have proven to be somewhat more diverse than other on-line systems. Most of the networks make it part of their mission to make information resources available to all, and many have active out-reach programs. Some systems, such as Montana's Big Sky Telegraph, focus on providing linkage to rural peoples. At least one system provides services primarily to Native Americans. Notable successes in serving broad constituencies have resulted from having publicly accessible terminals. PEN has been successful in giving homeless people a human presence in the community and provided resources that help the homeless find shelter and work. Professionals and school children have found places on community networks. One of the most consistent features of community networks is that their target audiences include non-profit agencies and schools. The New Mexico Community Development Network (NMCDM) was created to provide a link between social welfare organizations throughout the state. Many of the networks are actively supported by local school systems, with the explicit goal of bringing together school children, teachers, and community at large.

Some systems have managed to build up an impressive list of supporting agencies. The Heartland Free-Net in Peoria, Illinois, for example, boasts a list of over 40 affiliated organizations including the Red Cross, the Audubon Society, the Boy Scouts, HAM Radio of Central Illinois, Goodwill Industries, and numerous local schools and universities. One constituency that is relatively lacking in community networks is the business community. Roughly half the systems include their local Chamber of Commerce, small business development organizations, and economic development agencies as key participants. Few, if any, have a ratio of commercial to private or public participants that would reflect what exists in the community at large. Also, many of the systems do not allow commercial activities.

All of the systems have made it part of their mission to raise the awareness of and comfort levels with computer technologies for members of their communities. In general they seem to have met with success. While the consensus is that the network applications—on terminals or clients—are not as simple and easy to use as they should be, the systems have proven to be useable by computer novices. Often times new users have expressed surprise at how easy a system is to use, and that they derived some benefit from using the system that made up for any difficulties they experienced.

The average number of total users on community networks averages about 400, running the gamut from a few to several thousand. The National Capital Free-Net in Ottawa, Canada, for example reports having 4100 user accounts in April of 1993, with some 75 new accounts every business day, and averaging 2000 logins per day at that time. Big Sky Telegraph, on the other hand, is one of the best known community networks and it had 2000 members and was averaging just over 100 logins in the Spring of 1993.

All community networks have some form of organization that is responsible for deployment and operation. Typically, it consists of a board of directors, a small paid staff, and as many volunteers as possible. As with other specifics, the operational details of community networks varies greatly. The Santa Cruz County WAN is a self-described "anarchist co-op." Big Sky Telegraph, the Blacksburg Electronic Village, and numerous others are run by universities. Free-Nets are somewhat more consistent in organization, at least in part because of the guidance of NPTN. NPTN strongly encourages its members to be independent, non-profit corporations similar to public broadcasting stations, with the commensurate corporate structure and operations staff. A few community networks are run by commercial organizations—typically BBS or Internet access providers—as a pubic service. Chattanooga's nascent community networking organization is currently in the organizing stage and consists primarily of technologist working in teams. The Community Link project, as it is called, has Marketing, Technology, and Education teams consisting of two to five people. The system as it exists today is operated by the local Internet access provider.

All of the community networks depend on their users and affiliated organizations to provide information, but only a couple rely on third parties to provide services. Under the network model, roles in a community network should be divisible between users, access providers, service providers, information providers, and network operations. In almost all cases there is extensive vertical integration of access, service, and operation roles. The notable exceptions are NMCDM and scruznet, both of which exist to provide a point of interconnection for their constituents—NMCDM for non-profit agencies, and scruznet for BBS operators—and only fill the roles of access provider and network operations.

