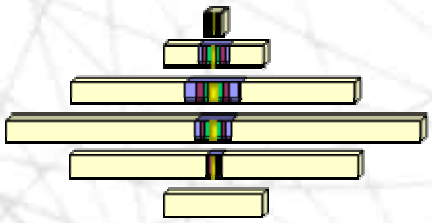
NetAge Working Papers

February, 2009

Principles for Reorganization

How To Mix Levels, Span, and Size to Maximize Communication and Decision-Making



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.

In "Analyzing the Organization as a Network," NetAge Report #2, we introduced the idea that common thinking about hierarchy might be wrong. We laid out three myths, contrasted them with three realities, and used the org chart of the most senior levels of the US government to illustrate some key findings about hierarchy. Then, in NetAge Report #4, "Organizing at the Edge of Chaos," we set out this hypothesis: hierarchy is shaped by contrasting tendencies to minimize communication paths and maximize decision-making. We came to our conclusions during a three-year-long detailed study of the hierarchical structure of one case, a 5000-employee unit of a global company. Eleum is a real company, the name a pseudonym. Our story and initial report on the Eleum case was published as The Virtual, Networked Organization, the concluding chapter in the *Handbook of High-Performance Virtual Teams* [1]

Here we offer a more detailed look at the data behind the hypothesis in Report #4, and provide greater insight into the metrics that those responsible for enterprises can use to reduce risk of failure, extend leadership circles, and improve organizational designs.

Related Writing

NetAge Reports on Reorganization

#1 - The Digital Reorganization Chart

#2 - Analyzing the Organization as a Network

#3 - How to Reorganize Virtually

#4 - Organizing at the Edge of Chaos

Full report - Reorganization: How to Create Smarter, Better, Faster Organizations without Moving the Boxes Around

Working Papers on

Management Science for Networked Organizations

Principles for Reorganization: How to Mix Levels, Span, and Size to Maximize Communication and Decision-Making

The Virtual, Networked Organization: How One Company Became Transparent

Organizational Networks: Core Concepts of People, Positions, and Relationships

The Stadium Parable: Making the Organizational Network Concrete

Revolution in Networks: Applying the New Science of Networks to Organizations

A Measure of Complexity: Organizations as Complex Adaptive Networks

A Systems Science of Networked Organizations

Table of Contents

Hubs in the Diamond Hierarchy

In this working paper, we present the data behind our theory of hierarchy as a network. We show how the complementary dynamics of communication and decision-making play out in the unexpected properties found in hierarchy. We provide more data detail because it allows a deeper look at the forces that shape the formal structure. These measurements of structures and forces enable organizations to predict and to prescribe, two hallmarks of science.

Accurate maps and data of organizational networks of positions help us see and understand the global configuration of relationships, which enables us to make better local decisions.

Our organizations are human. Humans organize themselves. They are self-organizations.

Self-Organizing Intelligences

Self-organization, a term introduced in the 1940s by Ross Ashby, has been a foundation idea of cybernetics, systems science, and, more recently, complexity science. It refers to the ability to change and grow in complexity without outside guidance.

Self-organization is the only route to managing complexity writ large in a networked world. “It” must manage “itself.” Indeed, the organizational network is already managing itself, but remains largely unaware it is doing so.

As we said in NetAge Report #1, “The Digital Reorganization Chart,” start toward a conscious process of self-organization by mapping the current formal structure. Then assess the existing pattern of communication-decision dynamics as suggested by the Eleum example that follows here. This analysis is available to all organizations. It falls out of the reporting data already sitting in the enterprise data system, much of it gold-standard quality in terms of accuracy and completeness.

Use the global map to provide context for local mapping and design decisions. Bring local intelligence to bear on local questions of optimal fit for purpose. This is redesign from the inside out, local answers to factors of size, span, and levels to meet immediate conditions.

At the same time, local decisions roll up and effect organizational behavior at larger scales. It falls to the executive cadre, managers who are directing teams of teams, to balance the strategic direction of large-scale goals with the local tactical optimization solutions.

Simple sorts of size and span spotlight the hub positions and bring extra attention to those critical areas of the organization. In particular, an organization wants to highlight the hotspots. Is this dual-hub structure the right design for this set of circumstances? If so, are the right people in these high-stress positions?

As Eleum demonstrates, knowledge of the level, span, and size of every position is immediately useful information with many practical applications. And it's not just about better, more adaptive organizational structures. It is easier to get the right people and skills into the right positions when you know the position's multiple roles in the overall configuration.

Measuring Hierarchy

We map organizations by the relationships among people's *positions*, their jobs, not their *personal* connections. Positions are the people-sized units of organizations. People flow into and out of this network of jobs. When people change positions, or leave an organization, the job remains, enmeshed in a network of relationships that await the next job-holder.

Everyone in an organization occupies a seat—a job—from the CEO to the janitor. Jobs collect together into sets of departmental containers. Each job connects to a boss through a single (solid-line) reporting relationship.

For the Finance function, these reporting links designate the managers who authorize paychecks for people in authorized positions. People's jobs collect into "headcount" within nested department boxes that provide the "roll-up categories for budgets and performance metrics. This is the standard model of the modern hierarchy-bureaucracy. It's also the reason hierarchy data is so readily available to organizations.

People and positions are two great entangled—yet distinct—networks that together animate real organizations. There is a growing effort to discover and map social networks in organizations, to better understand people-based patterns of influence and power.[2] We proposed to Eleum that we explore the other kind of network, the one that comprises all positions in relationship to one another.

A treasure of valuable insights, new tools, and immediately applicable guidelines sits in plain sight right under our collective noses. At its core is the much-derided hierarchy.

Eleum's reorganization combined eight country-based enterprises into a "region," a major business unit in one of the world's oldest companies. Let's begin with mapping the new organization chart, we suggested. Then, if the results looked promising, we would add other connections among the positions, like the matrix (what some call "dotted-line") reports, process links, team memberships, information flows, and even the personal relationships mapped in social networks. At some point, we reasoned, "hubs," key positions that have many more connections than most others, would begin to show up.

Why would it be important to identify such hubs, Eleum's chief executive asked? The answer was straightforward: Natural networks have "scale-free" properties.[3] This means that these certain key nodes—hubs—are the pillars of strength, the power spots that hold the whole together in robust structures. Hubs are also the

points of greatest vulnerability for networks. Take out a few strategic hubs and the whole thing collapses.

