Networks

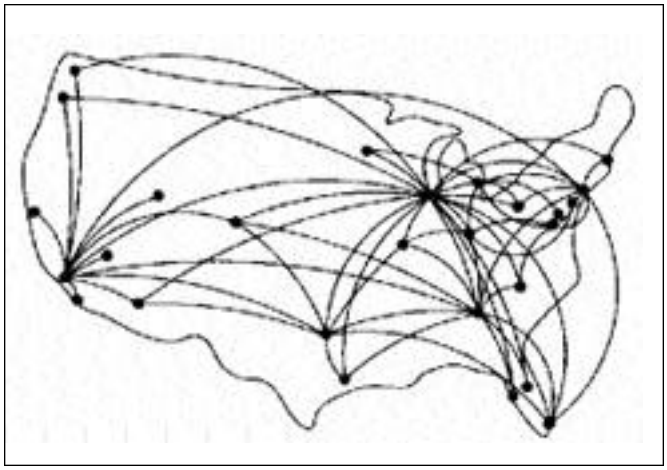
Introduction

Electronics are a qualitative change in technology. The electronics technology revolution has set the basis for an economic revolution and a social revolution. These cascading revolutions touch all of society, from the way we produce the things we need to live to the way we communicate to the way organizations are organized.

No organization stands apart from the technology revolution, least of all political organizations. Political work is constantly being affected by changes in technology, in the economy, and in society. Technology offers up new forms of communication, new ways of doing propaganda, new ways of organizing work and carrying out a program. Like any other organization, political organizations must periodically assess available tools, how they are organized, and how they might be able to do things more effectively with the resources at hand.

Network science

New technologies mean new tools for science; so science is also revolutionized. Nature can be explored in new and deeper ways, yielding new insights into the laws that govern the universe. One new field that has emerged from the use of computers in research is “network science”. Network science explores the way things are connected and interact.



An example of a real-world network, an airline route map. A few nodes have many links (the "connectors", e.g. Chicago O'Hare or LAX), most nodes have few links. (from Barabasi)

In network science, “networks” are a way of looking at the world as systems of interconnected and interacting (“linked”) phenomena (“nodes”). “Network science” is an aspect of dialectics using the tools of electronics. Network science looks at “real world networks,” the complicated systems of interactions we can observe in the universe. The new tools of science have uncovered general laws about how networks work that apply to phenomena as seemingly different as yeast metabolism, brain activity, social groups and the Internet.

Important concepts in network science include the following:

• Real world networks are not random collections of links and nodes. Instead, they share a common structure characterized by a few “hubs,” which are nodes that have many links; while most nodes have few links. Changing the properties of the hubs changes the architecture or behavior of the network.

• These well-connected hubs result in a “small-world effect.” Nodes belong to “clusters”, and the clusters are connected to each other by the “connectors”. Even though the network might have many nodes, this structure means that the number of links between any two nodes is relatively small. For example, any two pages of the billion or so pages on the Internet are separated by at most 19 clicks. According to the “six-degrees of separation” theory, you can reach any of the six billion plus individuals in the world through at most six other people.

• The “hubs” -- the nodes that have lots of connections -- make the network “robust”, but also represent weak spots in the network. If the hubs are attacked in a coordinated way,

More real world networks. The diagram on the left maps protein interactions within a yeast cell. The diagram on the right is a map of the Internet, circa 1998. Clusters of nodes are connected by "well-connected" nodes aka "hubs", making the network robust and efficient by minimizing the number of links between any two nodes and providing redundant paths between nodes. (Image on left is from Buchanan; the right from *Wired.)*

the network can be destroyed.

These features, it turns out, apply to all "real-world" networks. Networks are a basic architectural unit of the universe. The brain is a network of neurons: the clusters of neurons plus a smaller number of "long-distance" axons that connect different regions of the brain, give the brain its remarkable reaction, processing and memory ability. In cell metabolism, just a few proteins (the hubs) interact with and control the behavior of most other cell proteins. One approach for understanding some types of cancer examines the interactions of key (well-connected /hub) proteins in the life of the cell. In the spread of sexually-transmitted diseases, a relatively few, very active individuals represent the social hubs of the disease — target them and you have a shortcut to slowing the spread of STDs. Malcolm Gladwell, in *The Tipping Point*, describes a project to raise awareness among black women in San Diego about diabetes and breast cancer. The network science-savvy solution was to look for social connectors to disseminate information; in this case, beauticians. As well-connected hubs in the community, the salon workers were in an excellent position to reach many people.

