Networking for Success in Cyberspace

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Abstract

Several key technologies are converging to create the emerging cyberspace. We characterize this convergence process as one of cumulative synthesis and suggest that the network mode of organization is the most appropriate for facilitating convergence.

Introduction

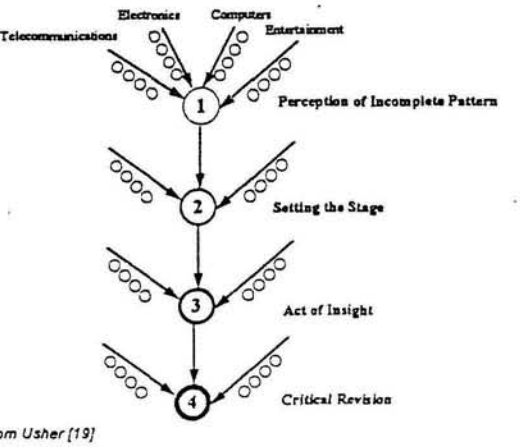
Almost 50 years ago, Usher [19] suggested a model of technological change that recognized both its incremental nature and its revolutionary effects. Specifically, Usher observed that technological changes occur through the *cumulative synthesis* of a stream of insights or innovations over time. He emphasized that cumulative synthesis was a continual process that entails the *perception of an incomplete pattern*, the *setting of the stage*, an *act of insight*, and one of *critical revision*.

Usher's model is descriptive of changes occurring in many contemporary technological fields. One such field is "cyberspace" (also labeled the information superhighway, interactive multimedia, or generically "convergence"). In cyberspace, several constituents have emerged including telephone companies, cable companies, computer vendors, media and entertainment firms, the Federal government and public interest groups. These constituents share a broad vision that telecommunications, computing and entertainment will converge to yield integrated multimedia applications. However, their preferred paths toward convergence differ. Additionally, there is great uncertainty regarding technological feasibility, market potential and the regulatory regime for these products of the future.

A common refrain for firms operating in such environments is to choose the "right" technologies lest they be left behind by others. Choice of technologies, while necessary, is not sufficient to survive in these environments. This is because monetary, organizational and regulatory constraints preclude any one firm from possessing all the competencies required to benefit from the opportunities that are created when technologies converge. A key question, then, is: *What mode of organization is best suited to enable synthesis in fields such as cyberspace?*

We suggest that the network mode of organization is the best suited for the challenge at hand. The network mode involves the participation of many firms that interact with one another in a "lattice like structure" [15] within an overall regulatory environment. This mode is relevant in technological fields where it is difficult for a single firm to internalize all competencies, and, at the same time, it is difficult to trade competencies between firms in a market.

Figure 1 - Cumulative Synthesis in Cyberspace



Adapted from Usher [19]

Background

The history of telecommunications and computers suggests that regulation has served as a barrier to synthesis or convergence. Specifically, the Federal Communications Commission (FCC) has used its powers to keep technologies (such as microwave

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transmission, television, cable television and computing) away from local and long distance telephony [2]. Indeed, AT&T was barred from offering data processing services and products in 1956, thereby limiting the potential for convergence between the computers and telecommunications industries.

AT&T (and earlier Western Union), in fact, courted regulation by lobbying the Interstate Commerce Commission (ICC) and the FCC to become a regulated monopoly and continue its dominance. A series of regulatory actions broke this monopoly and set the stage for the current environment. In particular, the FCC decided to foster more competition in telecommunications as entrepreneurs litigated to gain entry, and as markets coalesced. Furthermore, the FCC deregulated certain areas of telecommunications such as long distance telephony and permitted the entry of AT&T into computers.

These events weakened regulatory forces and removed the artificial barrier between telecommunications and computers, thereby setting the stage for the emergence of cyberspace. At the same time, this sequence of regulatory actions has also created a situation where different firms now possess different parts of the emerging cyberspace puzzle.