Identifying his hubs sounded like high-value information about his new organization and Eleum's CEO agreed to sponsor the work, with one proviso: Results had to be immediately useful.

Long story short, to analyze the organization as a network, we needed the right tool. Building on technology originally invented at Xerox PARC, we developed OrgScope, software specifically designed to model organizations as networks.[4] Into the OrgScope engine we fed high-quality HR data taken directly from Eleum's human resource system, in this case, SAP. Almost instantly, we were able to generate a very accurate model of the whole 5000-position formal reporting hierarchy. It was Eleum's entire org chart in one picture, one interconnected network that included every position.

To both our amazement and that of Eleum's executives, hubs showed up immediately.

Results in hand, Eleum's executives reacted quickly. They put to use what they learned from measures of position level, manager span, and sub-organization size. For example, leadership groups were studied and changed, new internal communication strategies devised, and high-risk positions examined. Results, immediately applied.

The Diamond Hierarchy

Every job occupies a place at a certain level in the hierarchy, the count of links to the top boss, or root node.

What is the real shape of an organizational hierarchy? At nine levels, Eleum seems to be a steep pyramid indeed. But, on closer inspection, it's not. The distribution of positions by level (see Figure 1) shows the distinctive bell curve of a random population. Its average position level is 6.1.

> *Myth #1: Hierarchies are shaped like pyramids.*
>
> *Reality #1: Hierarchies are shaped like diamonds, wide in the middle, narrow at both ends. Picture a bell curve turned on its side.*

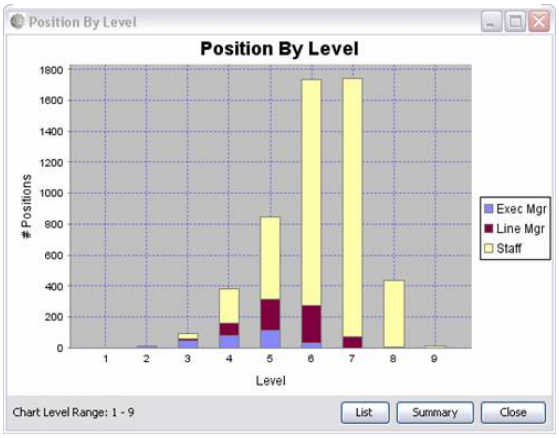
In profile, turned 90 degrees, the structure looks more like a diamond. Most positions are in the middle levels, not at the bottom. It doesn't look like a pyramid at all.

Perhaps our large-scale organizational hierarchies never have been pyramids. Which means our most basic mental model of organizations may be fundamentally flawed.

Why does this matter?

Consider the case of BP, which we discussed in greater detail earlier (Report #4). BP is said to have 11 levels for an organization of roughly 100,000 employees.[5] If the pyramid is your mental model of organizations, then you envision BP with a vast base at the lowest levels. A regular 11-level hierarchy with a fixed span of 6—meaning every manager has six direct reports—would employ 73 million people.[6] With the same view, you might also mistakenly assume there are large numbers of managers in bloated middle layers. These, you would imagine, could easily be eliminated at great cost savings. Cut away, except, as it turns out, there's not much there.

Figure 1: Distribution of Positions



Eleum data. Average position level 6.1; standard deviation is 1.14. Average manager level is 5.13.

To identify and make comparisons within an organization's complete management structure, we calculate three generic roles:

- *Staff* with no one reporting to them;
- *Line* managers with only staff reporting to them, often called supervisors; and
- *Executive* managers who have line and/or executive managers reporting to them.

While executive management is typically defined from the top down, we have tagged roles by calculating their hierarchical function from the bottom up.[7]

Positions, sized for individual people, are the "nodes" of the organizational network. Managers (with one or more people directly reporting to them) also represent the inherent management teams of the hierarchy.[8] Executives further represent multi-team organizations with their larger-scale decisions and effects. The CEO, for example, simultaneously operates at the individual scale of a person occupying a position, as leader of the small senior team, and as legal representative of the organization as a whole. It is the multiple roles that manager nodes play that give the spare one-line hierarchy its multi-scale texture.

Now, let's go back to the question of suspected manager bloat. In the Eleum dataset, 83% of employees are in staff positions with no direct reports; 17% are managers. Of those, two-thirds are line managers. Only 5.4% of positions belong to executive managers with organizations of three or more levels. This 83%-17% ratio compares well to an 80%-20% split found in a regular hierarchy constructed to approximate Eleum's size and span.

Not surprisingly, Eleum's managers are concentrated in the upper levels where structures have high ratios of managers to staff. In the company's three highest levels, the staff-manager proportion is 33%-67%. A high proportion of managers suggests optimization for complexity and decision-making. Conversely, there are fewer managers at the lower levels where structures appear more optimized for communications—across Levels 6-9, the staff-manager pair is 91%-9.0%.

A step between any two levels is one degree of separation. As a normal curve suggests, Eleum is widest in the middle, and its average position sits at Level 6.1. So, on average, an Eleum employee is five degrees of separation from the CEO. A large organization is its own little world.

The big finding here is that positions are unexpectedly randomly distributed across the levels. This characteristic variety serves the needs of "complex adaptive systems."[9] Natural variety in this real hierarchy shows up again in span and size measures.

Span Hubs and Smalls

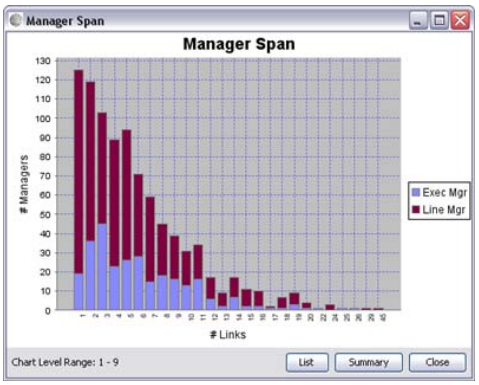
> *Myth #2: Most managers have roughly the same average span.*
>
> *Reality #2: Manager spans are not average. They vary widely with many managers directing quite small teams with only a few direct reports while a few manage large teams with many direct reports.*

When we first saw Eleum's map of 5000 positions arrayed as a single network, we were amazed at the variation in its organizational "topography." Our "hyperbolic viewer"[10] allowed us to "fly" over Eleum's hierarchical landscape. We could see steep mountains of small teams and many levels contrasting with flat plains of large teams and few levels.

