RELATIONAL NETWORKS, STRATEGIC ADVANTAGE: NEW CHALLENGES FOR COLLABORATIVE CONTROL

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A brief glance at the evolution of strategic focus reveals dramatic shifts in relevant context with potent implications for organization and control, rooted in the reversal of a century-old “long wave**{** XE "long wave" **}**” centered on internalizing various economic activities to control them that gave rise to the integrated firm, the corporation and the conglomerate (Chandler, 1977; Chandler & Salsbury, 1974). Where companies from the mid-1860s to roughly the 1980s created strategic advantage by internalizing activities for greater stability, efficiency and control, increasingly since then advantage has centered more and faster learning and innovation (IBM**{** XE "IBM" **}**_Global_Services, 2006; Prahalad & Krishnan, 2008; Schramm, 2006). But no company can control all the resources needed for innovation (Prahalad & Krishnan, 2008), so creating strategic advantage has increasingly required collaborative, outsourced, strategic alliances (Culpan, 2002; Doz, Santos, & Williamson, 2001; Doz & Hamel, 1998) and “open innovation**{** XE "open innovation" **}**” (Chesbrough, Vanhaverbeke, & West, 2006; Chesbrough, 2003). Moreover, such innovation embraces new business and service models, not just new products: thus new models of business are emerging, centering on networked interactions (Chesbrough, 2006; Sirkin, Hemerling, & Bhattacharya, 2008; Tuomi, 2002).

These developments pose critical theoretical and practical challenges for traditional conceptualizations of organizational control**{** XE "challenges for organizational control" **}**. First, most organizational theory of control has fixated on employees of “the firm,” yet contemporary relational networks explicitly transcend firm boundaries, to tap into expanded expertise. Much prior discussion addresses control in terms of hierarchical models, economic rationality, and managers' ability to enforce compliance (Bijlsma-Frankema & Costa, 2009) but these are not really options among firms in voluntary association. The evolution of control theory has embraced three central facets, control of *inputs*{ XE "Control systems targets:inputs" }, *behavior*{ XE "behavior" } and *outputs*{ XE "Control systems targets:outputs" } to induce desired results. More recently have theorists moved toward dynamic control theory within the firm over time (Cardinal, Sitkin, & Long, 2004). Yet the challenge today surpasses organizational boundaries – or rather, *firm* boundaries, for networked activities themselves are quite elegantly organized – a matter to which we shall return. In addition, the contemporary rapid-paced world of constant learning and innovation across firms requires frequent network reconfiguration – building new relationships, adding partners, and creating *ad hoc* assemblages of willing, capable collaborating partners for changing goals.

A reconsideration of control theory in light of these facts directs our attention to reframing the fundamental meaning of "control;" expanding the system within which control takes place to transcend boundaries of the firm; and extending our understanding of the control transaction to embrace mutual social control; iterative, and possibly intermittent engagements among partners; and changing networks that nevertheless must be coordinated to assure results. Relational networks{ XE "Relational networks" } that seek to build long-term trust{ XE "trust" }-based relationships across participants to foster innovation constitute an especially challenging case that will be our main focus, but not our only concern (Hagel_III & Brown, Forthcoming). Because the precise outcomes cannot be specified in advance, the partners in such networks are profoundly dependent upon one another – more so because each holds expertise or knowledge unknown to the others, yet crucial to shared goals. The organizers**{** XE "Network organizers" **}** in such networks of creation cannot compel compliance, because their partners are not their employees and do have alternative options. Nevertheless, neither the organizers**{** XE "Network organizers" **}** nor their partners are passive objects of others' unilateral power. Instead, members in such innovation networks are usefully construed to be co-controlling their interactions. Just how this might occur is our topic.

This chapter will begin by contrasting the "long wave**{** XE "long wave" **}**" of internalized activities and the controls to which they gave rise with the contemporary shift toward collaborative processes, increasingly embracing external partners. Specific examples of networks for innovative product and service design, and, by extension, new collaborative business models will provide our illustrations, underlining the increasing importance of a global perspective on resources and potential alliance or network partners. We next turn in sequence to three levels of managerial practice**{** XE "levels of managerial practice" **}** within such relational networks: identifying and engaging relevant partners; connecting across capabilities, products and sites, and amplifying opportunities for innovation and learning that are a major reason for networks in the first place. We then take up the broader implications of network control, closing with consideration of the consequences of our perspective for companies and managers, for policy makers, and for researchers.

FROM COMPANY CAPABILITIES TO NETWORK DYNAMICS

Beyond the Market: Externalizing Collaborative Co-Creation

If the central fact of business organization for much of the twentieth century was "integration" – internalizing activities in order to control them – a very different trend has characterized business organization since perhaps 1980. First visible in the US in the reengineering and outsourcing movements, and driven by financial pressures to lower costs and enhance return on assets, firms simply stopped performing activities others could do better (and often cheaper) (Hammer & Champy, 1993). Activities that did not directly add value were outsourced or eliminated while refocusing attention on what a given firm did best enabled superior performance (Quinn, 1992).[1] Specialist firms abounded, ready to take on contract manufacturing, software development, industrial design – an endless array of activities formerly the responsibility of an integrated firm precisely because they were often unavailable outside in earlier times – reflecting the growing elaboration of the world economy. In such conditions, old assumptions about what must be internalized come up for reconsideration, as does the very definition of "What business we are in" (Hagel_III & Singer, 1999).

Yet the issues of coordination, quality assurance and control that drove early firms to internalize these activities did not disappear: indeed, they become still more challenging when geographical, cultural, and institutional distance intervene. As this is being written, melamine contamination of dairy products, candies, chocolates and infant formula from China are in the news. Not long ago, so were children's toys with lead paint, counterfeit drugs and airplane parts, and "grey market" products (substandard rejected by Western companies, or "excess" production flowing through unauthorized

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[1] Some assert the standards for required returns, based on comparison with financial services industries, were simply inappropriate for manufacturing or other non-financial, non-service businesses: see, for example, Phillips, K. (2008). ***Bad Money: Reckless Finance, Failed Politics, and the Global Crisis of American Capitalism*** New York, Viking.

channels), as well as cars identical to those produced for GM that were "rebadged" with the name of the Chinese maker. Of course, China is by no means the only locus for such disputes; recent news found similar issues in the U.S. (McWilliams, 2008), underlining melamine contamination as a control issue, not a "China" issue. Moreover, such opportunistic behavior**{** XE "behavior" **}** is by no means the only difficulty in collaborative action.

Particularly where partners seek to create something new, to develop cutting-edge technologies, manufacturing processes or services, or even new business models where "the answer" cannot be specified in advance, much more is at risk – and it is much more difficult to ascertain whether a partner is performing in good faith. Once business moves from predominantly "inside the firm" to predominantly "with the network," a whole new set of control issues arise. Before we turn to control issues, however, some clarification of network terminology is required. Networks differ, and within different networks, different issues of relationship, risk and control arise.

A Taxonomy of Networks:

"Networks" have become increasingly important, both in business and non-business sectors, as means of collaboration to achieve complex goals. Analysis of relationships, communications flows, and influence as instances of social capital e.g., (Burt, 1992) has drawn much attention, but consistent terminology is needed to clarify among and between different types of networks, such as innovation networks, relational networks, creation networks**{** XE "creation networks" **}**, process networks**{** XE "process networks" **}**, and relational process networks**{** XE "relational process networks" **}**, among others. While humans have always collaborated, much organization theory has preferred to focus on matters internal to the firm, with relatively less focus on the very inter-firm or inter-organizational links that have become so important.

To highlight the dimensions of difference, we point to the character of the interaction involved. On one extreme, two or more partners may engage in one-off exchange, with no expectation of further interactions: this is a transactional relationship**{** XE "transactional relationship" **}**, at arm's length and emphasizing the transaction. The parties have no obligation to one another past the transaction; this is the focus of much single-round, zero-sum game theory analysis. On another extreme, multiple partners may engage in an on-going series of interactions: this is a relational exchange, engaging and requiring trust**{** XE "trust" **}**, and focused on continuing interaction. Further still, beyond simple transactions, partners may cooperate with one another to share business processes in their ongoing relationship.

We will use the following explicit taxonomy throughout the paper, starting with the broadest and moving to sub-categories of relationships:

- *Innovation networks* - any broad-based mobilization of resources across firm boundaries to deliver new value to the marketplace, including both transactional and relational networks.
- *Transactional networks***{** XE "*Transactional networks*" **}** - networks that access resources across firm boundaries largely through short-term transactions. There is no necessary expectation of a relationship beyond the immediate transaction, although parties may transact with one another repeatedly.
- *Relational networks***{** XE "Relational networks" **}** - networks that both rely on and build long-term, trust**{** XE "trust" **}**-based relationships to deliver new value to the

marketplace, including both tightly coupled{ XE "tightly coupled" } networks like the Toyota{ XE "Toyota" } supplier network and loosely coupled{ XE "loose coupling" } networks like Li & Fung{ XE "Li & Fung" }.

- *Relational process networks*{ XE "process networks" } - networks that rely on long-term, trust{ XE "trust" } based relationships but also organize extended business processes into loosely coupled{ XE "loose coupling" } modules of activity that enhance scalability, diversity and flexibility.

Using this taxonomy, the four examples we highlight in this chapter would break out as follows, distinguished by the nature of their interactions, the duration of continued exchange, and the degree of entrainment among shared business processes – which in turn create distinct requirements for trust{ XE "trust" }, distinctively different potentials for control, and concomitant potentials for achieving sustained innovation, accelerated learning, and richer opportunities through sharing of tacit knowledge in particular. In these kinds of networks trust is a critical underpinning for open information exchange and learning.

Innovation Networks: Any Broad-Based Resource Mobilization Across Boundaries

Network Types:	**Transactional Networks** Often market-mediated, partners access resources through short-term exchanges or transactions.	**Relational Networks** On-going or repeated exchanges, predicated on trust{ XE "trust" }, where partners depend on one another to create and deliver new value. May be loosely or tightly linked.	**Relational Process Networks** On-going, trust{ XE "trust" }-based relationships where partners devolve essential business processes to one another, collaborating to.
Examples:	InnoCentive	**Tightly Linked:** Toyota{ XE "Toyota" }'s supply chain. Dell{ XE "Dell" }'s suppliers. For its corporate clients, Dell{ XE "Dell" }	Taiwanese Original Design Manufacturers (ODMs{ XE "ODMs" })

	operates as a "virtual IT department."	
	Loosely Linked: Partners orchestrated by Li & Fung{ XE "Li & Fung" }	VISA{ XE "VISA" }'s shared process network; Flat Panel Display development

- Dell{ XE "Dell" } - Dell operates a relational network of suppliers like Toyota{ XE "Toyota" }'s system, but it relies on ODM's (Original Design Manufacturers) from Taiwan who themselves operate relational process networks{ XE "process networks" } to support the design of new computers. From its corporate clients' perspective, Dell's "virtual IT department" services themselves constitute a relational network, linked to software and component suppliers.
- Apple{ XE "Apple" }'s iPod – Apple's network depends on a key participant in its early iPod efforts, PortalPlayer{ XE "PortalPlayer" }, which in turn operated a relational process network that underpinned much of Apple's early success in the commercialization of the iPod.
- VISA{ XE "VISA" } - VISA operates a relational process network, although it is somewhat of a special case because at least in its early decades its participants all had an ownership stake in Visa.
- Flat Panel Displays{ XE "Flat Panel Displays" } - participants came together in a relational process network.

