

## Chapter 7

# Restructuring via Virtuality in the 3-G Context

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### 1. INTRODUCTION

Virtual firm arrangements enable one firm to use the assets of another as though they were its own. Virtuality is a way to enter (or remain in) certain types of businesses. Franchising arrangements have elements of virtuality to them, as do examples where firms, like Sears, Roebuck, with highly-esteemed brand (or corporate) names provide services, like kitchen cabinet re-facing or exterior vinyl siding, that are actually delivered by local contractors. The virtual assets being shared by affiliates using such arrangements can be tangibles as well as intangibles.

This paper investigates the structural phenomenon of virtuality to understand why it is favored over other modes of growth in certain industry contexts. It examines patterns concerning how virtual firm relationships have supplanted other business arrangements under certain circumstances, and suggests which forces drive firms to embrace virtual firm arrangements. Comparing the practices embraced by firms in industries like consumer electronics, pharmaceuticals, and electronic commerce, the paper examines how telecommunications firms use virtual firm arrangements in the 3G context and finds that their practices are more typical of industries with well-developed infrastructures than those that are embryonic or emerging.

## 2. VIRTUALITY AND NEW ECONOMY INDUSTRIES

Virtual firm arrangements are often associated with the rapid growth contexts of New Economy industries because of how they have been used. Firms use virtuality to build marketplace legitimacy, propagate technological standards, reach new types of customers, cooperate with potential partners, and enhance demand growth in other ways within industries where technologies and knowledge workers are critical competitive resources. Bolstered by the technology of corporate intranets – communications links that extend to a network of potential partners, suppliers, complementors, intermediaries, distributors, and customers (Cortese, 1996) – a firm using virtuality can modify the economics of competing advantageously as an industry's structure emerges and evolves. The virtual nature of assets employed minimizes some of the switching cost barriers firms face in dissolving linkages with partner firms that may have come together quickly to exploit fast-changing opportunities that have subsequently lost their luster.

Virtuality affords firms greater speed and flexibility when entering attractive, new businesses than *de novo* entry. It can provide cost savings in hypercompetitive environments where assets are irreversible. Virtual firm arrangements can restructure infrastructures quickly when industry success requirements dictate a radical change in strategy. Contextual changes -- such as slowing demand growth, consolidating technological scale changes, higher entry barriers due to winning bids in bandwidth auctions, and other exogenous changes -- may force firms to adjust their ultimate horizontal or vertical scope responses. In such cases, virtuality is a useful, intermediate transition mode that is often followed by irreversible changes in asset investments when uncertainty is resolved. Virtual firm arrangements can also be used quickly as an incremental outsourcing alternative that facilitates divestiture of internal functions.

## 3. DEFINITIONS

Virtual firm arrangements use the physical plant, personnel, and other resources of partner firms as though they were owned (Byrne, 1993). The relationship with partners determines what the arrangement is and whether it functions like a strategic alliance -- rather than an arm's-length contract. Some virtual models of cooperation are deeper and richer than mere outsourcing agreements because they encompass activities of high strategic importance (Economist, 2001).

*Horizontal* virtual arrangements adjust the firm's capacity and capabilities by supplementing them with other firms' resources. They are a means of expanding the reach of a brand or technology. *Vertical* virtual firm partnerships are webs of independent, but vertically related firms operating at various transformation stages. They extend a firm's influence over members of its value net of suppliers, value-added resellers, and complementors. Like other modes of diversification, members of the resulting virtual organization are linked together by something – a strategic alliance agreement, an outsourcing contract, *et cetera* – that presumes a meeting of minds on matters that can be foreseen and an agreement to cooperate on unforeseen dilemmas. Their arrangement is backed by advanced planning processes, integrated computer/ communications technologies, and collaborative networks of specialist firms (Bleecker, 1994). Implementation is premised on partners' willingness to work together through EDI systems, with employees seconded at partners' facilities, and frequent meetings (albeit via electronic conferencing) to coordinate future campaigns (Davidow & Malone, 1992).

Virtual organizations offer greater strategic flexibility than the equity joint venture which creates a stand-alone company (Harrigan, 1985). They can be more flexible than the strategic alliance, as well, because the focus of virtual firms is asymmetrical; the integrator firm outsources its functions to different partners as the need arises. There are fewer *quid pro quos* than in alliances because the identities of partners change more frequently in some kinds of virtual arrangements. If high partnering turnover is necessary to sustain strategic flexibility, virtuality is often the best way to earn high returns in risky environments with unresolved major uncertainties. In New Economy settings, where virtual arrangements are popular, promiscuity in changing partners becomes virtuous and the social capital that typically reinforces alliance partners' ties with each other erodes, as alliance behaviors become virtual, as well.