To say Eleum's average manager span is a modest 5.8 leads most people to assume that some managers have a few more reports and some fewer reports along a bell-shape distribution. This range is the load we expect the "average manager" to carry.

Most organizations have created standards and policies that they apply relatively uniformly to all managers (e.g., for performance reviews). In other words, they operate on the assumed "normal" model of formal leadership. However, the "average manager" is another part of the conventional view of hierarchy that we think is likely wrong.

Figure 2: Distribution of Spans



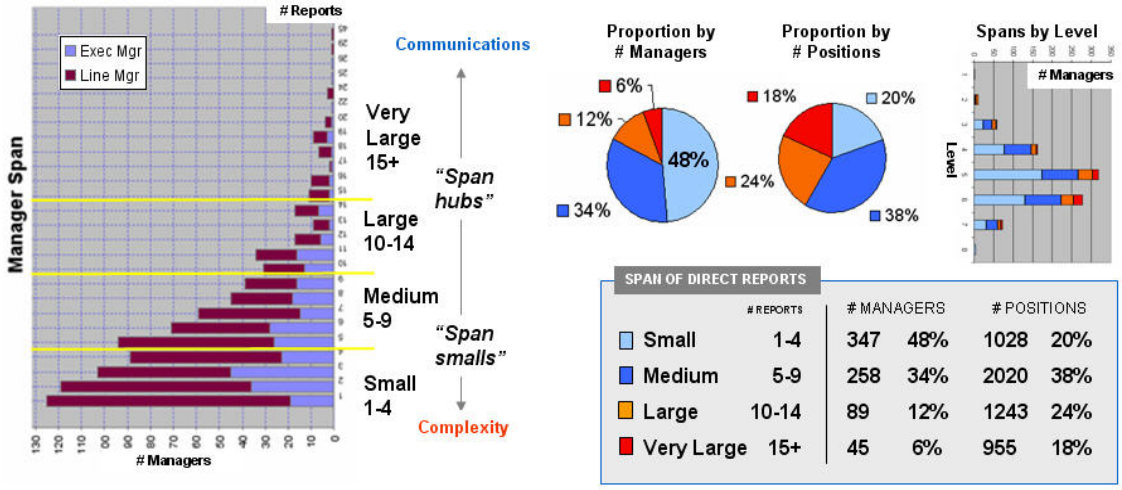
Eleum data. Spans range from 1-29 (one at 45). Average manager span 5.8. Average degree all positions is 1, with a standard deviation of 2.93.

When we plotted span for all managers in Eleum's hierarchy, we saw the ski-jump curve of a long-tailed exponential distribution (see Figure 2). It looked more "scale-free" than normal. In complex physical, biological, and social networks, scale-free refers to a distribution where a few nodes (positions) have many links (reports) and many nodes have few links.[11]

Hubs, with reporting spans ranging from ten to more than 30, are found in the long tail of Eleum's distribution. These are the most obvious features of the organization's topography, the many-spoke wheels of really big teams. We came to call these "span hubs."

Span hubs, about 18% of the managers, appeared at all levels of the organization (see Figure 3). Why is this important? Over several years of practical application, we learned that span hubs play key communication roles: they talk directly to almost half the organization (42% of the people).

Figure 3: Manager Span Categories and Proportions



Eleum data, grouped by span. Colors in rotated span plot (at left) identify line (purple) and executive (blue) manager roles. Colors in the pie charts and level distribution (right side) are keyed to the span categories.

Another 34% of the managers had spans of five to nine, teams that comprise 38% of the organization. This range is the expected "band of normalcy" for direct reporting relationships.

However, half the managers had four or fewer people reporting to them. Together, these teams comprise just 20% of Eleum's jobs. While span hubs were a big surprise to Eleum's managers, they (and we) were also surprised that so many managers—so many smalls—were directly responsible for so few people. Apparently, "one size fits all" managers doesn't fit two thirds of them—18% have larger teams than expected and 50% lead smaller than expected groups.

The communication value of the big hub teams is clear—it's easy to communicate with them. But why is the number of small teams so high? Are smalls a mistake? Are they the product of lazy managers? Maybe this is where organizations should go to take out some "slack." Improve communication by reducing managers and flattening levels. This would also cut costs, giving an apparent double bonus for de-layering. What's to lose?

The loss, potentially, is in the capacity to manage complexity and make better decisions. More levels and smaller teams enable more complex decision-making. This complexity capacity is squeezed out when the unexamined "flat-is-best" structure prevails, leaving big teams and minimized levels. By itself, this prescription for centralization is likely too simplistic in a globalizing world of increasing complexity.

Apparently, human hierarchy pulls off a way to do both. It stretches for the communication ideal while also accommodating the need for complex decision-making. How does it do this?

At Eleum, spans range from one to 29, with one outlier—an overburdened, it would appear, manager with 45 people on staff. The wide variety of spans gives the real hierarchy strength in both communications, with a few large hubs, and complex decision-making, with many small-span teams. Here, complementary organizing tendencies produce this pattern:

- *Most managers run small teams, "span smalls," that are good for decision-making.*
- *Most people work in large teams, "span hubs" that are good for communicating.*

High-span managers appear at all levels at Eleum, but most of them are in the middle of the organization, at Levels 5 and 6. This is well out of the visibility range of people working in the top levels. However, a network of hub managers offers express lanes of internal communication directly to the bulk of the organization.

Size, Leadership Circles, and Hotspots

Size Hubs and Smalls

- *Myth #3: Executives at the same level run organizations of roughly the same size.*
- *Reality #3: The size of most internal sub-organizations is small, at all levels. And, there are a few large organizations that show up at nearly all levels, not just at the top.*

A basic global property of all organizations—networks—is size, meaning the total number of positions (nodes). In network terms, size is the count of a node's sub-tree, plus itself. For line teams, size is span plus one manager; for staff positions,

size is one. For Eleum's CEO, his organization size of our snapshot data set is 5247.

In the hierarchy network, size (minus one) is the count of links. These direct solid-line reporting relationships mark the decision-making structure, the lines of accountability, the "bottom-line" reponsibilty for results. It is also the infrastructure for transmitting decisions, goals, and strategies to the organization—the executive communication system.

