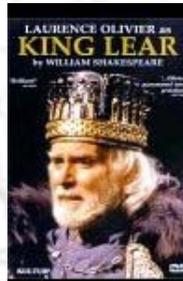


NetAge Working Papers

February, 2009

Understanding Nodes and Links

Core Concepts of People, Positions, and Relationships



Jeffrey Stamps and Jessica Lipnack

www.netage.com



NetAge Working Papers set out a new theory and practice for organizations. We feel compelled to publish these papers now as an urgent response to the collapse of traditional hierarchies and bureaucracies as evidenced by the current economic debacle. As the economic crisis deepens in 2009, we believe that now is the time for new ideas, new concepts, and new theory to come forward, approaches that will allow all kinds of organizations whether large or small to reorganize in smarter, better, and faster ways.

This paper contains the basics of a management science for networked organizations. Networks are known by their nodes, and we point to position in particular as the central concept that integrates ephemeral organization with flesh-and-blood people. The second focus is on links, and we begin with a taxonomy of relationships in organizations. These are directed links, both vertical and horizontal, in strong and weak forms, which generate dynamic network representations of organizational realities. It is also the conceptual basis for the design of OrgScope, our tool for mapping, navigating, and analyzing organizations as networks.



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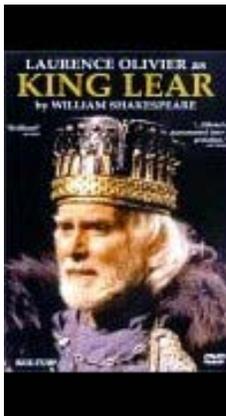
What Are We?

A formal organization is an emergent network of positions, a configuration of roles filled by people.

Simple idea, yet significant in consequence. Who or what are we? What is the *us* that works together as an integrated whole, from families and teams to enterprises and nations. It takes but a small shift in perspective to see individual people working together as an organization that is tangible, knowable, and measurable. An organized *us* happens when we step into roles and bring a particular configuration of positions to life.

An organization is its people—simple and obvious.

Yes, but...is that all? Is there something more, or different, something that is human in essence but separate from the people who comprise the organization?



Every organization tells a story, is its own play. It has a cast of characters and a plot. To perform their parts, actors step into their roles. Different personalities and capabilities emerge, depending on which actor plays the role. Whether great or poor, an individual's performance takes place within the same set of formal relationships any actor playing that role must contend with. Thus, the role or position is part of the play's structure, existing quite independently of the person playing that role. *King Lear* is William Shakespeare's play, King Lear is a role in the play, and Sir Lawrence Olivier played the King Lear role to great acclaim. Shakespeare and Olivier are dead. The play—and the King Lear role itself—lives on, and has for four hundred years.

When people step into positions, they take on roles that link into a network of other roles. But that doesn't prevent them from being the people they are, who come to their jobs with their unique preferences and idiosyncrasies.

Organizational life is both:

- *Formal*, with its the network of positions, constituent units, and working groups that stand apart from the people; and
- *Informal*, with its social interactions among particular people, who stand apart from the roles they occupy in and around the organization.

These two kinds of networks—organizational and social—are inextricable (see Figure 1). When we think about *all* the relationships relevant to organizational life, their entanglement contributes to our sense of chaotic complexity. But we can distinguish these two types of networks. By clearly defining and specifying the organizational network of positions, we can more easily identify relationships that make up social networks of people.

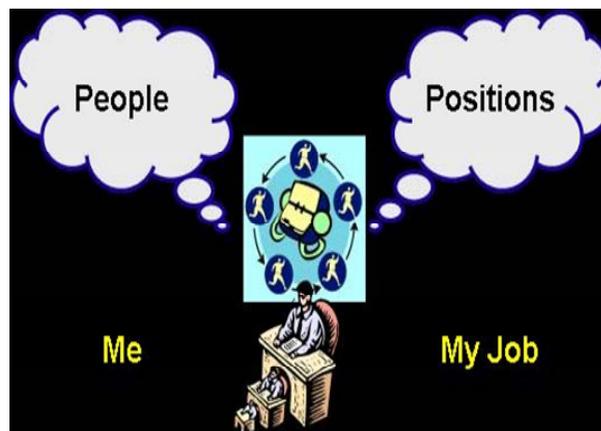


Currently, social scientists and management theorists are trying to understand group life largely by examining the network of relationships among the group's members. Social relationships are not only highly complex themselves, but they are especially obscured because the formal organizational framework is itself dynamic.

The network of positions moves to its own beat while the entwined people network has its own different rhythms.

The complexity of these two fundamental sorts of human networks is awesome, understandably hindering our ability to develop social and organizational sciences. New insights from network and complexity sciences, however, help us establish a new management science of organizational networks.

Figure 1: People and Position Networks



Understanding Organizations as Networks

It's hard to overstate the value of a science of human organizations. It has immediate, practical ramifications, starting with the learning that comes from generating data on the organization's leadership structure, its critical nodes and links. Metrics enable redesign improvements and the allocation of scarce resources (such as human resource and technology support) based on needs of different positions. Further, we can quickly identify optimal values for network metrics by comparing them with existing performance measures.

Knowing the dynamics of networks increases understanding of the dynamics on networks. Failure and innovation, decision-making and learning, searching and adapting all are processes that constitute the real-time story of organizations. The network of roles provides a framework within which a network of people acts. Because principles and metrics hold across domains, lessons learned in other networks become immediately available for application to organizations. A common example? How catastrophe starts and cascades through networks.



Knowing ourselves as agents in networks is vital to survival in an environment pulsing with every-increasing complexity.

Networks are known by the intertwining of their nodes: gene networks, neuron networks, television networks, and people networks all add up to something more than the individual nodes in the network. Likewise, networks of positions cohere and exist like other natural networks, with persisting patterns of nodes and links.

In these designs, positions are the parts, the containers populated by people, and organizations are the wholes, the arrangements of the positions. In the organization's story, the buckets of responsibilities that people leave behind when they move on are their roles. We flow through our jobs, changing the job as the job changes us, but leaving the job behind as we move on to another position.

It is said that most of the atoms in our body are replaced every year. That means every very real molecule that is me is a configuration of atomic roles and relationships that invite individual atoms to take up temporary residence, and then move on. Organization configurations are similarly real, and they may last many lifetimes of their human constituents.

A theoretically-grounded, tool-enabled, data-based science of organizational networks is a huge leap conceptually but a short step in application. Unlike the usual scientific delay between discovery and use, this management science makes practical contributions from day one.

Information displays of the network provide a sophisticated way for people to navigate large and widely-distributed organizations, especially important in fast-changing, everyday global life. Having a reliable map of the organization, allowing people to see who knows whom by virtue of their positions, opens new avenues for developing trust, especially among people who don't normally run into one another. The network view of the whole provides everyone a common mental model of how they are inexorably connected.

With computers, it is all but effortless to run organizational simulations, testing the effects of change in existing networks, and creating designs for new ones.

If I do this locally, what will its effect be globally? If we do that globally, how will it affect me locally?

What Is an Organisation?

The English (U.K.), spelling of organisation underscores the intimate connection between organisms and organizations. The root word organ means "a complete and independent part of a plant or animal that has a specific function." We sometimes abbreviate organization to org, particularly when it is used as a part of a larger structure, as a sub-organization.