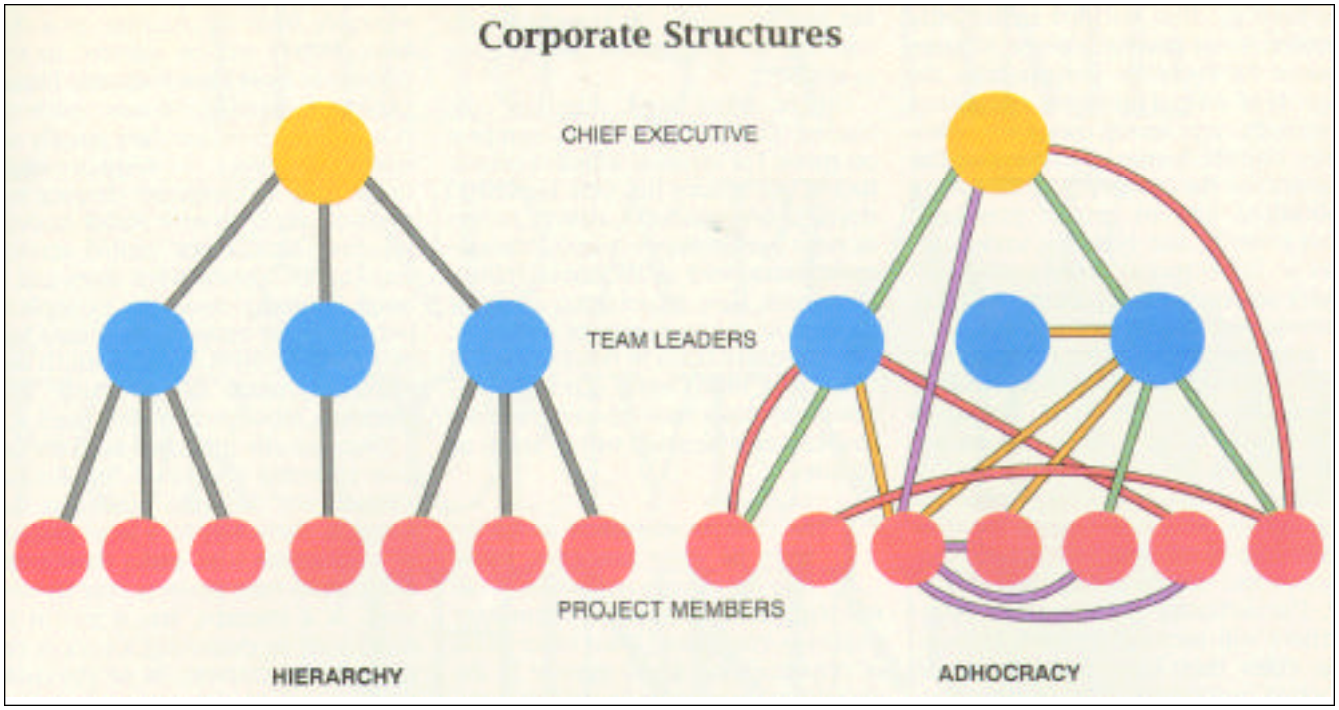
It perhaps needs to be said that "networks" do *not* mean "the Internet", although the Internet is an example of a real-world network, and has been critical in the development of "network science". The Internet has helped to understand and reveal the laws of real-world networks, but "network science" is a way of seeing *all* phenomena as interacting, connected pieces. We can take the laws of networks, and, like all laws, work with them.

Communication technology and organizations

New technologies mean new ways of communicating, new means of communication mean new organizational forms.

New technologies mean new tools are available for communication: Cell phones, email, faxes, digital publishing, cheap digital audio mixers, mp3 files, the Internet, etc., etc. Human society is about people interacting, and communication technology is the medium through which that happens. So changes in communication technology are bound to have a fundamental impact on social organization. That is, new communication technologies change the nature of the connections between the nodes of the network of society.

Organizations are social networks. New communication technologies change the way people can and will communicate. Once adopted, new communica-



From "Computers, Networks and the Corporation", *Scientific American*, 1991. "Adhocracy" was how the authors at the time conceived the network form. "By dramatically reducing the costs of coordination and increasing its speed and quality, these new technologies will enable people to … form new, coordination intensive business structures."And:"The textile firms near Prato, Italy illustrate a related kind of interorganization alliance... [T]he operation of a few large textile mills was broken into many small firms, coordinated in part by electronic connections among them..." Written in 1991.

tion technologies will inevitably lead to changes in the organization. Also, economic and social revolution inevitably change all organizations' mission. Organizational forms change as communication technology changes. Finally, if the mission of the organization includes changing peoples' thinking, then the new communication technologies also demand new doctrine for carrying out the organization's work.