The logical hierarchy constitutes an organization's formal classification system. Formal structure is the set of roll-up containers the finance function uses to aggregate information that becomes budgets and performance metrics. Size at the unit scale of position is headcount in the financial system. Thus, network metrics can easily be compared to financial and other performance metrics, extending the explanatory value of both sets of numbers.

Size (also the sum of internal degrees of separation) and its tree of connections represent the "perogative of leadership." With the right to direct any message or decision to any or all positions down a chain of command, the boss shouts, "Send a message to all my people."

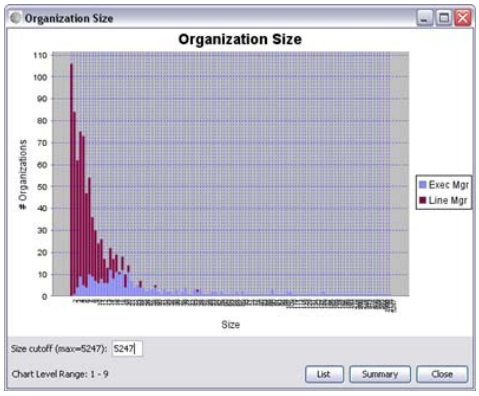
To say that managers with large sub-organizations are important seems almost tautological in management terms. When we sort Eleum's managers by size, the obvious ones pop to the top. But, there are a number of surprises deeper down, where we unexpectedly find managers with large organizations. While it is useful to recognize these managers and add them to leadership groups and training programs, it is hardly major news.

However, size is important, so we dubbed the large sub-organizations "size hubs." At first, we did not really appreciate the role these size hubs play. However, they are the key to a natural network's "robustness," its survivability in practical terms.

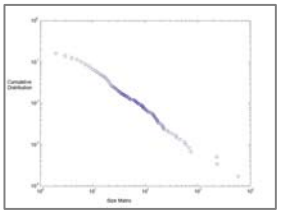
The major news is the now-obvious scale-free distribution of size: The power law operates in the heart of the formal organization.

The distribution profile of size produces an even more dramatic ski-jump, long-tail slope than the span does (see Figure 4). At Eleum, the

Figure 4: Distribution of Size



Eleum data. Total nodes are 5247. Average manager size is 30.8. Average size all positions is 6.13, standard deviation 85.8. The log cumulative plot is below:



sub-organization sizes range from 5247 for the CEO (all nodes) to one for a staff position. Average size for all sub-organizations (including staff units) is 6.1.

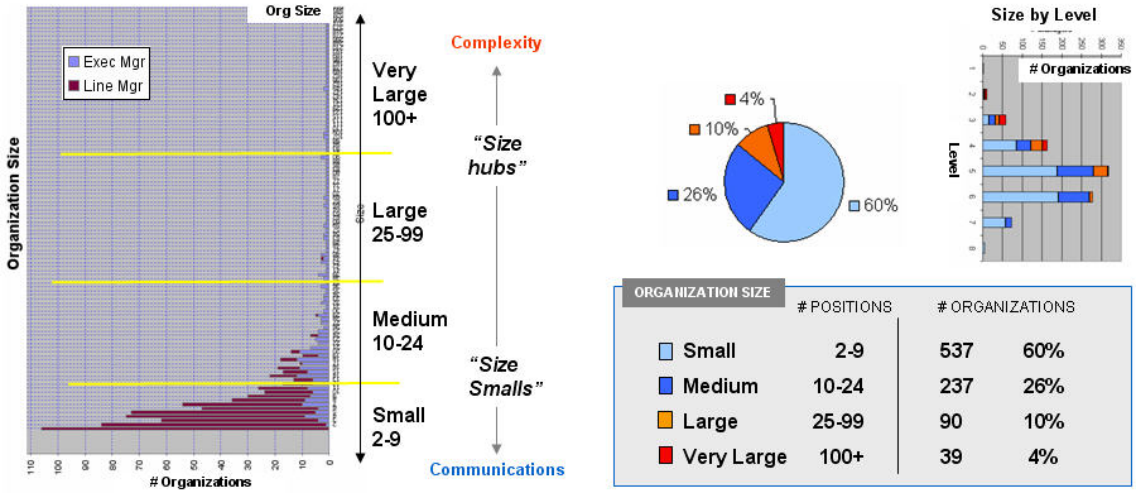
The scale-free properties of a power law govern size at Eleum. Evidence is the straight line of its log cumulative plot.[12] The size hubs along the long tail are the key nodes in a hierarchical network.

As pillars of robustness, hubs are measures of the ability of a network to withstand the inevitable accidents that knock nodes out of commission. Quite simply, because hubs are relatively rare, they are less likely to be randomly hit. A scale-free network is more likely to survive than a regular or random one—it is more robust. Hence, nature turns out to be full of scale-free networks. They are the ones that survived and evolved.

But, robustness comes at a cost. If a few hubs are inadvertently or deliberately taken out, or these positions are poorly understood and under supported (likely at lower levels), the network is severely damaged. Hubs are responsible for both the robustness and protecting the vulnerability of the networks they hold together. These are the natural centers of an organization's strengths, and its pools of risk.

At the small scale, more than half of Eleum's managers (60%) run very small organizations—two to nine positions (see Figure 5). Another quarter of the managers (26%) run big line teams and small multi-level organizations that overlap in the 10-24 position-size range.

Figure 5: Organization Size Categories



Eleum data, grouped by size. Colors in rotated size plot (at left) identify line (purple) and executive (blue) manager roles. Colors in the pie charts and level distribution (right side) are keyed to the size categories.

Only 10% of managers are responsible for large groups of 25-99. A tiny set (4% of all managers) run organizations of 100 or more people. These 39 managers, a

mere 0.7% of Eleum's positions, appear from Level 1 through Level 6. They are the most critical hubs that hold Eleum's hierarchy together. And, they are not all at the top.

We group size into four categories: small, medium, large, and very large. "Small" groups are those with fewer than ten. Neither people nor families live alone in a "natural state," but rather in small-group communities. Throughout the Nomadic Age, four-or-five families of four-or-five people lived in camps of 20-30 people. We call the group of ten to 24 positions a "medium" size. Managing small groups of medium size is probably quite literally in our genes.

The "large" category refers to sub-organizations with from 25 to 99 people. This is a well-known transition zone between the informality that groups with fewer than 25 people have and the formality that increases as sizes grow to 100 and more. Formality provides essential infrastructure in larger organizations where everyone can't know everyone else, or even very many people (relative to the size of the whole).