Traditional organizational modes are not adequate to enable convergence of these individual pieces within the cyberspace field. Markets are inadequate for two reasons: (a) the technological competencies involved are complex and difficult to evaluate, and (b) these competencies do not have clearly or tightly specified property rights. Consequently, it is difficult to exchange such competencies through arms-length bargaining in a market. Administrative mechanisms, too, are inadequate to foster the synthesis of component technologies. Given limited capital resources, it is impossible for any one firm to internalize and maintain all capabilities. Furthermore, an attempt to synthesize and offer the entire range of technologies will diffuse the focus of any one firm and stretch its organizational capabilities [18]. It is for this reason that many authors suggest that firms should focus on core competencies and rely on others for complementary technologies [16][11].

The Network Mode of Organization

The web of relationships that emerges when firms begin relying on others for complementary assets represents the network mode of organization. This network mode has recently received considerable attention from scholars pursuing various disciplinary perspectives [see [14] for recent research]. For instance, institutional economists have examined network modes recognizing that they might be efficient when disturbances between economic actors are infrequent and when inter-related firms are dealing with assets of intermediate specificity [20]. Institutional sociologists have examined issues such as trust, reputation, embeddedness, structural holes, and the strength of ties in organizational communitites [5][7][9][15]. Legal scholars have viewed network relationships as representing relational contracts [12]. Melding insights from these various perspectives, organizational theorists have explored network forms including kieretsus, dynamic networks [13], and virtual corporations [4].

Common to this literature is an appreciation that conceptualizing social and economic relationships in network terms allows us to see the whole *and* its parts. Each part represents a core competence that together with competencies possessed by other parts creates a technological system through cumulative synthesis.

Among firms that are members of such a network, there needs to be agreement and coordination on specific tasks to be undertaken to foster cumulative synthesis. In the technical arena, this involves coordination on interfaces and standards. In the social arena, this involves long-term relational contracting based on trust and reputation. Relational contracting allows the parties to agree upon a broad framework to guide their relationship and re-negotiate specific aspects with the passage of time [12]. The socially created rules that bind the parties change dynamically through mutual adjustment even as a new technology-regulation space is unfolding through a synthesis of the old.

These network forms are readily apparent in the emerging cyberspace where relationships range from coordinating alliances for standards creation and joint development, to custom trials of interactive TV technologies, and equity stakes in start-up ventures working on unproven technologies. These networks overlap with each other as members belong to several networks at once.

Clearly, the cyberspace field is a rich research site to apply a network perspective. In the next section, we explore the unique properties of the network mode of organization that create the right conditions for convergence to occur in cyberspace.

Cumulative Synthesis in Cyberspace

For cumulative synthesis to occur, the mode of organization adopted by firms should possess the following properties: (a) improve perception so that the incomplete pattern and the missing links are evident, (b) set the stage for synthesis to occur by bringing together the relevant competencies required for solving the problem, (c) allow learning to occur so that innovation and progress toward convergence is continual and (d)

possess self-organizing properties so that required adjustments are made to sustain the process of synthesis.

In this section, we demonstrate how the network mode of governance confers these properties on the emerging cyberspace so that eventual convergence can occur. We discuss these properties at the network level and infer implications of these properties for individual firms that constitute the networks.

Perception

Network-level Issues. Given the uncertainty in cyberspace, firms have created several networks of relationships to probe different possibilities and combinations of technologies. The network around each firm consists of partners possessing complementary pieces of the convergence puzzle. For instance, the partial network around AT&T's multimedia activities include: (a) cable companies such as Time Warner and TCI, (b) TV and cable programming companies such as Viacom, (c) Advanced RISC Machines (ARM), a vendor of RISC microprocessors, (d) vendors of networking software for computers and PDAs such as Lotus, Novell, and General Magic, (e) Sega and 3DO, vendors of video game machines, and (f) on-line services providers such as the ImagiNation network.