Various kinds of organizations — ranging from the military to corporations to activist groups — have been exploring new forms of organization based on what the new technologies make possible. Loosely described as "the network form", this new organizational thinking shares some key concepts:

° Network organizations are flat, not hierarchical. There is no "center" or "headquarters" to speak of.
° Network organizations are held together by a common vision.
° The "nodes" of the organization share a common doctrine, which enables dispersed nodes to work as one.
° Network organizations are "communication-intensive."
° Network organizations are resilient, adaptive, robust.
° The "hubs" (where several nodes or clusters are connected together) are weak spots.

The network form is the form that corresponds to electronic communication, just as the pyramid-shaped, hierarchical structure of the corporation "made sense" for the era of the railroad, the land-line telephone and mass broadcasting.

David Ronfeldt and John Arquilla have written a number of books and papers about the network form and "netwar" for the RAND Corporation. In "What next for networks and netwars?", they identify five levels of analysis and practice for network organizations: organizational design, the story being told, doctrine (how the network functions), the information systems that enable the network to function, and the personal ties that assure loyalty and trust. (The following quotes are from the above-mentioned article.)

> The strength of a network ... depends on its functioning across all five levels. The strongest networks

> will be those in which the organizational design is sustained by a winning story and a well-defined doctrine, and in which all this is layered atop advanced communications systems and rests on strong personal and social ties at the base.

In the dispersed, network form, the role of a common story or vision or "narrative" is especially critical to keeping the network together.

> First, stories express a sense of identity and belonging — who "we" are, why we have come together, and what makes us different from "them". Second, stories communicate a sense of cause, purpose, and mission.

A shared doctrine is critical because in the "leaderless" network, the various nodes of the organizational network need to know how to work together without someone giving orders. "Such a set of guiding principles and practices — a doctrine — can enable them to be 'all of one mind'even though they are dispersed and devoted to different tasks."

The network form of organization can work only if the dispersed nodes can maintain communication links. As such, it blossoms in the age of cheap, digital, electronic -based communication.

> The new information and communication technologies are crucial for enabling network forms of organization and doctrine. Indeed, the higher the bandwidth and the more dispersed the means of transmission, reception, storage and retrieval, the better the prospects for success with network-style organization.

There are many examples of the network form in practice. In politics, the anti-globalization movement, the fight against landmines, and the new peace movement are examples of social movements organized along the network form. Kevin Kelly's *New Rules for the New Economy* enthusiastically lays out network-form principles for business. In the military, the advance of technology, both in lethality and complexity, has demanded the pushing of decision-making down the chain of command towards the smallest units. Today, these units are tied together not just by radio, but by digital photos and video from robot planes, global positioning satellite receivers, and laptop computers.

The Internet

In the new communication environment of electronic-based devices, the Internet plays an especially key role. It is both a visible expression of a network, and perhaps the most important means by which the network form lives, grows and spreads. The physical Internet — the collection of personal computers, servers, routers, switches and fiber optic cable — provides the main infrastructure for the communication-intensive network organizations.

The Internet is also a qualitatively new communications technology. We can say this for a number of reasons: The Internet is qualitatively new because it re-unites communication and transport into one technology (via digitalization). The Internet is qualitatively new for the same reason the robot is qualitatively different than the machine (computer networks are "roboticized communication"). The Internet has revolutionized the economics of the one-to-many medium. Unlike publishing a book or newspaper, there is no direct relationship between the amount of resources one has and the number of copies one is able to produce. The cost of replicating information on the Internet approaches zero. One's potential to influence masses of people via the Internet is not limited by resources in the way that previous one-to-many forms are (like, say, book publishing). The Internet is the first many-to-many communications medium. That is, the communication is no longer one-way — everyone can broadcast, and everyone can receive. The possibilities for dialogue, cooperation, and coordination of effort on a global scale are growing.

However, we must recognize that the Internet is not just an incredibly powerful propaganda tool (which it is). It is also a transportation medium, a coordinating technology, a money exchange, a bookstore, a collective organizer, even a model of a new society. With large scale collaborative projects like Linux being done via the Internet, we can glimpse new communist forms of production and distribution. The so-called "Gift Economy" of the Internet demonstrates "from each according to ability, to each according to need." Music file-swapping on the Internet is threatening to destroy the music industry, because the arbitrary rules of property under capitalism make no sense and are practically unenforceable on the Internet. The Internet suggests a system

beyond property.

Ultimately, any political organization must embrace the Internet because the Internet is the reality of the economy and social life today. Not because so many households can get email or view an organization's website (although this is vitally important), but because that is how modern organizations succeed in their chosen mission.

Conclusion

Networks are a useful way of looking at the world in its complicated mess of interactions and contradictions; i.e. dialectically. Network science lays out the principles governing networks; the network form describes how modern organizations reorganize on the basis of electronics. Organizations must change with the times, or end up in the dumpster of history. The lessons of history tell us that social relations must correspond to technological foundations or they will fail. The same is true of organizational forms.

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