Our fourth category is "very large," organizations of hundreds and thousands that first arose in the Agricultural Age. Large grew larger in the Bureaucratic Age, and size is expanding again in the global environment of the current Information Age. All this growth in organization size has occurred as human population has grown exponentially. Managing organizations sized by orders of magnitude is definitely not in our genes.

When it comes to size, decision-making craves bigger organizations and communication wants them to be smaller. As the pressure to innovate and adapt to external complexity increases, organizations grow in size to incorporate more specialization and the leverage larger size brings. Under the contrasting pressure to speed communications, decisions are pushed down to smaller organizations. Information-sharing is simply simpler with fewer people.

With its distribution of size, human nature again finds a way to satisfy both organizing dynamics:

- *Most managers run small organizations, "size smalls," providing conditions favorable to communication.*
- *A few managers run large organizations, "size hubs," which favor the capacity to deal with complexity.*

It is startling to think of how few people really have experience running large organizations. We are still on a steep learning curve of how to do it well.

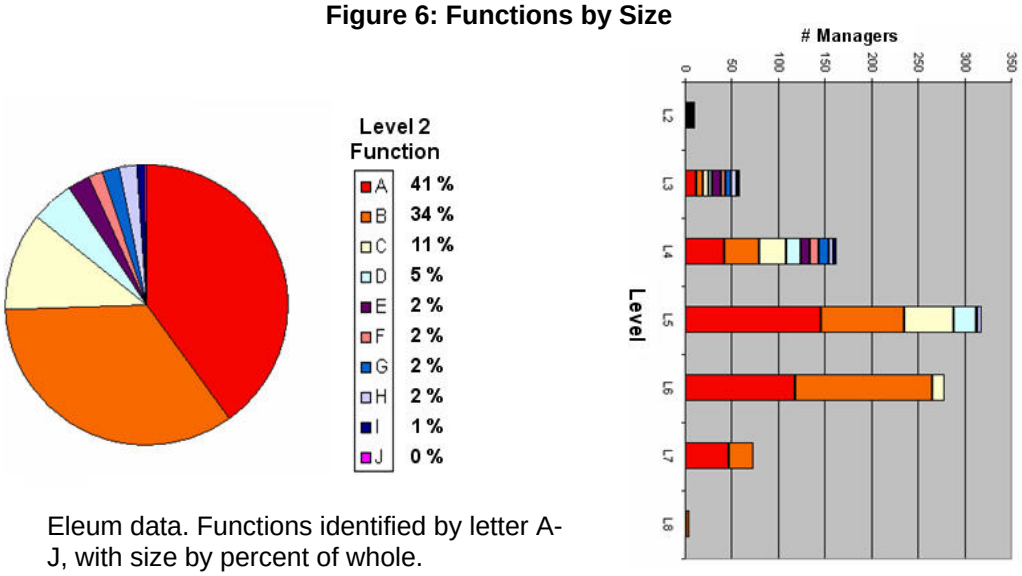
Leadership Circles at the Top

Even though we know otherwise, we behave as if the people who sit around the CEO's table run functions of similar size. This is another fundamental flaw in the standard view of hierarchy: managers at the same level run organizations of roughly the same size. As we've already seen, they don't.

Two of the ten people reporting to Eleum's CEO run organizations that comprise 75% of the company's positions (see Figure 6). By the 80%-20% Pareto Principle[13] (typical in power-law situations), this is not surprising. These "function hubs," responsible for three out of four people in the company, are the centers of the organization's complexity and, almost inevitably, its operating model.

Size is not obvious from an organization's topography in the same way that span and (local) levels are apparent. With a horizon of only a few degrees of separation across levels, it is hard to get a sense of size. But the distribution of size hubs is really important, particularly at the top.

Figure 6: Functions by Size



Eleum data. Functions identified by letter A-J, with size by percent of whole.

How many function hubs sit at a chief executive's Level 1 table with its typical seven to ten places? These seats represent a handful of interdependent operating units (e.g., Engineering, Manufacturing, Sales) and a few support functions (such as Finance, HR, and IT). Among the operating units, there are likely one, two, or three hubs who dominate Level 2.

There are only a few possible patterns at the top: One function has a near-monopoly, two interrelated functions split the bulk, or there is a more complex arrangement of three or four functional hubs. The more size is smoothed out at each level, the more random the distribution, which leads to less robustness.

Very unequal size of the top-level functions explains much of the mystery of how a lot of largely pyramidal functions add up to a normal distribution across levels. Most small functions, with only a few levels of structure, are quite naturally triangular, their heavy bases helping to fill out the middle levels. Larger functions reach deep to lower levels of organization. Indeed, the two large functions at Eleum have bell-curve distributions similar to the pattern of the whole.[14]

Standard Leadership Structures

Unequal function sizes, if unrecognized, have serious consequences for strategy discussions. Conversational opportunities for people at senior levels of big organizations tend to be arranged from the top down. Default circles of leadership reinforce hierarchy myths and spread distorted mental models of their own structures.

What happens when leadership is both defined top-down and is coupled with inattention to the tremendous differences in size? Big functions and their deep layers of leaders are woefully underrepresented in the strategic conversations of the enterprise. How does this come about?

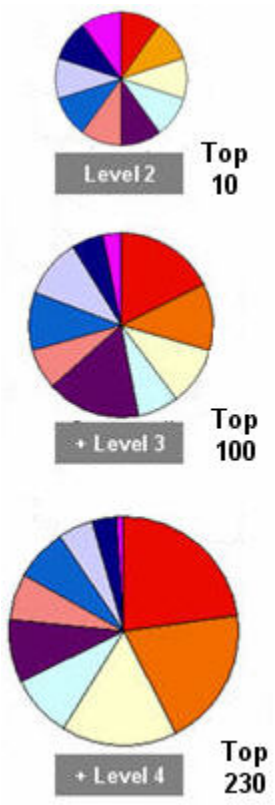
First, for every organization, are the top leaders, people who occupy seats on the CEO's team. All functions are, of course, represented in equal proportion, as the top circle shows (in Figure 7).

In most large enterprises, the second circle embraces the "top 100" senior leaders. This extended circle usually includes the Level 3 positions that report to the function chiefs. Leadership representation typically depends on the Level 2 manager spans, not the function's relative size. Thus, a function's representation in the extended circle depends on the span of the function's leader.