People comprise groups. Yet, if an organization arises from interacting people, then our attempt to grasp it is overwhelmed by a tidal wave of person-to-person connections too vast to comprehend, a paralyzing complexity.

Regardless, the answer to the question “what is an organization”—and we are about to expand ours—must include people as parts in some fundamental way. If organizations include entities like us, people, who are, everyone agrees, pretty complex in and of ourselves, then organizations are at least as complicated as people and probably more so. If we as people have evolved, so, too, must have our organizations.

So what is an organization? Is it only the obvious, a group of people? Or is it so complicated as to be beyond systematic understanding, a cacophony of human interactions and interdependencies. However, the human systems we seek are right in front of us, surrounding us, and sustaining us. It takes but a slight twist of the head to see organizations in a new light, an opaque system rendered into a transparent network of people playing roles.

Organizations are configurations with constituents.

More precisely, organizations are configurations of positions that particular people occupy at given moments in time. The organized whole *is* a network of positions, a pattern of relationships that persists even as people stream through it playing organizational roles offered by the jobs. While most organization configurations live only briefly, some may endure many times the human life spans of those who populate them.

Positions are Niches

Complex configurations with constituents are not so unusual. Most atoms (98%) in our bodies (that’s around 7,000,000,000,000,000,000,000,000) turn over at least once every year.¹ The atoms that make up our molecules and cells—come and go. Without patterns that persist over time in every domain at every level, complex entities like us could not exist.

No organism lives alone. Each is born into a species that lives in an environment of many species. To survive, each species has to find a way to “make a living” in its outer world; it must fill a *niche* in a local ecology. At the same time, a particular member of a species, like each of us, must find a workable niche in a local setting, a precise location in a specific community of niches. Niches and organisms co-exist, co-adapt, and co-evolve.

A niche gains meaning in relationship to its peers, its character defined by its position in the niche network. Evolutionary biologists speak of “landscapes” of niches with “fitness peaks” where “agents” search for the highest fitness potential. This is where we anchor the concept of “positions.”

A position is an internal niche in an organization, a way to make a living in the internal landscape of structured niches. Sized to fit people, there is, generally speaking, a one-to-one correspondence between one person and one position— one niche, one organism. On occasion, a particular person may have to fill two



niches, as was the case when Patrick Robertson, an executive at a company we call Eleum in our writing, had to take extended medical leave and someone on his staff, Evout Kruetzen, had to step up to act in Patrick's role plus continue in his own.

It is more than analogy to characterize a position as a niche. Positions literally take an external way of making a living internal, offering it up as a job. As a person fills a position, a real job results. Thus actual, live, breathing organizations are networks of jobs, people in interrelated positions. Together, positions and people an organization do make, but it's the pattern of positions that carries on.

Each organization in turn exists in an external environment where it needs to make a living. Each must have its own line of work, must fill an available territory in a particular arrangement in its local ecology. So an internal design of jobs presents externally as an entity that makes a living, an organization occupying a role in a larger economic landscape of niches.

A continuously changing cast of characters occupies the persisting network of positions. And these people do of course have their own social networks, the bedrocks of any culture, quite separate from the formal organization. The distinction we are making here is that social networks are just not the same as position networks. What networks of positions give us is a way to see and analyze organizations quite separate from any particular collection of people who happen to hold the jobs. Each position has its identity and special characteristics related to its place in a pattern. The design itself, in turn, the pattern of all the positions, has its own identity and characteristics, a niche in the environment of other organizations.

Positions 'R' Us

Organization networks result from the conjunction of people and positions, giving rise to the real working organization of jobs (see Figure 2). The nodes of the network refer both to the people in them and the knots at the intersections—the positions where people linger to play roles.

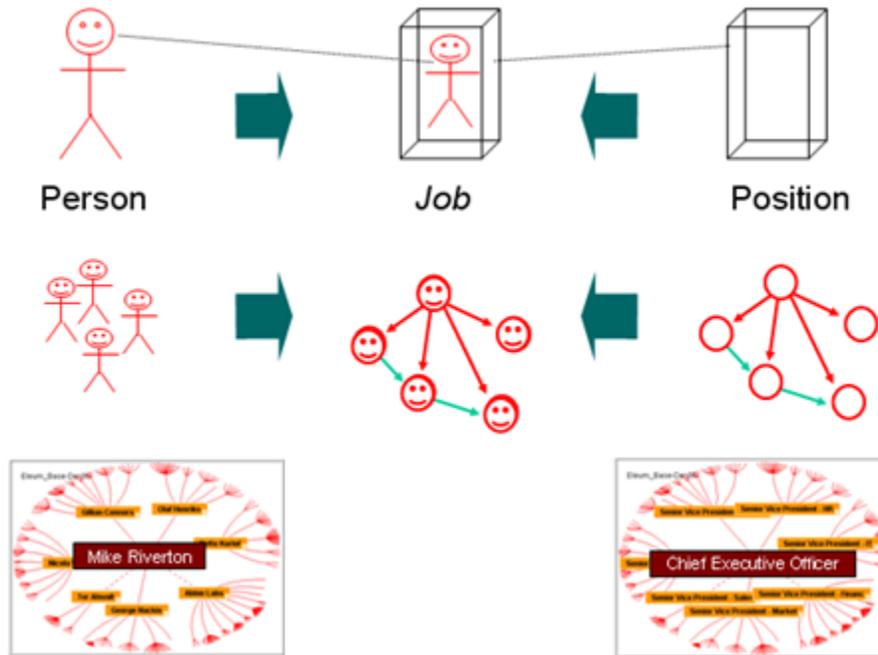
We define "position" as a formal niche in an organizational configuration. We define "role" in a more general way to include all types of niches in all types of human groupings, often in an informal context, e.g., roles in a social network of friendships.

Roles, like the configurations they're in, have evolved. They are just ways of making a living. Evolution has been exploring living niches since shortly after the molten planet congealed into a lithosphere, atmosphere, and hydrosphere.

We have been experimenting with small group roles for at least a few million years—and many millions more if we include all the ways organisms have laid themselves out as collectives. From mating couples to a hive of bees to a pride of lions to a crash of rhinoceroses to an "unkindness of ravens,"² organization has been part and parcel of the evolution of organisms. Every entity in the group has its role.



Figure 2: Jobs Are Positions with People



In an ecology that involves commerce new positions come into being as changes occur in the economic environment, creating or eliminating niches. If a position is successful, it will spawn more positions for others to occupy, making use of the same organizational resources and behaviors. Or, if economic choices are made that reduce the size of the overall configuration, niches disappear, e.g., reorganizations, layoffs, bankruptcies, mergers, outsourcing, and the like.

The effort of one species of position to multiply plays out in the context of others. Many types of jobs are competing in adjacent niches that make up an interrelated local fabric of jobs. All job types together support and exploit the surrounding economic ecology, thus mutually constraining growth of one another.

Different actors, members of a species, bring variety to the job type. Particularly valuable variations stick, becoming part of the method and tools associated with the job, making it more fit in the market. More threatening, local jobs are at risk of invasion from a new job species, just as foundry jobs supplanted blacksmiths, or less-expensive labor becomes available through globalization.