#### **4. STRUCTURAL TRAITS IN A NEW ECONOMY CONTEXT**

New economy industries tend to use high technology assets and have higher knowledge-to-capital ratios because the scientists, engineers, and other knowledge workers with advanced degrees working within such industries perform work that is higher in value-added content than in older industries. The capital assets of New Economy industries are largely intangibles (patents, brand equity, programming-content libraries, software codes, reputation, and customer-preference databases). Products are often

services (or tangible products with very high proportions of intangible value added). Quality assurance is often necessary to encourage widespread adoption of new services by a mass market.

New Economy industries are typically characterized by rapid technological changes that result in short product life cycles. This occurs, in part, because pressures towards standardization (to increase the number of users in the network and thus increase economies of scale) are eroding the uniqueness of knowledge-intensive products. Because the product lines of some new economy industries are still very new to customers (and their industry structures may still be embryonic), the rules of competition are malleable and unorthodox approaches to serving customers may be tried. Pragmatism dominates old ways of serving customers expediently and this pragmatism extends to using another firm's assets as though they were owned in-house to accelerate revenue growth.

#### **4.1 Unconsolidated, embryonic industry structures**

While industry structures are malleable and investors seek rapid gains, several competing coalitions will try to shape the industry's economics to favor their particular strategic postures by building platform bandwagons to attain legitimacy for their products (or standards). If the emerging industry offers increasing returns to scale (due to network externalities), alliances among complementors, as well as suppliers and re-sellers, may accelerate pressures for platform standards to be accepted to ensure compatibility.

Since competition in new economy industries emphasizes speed (to cope with short product life cycles, rapid obsolescence, and jaded customer ennui), flexibility and swiftness is highly prized. Virtual organizations facilitate the opportunism necessary to remain uncommitted (maintain flexibility) in the volatile settings that characterize emerging industries. Firms within virtual alliances in this context can be opportunistic without fear of eroding social capital (Gulati, 1998) because partnerships therein are less permanent and less formal when demand and technological traits change rapidly. Recriminations are lessened when dominant players (and standards) have not yet emerged. Companies can combine resources to meet a specific market opportunity and disperse once the need to work together evaporates (or different partners offer superior capabilities relative to extant partners).

When customer needs are fragmented and competition seems chaotic, pressures for rapid exploitation of perishable advantages encourage the pursuit of multiple modes of distribution -- under both branded and private labeling schemes -- as well as syndication arrangements to multiply the speed and scope with which properties can be exploited before they lose their individual novelty and bargaining power. Built-to-flip enterprises allow

technological novelties to outlive their inventors (Collins, 2000) and the backing of venture capital firms ensures that industry structures will remain mutable for firms willing to buy market share, like Qualcomm or Nokia.

## **4.2 Partnerships in embryonic industries**

In vendor-customer relationships, vertical alliances with virtual firms have displaced the importance of verticality via ownership in many industries of varying age and formality. The same issues of partnership selection and trust persist -- whether the partnership arrangement is an outsourcing agreement or virtual firm alliance. The same concerns of value chain management persist whether the integrator firm (or its partner) manages the vertical integration strategy on behalf of the alliance. The differences appear in the traits of partners who agree to cooperate and their expectations of each other.

Even in cases where the integrator firm manages physical assets, issues of virtual value chain management persist since firms continually re-evaluate their make-vs.-buy decisions to eke out cost advantages. As the hub of a virtual partnership, the integrator firm must manage the collection, processing, and sharing of germane information with its partners, like an Internet consulting business whereby concept firms own nothing and employ few people -- drawing instead on the talents of many affiliates. The project integrator uses a favorite dancing partner for doing graphics and another for building the technical backbone and yet another for providing the artwork. A fourth partner writes custom code. Identities of favored dancing partners may change as time goes by -- particularly if previous partners have failed to satisfy the consulting firm adequately or if technology changes while alliance partners lag behind. Since partnerships are based on performance and the work product is presented under the integrator's brand marque, many alliances can be reconstituted in New Economy settings with different dancing partners, as needed.