In accordance with the principle of requisite variety in cybernetics [1], this diversity of membership ensures that AT&T and its partners experience a wide range of stimuli. Each network member contributes primarily in its area of core competence and delegates choice of appropriate complementary technologies to other members that are most capable of making this choice [see [15] for a similar account of networks in Biotechnology]. Because individual members do not need to internalize all complementary technologies to achieve synthesis, they are not constrained by resource congestion.

Exchange of knowledge within these networks takes several forms including joint development and trials of new technologies, and investments in start-up firms developing futuristic technologies and applications.

Such a network as above aids cumulative synthesis by enhancing the perception of members and enabling them to gain a deeper understanding of the requirements for convergence.

Firm-level Issues. A firm's position within the network affects its cognition by determining relative access to information. A focal position within the network ensures that the firm has ready access to diverse information, thereby allowing it to improve its perception and shape its core competence appropriately. For instance, AT&T has used its expertise in transmission, switching and network management to become a key supplier to more than twenty different interactive multimedia trials worldwide. Its central position allows AT&T access to a variety of technological approaches so that it can perfect its own approach and influence technology and market evolution.

Obtaining information from many sources might lead to information overload. Therefore, a firm cannot maintain the same intensity of relationship with every network member. Some relationships represent stronger ties than others [9].

Even though strong ties between members provide the basis for integrated action, they tend to blind central players to new stimuli that arise at the periphery of the network. Therefore, it becomes important to cultivate and exploit weak ties [9][6] that extend perception of emergent stimuli at the fringes of awareness. This is especially true in the context of new technology development where, oftentimes, advances arise from peripheral actors.

Setting the Stage

Network-level Issues. For any innovation to occur, various capabilities and assets that constitute the technological system are required [17]. To the extent that there is uncertainty regarding relative importance of different capabilities, a network will require a "redundancy of capabilities", only some of which will be used eventually. It is for this reason that we find several networks in the cyberspace field comprising alliances that compete with each other in their objectives or product/service offerings. For instance, Apple's network contains Kaleida, a joint venture with IBM and HP, as well as General Magic, a global joint venture with nine other firms. Both these firms are competing to create intelligent networking software and operating systems for personal communicators.

An important step in setting the stage, one that nicely illustrates the relationship between the individual and the collective, has to do with determining the rules of the game. Convergence requires that new rules of technological and market governance be established. In the regulatory and political arenas, firms have to lobby to enact new rules, or push the regulatory envelope to trigger a response. For instance, several Baby Bells, including Ameritech and Bell Atlantic, have challenged the 1982 Consent Decree and the 1984 Cable TV Act that prohibit their entry into cable TV distribution, long distance services and information services.

From a technological perspective, convergence requires standardization and seamless integration of complementary technologies. Some standards are forged at the industry-level directly by broad-based standards

organizations. Illustrations of such standards are the MPEG-1 and MPEG-2 standards for video compression and decompression techniques developed by the Motion Pictures Experts Group of the International Standards Organization.

Other standards are developed by groups of dominant firms that agree to develop technologies jointly and standardize their product offerings to conserve scarce resources -- for instance, the agreement between consumer electronics firms including Sony, Matsushita, and Philips to adopt a common format for digital VCRs.

Firm-level Issues. From an individual firm's perspective, redundant relationships within the network create options that can be exercised at the appropriate time. A firm can pick and choose from various redundant options and integrate best components from each approach to create a distinctive product, thereby leveraging its bets. At the same time, each member contributes expertise in its area of core competence thereby increasing the probability that each of these options will reach the exercise stage. The more focal a firm is in such a web of relationships, the greater is its appropriability when synthesis occurs.

With regard to standard-setting activities, a firm has to sponsor proprietary technologies to ensure widespread adoption. Sponsorship involves development of new technologies and the sharing of breakthroughs with others to promote proprietary technologies as industry standards [8]. For instance, General Instruments, a dominant manufacturer of cable converter sets, has licensed its technology to other manufacturers like HP and Scientific Atlanta, and, together with TCI, is sponsoring its digital converter standard. Similarly Sony-Philips and Toshiba-Time Warner are competing to set the standard for videodisk formats. Without such sponsorship efforts, firms that are not part of networks risk becoming followers who are forced to adopt other technologies in preference to their own.