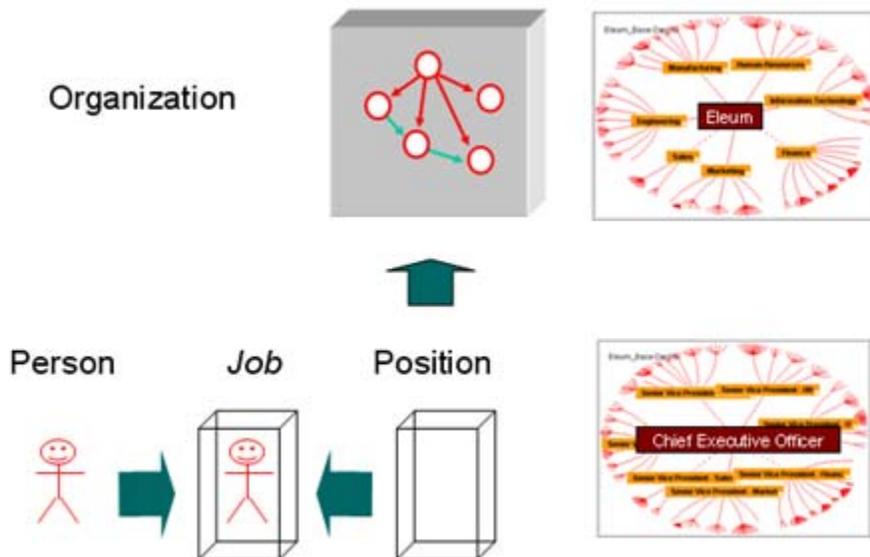
Over millennia, countless species of jobs have come and gone. Today, only a fraction of once-living species have survived the cycles of creative destruction. Simultaneously, we see new jobs a-borning with every new technology, with every new way to make a living. In a poignant example of this, the great management theorist Peter Drucker, then 86, asked for a list of job titles for those attending a conference we organized in 1995. "I read the list," Drucker told us via videoconference, "and I've never heard of most of the jobs you have." Some types of jobs will survive. Most will not.



Configurations of Constituents

Positions are the parts in the organization whole (see Figure 3). Some positions, typically *management* ones, stand for abstract organization units as well as their formal roles. We have characterized, quantified, and measured network configurations with the proxy of management position metrics. Configurations, however, exist in their own right. There is a more subtle group reality visible with yet another little twist of internal perspective that picks up the persisting patterns of collaboration as organizational units. Seeing abstract configurations as concrete entities, as nodes themselves, is easiest to do with legally incorporated bodies. In law, organizations are very real.

Figure 3: Positions Play Parts in Configurations



Incorporation means “to give form to” a group of people acting as a single legal entity. This entity is endowed with certain rights and obligations under the law quite separately from the individuals involved. Constitutions and charters are other instruments of incorporation, particularly for governments, the source of legal authority. Typically, the law regards an incorporated entity as an “artificial person,” an independent agent, a relatively complete whole that can act in its own interests in its environment—whether public or private.

A legal framework is a container for the whole organization, the single whole corporate (private or public) entity that is represented by the root (CEO-President-King) position. The blessing of incorporation then blankets each sub-organizational unit, carving them out as nodes in the legal configuration, the structure of parts making up the legal whole. Each formal organizational unit, each org—like engineering, marketing, and human resources—is represented by



a management position, with executives having fiduciary responsibility in the legal arrangement.

Management positions that stand for organizations do not just play their singular selves. Root and intermediate management nodes also stand in for the abstract organizational wholes they represent. Positions that play an intermediate role lead assemblies of positions that beget a multi-level structure.

From the root on out—or down—organizational development unfolds into levels of sub-orgs. Each branching leadership node has its own unit identity and network pattern. Management positions stand in for organization units that characterize the intermediate architecture of complexity. Positions function at one level or another within a hierarchical configuration.

Visualizing the Leadership Configuration



The translation of the Rosetta tablet discovered in 1799 broke open the mysteries of ancient Egyptian languages, a feat made possible by a common story written in three parallel texts—Greek, hieroglyphics, and demotic script. Organizations, positions, and people—three different node types—mean different things in three interrelated coding systems that are based on each type of node. Positions are key to translating from one organizational language to another, the means to unlock the organizational Rosetta Stone.

We see the pattern of positions as today's Greek, revealing both the hieroglyphic abstractions of formal organization structure and the messy demotic doings of people in their everyday work. This analogy underscores the formality made possible with invention of writing, a fundamental technology that drove the Nomadic-to-Agricultural-Age organizational transformation. Writing enables transmission beyond the sound of voice, persisting sometimes for ages.

The abstract configuration of an organization is very hard to see; it doesn't respond directly to the five bodily senses. To grasp the pattern, leaders have to model it for the rest of us, which they do most often through stories and examples. Leaders also draw pictures of a few elements and interconnections as organization charts or work process diagrams. Because it's so hard to grasp the whole in simple terms, we all rely on experience and intuition. This works with smaller groups, but is poor for understanding larger organizations.

Hard to see, yes, but, in the computer age, configurations are easy to model. Just define the nodes, identify the links, and, *presto*, you've got a network you can see and analyze. When you map an intact operating organization, you reveal the current blueprint of its construction. Analyzing this architecture as a network generates metrics for positions that exist quite separately from the current jobholders.



Imagine a network model of positions that has a switch you can flip to re-label the nodes. Start with their org unit names, then flip the switch and see position titles. Flip the switch again and re-label the nodes with the names of the people in positions. We can see this idea at work in the digital organizational map we made of Eleum (see "[The Virtual, Networked Organization](#)") where you can toggle between different labels—organization name, position title, and person name (see Figures 2 and 3). The arrangement of nodes does not change, only their meanings in the selected context do. This is the vision that led to the development of the [OrgScope](#) tool.³

The organization gains access to its own genetic code when it makes its configuration explicit, generating a complete model of a many-peopled organization. With this map, local knowledge becomes global. Self-improvement acquires a holistic context and self-organization gets smarter.

Roots and Hierarchies

Direct, solid-line, reporting relationships are the easiest links to see, the most agreed upon ones in organizations. Orientation by level is a primary means of navigating an organization, particularly a large one. This network of simple hierarchy links is inevitably modeled as an organization chart. It establishes the enduring framework of an organization and sets out the pieces for organizational play, making a place for each and every position. Important as they are, pictures of these connections rarely are rendered with more than a few chunks at time in typical org charts—generally they depict a group of groups, nothing more than a “camp-size” chart of 25 or so.

The reporting-relationship diagram defines a mutually exclusive set of categories and delineates the unambiguous chain-of-command. The boss at the top is the “root node” in the tree that becomes a hierarchy of positions. You know who the members (e.g., employees) of the network are by following the root, trunk, branches, and leaves of the tree. Any positions on the path of direct-reporting links that reach the root node are core members of the organization network. Like people individually, positions with jobholders are unique and mutually exclusive. There is generally only one of each.⁴

Since a root is relative, you can easily choose your perspective, moving the root to any leadership node. With each point of reference, the organization below is seen as whole.