## **5. VIRTUALITY IN FOUR INDUSTRIES**

Partner relationships are examined in four New Economy settings where virtual firm arrangements became useful: consumer electronics, ethical pharmaceuticals, electronic commerce, and mobile Internet services. Relationships between the electronics manufacturing services (EMS) firms and the purveyors of branded consumer electronics products have evolved to resemble an arm's-length contract. Relationships between drug companies and contract manufacturing organizations (CRO) are more like strategic

alliances because they carry greater long-term upside potential for profitability.

## **5.1 Electronics manufacturing services**

In competitive environments (like that of consumer electronics) where time is the most precious commodity, most consumer electronics firms are virtual with respect to manufacturing (and often additional activities). Their absence from manufacturing has been filled by electronics manufacturing service (EMS) firms that extended their activity scope and proportion of value adding services to fill the vacuum created by the virtualization decisions of consumer electronics firms. Soon many traditional OEMs had shifted from a vertical- to a virtual-manufacturing model by divesting their manufacturing assets (equipment inventory, facilities, and people) -- by selling these assets to their EMS partners and outsourcing increasing percentages of production from them.

Although personal computer makers were among the first consumer electronics firms to shed manufacturing plants, the large, vertically integrated telecommunications OEMs also quickly adopted the virtual-manufacturing model -- with an interesting twist that consolidated the market. For example, Motorola, Ericsson, and Nokia were fierce rivals in the cellular telephone device market, but all three outsourced handset manufacturing from the same contract manufacturer: Flextronics. (Motorola formed a five-year outsourcing agreement in 2000 with Flextronics for \$30 billion; in mid-2001, Flextronics was suitor for two troubled Lucent Technologies factories.)

Incremental divestitures to alliance partners such as these have heightened the urgency and magnitude of outsourcing arrangements by electronics competitors -- as witnessed by outsourcing announcements made in 2000 by firms such as Alcatel, Ericsson, Lucent Technologies, Marconi, NEC, Nokia, and Sony. In April 2000, Nortel Networks made the largest OEM-asset divestiture in the history of the EMS industry (to date) by selling Solelectron its four plants for \$900 million. Nortel also awarded Solelectron a four-year, \$10 billion outsourcing contract.

Virtual manufacturing had become a legitimate strategy alternative in consumer electronics by 2000; partnering was a prelude, intermediate step, and way of aligning partners' interests as their needs for close coordination increased. As EMS firms increased their share of a product's total value added by taking on new tasks for their partners, their scope extended to: (a) product design, (b) manufacturing protocols, (c) supply chain management -- buying the parts and ensuring that components and machinery were in place when the customer needed a quick ramp up, (d) making of the actual circuit

boards, (e) fabricating the plastic or metal boxes to hold the electronic device, and (f) shipping directly to customers. Some EMS contract manufacturers have even assumed responsibility for repairs and technical support. The services provided to the virtual consumer electronics firms assumed became increasingly central to marketplace success.

## **5.2 Contract research organizations (CROs) and contract manufacturing organizations (CMOs)**

Pharmaceutical firms sometimes outsource clinical testing and the manufacturing of certain active ingredients to specialist firms. Although these suppliers are called “contract research organizations” and “contract manufacturing organizations” -- and their relationship appears to be that of an outsourcer -- pharmaceutical firms rely heavily on their partners’ prowess in capturing the upside potential for successful introductions of blockbuster drugs – due to industry structure and regulatory practices. For pharmaceutical start-ups, an alliance with effective CMOs is a necessity.

CROs and CMOs invest in laboratory, kilo- and pilot-plant capacity and personnel for testing and production activities, respectively, at various stages of drug development. Much of their capacity may lie fallow until their partners need scaled-up capacity. CMOs, in particular, must carefully choose which partners to work with since being listed on a customer’s Drug Master File obliges them to have scale-up capacity available when needed for commercialization and a customer cannot change its CMO easily once a drug application is approved. To avoid holding too much idle capacity for too long, CMOs must support substances with high probabilities of successful commercialization by choosing the most promising pharmaceutical partners.