Innovation networks more broadly have been discussed by Chesbrough e.g., (Chesbrough, 2006; Chesbrough et al., 2006; Chesbrough, 2003) but we focus here on the opportunities and requirements of relational networks, and even more specifically, relational process networks{ XE "process networks" } that provide much richer opportunities for sustained and scalable innovation because of their ability to access and develop tacit knowledge among the participants.

From Input, Output and Behavior Control to Trust-Based Relations:

Since organizations – and most especially, firms – are intended to achieve particular objectives, some means of assuring achievement of those ends is needed (Tannenbaum, 1968). Control systems{ XE "Control systems targets" } have been described in three different targets – control of inputs{ XE "Control systems targets:inputs" }, outputs{ XE "Control systems targets:outputs" }, or behaviors{ XE "Control systems targets:behaviors" } (Cardinal & Sitkin, 2009) – each entailing various tradeoffs (Jensen & Meckling, 1976; Ouchi & McGuire, 1975; Williamson, 1981). Most firms deploy elements of all three systems, although often favoring one or another (Jaeger & Baligam, 1985; Oliver & Anderson, 1995; Ouchi & McGuire, 1975; Snell, 1992). *Behavioral controls* specify the procedures to be followed, and rely on close monitoring and supervision, along with behaviorally-based performance assessment (Cheng & McKinley, 1983). *Output controls* monitor results, rather than behavior{ XE "behavior" }, and rely on clear standards (Thompson, 1967), as well as outcomes that can be observed and measured (Eisenhardt, 1985; Ouchi, 1979). *Input controls* are suggested for situations where output{ XE "output" } cannot be easily measured, nor behavior closely monitored; these include “clan” approaches that emphasize social suasion and group social pressure (Ouchi, 1979), resource sharing and socialization (Govindarajan & Fisher, 1990) as well as hiring, training and selection (Snell, 1992).

These research findings are uniformly rooted in firm-based control situations, although peer pressure and informal socialization are also widely documented in social groups ranging from families to peer groups (Asch, 1958) to societies (Kuran, 1997). Yet their applicability to networks as voluntary associations – where individual survival is not at issue, as in families; where firms have alternative opportunities; or where the enormous social pressure of a repressive society (Kuran, 1997) is not at work – remains an open question. Even if the underlying theory seems apropos, what kinds of control might be suitable in such voluntary business associations? A simplistic answer is that participants join in the first place, cooperate in the second, and continue in the third because they perceive benefits to doing so outweigh the costs (Barnard, 1938; 1956). But what benefits, particularly when – for example, because a product is new and innovative – market outcomes may reside in a distant and uncertain future? And, beyond withdrawal of those uncertain future benefits, what controls make sense?

Control under such circumstances poses new challenges, and the mechanisms available to resolving the challenge are our focus: it is not clear that the traditional notions of behavior**{** XE "behavior" **}**, input**{** XE "input" **}** and output**{** XE "output" **}** as typically construed are applicable here. Why not? First, because the traditional mechanisms of control presume a hierarchical relationship not present in networks. Network members, after all, are not “employees,” and they typically have alternative opportunities for business, while the focal firm seeking their collaboration may have few options. Shifting strategy focus from inside a single firm (with a single, hierarchical order, legitimate authority, and at least a nominally common strategy) to a network is one problem: how shall non-employee participants be enticed to cooperate at all, or to shift to a new strategy, or to share critical insights?

Transactions, and indeed transactional networks, rest on the assumption that price in a marketplace subsumes the essential information needed. By contrast, relational networks undertake much less certain interactions, where value is “to be determined” in the future; where behaviors{ XE "Control systems targets:behaviors" } cannot easily or usefully be specified, because learning is a desired result; and where ongoing relationships, trust{ XE "trust" } and shared insight are central.

Shifting from static to dynamic capabilities{ XE "dynamic capabilities" } poses another challenge, for we focus particularly on networks aiming to learn and innovate, seeking to create new knowledge by their interactions, rather than simply enacting a prior recipe. Strategy theory on dynamic capabilities opened an important door, in providing theoretical grounding for changing configurations of capabilities. Recent work on supply chain innovation, involving other firms beyond the focal organization, also provides insight.

But this creates a dilemma: Most work on organizational control focuses precisely on *organizational* control – control of employee actors to assure coincidence of their acts with the firm’s strategic intent, for example, although more sophisticated observers also note that agile response to changing circumstances may sometimes be preferable to reproducing an abstract intent: see (Moncreiff, 1999). Once we step into networks of collaborating, but independent partners, hierarchical models of control don’t work – partners are not employees. Moreover, particularly for innovation networks, outcomes cannot be precisely specified in advance if the collaboration is to benefit from partners’ creative capabilities. Thus outcomes must be emergent – and cannot be tightly predetermined contractually. Learning, the most critical desired outcome, is unpredictable in detail.

How, then, to exercise control? Older methods – bringing activities "inside" the organization's boundaries to own them; exercising hierarchical control; depending on clan-like identity – are no longer feasible for external collaboration with equals who are often distant in geography, culture and expertise. Another critical limitation: because outcomes are emergent and breakthroughs are sought, results have a futurity and an uncertainty that disables transactional remuneration. Transactions require a here-and-now certainty about the exchange of value in the transaction; learning and innovation, by contrast, are rooted in ongoing interchange. This limitation is further exacerbated because all parties in relational networks focused on innovation have a critical need for trust{ XE "trust" }-based interactions – to address uncertainties, emergent outcomes, and sought-for home runs – that only enduring relationships can achieve.

We turn now to brief descriptions of four contemporary networks to illustrate the nature of emerging control practice. As our taxonomy indicated, networks differ along dimensions of duration of relationship, degree of engagement and trust{ XE "trust" }. Dell{ XE "Dell" } Computer's interlocked business network uses virtual networking to drive innovation. Dell's supplier network relies on enduring relationships with suppliers, but of a fairly conventional nature: Intel supplies chips, and Dell and Intel exchange information on customer demands and technical capabilities. Similarly, Apple{ XE "Apple" } Computer's iPod and iPhone networks highlight both agility and multiple usages of capabilities that an enduring network can provide. But beneath Apple's successful relational network is the much more process-entrained network of

PortalPlayer{ XE "PortalPlayer" }. While these particular networks center on so-called "high tech" firms, and technology-based products, they are by no means the sole practitioners of these new managerial arts: the birth of the VISA{ XE "VISA" } network exemplifies a similar network collaborating to create a new business model, a means of serving customers that was not only new to the world, but quite contrary to then-existing industry practice (Hock & Senge, 2005). Finally, we'll look at the international consortium of companies that developed flat panel displays: a central element in contemporary computers, especially laptops – but also in cellphones, video cameras and more. The project was so challenging that no company, and indeed no *country* possessed the technical, scientific, manufacturing and financial resources to achieve it alone (Murtha, Lenway, & Hart, 2001).

Dell{ XE "Dell" } *Computer's Virtual Networking:* Dell Computer is widely recognized for its made-to-order business model through which consumers can order a custom-built computer online or by telephone. Dell's customer service representatives are trained to query the customer, ascertain needs, and advise customers to assure the best choice. Less well known by many is Dell's much larger corporate business: Dell is essentially the IT service function for many firms, maintaining a website with pre-specified choices for hardware and software as negotiated by the corporate customer. The employee chooses from the available online options, seeing what appears to be an internal corporate webpage. Dell manufactures the computer and loads it with the firm's choice of software, then arranges for delivery of the fully loaded equipment to the employee's desk: true "plug-and-play," with no requirement for lengthy set-up processes (Magretta, 1998). . Dell operates "as if" it were the corporate IT support department:

from the client firm's perspective, an important activity is devolved to Dell, as a relational network partner, intertwined seamlessly with its clients. For firms with hundreds or thousands of desktops to maintain, the advantages are enormous.

Dell**{** XE "Dell" **}**'s own supply network is far more discrete. For Dell's supply network, the confluence of constant input**{** XE "input" **}** from consumers, high-demand gamers, and corporate customers translates to valuable information about changing computation requirements. Dell's high volume usage of key components makes the firm a highly desirable customer, with whom chip makers like Intel interact in early design stages: Dell's up to the minute customer knowledge helps to assure that new chips meet real customer needs. Because it holds mere hours or less of inventory, Dell quickly shifts to versions of top chips, Intel gets immediate feedback, and both consumer and corporate clients get effective, low-cost systems. While there is substantial trust**{** XE "trust" **}** in the Intel-Dell relationship, the partners' business processes remain discrete.

Dell**{** XE "Dell" **}**'s initial network pioneered in the design of a "pull" manufacturing system that tied customer requirements for highly customized configurations of a computer to on demand manufacturing for delivery within days. Its innovative direct selling channels, combined with lean manufacturing approach provided sustainable competitive advantage that other computer companies struggled to replicate. More recently, however, reports suggest that Dell is looking for a buyer for its factories – moving further, if it does sell them, into networked partnerships as a fundamental business model; for additional discussion of Dell's approach, see (Hagel_III, 2008).

What would be different about such outsourced manufacturing? Among other things, it would be predicated on having a core business process performed by others, requiring a different kind of loosely-coupled network arrangement (to which we shall return) to achieve the rapid innovation, agile response to changing customer needs, and high quality Dell{ XE "Dell" } needs. For laptop computers, Dell – like most other laptop makers -- relies on Original Design Manufacturerers (ODMs{ XE "ODMs" }) based primarily in Taiwan. ODMs now perform design as well as manufacturing functions for major computer OEMs – activities that were formerly considered core proprietary activities. The Taiwanese ODMs have gained market share by offering compelling value – bringing together higher-value-added activities as well as offshore manufacturing assembly, leveraging not only lower labor cost but also bringing their customers compressed design cycle times, component cost savings, tighter inventory management, and more adaptive (often local) supply chains.

Apple{ XE "Apple" }*'s iPod Network:* Apple's iPod is in many regards the story of PortalPlayer{ XE "PortalPlayer" }, a firm that played a central role in the commercialization of the iPod. The real relational network in this story was PortalPlayer's, not Apple's, although it was essential to iPod's success, and thus to Apple's. If Dell{ XE "Dell" }'s network reflects incremental advances in components, Apple's iPod display a much more aggressively innovative new product development activity arising directly out of the network. The iPod was not the first portable music player to the market – but its form factor, ease of use, style and component integration yielded performance quality that swept to market dominance rapidly. In 2008, Apple's market share was over 70% of all MP3 players, and 84% of all player sales: (Elmer-DeWitt, 2008), while iTunes was the largest seller of music in any format in the U.S.