This pattern tends to repeat itself. Leadership structures based on leader span a level above cascade down through the organization.

There is likely a serious distortion in the mental model of hierarchy held by the people at the top. Diamond-shaped hierarchies all have a similar sharp peak. This means the view from the top of one large organization looks remarkably like the top of another similar structure, just with different labels on the boxes.

Figure 7:
Leadership Circles



Circles constructed from Eleum data, functions A-J. These **are not** Eleum's actual leadership groups. See Figure 6 for function color key.

At Eleum, span at the top tends to be a little larger (an average of seven for Level 1-3 managers compared to 5.8 overall). The whole effect of the management experience for the top three levels is of a relatively regular, relatively flat, and very pyramidal pattern. People assume this regular motif extends all the way down the unseen levels of the hierarchy.

The “bubble at the top,” this tiny sliver of organizational reality, conceals the real variation in the living structure beneath the senior executive waterline (at Level 3). Nearly the whole organization—98% in Eleum’s case—operates with very different mixes of size, span, and levels from those experienced at the top.

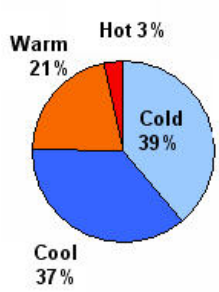
It’s not surprising that CEOs feel comfortable moving from organization to organization. It’s not that they know so much that can be applied anywhere, but that they know so little about the true nature of the hierarchy they sit atop.

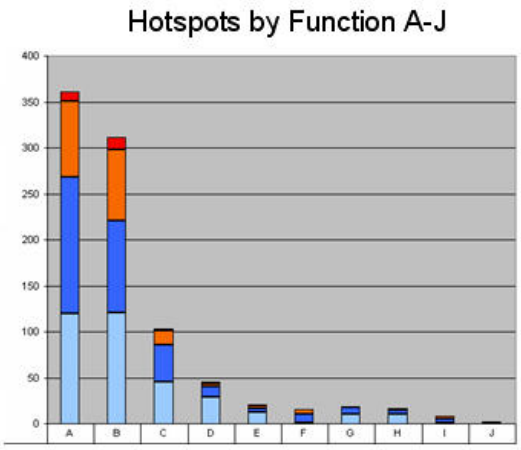
“Hotspots” of Span and Size Hubs

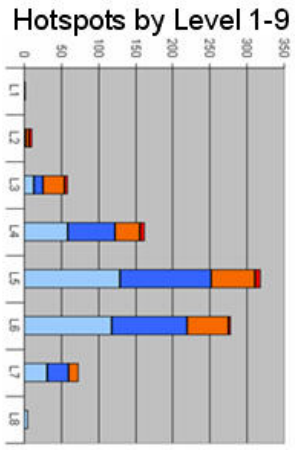
Two types of hubs power and anchor the organization—span hubs for communication and size hubs for complex decision-making. Sometimes these two hub types intersect in one manager.

Figure 8: Span and Size Hub “Hotspots”

	Index	Size	Span	Sum	Range		Name	#Mgrs
Very Large	4	100+	15+	8	7-8		Hot	29
Large	3	25-99	10-14	6	5-6		Warm	194
Medium	2	10-24	5-9	4	3-4		Cool	330
Small	1	2-9	1-4	2	2		Cold	350







Eleum span and size data. Span categories are from Figure 3; size categories from Figure 5.

Opposing forces come in contact most directly in a position that carries both types of hubs. These are managerial “hotspots,” as Eleum’s head of organizational development instantly dubbed them. You really want to know where these positions are, and whether the design is right for the circumstances. If the design is right, is the right person in what is highly likely a high-stress job?

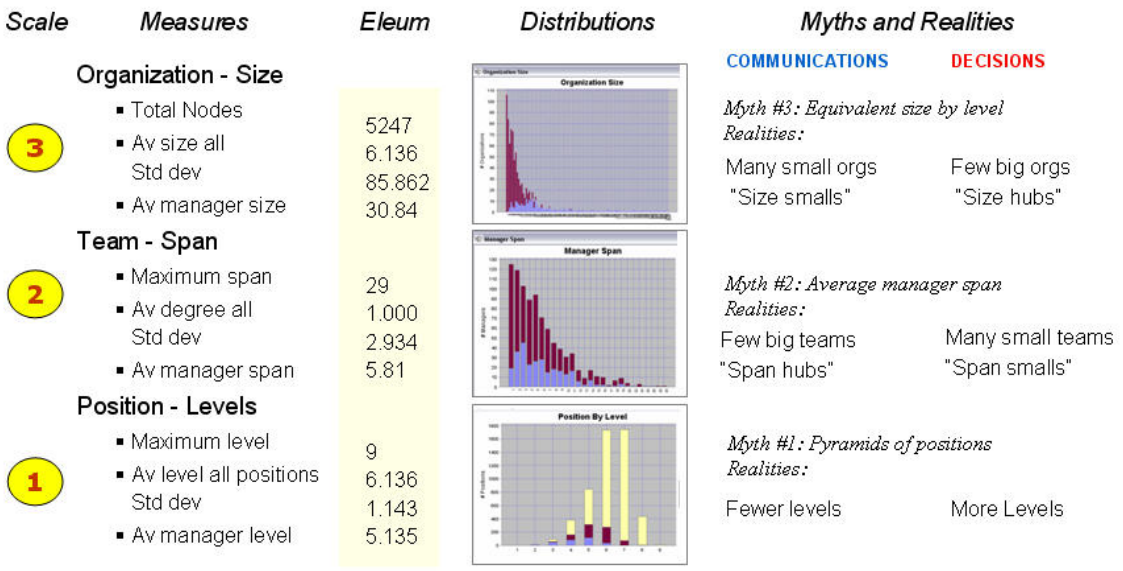
To determine hotspots, we combined the two hub patterns (see Figure 8). Indices of one (small) to four (very large) for each category are matched to the four-part classification schemes of span and size. The results approximate the overlap of hubs and smalls.

By this blunt calculation, a quarter (24%) of the managers seems to carry the hierarchy's most demanding jobs. Hotspots are found at every level, evening out the weight of size hubs higher up and span hubs lower down. They are most prominent in the two hub functions, the heart of the organization.

Summary of Framework and Data

Some genius can be seen at work in the human organizing processes. We summarize our conclusions in one chart (Figure 9), illustrated with key data from our case study.