Learning

Network-level Issues. Whatever emerges within the cyberspace field is not some deterministic technological trajectory, but an artifact of specific network relationships and learning that occurs in forging or maintaining these relationships. As synthesis and relevant learning occur, specific technologies become salient, and certain relationships become more important than others. Several alliances are disbanded while new ones are forged thereby changing the composition of the entire network. Therefore, the network of relationships itself must be viewed as a dynamic entity.

In cyberspace, several innovations have occurred thereby creating new knowledge and altering old perceptions. For instance, the perception that fiber-optics cable connection to every home is a pre-requisite for interactive multimedia offerings has been challenged. Rather, networks that use fiber-optics and co-axial cable (even copper wires, in the short term) are becoming the norm as technological advances like digital compression increase functionality of the existing infrastructure. As interactive TV trials proliferate, relatively small firms like Dolby Laboratories and Compression Labs that provide compression technologies and those like Crystal Dynamics and Paramount Interactive that provide digital "content" are becoming central players. The shift toward value addition through creative networking software is increasing the visibility and power of firms like Microsoft, Lotus and Novell. New services like Personal Communications Services (PCS) have emerged, offering alternatives to conventional cellular telephony. Certain other markets that had been declining such as supercomputers and massively parallel processors are experiencing signs of resurgence in alternative uses as video servers.

The network mode allows members to learn not only about technologies, but also about the commercial viability of new products and services. For instance, interactive multimedia games and video-on-demand trials excite the curiosity of consumers prompting them to try new technologies and services. In addition to creating demand for these new products and services, these trials gather useful information about the ease of use of these new technologies, propensity of consumers to subscribe to specific services, and the price they are willing to pay for these services. Access to such information at an early stage of development enables the modification of products at low additional cost.

Firm-level Issues. At the firm level, each innovation or act of insight creates an opportunity to learn and redefine perceptions. Learning implies choosing between redundant options created earlier and exercising only the most appropriate ones (i.e., strengthening certain relationships while weakening others). AT&T's actions over the past decade is illustrative in this regard. After its unsuccessful entry into the computer industry through internal development, AT&T invested in Olivetti and, subsequently in Sun Microsystems. As its understanding of the computer industry grew, AT&T divested itself of its equity stakes in both Olivetti and Sun, acquired NCR and sold Unix Systems Laboratories to Novell. Similarly, with the growing importance of wireless

communications, AT&T has upgraded its small equity investment in McCaw to full ownership.

Ultimately, this learning manifests itself in a firm's ability to absorb and synthesize technologies [3]. To the extent that the firm develops new competencies in addition to enhancing ones it already possesses, it becomes specialized in its own field and yet becomes sufficiently generalized to evaluate and absorb complementary technologies. At the same time, firms probe each other's cultures, experiment with new routines for collaboration, and establish reputational and trust-based relationships with each other. Over time, this process results in the standardization of "output routines" between collaborating firms thereby facilitating synthesis. Furthermore, creation of redundant options allow firms to maintain access to complementary technologies until conditions for synthesis are appropriate.

Self-Organization

Network-level Issues. We saw earlier that rules governing interactions in the regulatory and technological arenas have to be modified continually for convergence to occur in cyberspace. Exogenous institutions like regulatory bodies and standards organizations, in their effort to promote collective welfare and resolve conflicts between a myriad of interest groups, take time to align regulatory and technological regimes with the state-of-the-art. Absent continual alignment of regulatory and technological regimes with the state-of-the-art, convergence might be delayed or even jeopardized. It is for this reason that networks have to be self-governing.

Self-organization arises from several unique characteristics of the network mode. First, the network mode exhibits a paradox of cooperation and competition. Members cooperate with each other to jointly develop new technologies or integrate existing technologies. At the same time, they offer competing products and services of their own in the marketplace (e.g. equity partners in General Magic).