Apple{ XE "Apple" }'s success hinged on advanced performance capabilities: a minute disk drive, rapid development (nine months from concept to product!), and effective collaboration in an open business model with a range of partners. One of the key participants in Apple's network was PortalPlayer{ XE "PortalPlayer" }, which provided the basic platform for MP3 files, produced the reference design in collaboration with Apple, and orchestrated technical design input{ XE "input" } for the iPod through its own global network.

Once the iPod was up and out, subsequent development of the iPhone engaged many of the same partners, used similar software and the iTunes website user interface for device setup and updates. iPhone launched Apple{ XE "Apple" } into the cell phone business, with a runaway bestseller. But its significance is not launching "a single" new business; the development process multiplexed new features, redefined device categories, and blurred distinctions among product lines – and relied upon a network of capable partners. Apple has persistently utilized its networks' technical developments, features and user interface enhancements across its products. Thus the 2008 iPod Nano and iPod Touch have features initially developed for iPhone, like Album View, accelerometers to shift between landscape and portrait layout, touch screens, and the common iTune interface, including the App Store (for Applications, small computer programs for download onto iPods and iPhones). The result is a cluster of businesses, leveraging capabilities that sprang from earlier accomplishments of the PortalPlayer{ XE "PortalPlayer" } relational process network and other network participants. For network partners, these continued developments extend the benefits of participation, making continued participation highly attractive.

The marketplace results suggest the impact and strategic advantage of such collaborative innovation. As of September 2008, some 65 million users had downloaded over 100 million applications – in the first 60 days of the App Store's existence. As of September 2008, 90% of all US cars offer iPod integration. iPod Touch and iPhone blend the product categories of MP3 player, game platform, video and TV viewer, among others. With the help of its collaborating partners – game developers, music providers, and software developers as well as the collaborating hardware and components providers – Apple{ XE "Apple" } has moved well beyond its initial positioning as "a computer company," shifting customers' expectations along the way, to become … what? A portable musical device company? A cell phone company? An experience company? But Apple still makes computers, and indeed has seen its market share rise, along with its profits, in all its product lines; its network partners continue to benefit from these successes. For instance, in October, 2008, Apple's 3G iPhone was second only to Motorola's RAZR, which sold for as little as 25% of the lowest iPhone price. Moreover, through its iTunes website, Apple was also the number one music distributor in any format in the U.S., exceeding Walmart, Best Buy and Amazon. In short, Apple's network of alliances and collaborating partners has supported creation of dramatically new ways of being in consumer electronics, and entertainment, and software, and electronic devices, among other businesses. Apple's relational network and its dynamic processes accelerate capabilities development for all the partners, including Apple, and also speeding the pace of coherent strategic change.

VISA{ XE "VISA" }*, a Global Collaborative Finance Network:*[2] VISA's early development rested on an extraordinary relational process network that allowed VISA to focus on building and innovating around a shared processing platform, while the banks in turn could focus on innovating in terms of product design and marketing initiatives to accelerate adoption of this innovative financial service product. While it is hard to remember that when VISA was formed the credit card was still a relatively new innovation, and a troubled one at that, VISA's vision of a global network was a frame-breaking innovation. Moreover, without the common relational process network to solve major problems of transaction exchange and widespread card acceptance across individual banks' customer and retailer networks, credit cards could not have produced either widespread credit transactions or profitability to issuing banks. Having solved the problem in the US, similar issues reemerged when the credit card network moved across international boundaries, and new agreements and standards had to be negotiated.

The worldwide VISA{ XE "VISA" } network evolved as a collaborative participation of some 22,000 owner-member banks that simultaneously competed with one another for customers, and cooperated in honoring one another's charges – to the tune of more than $1.25 trillion annually, across borders and currencies. Dee Hock, the founder and CEO Emeritus of VISA, calls VISA's early organization "chaordic," by which he means it exhibits a self governing blend of both order and chaos, achieving "enough" harmony to operate, but enough chaos to constantly generate new, emergent capabilities (Hock & Senge, 2005).

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[2] We focus here on VISA{ XE "VISA" }'s early days, rather than its more contemporary recent incarnation as a much more traditional corporate entity: see Hock, D. and P. Senge (2005), ***One from Many: VISA and the Rise of Chaordic Organization***, Berrett-Koehler Publishers.

As with the FPD{ XE "FPD" } (see below) or iPod networks, VISA{ XE "VISA" } too is more than the sum of its parts – and more than it may be at any instant: there is always more potential because human actions are not deterministic. As problems, threats, or opportunities arise (the need to expand the network abroad, for example, dealing with currency exchange and expanded security), the partners can come together to generate new responses, share best practices, and commission experiments. Yet such networks as these do not arise within any of the standard frameworks we typically think of, as neither ownership rights nor short-term financial gains and incentives are sufficient to foster them. To succeed, banks had to agree to standards for exchange, honoring other banks' credit cards and respecting cardholders' credit. No individual partner has incentive to start a network according to traditional conceptualizations, because no partner owns it or has a primary claim on its benefits. Instead, the network must be created in order to enable the benefits enhancing each participant's credit card.

Indeed, the conflict between network needs and traditional ownership and financial gain ideas very nearly sank the network from the outset: Bank of America, the originator of the networked credit card idea, first wanted total control and rule-making authority, while the many smaller banks were enormously wary of being controlled, disadvantaged, or even taken over by BofA or by one of the other large bank partners. Moreover, in the U.S., the network even required a Justice Department letter assuring that no antitrust action would be taken so long as anticompetitive effects were not observed, since the services and products of VISA{ XE "VISA" } could only be provided by means of joint action (Hock & Senge, 2005):162.

In the VISA{ XE "VISA" } network, information – defined as “a difference that makes a difference” – served as a “boundary acid” to dissolve old boundaries and create new patterns of information sharing and cooperation: networked credit card interactions served as the boundary object (Star & Griesemer, 1989). Eventually, the U.S network was expanded to incorporate global partners – entailing massive additional amounts of information, raising additional issues of security, and standards for exchange, equitable rules and more. What had driven its success was profoundly simple:

> “At critical moments, all participants had felt compelled to succeed. And at those same moments, all had been willing to compromise. They had not thought of winning or losing but of a larger sense of purpose and concept of community that could transcend and enfold them all.” (Hock & Senge, 2005): 245.

Dee Hock’s network control approaches diverge dramatically from the ownership-based, centralized, command-and-control notions of organization embedded in most corporations and in most inter-corporate interactions. The network was the point: without the participation of many independent banks around the U.S. (and later, the world), the VISA{ XE "VISA" } card would be of limited value; local credit cards had not been especially successful. Yet without the trust{ XE "trust" }, collaboration and information sharing of Dee Hock’s organizing process, the smaller banks would not have joined to be subservient to BofA. While this seems evident in retrospect, initially BofA envisioned a traditional approach of centralized control, rules and regulations handed down from the dominant firm. By contrast, Hock’s approach relied on engaging the ideas of the participants as equals, open communication and discussion of problems, peer pressure, shared visions, and trust in an ongoing relationship.

Participants "felt compelled to succeed" because they began to perceive the benefits of networked collaboration, open information sharing, and trust**{** XE "trust" **}** that had characterized the organizing process Hock led. "The will to succeed, the grace to compromise," equitable treatment, open sharing of information, trust and open solicitation of opinions and ideas from collaborators were central to Hock's "chaordic" organizing ideas, even if they are far less characteristic of VISA**{** XE "VISA" **}**'s contemporary and more traditional form.

*Flat Panel Displays***{** XE "Flat Panel Displays" **}***:* Flat Panel Displays (FPDs) were the holy grail of the information age: the dream was of giant, wall-hanging flat TVs, available and affordable for any household – but also critical to on-board auto navigation screens, hand-held devices and medical instruments, and many other displays. FPD**{** XE "FPD" **}** was a new kind of industry, driven by knowledge that was distributed around the globe that had to be recombined, shared, redeveloped and redeployed. An international community of players, leveraging unique national capabilities, was critical to creating the new global industry, because no company and no country had all the necessary resources. Immense financial investments were required, but these did not initially make sense until a host of technical problems were addressed, and these could be solved only in collaborative interaction.

Companies "needed to participate in the rapid pace of knowledge accumulation and change in FPD**{** XE "FPD" **}** itself," because so much depended on tacit knowledge and experience (Murtha et al., 2001): 4. Moreover, the need for speed – "an awesome fact" here, as in many technology industries (Jelinek & Schoonhoven, 1994) – put a premium on partners' proximity, continuity and learning. Yet the critical expertise was scattered among American, Japanese and other firms that needed to "learn to know what they did not know" (Murtha et al., 2001): 170. Only by relying heavily on alliances, decentralized authority and accountability to and for operations outside their own home countries – and their firms – could these problems be solved.

For example, as (Murtha et al., 2001) reports, Corning's Display Technologies "coordinates among substrate R&D and production sites in the U.S., Japan and Korea, as well between the division and Corning's core R&D organization in the U.S. Affiliates retain a high degree of autonomy …" (193). Joint ventures and collaborative production continue, sharing authority and responsibility across countries and companies to this day.

What is interesting here is that at the outset, while the parties could agree on an end target, it was so far from the capabilities of any company, or any single national cluster of companies, that intermediate steps could not be specified, nor could effective contracts be written. Significant amounts of trust**{** XE "trust" **}** and openness were essential to move forward, as the participants were neither employees nor contractually obligated, nor could their knowledge be owned by any central company. Much of their joint achievement turned on tacit knowledge, developed in collaboration, as they shared insights and experiences, problems and solutions, ideas and even production protocols across firm boundaries. Partial successes – small FPDs – were successfully incorporated into cameras, cell phones and the like (where the participants competed). These paid the way for still more development and expansion into other products, all the while aiming toward the large FPD**{** XE "FPD" **}** computer display screens and wall televisions of today.

Early successes were leveraged into succeeding efforts as network participants shared their insights. Contributing those insights was central to continued participation – and continued network membership was essential to remaining part of the discovery process through which participation in the next round of product, and access to the next round of learning, were assured. At each step, potentially proprietary information was shared with network partners. Participants were constrained to operate on trust**{** XE "trust" **}** because traditional hierarchical controls were not suitable; behavior**{** XE "behavior" **}** could not be specified; and multiple cultures were involved, so cultural controls as typically understood would not do. Moreover, speed was of the essence.