In organizations, the vertical dimension is the level structure. You measure how deep you are in the organization by how far you are from the reigning authority, the CEO. We measure distance to the crown as the number of steps on a route of reporting relationships from here to there. “Steps” sound so friendly and inviting, but in most organizations the step from level to level is really a leap, sometimes a huge menacing one.



A hierarchy is a directed, solid-line network of positions connected to a root node, providing a familiar structure that we can later enrich with more types of links. We can always dial back the complexity of the network picture to this relatively simple logical hierarchy, although, as our Eleum example shows, logical turns out to be not so simple.

Network Rule of Two

We know from years of research—and the work of many thinkers before us including such giants as Herbert Simon—that levels are intrinsic to the very nature of complex systems. For people in management positions, levels naturally provide a clear vertical orientation within a complex organization. But there seems to be a natural human limit to “level perspective” that we dub the “Network Rule of Two.” This observed limit, now hypothesized, is analogous to the famous “Rule of 7,” from George Miller’s research on how many ideas, topics, or issues individuals can handle at once⁵.

In organizations, each level is a big deal. Whom you report to and who reports to you are both just a link away, one “up,” the other “down.” Your boss’s boss is two links up; two links down are the subordinates who report to those people who report to you. We have observed over the years that the typical leadership horizon in any organization is two levels away, both up and down. Three at a stretch.

Figure 4: Position Perspective Limited by Network ‘Rule of Two’



Check it out for yourself, especially if you are, or have been, in management in a large organization. You are (were) very well acquainted with your immediate



boss, your reporting context, and you likely stay tuned to the context of your boss's boss, but higher than that the details become vague. Similarly, you know (or should know well) the people in positions reporting to you and are fairly familiar with the people reporting to them. But details around people and positions three or more levels away will seem similarly hazy (see Figure 4).

Looking into the hierarchical organization, the Level 1 CEO naturally sees to Level 3. Level 3 leaders, the strategic connection between the CEO and the operational levels, naturally see down to Level 5. Level 5 leaders, in turn, only see to Level 7; the blunt end of Level 8 positions in Eleum's diamond-hierarchy was not even in the Level 5's view. In short, it's really hard to get a good and accurate feeling for a large complex organization from any single position.

Mapping and visualizing the organization network removes the two-level horizon limit. It opens up the whole structure to, potentially, everyone in the organization. Senior leaders and others can quickly navigate the levels and look at organizational detail at different depths. The vertical dimension is neatly complemented by the spread of functions, the horizontal orientation inherent in the network of positions.

The real gift of a dynamic network map is the transparency it offers. It lets light into the previously opaque "black-box" organization, opening it to internal observation. This whole-context-with-detail transparency can be available to everyone in the organization as a display and navigation system for organizational directories and resources, the knowledge management system, and online collaboration systems.

Organization networks can directly inform the design of the shared knowledge systems permeating the online workplace. Mapping the network to the digital collaboration space has its own benefits: it keeps current the inventory of people, positions, and groups. This means that near real-time network metrics, globally and locally, can be available to leaders throughout an organization any time, anywhere via the web.

Network maps and metrics add greater insight and produce a new holistic view of organization. We have much to gain if the network diagnosis holds generally true in organizations. It opens up management thinking to the rapidly accumulating knowledge about hubs and other general network features gathering across many scientific domains. Much of this literature is about robust networks and vulnerable hubs, subjects that directly impact organizational risk and prevention of confusion, paralysis, and collapse.

The ultimate payoff for use of new network knowledge, we believe, will be a step-change improvement of organizational performance at all scales.

A Rainbow of Links

To get a good grip, we need to add some more links to the organization network mix.



Links are more difficult to see than nodes. Like matter and particles, nodes are relatively tangible, while links, like energy and waves, elude detection except through their effects. We “see” links at work across a wide spectrum of connections, interactions, and relationships—without ever literally *laying eyes on* them.

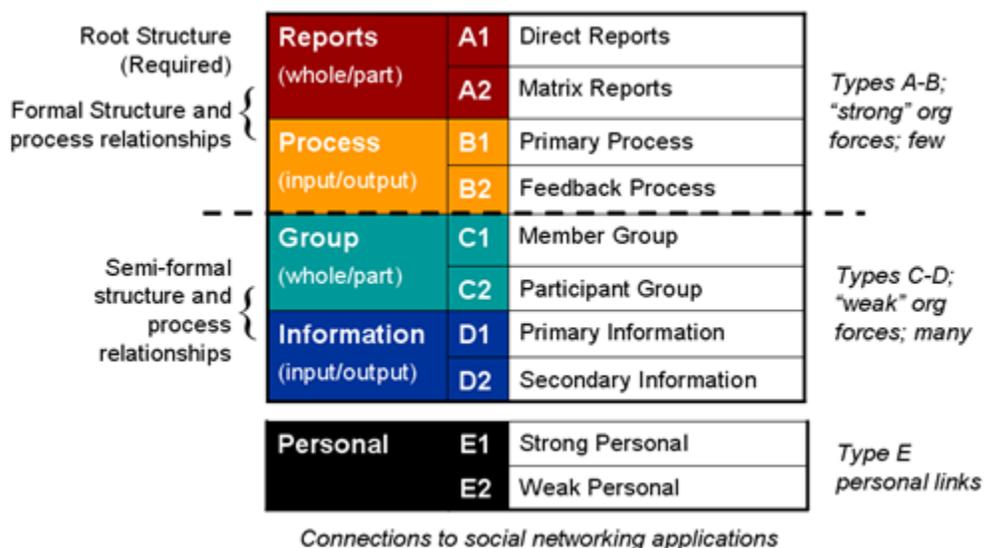
Looking at many types of links at once is akin to looking at white light. However, pass this light through a prism and it separates into the colors that permeate our world. By distinguishing among different types of links, we can see organizations at different frequencies—metaphorically, we see the low frequency waves of reporting connections, the faster waves of process linkages, and the very-high-frequency waves of social interactions.

We make light of the lines that connect us with others in our mental models of the world, but they are really hard to see. Nodes we know, but links are elusive. That’s what makes this material so difficult. Unfortunately, links are unavoidable in rendering an organization as a network.

According to standard network methodology, nature endows its links with an on-off direction switch. Links either are headed just one way, “directed,” and sketched with arrows, or are two-way, “undirected,” and drawn as simple lines without arrow heads. A URL, for example, is a one-way directed link, pointing to a specific address; a personal relationship, conversely, is usually portrayed as a two-way undirected link.

In these standard models, links also vary by weight, most often in pairs like “strong-weak,” or “near-far.” In our work here, we follow convention and distinguish between “solid” and “dotted” links. Reporting relationships exemplify this, distinguishing between a “solid-line” boss and a “dotted-line” matrix report.

Figure 5: Taxonomy of Organization Network Links





In our taxonomy (Figure 5), we identify four types of directed links in organizations, each with a strong and weak form. Undirected links between people *qua* people, a fifth link type which is the province of the social network thinkers (but not us here), also are conventionally described as strong or weak. In our model, however, these personal ties are drawn as directed links, interpreted as the flow of influence (from more to less). They may also be interpreted without direction.

From-To Directions

Links, then, point either one way or the other—or no way at all. Models of social networks typically represent relationship links as undirected, such as friendships. Organization networks, we have found, are most meaningfully modeled with directed links.