Assets used to provide some contractual services of CROs and CMOs came from the drug companies themselves. In 2000, pharmaceutical firms were beginning to divest manufacturing facilities to outsourcing firms and enter contracts with them for a supply of processed active ingredients. Typical pharmaceutical outsourcing clients are worldwide industry leaders, like Merck, Roche, Eli Lilly, and Bayer, with vast marketing organizations for distributing branded products – regardless of where the drug was created or manufactured. Leading pharmaceutical firms must maintain a virtual network of outsourcing partners to preserve their image as an innovative pharmaceutical company. At the other end of the product life cycle, generic drug marketers, like Mylan Labs, use outsourcing contracts to offer off-patent drugs at discount prices.

Start-up pharmaceutical firms – having many product ideas, but limited physical infrastructures -- also use CROs and CMOs to develop, qualify,

manufacture, and market active ingredients. Like the specialization that was facilitated by the electronic manufacturing services industry, virtual pharmaceutical firms can concentrate on exploiting their branded (and patented) properties while partners perform other steps. Contractors offer laboratories and services extending from fundamental research facilities, to applied research tasks, to clinical testing prior to FDA approval, to manufacturing of one (or all) of the active ingredients needed to formulate new drugs, as well as tableting and labeling finished drugs. CROs and CMOs permit innovator firms to accelerate their innovation process and subsequent clinical validation activities leading to patentable drugs.

Distinctions between outsourcing agreements and strategic alliances among vertically-related partners became blurred in the pharmaceutical industry as CROs and CMOs offered a full line of research and manufacturing offerings to provide turnkey services to pharmaceutical firms. For virtual pharmaceutical firms, the services provided by CROs and CMOs were increasingly important to marketplace success. The competitive partnering practices adopted by life sciences firms paralleled arrangements used to launch *de novo* firms that used the Internet to sell products and services to residential consumers – except that the stakes in creating blockbuster drugs were far higher than the ticket of admission to electronic commerce.

### 5.3 Electronic commerce

Use of virtual organizations was commonplace among dot.com firms when e-commerce solutions were first applied to wide ranging types of industries. Bricks-and-mortar companies used alliances with dot.com firms to learn about electronic commerce, while dot.com start-ups took partners' cash and functional assistance as outsourcers to create total product offerings (and Internet presence) instantaneously.

The speed with which turnkey web sites were launched by virtual firms reflects the piecemeal nature by which components were quickly assembled into systems to legitimize competitors' offerings and establish standards. Like the telephone, fax machine, and other networks subject to increasing returns to scale, access to the Internet became more valuable as more users were connected and as current users enjoyed more ways to use the Internet for transactions (Arthur, 1996). As customers, virtual firms were attracted to use particular software components based on their perceived legitimacy of a particular technological standard. Because a large installed base amplified the benefits of experience curve economies, organizational learning, and other network effects, early entrants forged terms for licensing that were highly advantageous to the dot.com user to build up their installed bases. As



is typical for increasing return environments, success breeds success and first-mover advantages were substantial in setting standards for billing systems, transaction security, and other infrastructure needed for electronic commerce. Simultaneously, the functionality of the Internet was enhanced for users by syndicates that bundled existing content – databases, streaming data, and other intangible assets – and provided users with access to that content in ways that were formatted to serve specific types of customers.

While their industry structure was chaotic, virtual dot.com firms did not own pieces of the value chain that were uninteresting to them, or that they were not particularly good at. As integrators at the hub of virtual firm arrangements, dot.com companies had opportunities to exploit their knowledge faster by working with skilled, outside partners (Rayport & Sviokla, 1995). The virtual companies focused on what they could do better than others could do, and brought together partners who provided the complementary pieces needed to bring products to the market faster (Hagel & Singer, 1999). Assuming that the infrastructures and proficiencies of supporting industries were well developed, the virtual firm could leverage the experiences, reputations, and skills of partners to skip the time needed to develop in-house what partners had already achieved – doing so without a loss of perceived leadership and legitimacy.

## **6. VIRTUALITY IN WIRELESS TELECOMMUNICATIONS**

The wireless telecommunications arena of third-generation (3G) services is another New Economy industry where the best technological platforms may not become industry standards because of the effects of first-mover advantages due to increasing returns to scale (Arthur, 1996). Accordingly, wireless telecommunications competitors were pressed to form partnerships, pool resources, and use other arrangements to maintain a market presence (albeit virtual) while the industry shakeout ensued. While the need for virtual firm arrangements in wireless telecommunications was like that for electronic commerce (because mobile Internet access required assets and knowledge controlled by a wide network of different types of providers), the use of virtual firm arrangements for the infrastructure underlying 3G wireless telecommunications services more closely resembled practices in the EMS business.