While ideas at any step along the way had potentially great proprietary value, their value in an ongoing stream of evolution was even more valuable. What did work for control was the incentive of continued participation, earned by collaborative behavior**{** XE "behavior" **}**; and the evident advantage of being part of the leading edge of development, well beyond what any single entity could fathom: continued membership meant continued, accelerated learning vastly beyond what non-participants could manage. Clearly, new means of control and new thinking about it are needed to address these needs. We term such learning-oriented, long-term associations relational process networks**{** XE "process networks" **}** because they share responsibility for core business processes with trusted partners, with and from whom each member learns, accelerating their own capabilities and those of the network. Central to such networks is that they both rely upon and build trust**{** XE "trust" **}**-based relationships over time.

GLOBAL HIGH TECH REGIONS AS RESOURCE AND CHALLENGE

FPD{ XE "FPD" } offers a good bridge into understanding network evolution, because FPD exemplifies an industry in which distinct, observable clusters of related technical expertise have arisen, evolved, and shifted locales. When the FPD effort began, integrated circuit and microcomputer design was led by U.S. firms, while the older technology of memory chips was dominated by Japanese firms (which also led in some consumer electronics). As the FPD effort proceeded, much manufacturing development at first took place in Japan, to take advantage of a cluster specialist expertise in precise, miniaturized manufacturing: the geographic proximity of advanced manufacturing facilitated network information sharing across firms.

Eventually, however, Taiwan became a center for flat panel display manufacture, as pioneering Japanese manufacturers licensed their technology to Taiwanese firms, thereby extending the revenue production of the (older) generation manufacturing processes as well as extending the network of participants. Further, by expanding production across the industry, component costs were further reduced, expanding the potential applications for earlier-generation (smaller-sized) displays, even as the advanced manufacturers moved on to the next, larger generation (discussed at length in Murtha et al., 2001). This expansion is an example of network evolution, showing how network benefits are extended as additional partners apply learning developed in an initial collaboration

Global clusters of creative action – “spikes{ XE "spikes" }” – offer both a locus and an exemplar for outlining the challenges of control in collaborative innovation networks, a special case with implications. Such clusters are mutually reinforcing sites of exponential development: near neighbors in the same industry attract others to serve them and their needs; industry incumbents exchange ideas (and, often, personnel as well) (Kenny, 2000). Such clusters of specialist expertise leap ahead of existing mainstream practice, because talent gathers in highly specialized local business ecosystems around the world. As such, spikes have always been a key engine of economic growth as talent seeks to come together in specific locations in quest of richer opportunities to collaborate and rapidly improve performance. As an example, spikes spread westward in the United States – from the textile mills of Lowell, Massachusetts to the steel mills of Pittsburgh to the automobile assembly plants in Detroit and finally the high tech companies of Silicon Valley – marking various stages of economic growth.

While Silicon Valley is the contemporary archetype, numerous other spikes{ XE "spikes" } are beginning to emerge as technical and scientific capability spreads, often assisted by government support (e.g., Chinese requirements for JVs and in-country research as the price of entry to China). Indian education has facilitated software training and development, while import and export rules have been adapted to favor software. Bangalore's software development sector is the result.

FPD{ XE "FPD" } made use of several global high tech regions to achieve the requisite research, development, manufacturing engineering, scale, and ultimately, innovation required. Note that this is true not just for the FPD case, but it's also clearly a key success factor in both the PortalPlayer{ XE "PortalPlayer" } and Dell{ XE "Dell" } ODM examples. The networked nature of FPD's (or PortalPlayer's and Dell's) broadly distributed international effort differs dramatically from another high technology breakthrough, the IBM{ XE "IBM" }'s massive System 360 effort. IBM transformed the global industry by its development of a new, massively scalable architecture, drawing on resources beyond those of any other company in the 1960s (Chandler, 2001). Where IBM's challenges for the 360 were financial, technical and (internally) managerial, the FPD project was technically, financially and managerially beyond any company – so it also added the challenges of innovation network control. For instance, where IBM could hold internal "shoot outs" to adjudicate alternatives, FPD participants' multiple solutions and possibilities required empirical resolution. These could be decided only on the factory floor – did they work? The financial hurdles inside IBM pale in comparison to those facing FPD, which could only be resolved in the marketplace as each sequential size improvement (and its associated manufacturing tricks) achieved applications that could be sold to fund further development. The critical value of multiple partners' contributions to the overwhelming complexity of manufacturing process meant that the network could make technical progress by virtue of its ongoing relationships that was simply impossible for non-participants.

Today, more centers of technical excellence in more diverse technologies have emerged, expanding the challenges and opportunities. On the one hand, "all of us are more knowledgeable, innovative and informed than any of us is." On the other hand, consorting with strangers in cyberspace where traditional input**{** XE "input" **}**, output**{** XE "output" **}** and behavioral controls don't work, and where trust**{** XE "trust" **}** is essential, requires development new management practices to achieve the functionality of control without power or hierarchy, detailed contractual obligations, or immediate incentives. What would effective network versions of these controls be like? A closer look at the requisite management practices for global networking can suggest insights.

RELATIONAL NETWORKS{ XE "RELATIONAL NETWORKS" } AS MANAGEMENT PRACTICE

Three levels of managerial practice**{** XE "levels of managerial practice" **}** can be identified as the minimum essentials for creating networks, with subsequent levels building on earlier ones. Since relational networks aim for enhanced capability, faster learning, and more rapid problem-solving, especially in service of innovation, managerial practice centers on these criteria for action. Moreover, the nature of contemporary alliances – increasingly global, often reflecting the emergence of new spikes**{** XE "spikes" **}** of creativity and expertise, and dynamic in their evolution – is mirrored in network requirements. Thus partners may not be found in familiar places – or with familiar faces. Multiple partnerships may bridge different locales, depending on what (new) capability is required, or what new possibilities emerge over time. Where relational networks deliver their greatest benefits, however, is in amplifying the participants' capabilities to learn and thus to innovate (in products, in processes, in business models or in all of these). As with FPD**{** XE "FPD" **}** and iPod, whole new product categories can arise; as with Li & Fung**{** XE "Li & Fung" **}**, whole new approaches to orchestrating business activities can generate new sources of strategic advantage.

First Level of Management Practice: Identify and engage relevant partners

Old paradigms of who's the "developed country" source of ideas, and who's the "developing company" recipient of products, advanced technology and the like are increasingly obsolete: (Doz et al., 2001; Doz & Hamel, 1998; Friedman, 2005, 2008).

Thus managers seeking to benefit from emerging spikes{ XE "spikes" } of creative capability need to recognize where innovation is that might be relevant, so that appropriate partners can be sought. Both the relevant capabilities – and thus pool of partners – as well as the locus of innovation can change, as new centers of creativity, talent, and skills arise in new places.

Partner selection can be construed as a classic instance of input{ XE "input" } control: identifying the right partners is an essential first step for possible success. However, it's input into *a network*, not into a firm; partners are typically (but not always) themselves firms. Criteria for consideration will surely include relevant expertise, reputation, reliability and past experience, and ability to learn and share information, among other factors: partner selection addresses hoped-for long-term relational behaviors{ XE "Control systems targets:behaviors" }, particularly around trust{ XE "trust" } because it is so crucial to information sharing, problem solving and learning. All this suggests that long-term relationships are a plus – so long as they don't become anchors to obsolete practice, too-limited partner sets, and outdated assumptions. The right partners may be new partners, in new places, with new kinds of knowledge; who's "right" for one project may not be for the next (but may still be valuable for other efforts).

Identifying the right partners, then, requires finding both requisite expertise and appropriate collaborators with whom to build a relationship, where "appropriate" has as much to do with relational behavior{ XE "behavior" } as nominal expertise. A critical question is whether a potential partner is trustworthy. But fabricating a relational network will also require attracting the partner's long-term interest and building trust{ XE "trust" } in a firm-to-firm relationship, where desirable potential partners may have many alternatives. The new network will then require generating mutually acceptable control mechanisms, as well as creating new ways of learning, sharing benefits, and exchanging both tacit and explicit information: in short, creating the infrastructure of the network's interactions. Potential partner firms' people, their organizational learning capabilities, openness to learning, and technical expertise are all important inputs{ XE "Control systems targets:inputs" } in the networked world, essential elements in a networked innovation process that is rooted in trust.

Assuming that potential partners have been identified, both selection and mutual socialization are involved, and these are more difficult when the parties interact across organizational and cultural boundaries, rather than simply within them. Dee Hock's account of mutuality among the VISA{ XE "VISA" } partner organizations, and of his savvy efforts to use group suasion to achieve consensus highlight the potency of shared visions of system-level benefits in trust{ XE "trust" }-building. Formal member ownership and control of the relational network of VISA recognized a reality vastly different from the enterprise-centric views still prevalent in organization theory, strategy, and managerial practice (and characteristic of VISA today, as a more traditional business). In short, collaboration in a trust-based network across firm boundaries relies on controls substantially different from traditional conceptualizations of control within the firm.

Similarly, the details in Murtha et al. of the shifting locus of major development in FPDs underline the importance of trust{ XE "trust" }, first in underlining how networked trust within a spike{ XE "spike" } can generate shared benefits. But they also reveal the dynamic nature of spikes{ XE "spikes" } over time: Japan as a focal player in precision manufacture has been displaced by Taiwan and China as knowledge was licensed out and networks expanded. Misconstruing FPD{ XE "FPD" } development as some form of "national" competition – as many policy makers were tempted to do – simply ignores the criticality of trust-based, network-level phenomena. Original partners had to share proprietary information, trusting partners' reciprocity; the Japanese had to license their manufacturing processes to others, trusting the benefits of on-going cooperation to fund FPD; FPD partners today continue delegated decision-making, information sharing, and interactions based on trust. Such relational networks transcend countries, even as they transcend individual enterprises – and they are becoming more common.

Today, many leading edge devices such as Apple{ XE "Apple" }'s iPhone and iPods are manufactured in China, where the burgeoning technology cluster will undoubtedly produce other such devices. Very likely, the Chinese engineers, scientists and technologists offer their own ideas, including some for localized application (Lewin & Peeters, 2006), and some may find global applications: Nokia's cell phone with scrolling screen was originally designed for Asian markets to display ideograms, but is widespread today. Partners to Apple's innovation included Philips, IDEO, Connectix and WebTV in addition to PortalPlayer{ XE "PortalPlayer" }. For these and many other innovation and networked business activities, broad knowledge of who is capable of contributing and where and how, will be critical: managers need to be looking out for resource opportunities.

As a first impression, these networks might seem to be assembled by a network organizer{ XE "Network organizer" } who serves as gate-keeper, deciding who could participate in the network. In traditional thinking, the network organizer{ XE "Network organizer" } would define fundamental governance processes to coordinate the activities of the network, for example, determining how disputes will be resolved and how performance will be measured. Yet the traditional view is incomplete. Participants in such a network enjoy choice on both sides.

