Creating Structures for Network-Centric Warfare: Perspectives from Organization Theory

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Abstract

Combat organizations are increasingly faced with the challenge to adapt to new and diverse engagements. The pace of change is being accelerated by advances in information technology. This article offers perspectives from organization theory that can serve as design principles for enabling combat organizations to adopt flexible structures to cope with changes in the external environment. The specific design principles articulated are technology-enabled virtual organizations, organizational "semi-structures", and anticipating the future by launching probes. We discuss the implications of these principles for military organizations.

1. Introduction

Dramatic global events in the past decade have precipitated new ways of thinking about the basic questions of how wars are fought, how forces are organized, and what are the objectives underlying missions. The focus of wars has shifted from a global bi-polar perspective to a variety of regional and local conflicts. Forces are increasingly organized with a view to creating adaptable structures and joint force capabilities. The objectives of engagements are becoming diverse, e.g., peacekeeping or humanitarian missions in addition to traditional war fighting missions. The pace of change in all of these dimensions is being accelerated by rapid advances in information technology.

Many of the innovations being explored in the structure of war fighting organizations are contained within the concept of *network-centric warfare*. Network-centric warfare envisages building organizations that seek to accomplish their mission through flexibility in roles and structures as well as autonomy of action. Such organizations make extensive use of information technology. Generally speaking, they have two distinguishing characteristics: *speed of command* and *self-synchronization.* Speed of command, which depends on information superiority and innovative command and control structures, seeks to achieve rapid massing of effects and ensure rapid foreclosure of enemy courses of action. It relies on the shock of closely coupled events for added advantage. Self-synchronization emphasizes non-hierarchical coordination for the dual purposes of exploiting local information to reduce uncertainty and making efficient use of the resources available. Self-synchronization also allows for replanning to adapt to situation changes as well as re-configuration of the command and control decision and execution processes - all with minimum time to completion. The concepts of speed of command and self-synchronization are thought to be essential characteristics of the type of agile organizations envisaged in Joint Vision 2010.

While the concept of network-centric warfare provides an overarching framework for organizing the forces of the future, many of the core principles and concepts remain to be articulated and refined. In addition, there needs to be a sustained effort to create concrete guidelines that can serve as design principles for organizing combat forces for mission planning and execution. In this research, we propose some first steps toward clarifying the conceptual underpinnings and design principles underlying self-synchronizing organizations. We seek to do this through an explication of relevant research in organization theory as well as related work in complexity theory. Organization theory has examined self-designing organizations, e.g., those that are capable of endogenous change on a continuing basis. Related research in complexity theory has discussed many of the principles of self-design under the umbrella of complex adaptive systems and self-organizing criticality. Our purpose is to weave the relevant strands in past research to create a set of expectations for organizations performing combat missions.

2. Organization Theory

Two intertwined threads of research in organization theory are of specific significance in discussing self-designing organizations (Borchert and Jones, 1999). The first thread explores the use *of modified organizational forms*, often enabled by information technology (Fulk and DeSanctis, 1995). The second thread examines the creation and survival of organizations that are capable *of rapid change and innovation* (Brown and Eisenhardt, 1997). Together, these threads constitute a perspective on the requirements for forming adaptive organizations critical to the efficacy of network-centric warfare.

2.1 Technology-enabled organizational forms

In the corporate environment, the need for technology-enabled organizations has been engendered by the increasingly global and competitive nature of contemporary business environments, which require organizations to offer a greater variety of products as well as more flexibility through customization. The life cycles of individual products have become shorter, thereby compressing the available window for recouping the expenses associated with product development (Bettis and Hitt, 1995). This has been accompanied by a progressive decrease in the available time-to-market for the products (Brown and Eisenhardt, 1997). These developments have led organizations to seek new ways to reduce the cost and time required for product development. Companies have responded to the imperatives of current business environments by using a variety of approaches such as concurrent design/engineering, collaboration with other organizations for the design and/or manufacture of products, and the partial outsourcing of product designs (D'Aveni, 1994; Fulk and DeSanctis, 1995; Hamel *et al*, 1989; Lele, 1992). Typically, these approaches are being executed in the context of modified organizational forms enabled by information technology, such as virtual organizations, strategic alliances, partnerships and networked organizations (Chesbrough and Teece, 1996; Fulk and DeSanctis, 1995; Hammer and Champy, 1993).