Directedness is pretty fundamental. The Big Bang set a direction for our Universe, giving the thrust to the evolutionary process that produces us and our future. The direction of evolution, say complexity theorists, is toward more variety, more complexity. From the human perspective, where our limit is bound, it has moved from the singularity beginning of the Universe to complex multi-organism life we experience here on Planet Earth today.

This is not mysterious. We experience the arrow of evolution everyday, and, at the current accelerated pace of change, see the accumulation of variety and complexity every year, if not by midnight tonight. It is this powerful push that we tap into with the input-output process flow.

Directedness is also present in the architecture of complexity, the holon (from “*holos*,” whole, plus “*on*,” part) hierarchy that unfolds from whole to part. The power of whole over part begins from a root, or top, position and flows to progressively more articulated sublevels. The universe itself began small but whole, subdividing into subsystems of galaxies and galaxy clusters, then suns and solar systems, then earths and us. In using holon architecture for our complex organizations, we have just been following the universe’s recipe.

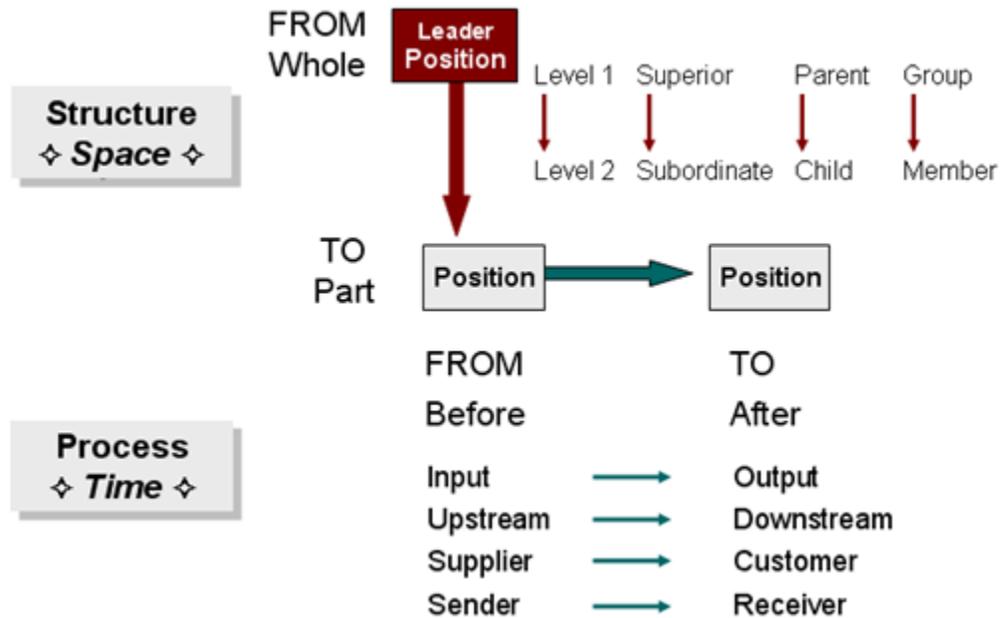
Formulas for complex concoctions call for ingredients that give us a good space-time outcome: spatial structures and dynamic processes that seamlessly interweave. “From-to” has the logic of an arrowhead, whether aligned:

- Vertically **from whole to part**, or
- Horizontally **from before to after, input to output**.

With it, we can line up the forces in organizational life, both structure and process, according to a consistent orientation (see Figure 6). Otherwise the arrows just might point any which way, and we would lose the coherence of the configuration.



Figure 6: Vertical and Horizontal Directed Links



The root plays a unique role for each basic type of relationship: it acts as the *ancestor* position, the origin “from” before there is a “to.” It is the biggest whole, the top of the heap of decision flow, the earliest input of purpose for the output process. It is the source both of space and time, structure and process, in organization. Practically, the root stands for the whole as the top leader of an integrated organization who sets strategy and is responsible for results.

A root is a matter of perspective. The root role is easily moved from node to node in a configuration, bringing along its ancestor function as an undifferentiated starting point of directed relationships. Every person models their organizational world with themselves at the center. A root role appears when a position has other people reporting to it, thus a whole-part (at least) and input-output (usually) configuration. Leaders are roots, origins of their own organizational worlds.

Links with arrowheads imply some force, some compulsion, some inclination. We are suggesting two fundamental types of organizational forces—structure and process—with whole-part and input-output linkages. As mentioned above, the forces each have strong and weak forms.

- For vertical *whole-part* relationships, the strong force is the superior-subordinate reporting link; and the relatively weaker force is group membership.
- For horizontal *before-after* links, the input-output process flow is the strong force; and the information sender-receiver flow is the weaker one.

We focus first on the strong forces, the reporting and process links.



Strong and Few Links

A. Reporting Links

The primary reporting link may in the imagination form an ideal command-and-control system, but alas the real world is not so simple for would-be autocrats, and it's becoming less so. What it does for all of us, however, and why it is so fundamental to understanding organizational networks, is that it defines a unique set of core nodes from a given leadership point of reference. It puts players on the board, jobs in the configuration, which can then be hooked up by a variety of relationships (see Figure 5). It identifies a clear boundary and reference framework for adding other nodes connected to the core set.

The boundary arises from the configuration of one-per-node primary reporting relationships (which we tag *A1*). This link type preserves the mutual exclusivity of a position where each position links into the whole just once, something like the Pauli Exclusion Principle that functions in the physical world, where only one thing can be in one place at one time.⁶ Practically, a position's solid-line reporting relationship usually indicates the source of a job-holder's paycheck, which is why the org-to-position relationship is hard-wired into financial and HR data systems.

When push comes to shove in the organization network, lines of command are clear, but they don't tell the whole story. Organizations have evolved ways to be more flexible than one reporting relationship alone provides. Positions sometimes play more than one part in the organizational drama. Secondary reporting links (the *A2* connections) tie some positions to more than one boss. These positions play subsidiary parts in other organizations that are not their hierarchical homes. Often called matrix reporting relationships, they are typically represented by—and even called—“dotted lines.” Such matrix relationships are used, for example, to make cross-cutting services more intrinsic to operations, such as human resources, information technology, and finance support jobs.

Matrix reporting relationships provide alternative routes to decisions. The network world calls these “shortcuts,” links with measurable impact on the overall distance between nodes. Shortcuts create the “small worlds” effect that increases decision speed and flexibility.

These secondary reporting links dance the first steps between order and chaos. The price of flexibility is some degree of instability, as alternative reporting pathways are bound to generate conflicts. “Remember who you work for” is a phrase heard more than once by people with matrix reporting relationships. When conflicts do arise, hierarchy, *A1*-style, rules in most organizations. Primary force trumps secondary. Indeed, the *A1* force supersedes all other directed relationships, at least in theory.

Only one reporting relationship, *A1* direct or *A2* matrix, can exist between any two positions. It does not make sense to make a matrix report to your primary boss, nor can you be formally and simultaneously the boss of your boss. This reporting pair constraint contrasts with process relationship pairs.



B. Process Links

A second type of strong link comes from the organization's primary process interactions, connections that appear as we look at the *horizontal* relationships among positions. These links show up in processes that flow from function to function, typically from supplier to customer, from "upstream" to "downstream" along a value chain. For example, R&D links to engineering which links to manufacturing which links to sales. Network diagrams often draw these links among functions as solid arrows, while feedback and feed-forward connections are shown as dotted arrows.