Network orchestrators will be known not only for the ultimate success of their products in the marketplace, but also for the fairness of their dealings with partners, their willingness to share benefits from collaboration – including learning opportunities, accelerated practice improvements and financial rewards. In short, rather than a simple power position, network organizers{ XE "Network organizers" } will be enacting a persuasion, articulation, and demonstration position. Some sharing of control or mutuality seems essential to maintaining the cooperative network, even if the orchestrating firm is *"primus inter pares."* These characteristics relate both to the inapplicability of traditional centralized controls on the one hand, and the mutual dependency of network members – including the organizer{ XE "Network organizer" } – on the other. Since the relationship is central, ongoing interactions, their fairness and continuing benefit to participants are critical to continued willingness to participate (compare to (Barnard, 1938; 1956).

The greater the stakes and the less calculable the ultimate outcomes, the more important enduring relationships, reputational capital and trust{ XE "trust" } among the partners will become. Because new capabilities will be needed for new product categories like FPD{ XE "FPD" }, with needed breakthroughs unpredictable in advance, the ability to use and reuse network achievements will be essential to providing extended remuneration. For example, as we have noted, Apple{ XE "Apple" }'s iPhone made use of technologies and partners from the earlier iPod project – and the subsequent iPod Touch traded technologies from iPhone. FPD developers at first could produce only tiny screens – but these were useful for cameras and video display.

Such savvy multiple uses of technology solutions create an ongoing stream of revenues and profits for all; support continued development; and if equitably shared to the satisfaction of the partners, offer substantial inducements for continued collaboration, because the real rewards accrue long-term. Such relational process networks**{** XE "process networks" **}** enable participants to get better faster by working with others in the networks than they possibly could working on their own (Hagel_III & Brown, 2005). This motivates participants to do the right thing in the near-term – sharing insights and information, going the extra mile to solve a problem rather than pursuing opportunistic short-term profit maximization at the cost of the process benefits and the long-term rewards. Successful relational process nets aiming for innovation must therefore focus on building long-term relationships among their participants, creating opportunities for repeated interactions that demonstrate the value of cooperation and leveraged, shared learning.

Critical management practice for relational networks at this level, then, first involves much more systematically scanning for potentially relevant partners, who may very well be global. Because new centers and new technologies are constantly arising, so, too, are new potential partners. Knowing “where to look”-- in terms of the desired arenas of technology, functionality, or science, customer need, latent possibilities, adjacent prospects and trust**{** XE "trust" **}**-building potential -- becomes a central management practice that positions a firm for expanded opportunity.

Second, firms need a more dynamic view, because what was true of an area yesterday may not be true tomorrow: what's needed is focus on trajectories of capability evolution, rather than simply on capabilities at a given point in time. This, too, depends on trust{ XE "trust" }. Such new capabilities and prospective partners constitute competitive opportunities, but also potential competitive threats, if unrecognized. Firms oriented toward relational networks are more likely to be alert to the possibilities.

Third, firms need to take a more active role in shaping promising spikes{ XE "spikes" } – catalyzing growth, technical development, and bridging gaps to enable partners' capability trajectories. Building such relationships early, before the capabilities are fully in place and discernible to the outside world, can create the foundations of trust{ XE "trust" } and mutual respect from which creation networks{ XE "creation networks" } spring. Building relationships early can also offer additional competitive advantage, foreclosing rivals.

Fourth, firms need new control methods suitable to such relationships' nascent capabilities, trust{ XE "trust" } building across cultures, and developmental perspectives. Western firms' reliance on highly formal, tightly specified, short-term transactions to access capabilities from specialized third parties will not be appropriate. Nor will hard-nosed, short-term cost-benefit focus work well. Instead, trust and capabilities can be bootstrapped: a laddered series of value exchanges can serve to create a staircase of accelerating trust. Firms can begin with relatively low value collaborations that are not very tightly specified, so that the partners can begin to develop experience working together and explore opportunities to learn from each other. As their experience and confidence in each other grows, they can move to higher value collaborations where more is at stake. Such trust-building is central to relational networks, which create trust as well as depend upon it.

Alternatively, early high value collaborations that are tightly specified can systematically move to lower levels of specification over time, allowing partners more opportunity to improvise and experiment in collaboration. Companies like Li & Fung**{** XE "Li & Fung" **}** and Nike are masters at integrating new partners into their relational networks quickly through such trust**{** XE "trust" **}** building processes. Long-term, trust-based relationships are key to effectively collaborating in dynamic markets, because trust is the key to the tacit knowledge that drives learning and innovation. It is precisely this tacit knowledge that is most valuable, most impossible to specify in advance, and most fundamentally rooted in trust. Where trust flourishes, tacit knowledge can be shared, to enhance learning, problem solving and innovation.

Companies that build successful relational networks are also thoughtful about other aspects of building trust**{** XE "trust" **}**, including attending to potential dependencies. Li & Fung**{** XE "Li & Fung" **}**'s "30 – 30" rule addresses trust by explicitly considering partner strength. The rule commits Li & Fung to utilizing a minimum of 30% of any partner's capacity in a given year, but never more than 70%, leaving a minimum of 30% of capacity for the partner's other business. This ensures Li & Fung will be viewed as a significant partner who gets priority, but not as a dominator. Because both sides are making a significant commitment of resources, both invest in building trust.

The safety cushion of 30% of capacity avoids total dependency, insuring that partners are more self-reliant and thus more independent, while inviting trust**{** XE "trust" **}**. Moreover, because network partners see other businesses' needs and capabilities, Li &

Fung{ XE "Li & Fung" }'s network is not doomed to tunnel vision. The partner's long-term well-being is served, and with it the long-term potential of the relational network. Maintaining a partner's capability for independent action and avoiding dependency builds trust – and thereby facilitates mutual learning, sharing of insights, and continued relational participation.

Second Level of Management Practice:
Connecting across capabilities, products and sites[3]

The deeper partners get into modular, loosely-coupled business activities shared with partners, the more scalable, diverse and flexible their businesses processes become. Where a firm orchestrates core activities with multiple partners, as Li & Fung{ XE "Li & Fung" } does, the relational network becomes increasingly a relational process network. As strategic needs change, new capabilities will be needed; new products don't necessarily reiterate the last innovation network state, but may require new partners, or different configurations altogether. This creates reiterated issues of trust{ XE "trust" } and control, as "old" partners need to embrace "new" partners, or be content not to be included in some activities: perceptions of fairness and legitimate participation arise at each iteration. Li & Fung's 30-30 rule acknowledges the partners' long-term well-being, but also contributes to Li & Fung's freedom of action to reconfigure its relational network: no partner is wholly dependent on the others. All the partners can engage with diverse others, and utilize their enhanced capabilities elsewhere – potentially further

[3] We draw heavily on three prior papers here: Hagel_III, J. and J. S. Brown (2006). Globalization & Innovation: Some Contrarian Perspectives. World Economic Forum Annual Meeting. Davos, Switzerland; Hagel_III, J. and J. S. Brown (Forthcoming). "Creation Networks: Harnessing the Potential of Open Innovation." Journal of Service Science; and Hagel_III, J. and J. S. Brown (Forthcoming). "From Push to Pull: Emerging Models for Mobilizing Resources." Journal of Service Science. See also: Hagel_III, J. and J. S. Brown (2005). The Only Sustainable Edge: Why Business Strategy Depends on Productive Friction and Dynamic Specialization Boston, Harvard Business School Press.

enhancing the original network, adding flexibility and enabling the network to scale up at need.

Such reconfigurations occur because highly specialized capabilities from any one spike**{** XE "spike" **}**, or cluster of capability, may well have potentials in multiple applications. Capabilities acquire even more value when they are connected effectively with complementary capabilities available in other spikes**{** XE "spikes" **}** around the world. Those who can connect, can create new value-generating configurations: The next wave of value creation in the global economy will come from platforms for connecting capabilities across spikes: Rather than building self-contained bilateral relationships like traditional outsourcing relationships with individual outsourcing providers, contemporary companies need to begin developing networks of relationships spanning across diverse participants in multiple spikes, adding and reconfiguring as new capabilities and new application possibilities arise, and connecting partners effectively. These practices dramatically enhance flexibility by virtue of the diverse possibilities they access.

PortalPlayer*{** XE "PortalPlayer" **}*'s Connection Advantages: One of the most interesting network organizers**{** XE "Network organizers" **}** is PortalPlayer, founded in 1999 by a group of former National Semiconductor executives, and a central player in the introduction of Apple**{** XE "Apple" **}**'s iPod product line, as we mentioned earlier. PortalPlayer's founders recognized commercial opportunity in the emerging MP3 product category. From the outset, the company was organized as a micro-multinational with its own operations based in both San Jose and Hyderabad. They focused on the opportunity to design an MP3 decoder and controller chip with rich firmware explicitly constructed to incorporate technology from a broad range of other companies, so PortalPlayer invested significant efforts in building a global network of technology companies with complementary capabilities to support MP3 development.

PortalPlayer{ XE "PortalPlayer" }'s relational network partners included UK technology providers like the microprocessor company ARM and Wolfson Microelectronics, a specialized provider of digital to analog conversion technology. US participants in the PortalPlayer network included Texas Instruments and Linear Technologies, a small company specializing in power management integrated circuits. From Japan, PortalPlayer recruited Sharp to provide flash memory, Sony for battery technology and Toshiba for hard disk drive technology. In Taiwan, PortalPlayer developed close relationships with both UMC and TSMC to access silicon foundry capabilities.

PortalPlayer{ XE "PortalPlayer" }'s network was assembled to design and produce innovative prototypes of MP3 players that could meet demanding price points, form factors and performance requirements, using PortalPlayer's platform. That is, PortalPlayer created a relational process network to collaborate on core business processes: its business model is deeply rooted in collaborative innovation and development. When Apple{ XE "Apple" } approached PortalPlayer with the idea for a new MP3 product line coupled with an online music store, PortalPlayer mobilized its global design network to help Apple enter the market nine months after the initial product and business concept were approved.

In terms of the iPod product itself, Apple{ XE "Apple" } focused on the external design and the user interface, leaving the rest of the design to PortalPlayer{ XE "PortalPlayer" } and its network. Leveraging its initial success with the iPod, PortalPlayer generated over $250 million revenue with only 280 employees on a variety of products in 2007, and enjoyed ongoing revenue contributions for every iPod and iPhone that Apple sold.[4] On the one hand, PortalPlayer enjoyed an ongoing revenue stream tied to Apple's ongong success; on the other, PortalPlayer's network enabled vastly accelerated development of multiple generations of product. Furthermore, PortalPlayer's own relational network is how the firm did business: it is a "fabless" semiconductor company, relying on network partners for critical manufacturing capabilities and sharing proprietary knowledge in order to innovate rapidly (as did Apple). Speed, mutual learning, and sharing of proprietary information rests essentially on trust{ XE "trust" }, and PortalPlayer's reputation as a trustworthy participant constitutes important reputational capital.

