Paper:

Plasticity in Network Organizations

Saad Alqithami and Henry Hexmoor

Department of Computer Science, Southern Illinois University
Carbondale, IL 62901, USA
E-mail: {Alqithami, Hexmoor}@siu.edu
[Received July 20, 2013; accepted January 29, 2014]

The *network organization* (NO) is flexible and changes rapidly to address events in volatile environments. These organizations are preferred to traditional organizations that are networked. The property of the NO that enables it to change so rapidly is *plasticity*. A model is presented for spontaneously formed NO and the quality of plasticity is discussed in the context of this model. We touch on how this model accounts for external change in an environment through internal adjustment. A case study illustrates the main tenets of our conceptualization.

Keywords: agent societies, social and organizational structure, formal models of agency, co-evolution

1. Introduction

Groups of individuals or firms as nodes of a network that direct exchange primarily through the network are said to be using a network-centric paradigm. The US Department of Defense adopted this paradigm early on to accommodate collaboration and information resource sharing among distributed military assets and work units [1]. The network-centric paradigm encompasses a large number of technologies and devices, including cloud computing and mobile devices, beyond our present scope, however. Net-centricity fortifies conventional communication patterns among individuals from prescribed doctrines to less regimented "as needed" information exchange over the network. Net-centricity promotes self-organization and self-integrating coordination [2]. The nature of communication in net-centric environments goes beyond data and information exchange. Exchanges are characterized by and large as knowledge-intensive and create new knowledge. Individuals engage in exchanges that rely on interpersonal relationships helping to transform information into knowledge pertinent to the organization. Relationships among individuals in turn correspond to network link types subject to social constituents of trust, reciprocity, and beneficence.

In this context, the development of social familiarity among individuals is possible because network interactions are free, frequent, and personal, and the knowledge that is thereby exchanged is critical to functional roles in the organization. The success of net-centric organizations depends heavily on the capacity of the network to evolve and enable social learning. Individuals must learn from both one another and from collectives, and must develop ties to a group, be aware of groups centers of gravity and direction, and consciously synergize with the allies of groups. This group awareness is essential to organizational cohesion, teamwork, and unity. Net-centric organizations add value through teamwork and cooperation driven by network climates that support interpersonal interaction leading to cohesion, commonality of identities, mutual trust, and teamwork. To ensure these desirable properties in a network organization (NO), we must provide a network together with a culture of invitation to internalize organizational objectives and to use the network as a medium for upholding organization values and for providing incentives for collaboration. Net-centricity combines technological network connectivity with social and management skills that guide social climates for collaboration among heterogeneous sets of networked individuals. Net-centric organizations use well-rooted paradigms that are critical to success for many applications, ranging from warfare and counter terrorism to health care and trade.

The net-centric property among nodes may be well established and stationary, in which case interactions are often codified in a contractual document called a service-level agreement (SLA) that is a formally negotiated agreement between pairs of parties [3]. SLA provides formalized, binding contracts among network nodes while supporting coordination and predictability for all interested parties. A typical example is the automobile industry, in which parts producers and suppliers are widely distributed. This requires a dependable supply chain. With a specific product and uncompromising time constraints, interactions over the network must be standardized. This hard-wired network codifies all net-centric qualities. The social nature of network interactions provides a high degree of resilience and flexibility to address environmental changes.

In contrast to stylized stable network relationships, an alternative to the network is the dynamic, fluid relationship. A group may gather loosely under connections with no physical presence, such as a business label. Due to the absence of tangible places and resources to identify the group, such a dynamic network is often called a vir-

tual organization [4]. Norman et al. [5] provide strategies for forming virtual organizations. Another type of dynamic network, called a networked organization, is a group with complementary expertise and interests that forms a temporary, impromptu network to work on a short-term goal [6]. Networked organizations typically lack rigid coordination and control schemes before they start. Postmortem analysis often reveals serendipitous, implicit, and emergent coordination protocols.