Though rarely represented explicitly, the work of an organization is implied by how it chunks and labels its inner world of org units and jobs. The internal process configuration is implicit in the category labels of the jobs that compose it.

Process diagrams are common in organizations, but organization charts also wired by process are not—except sometimes. Enter a conference room in a company under reorganization and you are likely to find an input-output systems chart of sub-organization units and jobs on the whiteboard, perhaps a different sketch of it on a flipchart. The same is true when there is a strategic focus on cross-organizational work-process design, such as in quality or process improvement efforts. The relationships on these charts show how internal chunks of work connect together in upstream-downstream process flows. This flow maps (or should map) to strategy, which itself should reflect knowledge of external requirements for how the organization makes *its* living (see example in Figure 7).

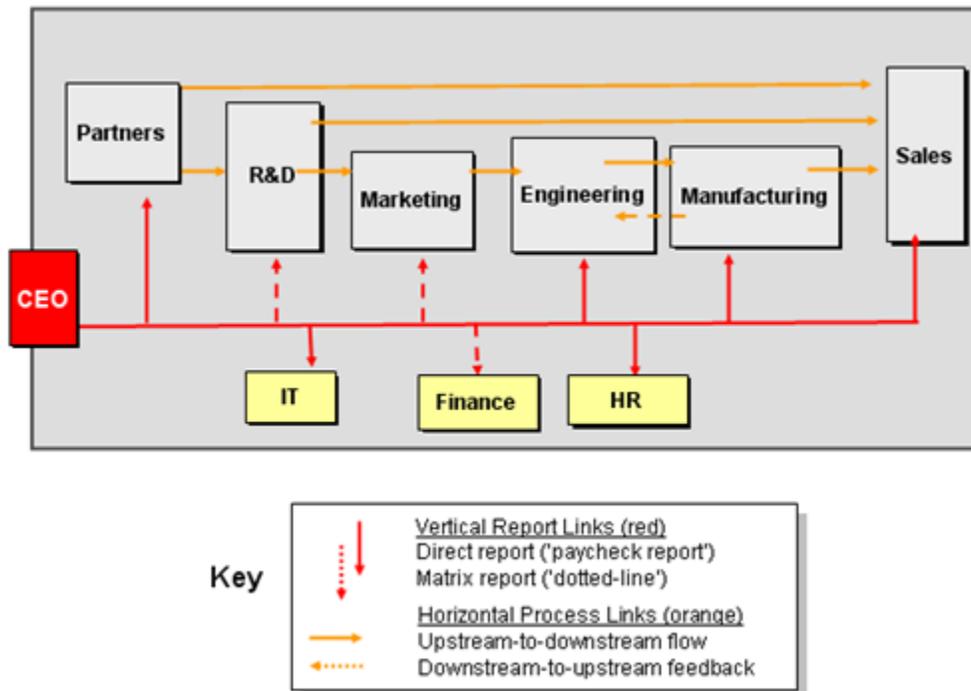
Usually, if you understand the terminology, you understand how functional parts inter-depend. People know which functions are product players and which are support actors. Widely known as line and staff, line is where the action is, and support is regarded as a burden to minimize. Leadership and its associated staff functions are, however, the price of integration, the means to greater effectiveness and efficiency in the productive whole.

An organization's functions hand work down the line in an overall order that produces the organization's output, its contribution to the external world where it competes for survival. This compulsion to survive and thrive drives the primary links of process flow (which we designate *B1*). The primary process actualizes an organization's mission, producing its quite concrete *raison d'être* as a viable output.

The downstream direction of process flow also bears the course of its complement, the upstream flow called "feedback." These secondary links (*B2* loops) connect back from output-to-input, informing inputs about what is happening to outputs. Feedback links incorporate the great insight of cybernetics, a precursor to both systems and information theory. Feedback is essential to the basic structures of regulation and learning. It creates dynamic closure in open systems. Without feedback there is no adaptation, no innovation, and, before long, no survival.



Figure 7: Adding Process Links Puts the Organization into Motion



Feedback provides vital links, yet it is the most volatile of the strong links. Like electricity with its arbitrarily named positive and negative poles, feedback has its plus and minus forms. Cybernetics teaches us that feedback can produce dampening effects to increase stability (called negative feedback) and amplifying effects that decrease stability (called positive feedback).

To call feedback that sometimes turns into a runaway, order-destroying process “positive” may seem perverse, but it is this same tendency that enables creativity and powers the leaps of emergence. Feedback forces, expressed and unexpressed, are probably most often responsible for pushing an internal configuration beyond its edge of chaos, for better or worse.

Feedback is the most internally obscure of the strong forces. Most often not formally designed in, “back channels” open up to informally meet the flexibility requirements of process. Needless to say, unrecognized back channels also can cause considerable distortions in the formal configuration.

In contrast to reporting links, two functions may have an interacting primary and secondary flow. Indeed, such a formal back-and-forth in pair relationships may be healthy. But, as with reporting, at the end of the day, primary process flows set the direction and dominate.

Generally speaking, reporting relationships trump process connections when they conflict. But over time, it is the quality of the process connections that determines whether the organization is successful and meets the needs served by its niche. Hierarchy may bluster, but if it’s the wrong work at the wrong time,



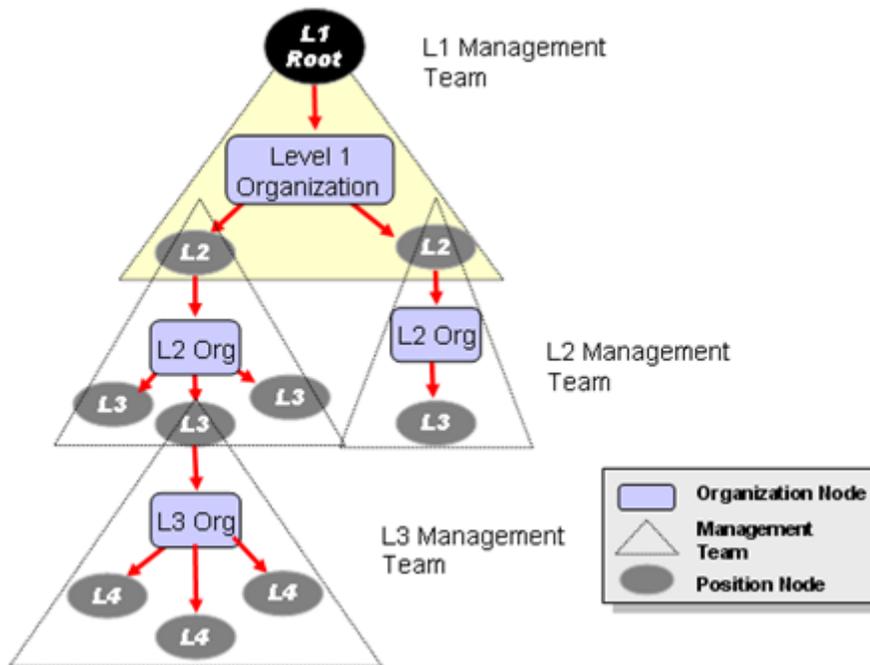
the environmental reaper will take its due, and someone else will move into the niche.