Community networks have financing methods that are just as varied as their organizational approaches. The Free-Net system is based on voluntary donations in the form of memberships, and corporate sponsorship. Free-Nets are dedicated to creating free public information, and do not charge user fees. Many of the other system do charge modest fees. Most of these systems provide access for free, charging for services such as e-mail and Internet access. Community networks almost universally support their operations with donated equipment and time. Technical expertise could be a major expense, but community networks have managed to find a large base of computer and networking professionals willing to donate their services for network operations. Many of the systems have federal tax exemption status that allows donors to receive a tax deduction for donations. The other major source of funding is from grants. Several of the systems benefit from private foundation grants. Both the Corporation for Public Broadcasting (CPB) and the National Telecommunication and Information Administration (NTIA) had major grant programs in 1994. Through the Telecommunications and Information Infrastructure Assistance Program (TIIAP), NTIA competitively awarded twenty-six million dollars that Congress had appropriated "for the planning and construction of telecommunications networks for the provision of educational, cultural, health care, library and public information, public safety or other social services" in fiscal year 1994. Much of this money went to seed funds to finance the start-up of new community networks. The CPB has not only run a competitive grant programs aimed at community information services, but its subsidiary, the Public Broadcasting System (PBS) is actively providing dial-up computer network components to its member stations.

There are two technologies that are overwhelmingly used by community networks. The first is NPTN's proprietary FreePort software. The other is a combination of Unix and IP. NPTN software runs across multiple processors, but appears to its users as a single program. Services are accessed via a terminal or terminal emulation program. The system doesn't support a GUI or pointing device and can only display text and simple graphics. While FreePort runs on Unix and supports most of the IP application protocols, it does not provide a packet-based connections or workstation-based client software.

Most of the non-Free-Net community networks provide packet-based (PPP) connections to IP services and character-based connections to a hypertext host. Users of the system may purchase commercially available client software, or the systems will provide shareware/freeware clients. A hand-full of community networks use BBS software such as FirstClass or Wildcat. The San Jose Mercury Center, which is technically an on-line newspaper run by the San Jose Mercury News, uses a system that was developed in conjunction with America On-Line, a major consumer information service that is owned by the newspaper's parent company, Knight-Ridder. FirstClass is being used by several systems, including the Cupertino City Net, and has been chosen by PBS for use by its affiliates. While the Mercury Center and FirstClass both have attractive point-and-click interfaces, they are terminal/host systems with limited support for network functionality, e.g. dynamically changing or transparently interconnecting multiple services.

All of the active community networks provide access via phone lines and modems, and most of them allow for character-based telnet connections through the Internet. Several systems support high-speed digital connections to their larger members (universities, local governments, libraries, etc.), as well as to the Internet. One system, Minneapolis Telecommunications Network (MTN), also provides non-profit public cable TV services, but does not offer any kind of network access through the cable infrastructure. The most unique and progressive access is offered by the Blacksburg Electronic Village, not only does it support connections through high-speed digital phone lines, but it can be accessed from LANs that have been installed in several apartment complexes.

CONCLUSIONS, OPPORTUNITIES, AND RECOMMENDATIONS

We have seen that individuals, families, organizations, and institutions need community in order to grow and prosper, that it is a social meta-system in which other social systems function. Community is a mechanism for personal, social and economic fulfillment, providing its constituents with the means for adaption, goal-attainment, integration, and tension management (Clark 47). These functions are closely related to the various relational systems, their associated systems of customs and values, and the primary processes of a community: recruitment, socialization, and social control. The processes and components of a community give it the form of an extensive, complex social network. The stronger the links in these social networks, the more effectively they support community processes. Unfortunately, strengthening many social ties using traditional means would be either very inefficient or inequitable.

Large corporations found themselves with much the same problem at the end of the industrial revolution. They were beset by a crisis of control, in which their operations were becoming so complex and fragmented that they had a problems monitoring, let alone optimizing, processes. Big businesses were having trouble keeping track of their far flung ventures, finding problems and opportunities difficult to handle. Large, centralized information systems made large corporations more manageable. They also gave them such structured operations that they couldn't respond to chaotic market dynamics. Small, innovative firms found that by being flexible, well-coordinated, and diverse they could provide customized, inexpensive products, and steal markets right out from under corporate giants. Businesses began to downsize their information systems, and to re-engineer their business processes. Deeper down in the org chart, people were hooking their computers up to share printers and files. When middle management downsizing met grassroots networking, executives realized they could strengthen their enterprises without setting their processes in stone, that it could be done incrementally, and that costs could be easily assigned to specific departments or projects. In general, businesses found that computer networking allowed them to:

- Control costs
- Improve productivity

- Innovate

Can communities adapt computer network technologies to their social processes? Individuals seem to benefit from interactions through community computer networks. What is not clear is whether such systems can be attractive enough to achieve critical mass, to become valuable, persistent social innovations. Community networks have done an excellent job of automating specific processes—looking for library books, ordering flowers, writing a letter to the mayor. But, in the sequence of events that networked organizations go through, automation is just the first step:

> 1. Automating existing jobs...typically to boost productivity...[l]ittle changes but the number of people and the capital costs of doing business.
> 2. Electronic infrastructure. Islands of functional automation are linked together....[but] without change there is usually little economic incentive to overcome the inevitable technical incompatibilities and to battle over who does what....
> 3. Business-process redesign....computers enable things to be done in new and more efficient ways.
> 4. Business-network redesign. Creating links with suppliers and customers not only creates new opportunities for changing business processes, it also changes the balance of competition.
> 5. Business-scope redesign. As part of the process of self-improvement, information technology enables some companies to move into new businesses. (Browning 7-8)

When we place community networks in this sequence, we see that they have only gone halfway. For networking to empower people to restructure community conflicts, to find opportunities instead of problems, to not only work together, but work better and smarter together, it has to take them all the way to "community-scope" redesign. It should distribute authority more evenly, take shorter paths to quality decisions, and "informationalization" the community. Luckily, communities are organizationally well-suited to informationization; the only thing they have to do lose is a couple of layers of bureaucracy.

The challenge for community networkers is to push architectural changes in their own systems even as they are facilitating architectural changes in their communities. Enterprises have become more efficient, effective, and equitable using networked computer systems. In order to capture similar benefits, community networks will have to continue on the virtuous spiral of network evolution:

1. Build flexibility and scalability into the network infrastructure,
2. Reduce overall costs with hardware, software, and telecommunication improvements,
3. Get more members of the community into the system,

4. Improve productivity through user education, and

5. Distribute control by distributing capacity and costs to the periphery of the network.

A flexible, scalable network infrastructure requires a transition from terminal/server systems and character-based connections, to a client/server or peer-to-peer architecture operating over digital packet connections. This architecture provides for better performance and reliability, makes the system more widely applicable, allows improvements to be made incrementally, and leverage investments in existing equipment.

Information technology markets are extremely competitive. Vendors are constantly introducing new, improved, exciting technologies. Unfortunately, many of the leading network technology firms have no presence community networks. Community networking is currently a tiny market compared to enterprise networking. If the network model were to be adopted and used by even a small portion of the general population, it could turn the market inside out. Several of the computer industry's most innovative products are quite well suited to community networking. Dial-in and branch office routers, groupware, wireless communication, and commercial NOSs are all conspicuously absent from community networks. Hardware and software manufacturers would be ill-advised to ignore community networking. Residential and home office computer sales have outstripped commercial sales. The more computers there are in peoples' home, the more beneficial it will be to interconnect them—such is the nature network economy.

Utility companies, telephone companies in particular, should also pay close attention to community networking. With telecommunications deregulation reaching into the local exchange, competitors will soon looking for the ways to differentiate themselves. Fast, inexpensive, and easy to use digital transport might be just the thing. The synergy between a powerful distribution system, burgeoning consumer computer sales, the inherent richness of community networks, and interest in the Internet could make for explosive growth in the telecommunications market.

Building membership is a perennial problem for most all non-profit organizations. For community networking, perseverance should be the primary strategy. Computer systems are getting cheaper, more powerful, and more useable. And the old equipment isn't going away. Be proactive. Consider working to get a computer, modem and software into the hands of anyone who has the faintest interest in community networking. If the network model holds true just having information tools available will encourage their use. Also, form partnerships with vendors, resellers, and service providers to get your users "turnkey" systems for good prices.

Choose tools that are easy to use and intuitive, technologies such as electronic documents and interactive multimedia. This may sound blatantly obvious, but there are numerous excellent system that are used extensively in business, but do not show up in community networks. But more than anything else, we must make sure the members of our communities are educated about networking. A basic reality of networking is that each person captures network economies in different ways, because the value of networking comes from interaction, and each interaction is unique. No matter how powerful and functional the tools may be, the worker still has to know how to use them.