Figure 9: Framework, Results, Hypothesis



See Figures 1-5 for more detail on the case study measures and distribution

Individual position (1), team (2), and organizational (3) scales each have a characteristic measure (level, span, and size respectively). Summary numbers and standard deviation values should allow those with some statistical knowledge to make a quick coefficient of variation analysis of the distribution profiles. Three myths map to the three scales and measures. Realities of the data are, we suggest, explained by the communication-decision dynamic, summarized in two columns for each scale.

We think this hierarchy case is archetypical. Our hypotheses are testable. If these results are borne out with more cases across a variety of organizational

types, then we will finally have proof that human organizations are not machines but natural networks. The network paradigm becomes the basis for a true management science to inform our collective design of our larger selves.

Principles for Better Organization

One case does not a proof make. But the right case unfolded the right way can be revealing of principles and properties that may apply generally, perhaps to your organization. The hierarchy data measures are replicable and the principles are predictive. With accurate prediction, prescriptive methods can follow.

Is Eleum an aberration or an archetype? Your data will tell. In any case, the data is directly useful, and the digital organization map can be visualized, navigated, and analyzed. It is also the necessary starting point for creating more complete maps of the internal working relationships with matrix, team, process, and information links added to the direct reporting (hierarchy) link analyzed here.

For a network-based management science, there is a very fast connection between an organization's self-research and its immediate use of the results to enhance communication, collaboration, and coordination.

Getting Started With Your Data

As we mentioned above, it is not hard to get the required enterprise data for creating the network map. The data is likely readily available and virtually free. Big organizations have already invested the necessary millions and billions in IT, Finance, and HR data systems over the last several decades.

You do not have to mine massive data bases to find what you need. A simple spreadsheet will do. An astonishingly small dataset reveals the hidden logic of a hierarchy. With just two fields, a position ID and a manager ID, where the manager ID is in the list of position IDs (excepting the top position), you can generate the one-node-one-link hierarchy network. Associated organizational, positional, personal, and place names and titles fill out this multi-faced box of an org chart.

The network essence of the entire Eleum enterprise, all the numbers presented and reviewed in this paper, is contained in a spreadsheet of 5247 rows and two columns of data. A network lives in a simple list of links between two nodes—a position and its manager.

A huge amount of intelligence is packed into a tiny data space extracted from a huge human resource system. The "secret code" of the organization sits quietly unnoticed in information stores that its people use every day.

Prediction of Current State

We use Eleum as a predictive model for how the hierarchies of many, if not most, large organizations (on the scale of thousands) are structured.[15] The three basic measures of level, span, and size offer a start to revealing this intelligence in any

organization. Maps convert to lists. In organizations, network nodes identify real people in real jobs.

Here's how it works:

Levels. First, map all positions by level. Based on Eleum's results, we predict that it will likely be shaped like a diamond rather than a pyramid. When aligned vertically, the diamond shape suggests a random distribution of positions across levels. This leap to prediction from one case is made because of Eleum's normal distribution, not a hard-to-explain curve or zigzag of data. Its longest chain of reports may be longer than expected to insiders, but the average level is likely to be in the middle and not so bad.

Spans. Next, an organization can test itself for span hubs. If it has hubs, like Eleum, then it can look to see if the work of its big teams reflects, generally speaking, a structure of high communication capacity. Conversely, an organization can look at areas with many small teams and deeper levels to see if, generally speaking, more decision-making is going on in those areas.

Sizes. After that, test for size hubs. If the power law applies, there are probably a few hub functions on the senior team. Senior people already know this. But they may not know exactly what the critical path of size hubs is down through the many levels of the organization. Who, specifically, holds the 1% of positions that knit the whole enterprise together?

Predictably, an organization has some areas (sub-organizations) adapted more for communication. These help align the organization along the strategic course set by top management. Other areas handle more complexity, situations that require making many decisions about more technical issues in greater depth. The communication-decision balance of each executive's organization can be tested for its average degree of separation and compared to groups of similar size.

For example, a two-level team of 25 (with an average degree just under one) is optimized for communication; its manager is a span hub. A three-level team of 25 is more typical (it has an average degree of separation between one and two), reflecting more of a balance between the dynamics. But a four or five-level structure of the same size would be predictably oriented to complex, specialized tasks (with an average degree of separation between two and three).

This calculation of average degree of separation works to make distinctions between any set of comparable-size organizations. Thus, the average degree for organizations of 100 can be compared. Relatively low averages point to communication optimization and relatively high averages point toward decision-making.

An organization already has a configuration of "hubs and smalls" denoting zones of differing capacity for complex decision-making and effective communication. An organization can continuously update this inherent network with current data as the formal structure changes.

Is it, however, the right configuration? Is it the smartest, most adaptive structure possible for the people who work in it?

Prescription for Improvement

The flip side of good prediction by principles is prescriptive power. If principles are explanatory by prediction, then you can use principles practically to shape organizations in the direction that enhances their fit with local circumstances (see Figure 9).

Figure 10: Complementary Organizing Dynamics

Scale	Communication		Decisions	Measures
Organizations	Small orgs		Big orgs	*Size*
Teams	Big teams		Small teams	*Span*
Positions	Few levels		Many levels	*Levels*

Structure is not static, particularly not now, with so many organizations in flux. Organizations are always tending either towards communication and centralization or decision-making and decentralization. And executives are constantly nudging organizations one way or the other to better fit the changing situation on the ground and/or the changing strategy at the top.

What can your “re-organization” learn from the analysis of Eleum’s hierarchy?

Eleum’s results indicate that:

> *(1) Most people work in the middle levels;*
>
> *(2) Most people work in large teams; and*
>
> *(3) Most managers run small organizations.*

These are indicators of centralizing structure optimizing for communicating, and thus they provide a recipe for how an organization’s vertical communication system can improve:

- *Decrease levels to minimize degrees of separation;*
- *Decrease the number of managers;*
- *Increase span, making larger circles of one-degree teams; and*
- *Decrease the organization size for operational decision-making to increase internal communication ability.*

Where organizations need to increase their capacity to make decisions, they can also look to Eleum for clues:

> *(1) Managers and staff are randomly distributed across levels;*
>
> *(2) Most managers run small teams; and*

(3) Most people work in a few large hub functions.