The wireless telecommunications industry structure was characterized by an extensive web of relationships between telecommunications companies that could take one of four forms: commercial (which included deals like leasing capacity on one company's network by another, such as in 1998,

when Winstar Communications agreed to provide wireless capacity to Williams Communications); strategic (which included investments in competitors); equity (which included purchases of shares in another, non-competitor company); and vendor financing (by which one company provided funds so that another can buy the vendor's products). Success in bringing the Internet to every cellular telephone was influenced by the openness of architecture, network superiority, and software for browsing, among other requirements. Virtual firm arrangements were part of the artillery in the battle for worldwide mobile Internet supremacy. Service providers were allying with infrastructure, handset and software producers to create 3G service capacity in anticipation of customer demand.

## 6.1 Service providers

By mid-2002, only NTT DoCoMo offered 3G service (in addition to its "i-mode" text messaging system). NTT DoCoMo could do so because Japan's base stations were densely configured (containing much intelligence on the servers). When NTT DoCoMo launched service in Germany, the Netherlands, and Belgium, it did so through a virtual firm arrangement with KPN Mobile and offered only "i-mode" service. Reeling from the cost of their 3G licenses, Europe's cash-strapped operators were cutting back on the number of 3G base stations constructed in 2002 (as Vodafone was doing in the EU). Or they were building "thin client" 3G networks (instead of dense ones) -- leaving more applications directly on the handset (or in a Subscriber Identity Module [SIM] card). Internet Protocol (IP) technology was needed to offer the full range of 3G services (like video on 3G phones) and some wireless service providers could not justify investing in IP alone.

As survival became more important than competition, wireless service providers began sharing their networks to reduce economic risks. When British Telecom and Deutsche Telekom announced plans to share 3G-network infrastructure, Nokia introduced a base-station kit explicitly for shared networks. Although wireless service providers had previously resisted the wholesaling of excess capacity to mobile virtual network operators (MVNOs), economic conditions made such virtual firm arrangements attractive in 2002. Popular portals (like Yahoo!), banks, media companies, and content aggregators were candidates to become MVNOs. (Some content aggregators (portals) were already owned by network operators, e.g., Genie [owned by BT], zed [owned by Sonera which was acquired by Telia], and T-Motion [owned by Deutsche Telekom]).

In the United States, AT&T Wireless, Cingular Wireless [a joint venture of SBC Communications [60%] and BellSouth [40%]] and Voicestream Wireless (the wireless unit of Deutsche Telekom AG) cooperated to provide

nationwide GPRS coverage and several large wireless operators agreed to pass text-message traffic between their networks. Cingular Wireless and Voicestream Wireless planned to share mobile infrastructure in New York, California, and Nevada. Convergence towards Internet standards for wireless communications benefited from the demonstration effects of applications software for conducting e-business in the U.S.

Because Vodafone AirTouch PLC was one of the largest wireless telecommunications companies, but an Internet neophyte, it gathered partners around it that were knowledgeable of Internet operations (including IBM). In the United States, Vodafone launched Verizon Wireless -- a joint venture with Verizon Communications that combined the wireless networks of Bell Atlantic Mobile, AirTouch Cellular, and GTE Wireless. AT&T expanded its U.S. wireless network through affiliate agreements (which are like franchise arrangements). AT&T's affiliates own the wireless spectrum and build the network infrastructure in their geographic territories, but give AT&T Wireless more favorable roaming agreements with them under these arrangements.

## **6.2 Infrastructure**

Several infrastructure suppliers formed alliances to enhance the formation of the wireless data market. Cisco Systems and Motorola cooperated to develop mobile Internet networking equipment. Motorola cooperated with Nextel, Netscape, and Unwired Planet (an Internet software specialist) to provide Nextel's customers with an Internet gateway and email service. Cisco and Qualcomm cooperated to develop a high-speed wireless Internet service for US West. Microsoft and British Telecom (BT) cooperated to create data communications services for BT customers in ten countries.

## **6.3 Internet access and operating system software**

In 2002, Microsoft battled Nokia to control the platform for accessing Internet services via cellphones and personal digital assistants (PDAs). Their battlefield was in Europe where mobile-phone operators upgraded from second-generation technology to third-generation platforms that required software to support Internet access, e-mail, and audio/ video features.