Alternative Connection Approaches: Both Apple{ XE "Apple" } and PortalPlayer{ XE "PortalPlayer" } are important contributors to a mighty network of innovation that spans multiple technology hot spots. Original design manufacturers (ODMs{ XE "ODMs" }) in Taipei – companies like Lite-On and Compal – have organized their own relational networks of hundreds of business partners. These relational networks link complementary capabilities in geographic spikes{ XE "spikes" } across Asia and North America to support the design of new consumer electronic and other high tech products, with learning opportunities and accelerated technological development. Yet "high technology" is not the only prospect for connecting capabilities across spikes of capability.

Procter and Gamble{ XE "Procter and Gamble:P&G" } offers a contrasting, transactional innovation network approach, which clarifies just how relational networks

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[4] On January 5th 2007, PortalPlayer{ XE "PortalPlayer" } was acquired by NVIDIA.

differ from transactional networks. P&G{ XE "Proctor and Gamble:P&G" } now draws half of its new product ideas from outside the company, and the company's collaborating partners are not only the few large, Western firms of comparable size to P&G{ XE "Proctor and Gamble:P&G" }, but smaller players as well. P&G{ XE "Proctor and Gamble:P&G" } began in-sourcing innovation ideas because even with global research facilities and the best talent money could buy, "By 2000, it was clear to us that our invent-it-ourselves model was not capable of sustaining high levels of topline growth" (Huston & Sakkab, 2006): 60.

P&G{ XE "Proctor and Gamble:P&G" } is an example of how global competition drives networked approaches to innovation. In the face of an explosion of new technologies and escalating competition from widely distributed new spikes{ XE "spikes" }, along with growing overseas markets, the company needed more new ideas from all quarters, because it can get better new products faster and cheaper by networking: its printed Pringles chips relied on technology sourced from a small Italian bakery (Huston & Sakkab, 2006). P&G{ XE "Proctor and Gamble:P&G" }'s ability to develop methods to tap into such a solution centers on connecting with varied capabilities, wherever they may reside, marshaling them into an effective, usable network.

Yet unlike Apple{ XE "Apple" } and PortalPlayer{ XE "PortalPlayer" }, the FPD{ XE "FPD" } network or Li & Fung{ XE "Li & Fung" }, P&G{ XE "Proctor and Gamble:P&G" }'s is a transaction-based network. P&G{ XE "Proctor and Gamble:P&G" } buys or licenses inventions and ideas sourced elsewhere, then develops them into innovations inside. Only the initial idea draws on others, although even that limited expansion has substantially enhanced P&G{ XE "Proctor and Gamble:P&G" }'s volume of new product innovations. The rest of the innovation cycle remains limited to P&G{ XE "Proctor and Gamble:P&G" }'s internal capabilities. In contrast to the more loosely-coupled, modular capabilities of relational process networks{ XE "process networks" } like those of Apple and PortalPlayer, FPD or Li & Fung, P&G{ XE "Proctor and Gamble:P&G" }'s "connect and develop" may still be too slow and too constrained to compete. Relational process networks' enhanced ability to access tacit knowledge – and thus to rapidly learn and innovate – arises precisely from long-term, trust{ XE "trust" }-based relationships not available in P&G{ XE "Proctor and Gamble:P&G" }'s transactional approach.

The role of network orchestrator*{ XE "network orchestrator" }*: These differences come into focus with the definition of the role of network orchestrator: the "first among equals" that identifies potential participants, defines standards and protocols for interaction, specifies the action points where decisions resolving differences must be taken, and facilitates the network culture to enhance participants' learning. As we shall see, the network orchestrator takes primary responsibility for developing the network. P&G{ XE "Proctor and Gamble:P&G" } undertakes no such activities, instead identifying useful external technologies, purchasing access to them, and then enhancing, scaling up the manufacturing and then distributing them through their own channels. By contrast, Li & Fung{ XE "Li & Fung" } or PortalPlayer{ XE "PortalPlayer" } devote extensive effort to ensuring their networks' ongoing capabilities evolution, enlisting partners' insights, developing knowledge, and innovation ideas.

Relational networks{ XE "Relational networks" } can make use of loosely coupled{ XE "loosely coupled" }, modularized products designs to innovate – specified only as to interface, or performance – or more tightly coupled{ XE "tightly coupled" }, stable product and process designs. Even here, relational networks pay dividends, visible in Japanese automakers' superior products and processes, based on long term engagement with their prime components suppliers' innovating capabilities (Womack, Jones, & Roos, 1990). But loose coupling offers the greatest potential, which hinges upon trust{ XE "trust" }: The greater the trust, the greater the scope for partner innovation. Such loosely coupled{ XE "loose coupling" } relationships both build trust and rely upon it, gaining enhanced ability to improvise and experiment within modules of activity relative to more tightly integrated business networks. Modular structure, loose coupling, and free information exchange also makes it easier to mix and match modules in ways that can deliver more customized value in response to evolving needs and opportunities. Finally, loose coupling also facilitates introducing new participants and new capabilities that can help push current participants to get better faster.

Not only products, but also processes can be loosely coupled{ XE "loose coupling" } – including management processes – to accelerate learning across in global process networks{ XE "process networks" }. Few people appreciate what a high tech product the athletic shoe has become, yet for decades it has been manufactured in China and other developing countries. Nike aggressively seeks out new materials and ways to integrate them into its shoes to push the performance envelope for its customers. New materials and processes imply new business partners with promising new capabilities to enhance Nike's shoe design and manufacturing process networks. New partners become part of a sophisticated tutelage system, working with other network partners with complementary capabilities to teach them how to take more advantage of new materials and manufacturing techniques to improve performance. In return, new partners also gain greater insight into the activities of complementary partners and can refine their own materials and practices. Mutual tutelage, information exchange, and peer influence ratchet up capabilities of the network, not just the individual firms: participants gain multiple capabilities and resources.

Third Level of Management Practice:
Amplify Innovation and Learning Opportunities

Benefiting from relational networks centers not just on accessing existing capabilities, but on rapidly developing capabilities available only through the network – learning more and faster by learning together, creating a “choice architecture” to reframe attention and control (Thaler & Sunstein, 2008), and gaining from fresh independent inputs**{** XE "Control systems targets:inputs" **}** from partners. The focal point of “the organization” is no longer “the enterprise;” instead, it is the network, made up of multiple, interdependent, mutually-influencing enterprises that also access external experience. The focal point of any given exchange is not “the transaction;” it is its effect on network capabilities. The deepest pools of potential arise when business processes become collaborative. But such network capabilities and advantages do not “just happen;” instead, they are the artifact of explicit management of the network. This third level of management practice centers on enhancing learning opportunities, and exploiting the generative potential of loosely-coupled processes shared across diverse network partners.

Potential diversity benefits: Folding these ideas into the rich environment for focused learning and innovation found in spikes**{** XE "spikes" **}** of coalescing capability raises the ante. While any given global spike**{** XE "spike" **}** offers benefits, connecting capabilities across spikes can actively evolve a robust, reconfigurable platform – a pool of known partners and capabilities – for repeated learning and innovation that draws on multiple spikes' sheer diversity. Spike participants with diverse specializations can learn from each other to deliver more value to the market, enhancing their network by means of the productive friction{ XE "productive friction" } of their interactions. Yet "productive friction" seems an oxymoron; like other relational network capabilities, it does not "just happen," but must be carefully built, as we shall discuss.

Process networks enable learning and innovation loops that can fold back in on and reinforce the innovation and learning loops already in play within individual spikes{ XE "spikes" } – if the network takes advantage of them. The dynamics are fractal – individual spikes derive network benefits through participants who engage in relations within the "home spike{ XE "spike" }," while further benefits are found in a larger, multi-spike network. As a result, relational networks at both levels are highly dynamic in terms of potential to deliver growing value over time. However, such dynamism depends utterly on trust{ XE "trust" } that enables active disagreement and productive resolution of differences that arise precisely from the participants' different experiences and expertise, as well as the willingness to expand the network to embrace new participants, capabilities and ideas. Participants must behave in new ways, contrary to immediate short-term transactional self-interest; and relational network orchestrators must encourage such new behaviors{ XE "Control systems targets:behaviors" }.

Bidirectional influence: Network partners can accelerate and facilitate active improvement by learning from each other, sharing information broadly, then rapidly applying and reapplying what is learned both within the network and beyond it. Such learning arises specifically in surfacing and resolving differences of viewpoint and problems of execution, and bringing differences into discussion. Traditional ideas of control – stereotypically thought of in terms of compelling behavior{ XE "behavior" } on the part of the controlled – is clearly inadequate for encouraging such outcomes. Instead, the character of the network prescribes the nature of the controls appropriate to the situation, closer to a network of equals in an architecture of interactions designed to foster trust{ XE "trust" } and learning, and iterative reengagement.

Here, control is usefully thought of as bidirectional mutual influence, as already suggested by Li & Fung{ XE "Li & Fung" }'s 30-30 rule, or PortalPlayer{ XE "PortalPlayer" }'s ongoing participation in both revenues from the initial iPod product design and in subsequent product generations. Because network participants have an on-going stake in the network, incentives align with network responsibility, rather than immediate transactional advantage. Instead of zero sum, the game is sum enhancing. Partners can trust{ XE "trust" } in one another to enhance the exchange of the tacit knowledge exchange to drive enhanced innovation and learning – because they, themselves, must share their knowledge to legitimize continued participation, from which ongoing benefits flow.

Learning opportunities, information exchange, and experience-based trust{ XE "trust" }, along with the other long-term benefits of continued participation, suggest new understandings of control within such relational networks. Learning opportunities for participants amplify network innovation, while shared information serves as a tool for leveraging innovation possibilities. Active learning is valued partner behavior{ XE "behavior" }, while sharing what is learned builds trust, demonstrates trustworthiness, and creates forward-looking reputational credits for further exchange downstream, along with subsequent benefits.

Misty Loughry's focus on peer control within a firm offers a relevant parallel (Loughry, 2009): we see network partners similarly, as symmetrical participants in a relational network that is a collaborative creation. In relational process networks{ XE "process networks" }, however, an orchestrator who is first among equals serves key governance roles, including gatekeeper, defining standards and protocols for interaction, establishing procedures for dispute resolution, defining performance measurements and allocating resulting rents. It is the orchestrator who organizes activities into loosely coupled{ XE "loose coupling" } modules –designing opportunities for productive friction{ XE "productive friction" } that lead to innovation, shared learning, enhanced network participant capabilities, and ultimately shared profits. And it is the network orchestrator{ XE "network orchestrator" } who initiates the network management practices we have been describing, such as encouraging productive friction and open information sharing, that enable peer influence.