Examples of these situation-based networked organizations are common in law enforcement, where disparate law and crime professionals collaborate as needed to solve crimes. A synthesis of ideas for emergent networked organizations is the dynamic network theory described by Westaby [6], who present sociopsychological explanations for how individuals in a social network are motivated to pursue goals. He develops qualitative metrics accounting for social forces that propel or inhibit progress toward goals. He contrasts rigid role-based organization charts with sociograms in which actual communication does not follow an organization chart. This is in contrast to dynamic network charts where meta-roles illustrate the informal groupings of individuals who positively or negatively influence goal pursuit and achievement. The eight metaroles defined by Westaby are goal striver, goal preventer, system supporter, supportive resistor, system reactor, system negator, interactant, and observer.

Network motivation is a function of strivers and supporters as social forces that promote goals. Its opposite is the social force of network resistance serving as a function of goal preventers and supportive resistors. Network affirmation and deaffirmation are social forces that approve or disapprove of network goals, although, without the active participation of goal striver. Theory considers various goal conflicts. Westaby introduces activation levels and performance measures to determine scales for overall network efficacy. Westaby's system of visualizing metaroles overlaid on an NO is very enlightening and aids in analyzing dynamic processes operating inside an NO. Westaby's characterization of NO organizations is certainly all-embracing and articulates many interesting NO features. It is implemented as a computational decision aid, but determining measures of social force cannot be automated and remains subjective, meaning that it must be entered subjectively. This drawback limits its wider applicability and the proliferation of Westaby's theory.

Members of a collaborating group that shares common medium- to long-term objectives may actively pool their coordination and control mechanisms through the network and thus be considered an NO that is also netcentric. Because such groups are formed for a long-term life but lack hard-wired networks, interaction may not require legally binding contracts. Instead, interactions within an NO are largely normative and may be governed by evolving, applicable institutional frameworks.

Network, virtual, and networked organizations are subsets of the network-centric paradigm. Independent of network topology describing structural relationships among nodes of an organization, operations within an organization may be guided by styles of authority, role, right, and responsibility over communication and control. When there is a rigid, unchanging chain of control and corresponding communication channels in the organization in which individuals must yield control to a superior and report to it, the organization is said to be hierarchical. Those in higher positions in a hierarchical organization possess wider, i.e., more global, organizational scope and greater authority than those below them. Data travel up and control travels down in a hierarchy. If a problem space can be decomposed into layers and task decomposition parallels the problem structure, the hierarchy is a appropriate paradigm. For modeling a more flexible autonomy for individuals and for under specifying roles, a paradigm called a holoarchy is a better fit, creating semiautonomous holons, i.e., autonomous self-reliant units. Coalitions provide yet greater flexibility in task adoption by forming deliberate terms about the synergistic effects of grouping to address tasks concerning values returned to the organization as well as to individuals. Federations provide natural distributions of specialties and coordination among disparate work groups. Markets model the competitive clustering of tasking groups that is the farthest from the rigid control and coordination found in hierarchies [7]. Later in this paper, we discuss a model of an NO with specific functions modeled as specialized roles.

2. Plasticity in the NO

We allow the individuals capacities to migrate in and out of the organization and roles are not assigned rigidly to individuals, so the resulting system is nonhierarchical in function. At the same time, we do not specify the nature of authority and coordination protocols among interactions. Hierarchy imposes strict subservience. A team of peers is not hierarchical. An organization may have constituent components with differing but coordinated objectives that will not be hierarchical if units have nontrivial autonomy or the information flow is amorphous rather than prescribed. The layout of organizational units generally constitutes its architecture, which is independent of the organization's network substrate or its functional paradigm, as detailed in [8].

Organizations are guided by institutions that provide them with rules and norms of operation [9]. Part of institutional oversight lies in the terms for establishing and enforcing social norms. Institutional norms exert strong and even legal controls over organizational behavior. The United States Securities and Exchange Commission strictly regulates all securities and stock trading in the US, for example, and infractions are legally enforced by fines and censures. Norms are, however, typically subject to change over time in response to interactions with other institutions and general social forces. An implicit type of organizational plasticity is an organization's internal operational adjustments in response and adherence to nuances in norms promoted by the oversight of an institution. Institutions set social standards, which means that organi-