Weak and Many Links

C. Group Links

Hierarchy is modular, and people cluster. Holding a hierarchical leadership position implies membership in at least two teams—your own team of reports and your boss’s management team. Hierarchy carries with it the implication of interlocking management teams (see Figure 8). These management leadership teams may be formally defined as all positions connected to an organization unit by one degree.⁷ In practice, some direct reports may not be considered part of the “real” leadership team (e.g., an administrative assistant), while others may be added (e.g., a special assistant to the root leader with a formal report elsewhere).

Figure 8: Hierarchy of Management Teams



Corporations and other institutions establish many other groups quite formally by constitution, policy, and decision. Boards, committees, panels, programs, and many other types of working groups are well-known parts of modern organizational structure and clearly established with sponsors, leaders, and members. Formal groups may also be associated with processes, such as the networks of task specialists, project teams, expert advisory groups, and communities of practice. All these groups are concretely accounted for in budgets and considered in performance reviews. Since groups take time and resources, they are not lightly formed.



It's not enough to just model the hierarchy of positions. To have a more complete picture of the organization, we need to include at least the formal groups that the positions belong to, such as the executive management team or the human resource executive council. These are groups that people belong to by virtue of their positions rather than their social connections or interests. A broader whole-part *membership* linkage connects positions to a variety of groups that thread across the interlocked management teams.

Management teams and other formal groups illuminate the natural modules of the organization. We can expect, with some probability, that members of these groups know and communicate with one another, generating personal relationship links. Hence, even in hierarchy networks, we find embedded clusters of nodes with strong, local relationships. In network theory, this is known as clustering, a measure of how many of a node's neighbors know each other.⁸

Management teams at every level are often the source of intense work-related personal relationships. If we know a person's position and the group memberships the position brings, we have a pretty good idea of the people that person is likely to know and interact with in the normal course of work events. Savvy employees keep eyes on these relationships.

D. Information-Communication Links

People Connecting With People. The real buzz of human connection comes when we look at the organization as a network of groups with inter-communicating members.

We have focused on organizations as configurations and people as positions to shine light on the inner world of the self-organizing network. The direct substitution of person for position puts a human face on every abstraction. While a reporting link between two positions a level apart seems like a cold rendering of a relationship, the superior-subordinate interaction is likely among the hottest person-to-person connections in a working life. Even if your boss doesn't talk to you, the silence speaks volumes. A network map of job titles resolves into unique faces as position labels are switched out and people's names are brought in. Names and faces bespeak interaction and conversations among people connected in the natural course of doing their jobs.

In today's Internet Age, an immense amount of anecdotal evidence of personal-positional relationships of an organization lies in its knowledge management system. From emails to calendars to web site click trails, connection data is available for mining and patterning into network maps of who knows who based on what issues and topics. Much of this connectivity can be traced to position-based interaction, and thus can be used directly to flesh out the living configuration of jobs. Other interactions are based more on personal relationships, some work-related, many not.

Every relationship carries with it the implication of interaction, whether a transaction, conversation, dialogue, debate, conflict, or neglect. While a strong

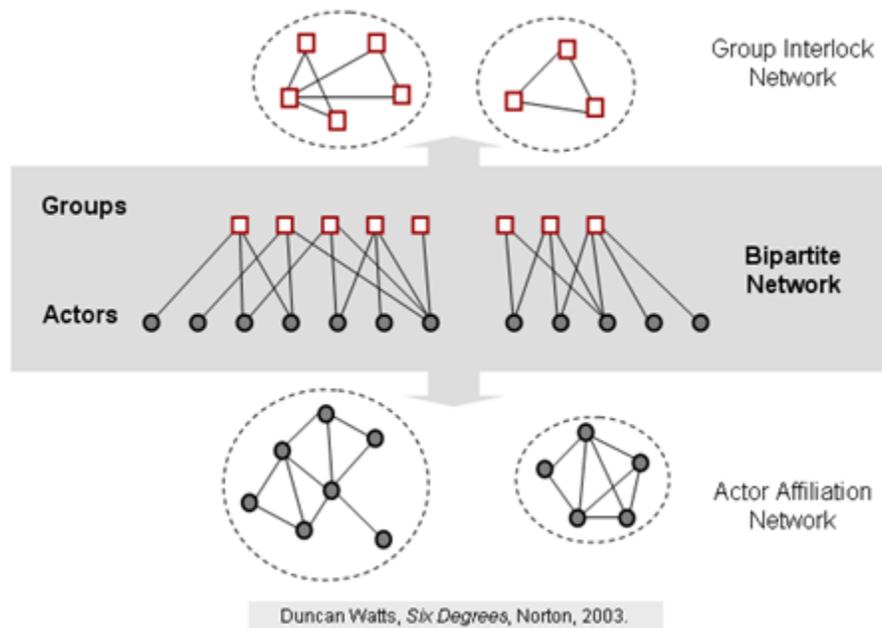


directed link in the configuration of positions cannot reflect the quality of the human interaction, it can attest to its highly likely presence.

Translating the hierarchy into an interlocked set of management teams provides a start on mapping your position in the pattern of message traffic. Span plays a huge role here in defining the extent of the circle of leadership connections. Most managers lead small groups and report into someone else who is part of a small group; some may have a large span or report to a hub; and, a few hubs report to hubs.

Circles of connection expand as other groups and organizations add to the mix of leadership units. As in management teams, we can assume that members of other functioning groups, with some probability, know other members of their group. Adjustments to the likelihood of acquaintance can be made for size, with smaller size meaning more probability of personal connection. However, every formal organization structure is either a small group or is composed of small groups, so circles of direct connection are implied throughout.

Figure 9: Bipartite Network of Groups and People



When we create a network of groups with positional actors, we have constructed what in network terminology is known as a “bipartite” network (see Figure 9)⁹. Network models with both group and position nodes offer fascinating new ways to assemble configurations. A bipartite network can be projected into two unipartite networks (which is the typical kind):

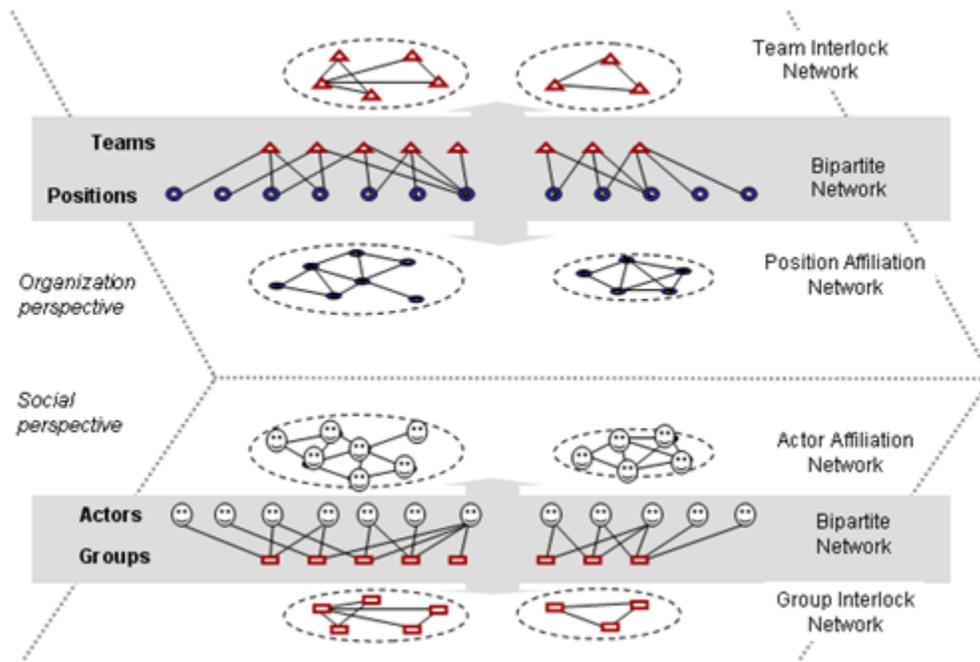
- A “group interlock” network where groups are linked when they have one or more members in common; and



- An “actor affiliation” network, a web of relations with other actors that springs from a position’s membership in multiple groups.