Network partners wishing to enjoy the benefits of enhanced capabilities, superior learning and better, faster innovation must both "lend to" and "borrow from" one another's tacit understandings to succeed, while also demonstrating their own network-responsible behaviors{ XE "Control systems targets:behaviors" }. Thus trust{ XE "trust" }-based multidirectional peer control, incentivized by learning and capabilities enhancement as well as profits, is the control mode of choice, orchestrated by the lead firm but also affected by participants. This control operates among and between firms, as network participants: the network and behaviors{ XE "Control systems targets:behaviors" **}** within it form the “organization” within and through which this new sort of control emerges.

Moreover, this kind of “organizational” control aims at maximizing the learning, innovation and trust**{** XE "trust" **}** of the network as a whole, rather than at traditional near-term, firm-level goals of minimizing cost, maximizing profit, or seizing transactional advantage. Although costs may indeed go down and profits up, and although exchanges are performed, these immediate outcomes are by-products of the relational network, not its primary focus. Rather than transactions (as in the P&G**{** XE "Proctor and Gamble:P&G" **}** network), relational process networks**{** XE "process networks" **}** (like those of PortalPlayer**{** XE "PortalPlayer" **}**, Li & Fung**{** XE "Li & Fung" **}** and the FPD**{** XE "FPD" **}** partners) aim at ongoing relationships that foster productive friction**{** XE "productive friction" **}**, learning and capability building, and emphasize mutual influence and peer control, rather than top-down direction.

New network management techniques: Harnessing the potential for accelerated learning and capability building requires new management techniques that shift focus from a single enterprise to the relational network, actively exploiting the diversity inherent in multiple firms, diverse specializations, particular insights and varied experience. All this generates productive friction**{** XE "productive friction" **}** in successful networks: friction, as a result of differences; productive friction, because the differences get resolved. As diverse human resources with varied skill sets and backgrounds come together around challenging problems, they bring different viewpoints and potential solutions. Such differences simultaneously contain both potential conflict and the fuel for creative new approaches that push performance boundaries: effective management of the relational net is what generates the benefits.

Our key point is that productive friction{ XE "productive friction" } does not just "happen" – it needs to be catalyzed by a thoughtful orchestrator who actively manages the creation, evolution and maintenance of the network and its good operation, engaging participants in the process. Productive friction emerges, nearly always, around concrete/grounded problems and mismatches among adjacent parties in relational process networks{ XE "process networks" }. We are not talking about abstract issues here, but very explicit issues, as in "Your chip draws too much power at this point," or "the fit of your part here is not perfect."

Yet much trust{ XE "trust" } and mutual respect underpin forthright disagreement and productive friction{ XE "productive friction" }, which do not arise without them. Trust in this setting translates to genuinely listening to another's perspective and ideas, seeking to incorporate their essence in a shared solution. Past experience at listening and being listened to offers a robust bridge to deeper trust, as do understanding and respect for partners' diverse viewpoints and skills. The relational network's enduring, iterated exchanges build a powerful foundation for further engagement, because partners have learned to value one another's differences.

The ability to foster productive friction{ XE "productive friction" } can therefore be very powerful in accelerating learning and capability building, which might well be seen as control at a meta level – network control. Network organizers{ XE "Network organizers" } can be very helpful in ensuring that the key ingredients are in place. As we have noted, it is important to identify participants with the appropriate skill sets and backgrounds, to ensure that the elements are available for a solution, and that creative new approaches can be put on the table: this is, as we noted earlier, the network version of input{ XE "input" } control.

In this context, the loosely coupled{ XE "loose coupling" } process management techniques described earlier become very helpful in scaling networks to include a growing number of participants with a rich diversity of skill sets and backgrounds. This is also behavioral or process control, insofar as peer influence, modeling of expected behavior{ XE "behavior" }, and socialization of new members helps outline a template for effective behavior that experience validates in superior results. Yet this kind of control is quite different from the behavioral or process focus of most traditional control conceptualizations, which tend to emphasize explicit specification of activities and systematic monitoring of those activities, versus the kind of implicit norms and mutual exchange we are discussing here. Traditional considerations of normative control do include implicit norms and mutual exchanges of tacit knowledge within a single work-group and firm, but the network controls discussed here reside between and among network partners, and extend over multiple projects. Such network controls aim specifically at scaling the network and its capabilities.

Beyond the traditional control approaches, especially in light of the uncertain and distant eventual marketplace results of breakthrough innovations, some other forms of outcome control like those we suggest are essential, highlighting ongoing relational outcomes rather than those of individual transactions. Network orchestrators must focus participants' efforts on explicit and aggressive performance objectives, of subcomponents, for example, while at the same time removing as many constraints as possible on the solution. Yet it makes sense to loosen constraints only where partners merit trust{ XE "trust" }, and ongoing engagement is anticipated: the distinction from transactional networks is where relational networks, and even more so, process networks{ XE "process networks" } create their advantages of enhanced learning, superior speed, and rapid innovation.

This focus on objectives and outcomes rather than specifying activities is quite compatible with the design philosophy shaping loosely coupled{ XE "loose coupling" }, modular process networks{ XE "process networks" }. Just as traditional firms typically deploy input{ XE "input" }, output{ XE "output" } and behavioral controls, so, too do networks. From our perspective relational process networks{ XE "relational process networks" } move increasingly toward network performance outcomes over time as the primary form of control, with a very different form of network behavior{ XE "behavior" } control through informal norms also playing a role in building trust{ XE "trust" }. Still, it’s important to note that individual transactions are not the heart of the matter – the relational network is, with concomitant emphasis on trust, learning, and ongoing network capability enhancement creating the prospect for increasingly shared business processes.

Partner behaviors{ XE "Control systems targets:behaviors" } that can contribute to such enhanced trust{ XE "trust" } and deeper process engagement include reliable delivery on promises (especially timetables), and rapid-fire response to the predictable failures – an ability to shift to “Plan B” (or C or D) at need, and still deliver superior eventual performance. Prototypes operate as boundary objects, enabling participants to develop shared understanding of potential solutions while testing competing options against the relevant performance requirements (which may themselves change, as participants innovate to improve possibilities). Above all, participants need to be provided with clear action points – decision milestones where differences need to be resolved and agreement reached on the best approach to go forward at that moment. Here is another key aspect of the orchestrator's role: bringing the participants to the action point, as a means to build capability, resolve friction productively, and achieve challenging performance outcomes.

The interplay of process controls –interaction around prototypes, generation of alternatives, and the articulation and resolution of differences to arrive at (perhaps changed) consensus goals – together with the discipline of demanding performance goals themselves – is noteworthy here. While it might be tempting to consider this as solely the network orchestrator**{** XE "network orchestrator" **}**'s responsibility, we see mutuality, peer control and collaborative behavioral, process and attitude controls as a more accurate view. Orchestrators like Li & Fung**{** XE "Li & Fung" **}**, Apple**{** XE "Apple" **}**, PortalPlayer**{** XE "PortalPlayer" **}** or Nike surely do have their own routines, processes and protocols – but they aim at enhanced network capabilities, rather than any individual transaction. Moreover, the orchestrators themselves are also influenced by their partners, learning from them and adapting their own behavior**{** XE "behavior" **}** accordingly, always aiming to enhance network capabilities.

Building process network advantages: Original design manufacturers (ODMs**{** XE "ODMs" **}**) in Taiwan use such techniques to orchestrate design activity across many specialized component and sub-system vendors for new consumer electronic products. Rather than detailed design blueprints to be handed off to manufacturing or component partners, ODMs focus on defining aggressive component performance targets and establishing appropriate action points where participants must come together to mutually resolve any disagreements that may prevent effective integration of the components and sub-systems. Network participants interact around electronic design documents and prototypes to systematically explore design options and improve the product together. (This is in sharp contrast to Detroit automakers' historic insistence on fully specified components, with contracts awarded solely on price, and focused solely on the present transaction: (Womack et al., 1990).

Li & Fung{ XE "Li & Fung" }'s "30 – 30" rule acquires additional significance in the context of accelerating learning and capability building. By ensuring that partners always have a minimum of 30% of their capacity allocated to other customers, as we noted earlier, Li & Fung nudges partners to gain exposure to new practices and techniques outside the network – encouraging them to act in their own best interests through an architecture of choice (Thaler & Sunstein, 2008). Each partner then brings this learning back into the Li & Fung network when they engage with around the performance requirements of the next round of specific products: partners' process enhancements benefit the network.

Li & Fung{ XE "Li & Fung" } is also using its own investment in service-oriented IT architectures to accelerate learning and capability building by sharing information – in essence, enhancing informational relations within the network. One of the benefits of automating routine coordination activities is systematic capture of performance data from network partners. This performance data can be used to deliver real-time performance benchmarking information to each partner, telling them how they are doing relative to comparable network participants along twelve different dimensions of performance. Similar performance comparisons have been shown to encourage improvement in a medical settings, for example where hospitals' differential rates of infection or varied surgical outcomes are compared – examples evidence-based medicine, and consistent with calls for evidence-based management (Rousseau & McCarthy, 2007).

Trust and the expectation of enduring relationships are critical here: thoroughgoing transparency could be used to extract concessions, but greater benefits arise from identifying and addressing key performance gaps, with coaching on how to improve. Li & Fung{ XE "Li & Fung" } has shifted its own focus in response to network potentials: its staff formerly responsible for routine coordination activity now concentrate on coaching and bringing network partners together to explore ways to improve capabilities, using evidence from the IT system's tracking. Best practices, explicit experiments, and real time data serve to enhance network performance.

Information technology can also support accelerated learning and capability building in other ways as well. Interaction tools like mobile phones, instant messaging, IP based video conferencing, Wikis and other forms of collaborative workspaces facilitate richer and more frequent collaboration among distributed participants. Rather than simply focusing on automating tasks and eliminating people, this new generation of technology combines high tech and high touch to enable collaboration on demand, fostering rapid-pace learning and thus innovation.

Beyond zero sum: Dynamic specialization within networks can also accelerate learning and capability building. We have already mentioned networks scalability; it has an important side effect in that it encourages and rewards rapidly evolving specialization. As more and more diverse participants join a network, each can afford to focus more tightly on its own truly distinctive activities, and rely on other network participants to provide complementary capabilities. At the same time, participants have strong incentives to deepen their own specializations more rapidly to exploit the growth opportunities created by expanding networks. By concentrating on further developing areas where they already have great strength, participants have the potential to learn more rapidly in contrast to companies spread across a broader set of activities.

Thus specialist network partners become increasingly distinct from one another, each bringing more distinctive benefits to the network and each increasingly differentiated from others, reducing competition with them – at the same time increasing potential for productive friction{ XE "productive friction" }. For example, specialized semiconductor fab (fabrication plant) operators in Taiwan anchor the design process networks{ XE "process networks" } that enable specialized semiconductor design firms to focus on strengthening their design capabilities, without the distraction, expense and challenge of building and operating semiconductor fab facilities, which the fab operators own and manage. Fab operators bring a distinctive viewpoint to discussions, which ODMs{ XE "ODMs" } now rely on for critical insight.