Second, these networks create technologies and standards that have the properties of both private and public goods. These technologies are private to the extent that alliance partners can restrict other firms from accessing their technologies. However, as firms sponsor their technologies, "open standards" arise. In this manner, these technologies have the potential to become "public goods". Additionally, existence of several alternative approaches makes it unlikely that a single dominant firm or a group of firms might gain control over key standards and achieve monopoly power.

Self-organizing networks imply a lesser need for exogenous regulation (e.g. success of the Internet). Also, since the interdependence of firms in the network reduces opportunistic behavior and transactions costs exogenous regulation acts as a deterrent rather than a facilitator of cumulative synthesis. For instance, regulatory reviews of announced alliance and merger plans have delayed progress towards convergence by placing inordinate demands on firms to demonstrate that their actions are in the public interest. Rather, the very appreciation of interdependence between members, both for promoting technological synthesis and market viability, confers self-governing properties on the network.

Firm-level Issues. At the firm level, the paradox of simultaneous cooperation-competition necessitates a sea change in attitude towards other firms. It is no longer possible to define specific firms as rivals and others as partners and tailor competitive strategy accordingly. This requires a firm to install mechanisms that allow sharing of technology and knowledge with a network member in specific areas while at the same time restricting access to other areas.

Revision at the firm-level includes firms' efforts to shape their internal and external environments. Firms may have to adopt technologies developed by others in preference to their own technologies. For instance, 3DO (a venture in which AT&T is a partner) uses ARM's RISC microprocessors instead of AT&T's Hobbit microprocessor.

Firms may also have to redesign their products and services based on consumer preferences and usage patterns. For instance, Apple redesigned its PDA, Newton, to cater to customers' preferences for more functionality and a cheaper price. Potential entrants into the PDA market such as Motorola and Hewlett Packard too learnt from Apple's experiences and made appropriate changes in design and the timing of product introduction.

Additionally, as learning occurs on the prerequisites for success, firms may have to modify their cooperative and competitive strategies. Within each market segment in cyberspace, firms are consolidating to enhance their core competencies and to attain a position of strength from which they can negotiate with potential partners. For instance, in the desktop publishing software market, Adobe acquired Aldus Corp. to compete effectively in the emerging market for multimedia software.

Investments and courses of action that seemed irrelevant may become significant and vice versa. MCI's initial spurning of Nextel, its subsequent agreement to invest in the mobile-radio service provider and its eventual reluctance to invest illustrates such a situation. Meanwhile, regulatory actions and technological

developments have made Baby Bells and cable companies to pause in their frantic bids to merge with each other. As difficulties arise in synthesizing complex technologies (for instance, implementation delays in interactive multimedia trials), firms are revising their expectations to more realistic levels.

Conclusion

We began this paper by noting that many technologies are converging in the cyberspace field and that the process of cumulative synthesis represents a powerful way of conceptualizing this phenomenon.

In such an environment, we suggested the need for the network mode of organization. As summarized in Table 1, the network mode increases perception, brings together required competencies, enables sustained innovation and learning, and finally, confers self-organizing properties on inter-firm relationships. Together, these properties of the network mode is driving the process of cumulative synthesis or convergence in the cyberspace field.

Indeed, the prevalence of the network mode in several industries including biotechnology, aerospace and automobiles adds credence to our argument that it is the most appropriate form for cumulative synthesis to occur in fields where change is continual and technologies are systemic. In these fields, the technological approaches are many, and the choice of an appropriate organizational mode is as important as the choice of appropriate technologies.

Table 1 - Cumulative Synthesis in the Network Mode

Cumulative Synthesis	Network issues	Firm-Level Issues
Perception of Incomplete Pattern	Requisite variety Network level absorptive capacity Core and peripheral actors	Originate ties and determine positioning
Setting the Stage	Redundancy of functions Push regulatory envelope	Create internal and external options Sponsor technologies
Act of Insight	Dynamic network with fluid membership	Strengthen and weaken ties
Critical Revision	Regulatory re-enactment	Fine tune core capabilities

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