Thus, the principles that follow suggest a recipe for how organizations seeking to make better decisions can improve:

- *Increase levels to create more complex structure and classification;*
- *Increase the number of managers;*
- *Decrease span to make smaller teams; and*
- *Increase sub-organization sizes to include more variety and exert larger-scale effects.*

Being intentional about how a local organization should be structured is not somehow "going against the natural pattern." It is exactly what should be done. The remarkable effects of networks arise from the myriad local decisions made by all the nodes and clusters that comprise it.

Reprising Myths and Realities

The configuration you see depends on your mental model, your own mix of myths and realities about organizations.

The *"myth of the pyramid"* underlies the conventional method of executive communication. However, the actual diamond shape of the organization and the wide variation of (mostly small) spans explain why the standard cascade mode of communication is so ineffective. Not only does it contend with the loss of resolution as messages tumble down the levels, but most managers receiving messages have few staff to press them upon.

On the positive side, you can use the same knowledge of how people and functions array across the levels—especially where the structural communication centers reside—to deliver messages much more directly to the organization's bulk. With the real organizational topography in hand, executives can craft targeted communication strategies that use as few degrees of separation as possible.

The *"myth of the average manager"* has led to global policies and standards that only fit a minority of managers. Support functions like HR look to shrink and push responsibilities out to managers "in the business." While the majority of managers may report ease in meeting requirements, there also may be some apparent "whiners." These, unfortunately, likely include key managers with unusually large spans who are overwhelmed. Leaders of large teams probably need to do things like performance reviews in substantially different ways from managers with only a handful of reports.

Another salient distortion arises with global IT attempts to serve all managers and teams equally. However, the demands of communication-heavy teams for collaboration tools and virtual team training may be appropriately high. Managers and staff in more complex zones probably need more applications and support that reflect their greater diversities of specialties.

More positively, you can use the same diagnostic analysis to shape more tailored policies. Direct scarce support, training, and technology resources where needed most. Smarter organizational structure enables people to be smarter and more effective.

The *"myth of equivalent size by level"* goes with the general view that "higher is better" in hierarchies. It is very important to separate the social penchant for establishing value-based ranks and pecking orders from the general organizing principle of levels.[16]

In reality, critical organizational roles, which are found at all levels of hierarchy, are consequences of the configuration of the whole. As people move through various jobs around an organization, they find themselves traveling up and down the levels. People who are members of multiple teams sometimes play roles at several levels simultaneously.

This requires a mind shift—from being stuck at a level, or a structure of fixed levels, to working flexibly across levels. Shift to being aware of the effect of distance from the center as well as the effect of other, more local, leaders.

People confuse decentralization of physical location with organizational decentralization, which means more distance, more levels, away from central authority. When people say they are getting things done by "flying under the radar," innovation and experimentation being two such initiatives, they are usually cruising many levels below senior management oversight.

At the top, levels are a big deal, but further down they are just different elevations, the local topology of decision-makers, not such a big deal.

In consciously self-organizing, everyone shares a common, accurate model of the whole organization that can be periodically refreshed. With the whole in hand, everyone can better contribute to the next generation of organizational intelligence.

We really need much smarter organizations, quickly

Footnotes

[1] Eleum is a real company, the name a pseudonym. See more on the Eleum case in The Virtual, Networked Organization in the Handbook of High-Performance Virtual Teams (Jossey-Bass, 2008).

[2] See, for example, Rob Cross, *The Hidden Power of Social Networks: Understanding How Work Really Gets Done in Organizations*, Harvard Business School, 2004.

[3] "Scale-free" is the term applied to non-random networks where most nodes have a few links and a few nodes have many links, the latter called hubs. Scale-free networks follow power-law distributions.

[4] See more on OrgScope at our website: www.netage.com/orgscope.

[5] BP's announcement in October, 2007, of its plan to reduce an 11 level structure to 7 levels is the story that threads through our companion paper, "Organizing at the Edge of Chaos."

[6] Regular hierarchies, introduced in the preceding paper, expand by a power series, each level an increase of one in the exponent of span (e.g., $6^0+6^1+6^2+6^3\ldots 6$ to the 10^{th} power for 11 levels).

[7] In the graphs, such as Figure 1, staff are plotted in beige, line managers in purple, and executives in blue.

[8] Hierarchy networks are structured with directed links, *from* whole *to* part. All nodes, except the root, have an in-degree of one. Staff nodes have no out-degree. Manager nodes have an out-degree of one or more. Average degree of the whole network is just under one—each node, except the root, carries just one link, to its manager, into the hierarchy-only dataset. The miracle of natural hierarchy is that all these metrics and zones and profiles arise from a 1-node-1-link model--from its arrangement, its configuration of these mutually-exclusive node-link pairs.

[9] See "Organizing at the Edge of Chaos" for more on organizations as complex adaptive systems.

[10] John Lamping, Ramana Rao, and Peter Pirolli (1995) "A focus+context technique based on hyperbolic geometry for visualizing large hierarchies." In Proceedings of the Conference on Human Factors in Computing Systems, 1995, 401-408. Rao, the youngest member of John Seely Brown's team at Xerox PARC, was one of the founders of Inxight (who make the OEM platform for OrgScope), and is currently advising NetAge.

[11] The original paper on scale-free networks was "Statistical mechanics of complex networks," by Réka Albert and Albert-László Barabási, in *Reviews of Modern Physics*, January, 2002. Download the paper from Barabási's Center for Complex Network Research website.

[12] Thanks to Dan Braha in particular for this plot and discussion of its implications.

[13] Named for the economist Vilfredo Pareto who noted such distributions as 80% of income goes to 20% of people, or 20% of pods produce 80% of peas. Interestingly, the principle was named by the noted management and quality thinker Joseph Juran, and the short-hand rule is often used in business.

[14] The property of "self-similarity," often represented through visual fractal patterns, means that one or more parts is exactly or approximately the same shape as the whole. Complex adaptive systems typically show self-similarity.

[15] More cases will identify circumstances of size, interdependent functionality, and self-similarity that will suggest a predictably random distribution of positions across an organization's levels.

[16] "A hierarchy is a system of ranking and organizing things or people, *where each element of the system (except for the top element) is subordinate to a single other element*" [emphasis added]. This Wikipedia definition succinctly captures the two different meanings of hierarchy while correctly underlining the common logical structure. See http://en.wikipedia.org/wiki/Hierarchy .