Where positions are affiliated, people are sure to follow. So a group membership scheme based on positions can be flipped to reveal an implicit underlying social network of personal connections.

Figure 10: Overlapping Bipartite Networks Relate Positions and People



Affiliation networks are well represented in studies of scale-free networks and small-world clustering. Literally comprising actors, the famous “six degrees of Kevin Bacon” game based on the database of actors and movies is a bipartite network, the movie serving as the group to which an actor belongs with other actors in the picture. Another example is the network of scientists drawn from paper publication databases, where common authorship on a paper (the group) is taken as evidence of relationships between scientists. One of the earliest studies in this area brings us very close to our topic, corporate board memberships.¹⁰ Studies of these bipartite networks reveal the interlocked networks of boards and, quite distinctly, the social networks of people connected through common board memberships.

A people-in-position affiliation network arises from co-membership in management teams and other position-based groups. This social network is related to but different from the formal positional structures from which it springs. The pattern of personal relationships implies associations in multiple groups. Thus, there are really two interlocking bipartite networks, one of orgs composed of positions and the other social groups composed of people (see Figure 10). Interpretation is a matter of perspective, positional or personal.



We cannot pretend that somehow the welter of personal connections in and around an organization is fully mapped by projecting the affiliation network from formal working group memberships, but it's a big step in that direction. Personal network data gathered by social scientists complements the organizational data described here, each framework adding insight to the other. Many tools of social network analysis (SNA) will be particularly valuable in deepening our understanding of organization networks of positions, especially clustering and path-length (small-world) metrics.¹¹ Current SNA tools are among today's hottest new entries for enterprise software¹² and a host of new web services.¹³

However, when network data is collected and analyzed as an ordinary course of business, we need to be extremely careful in our development and use of person-based information maps. Happily, connections and communication based on position are by implication more public and more available to the organization than those of private people on private matters. Unhappily, there is not now an easy way to separate these two classes of messages, since IT transitioned from positional logins to personal logins. Ideally, we could toggle between our positional selves and personal selves as we roam cyberspace sending emails, posting notes, and performing a myriad of other communication tasks.

Cooperation and Competition

Internally, the organization functions predominately through collaboration. Externally, it's another matter. Each organization player is embedded in external networks with different proportions of cooperation and competition. Boundaries of external networks relative to a particular organization can be defined by "degrees of separation" from core nodes.

- *Organization* is the predominately cooperative configuration of a core set of nodes connected to a root;
- *Neighborhood* is **one** link away from an organization's core nodes and is a mix of cooperative and competitive relationships;
- *Community* is **two** links away and is, by analogy to a local ecology, predominately competitive; the
- *Environment* is **three** or more links away and appears as a chaotically uncertain landscape (mainly due to lack of knowledge).

For intra-neighborhood (one-degree) relationships, there is usually a healthy and rambunctious mix of cooperation and competition. Lots of mutualism mixes with patterns of looking out for "number one." Common defense against foreign enemies combines with sometimes lethal scuffles as local niches get sorted out. Think of the inherent tension in customer-vendor relationships where collaboration and competition are both present for both parties. So clear is this



cooperative-competitive dynamic in the near and dear external neighborhood that it has a name: co-opetition.

Intra-communities (two-degree) relationships are dominated by competition, being the larger market domain in which the organization and its local neighborhood are embedded. The community-ecology label is meant to evoke the metaphor of local biological environment where every organization and species of organization competes for survival and interdependently shape their shared landscape. In its ecology are all the competitors an organization worries about, all potential collaborators, all relevant regulators, and all agents representing relevant physical and economic factors. The local context is the immediate marketplace that matters as an organization pursues its happiness.

Beyond the generally understood local community ecology lies the vast Darwinian terrain of the environment, a source of unpredictability, sometimes helpful surprises, and often toxic variety. From beyond the local horizons, storms of unimaginable catastrophe sweep away whole neighborhoods and communities of organizations. This destruction also seeds new cycles of diversification and complexity. Environments are, from a root organization network's perspective, chaotic. But, still, it's a small world.

- *The world of everybody together is **six** or so links apart.*

We are all connected to everyone. Some are closer than others, but none are far away. The edge of the human world is not itself very far away. Stanley Milgram has demonstrated that we are all connected by only six degrees of separation, by six links. But you already knew that.



Footnotes

¹ Our skin turns over every month, liver every six weeks, skeleton every three months, DNA every six weeks—these are just some of the representative exchange rates found in a brief web search with references ranging from an [Italian chemist](#) at the University of Bologna to [Deepak Chopra](#).

² An unkindness of ravens is the term for a flock of them. See also *An Unkindness of Ravens: Poems* by Meg Kearney (BOA, 2001).

³ The OrgScope technology is built on top of a “hyperbolic viewer” first developed at Xerox PARC in the mid-1990s. It is designed to map networked organizations using the five node and 10 link types described in this paper. See <http://www.netage.com/orgscope>.

⁴ Albeit a position may sometimes be shared by several people, as in job-sharing. Most co-leadership positions, such as co-presidents, are better seen as two or more positions so tightly entwined that they function as a single root, leadership, or specialist role.

⁵ The Rule of 7 is commonly considered to apply leadership reporting spans, strengthening the myth that organizations have normally distributed reporting structures. See www.well.com/user/smalin/miller.html.

⁶ The principle proposed by Wolfgang Pauli in 1925 states that no two electrons in an atom can be at the same time in the same quantum state or configuration. It has since been demonstrated to hold more broadly in quantum physics, and some (e.g., Harold Morowitz) have proposed it as a broader law within the evolution of complexity.

⁷ The group includes the in-degree of a leadership position plus the out-degree, the span, reflecting all the primary reports to the leader.

⁸ In a small group, we typically assume a nearly all-to-all set of personal relationships, which yields a clustering coefficient near 1.

⁹ Duncan Watts, *Six Degrees*, Norton, 2003.

¹⁰ Davis, G. F. “The significance of board interlocks for corporate governance,” *Corporate Governance*, 4, 154–159, 1996.

¹¹ See the International Network for Social Network Analysis [insna web site](#).

¹² For example, [Tacit](#) and [Visible Path](#).

¹³ For example [Facebook](#), [Friendster](#) and [Linked-in](#),