The concept of virtual organizations constitutes a particularly important innovation in this regard. A virtual organization can be thought of as an *ad hoc c*ollection of individuals, brought together for a specific purpose, e.g., the design of a product. These organizations are usually *cross-disciplinary* in that the members come from different functions or specialties. For example, a product design team typically consists of representatives from research and

development, manufacturing and marketing (cf. Dougherty, 1992). The membership of virtual organization is often *inter-institutional*. For example, multiple organizations sometimes pool their expertise in product development (Cutkosky *et al*, 1996; Hardwick *et al*, 1996). More typically, representatives of suppliers and/or customers increasingly form an integral part of the design teams of companies. Finally, virtual organizations are *transient* in their existence (Davidow and Malone, 1994). That is, such teams are usually disbanded (or radically restructured) after the assignment is completed (Grenier and Metes, 1995). Virtual teams have been used extensively in tasks as diverse as product design (Sweha, 1996), software development (Dubinskas, 1993; Voegtli, 1996), management consulting (Dubinskas, 1993), and health care (Pomerantz *et al*, 1995).

Virtual organizations share many of the properties of joint task forces designed for missions such as humanitarian relief (wherein the core military units collaborate with local governmental units and other institutional structures such as non-governmental organizations for a specific purpose), coalition warfare and traditional combat missions. For example, a joint task force is composed of multiple components, each of which is cross-functional, being an aggregate of multiple communities of practice. Each community of practice is based on a specific knowledge domain. Joint task forces are constituted for specific missions and similar to virtual organizations, are disbanded after completion of the mission.

The use of virtual organizations offers several advantages (Mowshowitz, 1994). The ability to create temporary, dynamic project-oriented structures enables flexibility (cf. Nohria and Berkley, 1994). Second, the composition of the teams can be tailored so as to provide an "optimal" mix of skills for accomplishing a task (Grenier and Metes, 1995). Third, because the teams do not have to be co-located, they can include members who are also engaged in other tasks performed at other locations. Thus, virtual teams constitute a handy mechanism for bringing together expertise that is otherwise dispersed across - or even located outside - an organization (Dubinskas, 1993). Fourth, because of their transient nature, virtual teams are less likely to be burdened with the entrenched organizational routines and authority relationships that so often inhibit performance in more permanent organizational structures (cf. Brown and Eisenhardt, 1997). Finally, virtual teams offer a means to create organizational forms (such as task-specific alliances with other organizations) that are difficult to accomplish in more conventional situations (Fulk and DeSanctis, 1995).

However, virtual organizations also suffer from shortcomings, because the processes underlying their collaborative activities are social as much as they are technical. Such activities, e.g., articulation of doctrine and the commander's intent, require shared understandings which emerge from social interactions among individuals and groups. The interactions are characterized by extensive communications, both within the team as well as with individuals external to the activity (Brown and Eisenhardt, 1995). The quality of the output therefore critically hinges on the efficacy of the collaborative process. This, in turn, depends on a team's ability to create an appropriate structure as well as adequate mechanisms for communication (Wholey *et al*, 1995). The presence of a structure also helps an organization develop its own implicit culture and norms (Carley, 1991), helps make sense of ambiguous situations (Weick, 1995), and provides a scaffold to facilitate the learning and socialization of new members (cf. Lave and Wenger, 1991).

Now, consider a virtual organization such as a joint task force, which is comprised of multiple entities brought together for a specific mission. The *ad hoc* nature of the organization can imply the lack of a well-established and time-tested structure for coordinating its functioning. While this may be ameliorated to an extent by the presence of a well-defined doctrine, the process of melding the units may still be difficult because the key members may not be familiar with each other. In addition, the task at its initial stages can have a high degree of equivocality, at least in how it is perceived across the different units in the organization. Further, the cross-functional and inter-institutional composition of the organization can create ambiguities in the status, authority, and expertise of the members (Finholt *et al*, 1990). All these difficulties may be exacerbated by the geographical dispersion of the organization. Thus, for a virtual organization to function effectively, it would have to go through a period of time wherein these problems are addressed and settled satisfactorily. In essence, this constrains the range of tasks, missions and time scales within which virtual organization can be deployed. Thus, while virtual organizations do offer much potential for solving a diverse set of problems, it needs to be noted that virtual is not always virtuous (Chesborough and, 1995).

Organizations that innovate continuously

Research on organizations that innovate has traditionally followed the concept of punctuated equilibrium, which perceives organizations as changing incrementally until a dramatic set of events precipitates radical changes in their structure and processes. In this view, organizations are thought to function in a steady state of variations around an equilibrium; periodically, this equilibrium is punctuated or disrupted, thereby causing tectonic shifts in the organization's structure. Thus, innovation is seen as dramatic and infrequent.

However, recent research has, pointed to a very different view of innovation in organizations. In this view, innovation in many organizations is not episodic in the sense of being shaped by sharply defined perturbations. Rather, the change occurs on a continuous basis, which over time can dramatically alter the structure and profile of the organization. These organizations, often referred to as of "high-velocity organizations" (Eisenhardt, 1989; Brown and Eisenhardt, 1997), can be found in highly competitive industries, such as the computer industry. These industries are characterized by rapid product development, short product life-cycles and a continuously changing competitive landscape.