No matter how easy to use or powerful a system might be, people will still need compelling and engaging content to get them on-line. There are three tried and true ways to get people's attention: conflict, fun and money. The first item is especially important. People love conflict and will go out of their way to see a fight or argument. But morbid fascination is not the primary reason to put conflict on the network. Community networkers should seek out conflict within their and get it on their systems, because that's what networks are good for. Look for groups that disagree, contentious issues, and high-profile problems, and put them on-line as a means of resolving and settling things. Networks are excellent environments for expanding perspectives, finding synergies, and redefining problems as opportunities.

Business and recreation should also become more important objectives of community networking. Social activism is admirable and necessary, but making money and playing are more fun, possibly more fulfilling, and definitely excellent ways to build rich relationships. Putting recreation and commerce on-line don't mean simply automating them. Automated gaming and buying has been attempted without notable success on every on-line system that has ever been set up. As we already noted, automating processes doesn't even go halfway towards realizing the potential benefits of networking. The community network must provide an innovative environment for work and play. Think telecommuting, electronic commerce, collaborative engineering, virtual corporations, and a host of other business innovations. Doing business on-line is quick, efficient and doesn't create hazardous byproducts. Recreational activities could also make good use of the network, whether for multiplayer games, results and statistics, sports images, whatever. Networking provides the greatest value when it enhances face-to-face interaction, when it allows us to find and develop rewarding relationships.

Some may respond negatively to these last recommendations. They may fear that bringing commerce and games to the network will lower the quality of interactions, attract people who just want to goof off or make a fast buck. Well, for better or worse, those people are your neighbors and members of your community. Community is at least partially about social control. Getting someone into a virtual space can be an excellent way to expand their intellectual horizons without threatening them. If someone logs-in to play NetTrek but stays on for the discussion of clear-cutting then the network and community are better for it.

Another important way to get people on-line is with a compelling theme or idea. In Chattanooga, where environmental and economic development are both important issues, members of the Community Link project are using interest in sustainable development as an issue to get people interested in community networking. The linkage is not a superficial one. Knowledge is the only resource we have that is practically inexhaustible, and it may well be impossible to overdevelop cyberspace.

Lastly, we must work to make community networks more accessible. This may be repeating what has already been said, but it is a point that bears repeating: the more accessible the system is, the more it will get used. Think of ways to get it into peoples lives and minds. Think of putting the network into places where it shouldn't be. Think of it as a ubiquitous community resource. And accessibility is more than just physical, it's intellectual, aesthetic. Possibly the first constituents we should be getting on-line are artists, authors and musicians. What would happen if Chattanooga gave its arts community first shot at a blank, interactive, digital canvas? Who knows what they would come up with. Whatever it might be, it would probably be unique, challenging and a true synthesis of the community and network technology.

Community is a commodity that is all to rare in our society. While we can probably never recapture small town or neighborhood intimacy, if it ever existed at all, it is possible to use information and communication technologies to support recruitement, socialization and social control. Enterprises have demonstrated to power of these technologies, whilte existing community networks have given us a glimpse of their potential for communities. The key to community networking is that the network must be as unique as the community it operates within, and must indeed become an organ of the community, in order to be successful. While enterprise networks use highly standardized technologies, they are as diverse as the enterprises. This is because each enterprise is made up of very different people, with different strengths, weaknesses, values, and customs. There is no pat solution or simple formula for community networking. There are a range of social, economic and political issues unique to each community that must be addressed along the virtuous spiral to a functional community network. Not the least of the issues is the very redefinition of community, for that may be the greatest lesson of enterprise networking: computer networking changes the way members of an organization find and use information, the way the interact with each other and with other organizations, often radically changing the organization itself. Networking provides its greatest benefit when it is used as a strategic resource, to manage these changes for the greatest overall good. The challenge for communities is to develop a pervasive awareness of innovation among their members and a willingness to use networks as a means of improving their community, their lifestyle and themselves. It is only through this prediliction that a computer network could foster social interaction and build community.

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