Nokia favored an open platform based on Symbian's operating system and Java. (Symbian is a London-based software joint venture with Psion, a British maker of handheld computers, that linked Ericsson, Nokia, Motorola, and NTT DoCoMo. Symbian's operating system for wireless Internet phones went head-to-head with Microsoft's Windows CE. Symbian had the

support of IBM and Oracle in setting the EPOC32 operating as a standard.) Microsoft's plan was to bundle its 3G platform with its Windows operating system. Its plan was buttressed by deals with Cingular, Verizon, and Voicestream in the United States, as well as with T-Mobile's cellular service in Germany. (Microsoft had commitments also from mmO2 --the British Telecom spinoff, France Telecom's Orange, Spain's Telefónica, and Britain's Vodafone.)

## 6.4 Handsets

In Japan, closed telephone handset standards helped to launch mobile Internet service. If Japanese consumers wanted to switch from one service provider to another, they purchased a new cell-phone because the three Japanese competitors used incompatible standards. When an operator wanted to launch a new service (such as picture messaging or videotelephony), it specified in detail how that service would work, asked manufacturers to build the appropriate handsets, and ensured that the high-end handsets were available when the service was launched.

Where service providers could not dictate standards to handset producers, there was a "chicken-and-egg" problem regarding wireless service innovation. In Japan, handset makers worked closely with the three service providers -- each of which used its own network technology. KPN Mobile's European "i-mode" service required a special handset made by NEC or Toshiba that was similar to NTT DoCoMo's handset.

The idea of operator-specific handsets was catching on in Europe in 2002. British service provider, mmO2 PLC, was launching an organizer-style handset using a design licensed from Danger (of Palo Alto) and was working with Microsoft and HTC Corp, an electronics company in Taiwan, to develop its own high-end wireless phone. Microsoft and Intel teamed up to develop a high-end wireless phone template that included software from Microsoft and chips from Intel. Such templates enabled more handset makers to make operator-specific devices -- especially if the radio chip for connecting to the network was included in the design. Microsoft hoped that wireless telephone-system operators would hire contract manufacturers (EMS firms) to produce phones based on its templates for their customers. Microsoft had already developed a high-end wireless phone template with Texas Instruments. (Hewlett-Packard relied upon Texas Instruments to supply the key chips for its personal organizer that was resold by Orange, the mobile unit of France Telecom SA.) Alcatel SA announced plans to second hardware engineers to semiconductor supplier, ST Microelectronics NV to influence the design of high-end wireless phones for its use. Motorola Inc.

and Telefon AB L.M. Ericsson had also launched their own reference designs for service providers' use.

## **7. USING VIRTUAL FIRM BUSINESS MODELS**

Virtual firm arrangements facilitated speedy turnovers in the New Economy industries where they were embraced. Since product life-cycles were short, speedy turnovers created more opportunities for firms to extract rents before obsolescence occurred. The strongest competitors used their control of a bottleneck resource – a portal, an application, a brand name, et cetera -- to build a resilient platform for building an installed base of customers to whom new applications could subsequently be sold. The new features and product applications were typically created through virtual firm arrangements with complementors – firms providing additional products and services that increased product functionality for the installed base of users. Network partners frequently engaged in reciprocal outsourcing agreements with other partners in other value nets to leverage an integrator firm's bottleneck asset even more.

The downside of virtual firm arrangements pertains to the short life expectancy of partnerships and firms' behaviors as a consequence. Because product life-cycles are expected to be brief, partnering opportunism is exacerbated where industry evolution is not triggered. Innovation in offerings of products and services exacerbates firms' eagerness to integrate with best dancing partners in virtual firm arrangements. Each new product generation that is introduced to the industry is subject to a new cost curve of increasing returns to scale, where the greatest cost improvements are in the first doubling of cumulative units sold. The rush to reconfigure partnerships and capture market share gives rise to churning behaviors that destroy social capital among partners. The loss of social capital motivates firms to make vertical investments in lieu of trusting their partners. The increased risk associated with integrated operations results in an unstable industry structure, with ensuing shakeouts and consolidations.

Although the wireless Internet service offerings of 3G network providers were becoming available with greater frequency in 2002, the key impediments to market development were the lack of infrastructure and limited applications available via wireless telephone handsets. Virtual firm arrangements were a promising means of supplementing these shortfalls by using the extant assets and capabilities of partner firms to accelerate the demand for 3G services.

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