In studying innovation in self-synchronizing combat organizations, the second view of innovation strikes us as being particularly appropriate. This is because the organizing structures envisaged in network centric warfare share several features with high-velocity organizations. For example, both types of organizations have to cope with harsh environments; which require constant adaptability to ensure survival and success. Thus, perspectives gleaned from continuously innovating organizations can help shape our expectations and views of self-synchronizing combat organizations.

Studies of continuously innovating organizations reveal two key insights (Brown and Eisenhardt, 1997). First, successful innovation on a continuous basis requires the presence of "semi-structures". Second, successful organizations anticipate the future by placing probes in the environment. We address each insight in turn.

Semi-structures

The term reflects a situation wherein an organization functions on the basis of a limited structure, around which the managers are free to improvise. The limited structure can consist of a set of explicitly defined building blocks, e.g., well understood routines and procedures that remain largely invariant, or clearly stated organizational priorities and managerial responsibilities. These building blocks work as pivots around which the organization functions. Managers are free to improvise around these semi-structures, and often complement them with extensive communication. Semi-structures are similar to what Weick (1993) refers to as minimal structures: a base-level structure that is essential for organizations to make sense of the environment.

What are the boundary conditions for defining semi-structures? In an abstract sense, a structure should not be so rigid as to preclude innovation. At the same time, the structure should be strong enough to enable recovery from errors, and in general, prevent the organization from collapsing from the consequences of the innovation. At the rigid end of the spectrum, there are numerous examples of how overly specified structures stifle innovation (an example from military domains here?). In contrast, the impact of inadequate structure is provided by Weick's (1993) description of a team fighting forest fires. The absence of even a minimal structure prevented the team from formulating an adequate perception of the enormity of the fire, which resulted in several fatalities among the firefighters.

A theoretical perspective for a better understanding of the stability of semi-structures is provided by complex adaptive systems theory. The theory views organizations as systems with a large number of independent but interacting actors (Brown and Eisenhardt, 1997). From the perspective of this theory, organizations with self-design properties do reach steady states that consist of multiple equilibria. Instead, they keep changing continuously, in the process remaining at the "edge of chaos". However, because of their underlying structural properties, these organizations seldom disintegrate. The macro-structure (or semi-structure) of the organization emerges from the collective interactions of the components of the complex system (Kauffman, 1995; Waldrop, 1992). Over a period of time, the decisions of individual participants interact to reconfigure (or redesign) the organization's structure and processes in order to adapt the organization to its environment (or adapt the environment to itself). The semi-structure, while stable, and hence resistant to the vagaries of the environment, does change over time. Complex adaptive systems theory discusses how changes in the organization follows a power law – many small adaptations which do not change the semi-structure, and some large changes that do affect the semi-structure. Even the large changes are caused by what appear to be relatively minor events (the tale of "for want of the nail, the horseshoe was lost, etc." is an apocryphal way of expressing the magnitude of potential changes caused by small events.). The stability of the semi-structure (and therefore the viability of the organization) relies on its ability to engage in *self-organizing criticality* (Bak, 1996), i.e., navigate the cusp that separates adaptability from disaster.

The region of self-organizing criticality for an organization can be determined analytically, primarily through the application of tools such as genetic algorithms. However, as a practical matter, defining the comfort zone for adequate structure is largely a question of experimentation, wherein alternative structures are tested against a variety of scenarios to determine “families” of

semi-structures with stable properties. It seems useful to consider war games and simulations (backed eventually by Fleet Battle Experiments) as appropriate mechanisms for identifying the region(s) of self-organizing criticality in combat organizations.

Probes into the Future

Much research on organizational competence stresses the need to form distinctive competences, i.e., building from expertise developed in the past. However, many continuously innovating organizations also rely on the future to develop competences (Brown and Eisenhardt, 1997). The preferred mechanism for accomplishing this is to develop a vision for the future. The vision can be formed in multiple versions. The credibility of competing visions is established through experimentation, typically by launching experimental products and gauging their performance. This view of defining strategies (and consequently, missions) is much more experimental in essence than traditional exercises, which rely on detailed definitions of strategies. The underlying rationale is that the future is difficult to anticipate. As a result, neither rigid planning for the future nor reacting to events is satisfactory. Instead, the future can be probed through a variety of low-cost options, e.g., experimental products or strategic partnerships.

In one sense, Fleet Battle Experiments and related exercises are useful for these types of probes into the future. However, there is one important difference. Whereas the probes instituted by commercial organizations reveal "real" data, those instituted by combat organizations are simulated, and as such, constituted best guesses about likelihood. Thus it is even more important for combat organizations to adopt mechanisms for change and adaptation.

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