Productive friction and increasing specialization permit network organizers{ XE "Network organizers" } to shift the incentives for participation from near-term cash rewards to the longer-term opportunity to get better faster by working with others. Successful network organizers{ XE "Network organizers" } increasingly focus on the objective of accelerating learning of all participants as they build long-term relationships with business partners. The key test of these relationships becomes “will all parties be better at what they do as a result of having been in a relationship together than they would have been in the absence of a relationship?”

In fact, without this longer-term opportunity to get better faster, building long-term trust{ XE "trust" }-based relationships becomes more challenging, since participants become vulnerable to all the zero sum behaviors{ XE "Control systems targets:behaviors" } that economists worry about (e.g., holdup, moral hazard, cheating, shirking, etc.). When there is a fixed set of resources, one party loses when the other party gains, focusing everyone on short-term efforts to gain more of the finite resources, inevitably eroding trust and fostering adversarial behavior{ XE "behavior" }. By contrast, relational networks can focus everyone on the opportunity to expand total available resources through learning and capability building, thus creating more incentives for collaborative behavior. Such a self-reinforcing cycle lends dynamic stability and enduring benefit to the network (Greif, 2006).

This third level of management practices amplifies innovation and learning opportunities, moving progressively toward the networks that we describe as relational process networks{ XE "process networks" }. Rather than focusing narrowly on mobilizing existing capabilities, such creation networks{ XE "creation networks" } seek to deploy the mechanisms required to accelerate capability building over time. This in turn leads to a third, and much more powerful, form of strategic advantage – more rapid innovation and learning – that becomes critical for success in a rapidly changing global business landscape.

Such loosely coupled{ XE "loose coupling" } relational networks can overcome the organizational inertia that often tends to slow innovation initiatives within large companies, while at the same time providing access to a broad scope of diversified resources. Note that while some organizational theorists point to dynamic capability, they address individual enterprises, rather than the network level that is our focus. Relational networks{ XE "Relational networks" } represent a powerful way to transcend the organizational tensions that often result from trying to build ambidexterity within a single enterprise. External scalability endows these loosely coupled{ XE "loose coupling" } networks as powerful catalysts for both systemic innovation, requiring the collaboration of large numbers of complementary resource contributors; and compound incremental innovation, requiring rapid iteration of small improvements in products and processes.

As such, creation networks{ XE "creation networks" } may come to dominate a growing number of global industries and markets for two reasons. First, they access all three forms of strategic advantage created by each level of management practice discussed above – enhanced access to tacit knowledge, expanded access to diverse specialized participants in capability spikes{ XE "spikes" } around the world, and accelerated innovation and learning: thus they get better, faster. Next, these networks also provide a sustainable foundation for the long-term trust{ XE "trust" } and loosely coupled{ XE "loose coupling" } relationships built through the first two levels of management practice, active selection of participants and connecting diverse resources across locales.

Because theirs is not a world of fixed resources, it is easier for them to sustain trust{ XE "trust" } as participants avoid adversarial practices designed to gain privileged access to scarce resources. Because the networks create new resources through innovation and learning, they foster longer-term trust: participants focus on collaboration to expand total resources. In the absence of trust, loosely coupled{ XE "loose coupling" } networks begin to unravel; networks focused solely on mobilizing existing resources, rather than accelerating capability building, are soon consumed in disputes about allocating fixed rewards. By contrast, opportunities to expand total resources through innovation and learning enables creation networks**{** XE "creation networks" **}** to leverage loose coupling into a key ingredient to support productive friction**{** XE "productive friction" **}**, rather than succumbing to dysfunctional friction.

BROADER IMPLICATIONS OF NETWORK INNOVATION AND CONTROL

Relational networks**{** XE "Relational networks" **}** challenge theorists and practitioners alike to re-construe “organizations” to transcend a historic fixation on rigid structure and fixed boundaries of the firm, in favor of expanded networks of activities and relationships. Not just bilateral external partners, but a wide and variable range of others within a knowledge-based, innovation-focused innovation network will benefit. Theory too will gain from a trust**{** XE "trust" **}**- and relationship-oriented concept of organizational “control” that acknowledges mutual obligations and responsibilities among partners across firm boundaries and the network, as the tradeoff for access to enhanced learning and innovation opportunities.

While identifying and engaging potential network partners can be seen as input**{** XE "input" **}** selection, it operates beyond the boundaries traditionally envisioned for organizational control, across and among firms. Moreover, trust**{** XE "trust" **}** is also highly implicated in this form of input control – to a much greater degree than typically acknowledged in the more asymmetric power relationship between individuals and their firm employer: potential partner firms are more autonomous and have genuine alternatives, more alternatives the more desirable those firms are as potential partners.

The nature of the behavioral controls visible in successful relational networks diverges substantially from behavioral controls within firms. In part because the partners are more equal, in part because the emphasis is on mutuality, and in part because the focus in relational networks shifts towards the expansion of available resources and benefits, peer influence, implicit and normative controls take on greater importance, and become more future-focused. In addition, because network participants are true partners with a claim on longer term network benefits, they share responsibility for the good order of network operations to a greater degree than employees. Incentives flow from learning, from enhanced capabilities, as well as from downstream profit flows.

Output controls also differ in relational networks: first, on any given project, the outcomes in performance terms are challenging and primary. Where a new product like iPod is concerned, performance targets good enough to attract market notice are the aim, and pushing the state of the art (rather than satisficing) is the means. Participants challenge themselves because their joint success creates network outputs{ XE "Control systems targets:outputs" } downstream: not just the results of the present project, but opportunities for learning, subsequent projects, and additional applications of what has been learned to other activities within the network or beyond it. This rich array of outcomes is available to network participants, and dwindles, if participation ceases. The promise of future benefit flows is intimately entwined with relationships in the network, and with possibilities the network avails.

The promises extend beyond any individual network at a given moment: the success of networks that bridge emergent spikes{ XE "spikes" } of developing expertise holds promise for developing economies, for policy makers, for firms seeking to innovate, and for citizens of our “flat, hot and crowded” world (Friedman, 2008). Network management practices will strengthen incentives to catalyze formation of new spikes and more rapid growth of existing spikes (Ernst, 2003). Connective capabilities across the flat world will paradoxically lead to the proliferation and growing prominence of spikes, and with them more opportunity for developing economies like China’s, for instance (Ernst, 2007b, 2007a, 2008).

A combination of institutional mechanisms, management practices and new generations of IT will offer powerful platforms for expanding the global reach of participants within each spike{ XE "spike" } of capability. For example, global process networks{ XE "process networks" } and new approaches to managing modular business processes help to connect participants within spikes{ XE "spikes" } with complementary capabilities around the world, and with relevant customers in global markets. Emerging IT architectures and interaction tools discussed earlier will also help to expand the scope of collaboration across spikes by making it easier for individuals in a large number of companies and locations to interact with each other. All of these elements will make it even more attractive for people and companies to come together in specialized local business ecosystems, because their efforts will be amplified on a global scale. As a result, these elements will become significant catalysts for the proliferation and growth of spikes.

Spikes offer powerful environments for learning, only partly driven by specialized educational institutions, and they will become even more attractive for learning as participants discover their ability to connect with individuals and institutions in other, equally specialized spikes{ XE "spikes" } around the world. To connect is to access learning possibilities. Connection will drive enhanced, accelerated learning where partners share their insights and jointly engage in productive friction**{** XE "productive friction" **}** to solve problems. Excellence within spikes and across spikes will help to breed even higher levels of excellence by virtue of powerful feedback loops. Networks are the means to access these capabilities, and to configure and reconfigure them into effective, profitable engines for learning, growth and innovation.

THE BOTTOM LINE

So what? The network characteristics we have outlined, and the resulting possibilities and constraints for control in networks carry implications for companies, policy makers and academic researchers. Conventional control theory's firm-centric and often transactional approaches ignore potential levers and incentives, while emphasizing modes of control less available, or inapplicable in extra-firm settings. Shifting focus beyond the firm to the network directs our attention to network trust**{** XE "trust" **}** and learning dynamics, encouraging consideration of the very characteristics that distinguish networks from firms.

For Companies

The relational process networks**{** XE "process networks" **}** we have described are not transactional: instead, their essence evolves in and through extended interchange among network partners who learn from one another, become more distinctive from each other over time, and learn to depend upon one another for specialized expertise to perform core business functions, thereby fueling much more effective new business models. These models emphasize learning, capabilities development, trust{ XE "trust" } and enduring, if protean, networks of recurrent engagement.

From the mainstream perspective, the immediate challenge of relational networks and networked creation activities is how to balance the desire for proprietary advantage with realities of the open innovation{ XE "open innovation" } advantage. Recognizing how inadequate prior, internally-oriented approaches are is a powerful driver for change, as in the case of P&G{ XE "Proctor and Gamble:P&G" }. Yet relational process networks{ XE "process networks" } go beyond P&G{ XE "Proctor and Gamble:P&G" }'s transactional network: Successful networks like those of early VISA{ XE "VISA" }, Apple{ XE "Apple" } and PortalPlayer{ XE "PortalPlayer" }, Li & Fung{ XE "Li & Fung" } create dramatic innovation as a result of their external collaborations. Their success exerts still further push: such collaborative innovation is enough better that networking innovation capabilities become an enduring competitive advantage – and ultimately, as rivals eventually duplicate these skills, a requisite for survival.

As we have described, new management skills are needed: finding partners, creating dynamic networks characterized by enduring trust*{ XE "trust" }* relations and reconfigurable capabilities, recognizing innovation possibilities beyond the borders of the firm (or its current network, or its current product/process focus), and generating the internal network processes of mutual trust, shared discipline, intensively productive friction*{ XE "productive friction" }* and demanding performance goals. These are very different desiderata from the typical profit maximization, cost minimization, transactional mantras of contemporary business gospel. Relational innovation networks focus on emergent outcomes, which are nevertheless challenging because participants enlist to make them so. The intrinsic rewards of learning, capability development, access to exciting opportunities, challenging projects, and partners who contribute to one another underpin the extrinsic rewards of ongoing profits, and continued participation, and superior performance.

For Public Policy Makers

Those concerned with economic development have long sought to facilitate innovation clusters. Whether within a country, a region or a city, innovation has fostered growth jobs and prosperity. For developed economies, outsourcing and offshoring have been seen as dangerous slippage toward economic downturn – yet the networked picture we see instead emphasizes collaborative creation of new products, jobs and industries, not mere replacement of activities. What can easily be transported offshore is what is already well-characterized, mature, and not especially innovative: in short, yesterday's business. In sharp contrast, relational process networks{ XE "process networks" } of creation are much more interesting: they involve managing the absorptive capacity of firms by growing joint network capabilities that transcend any individual firm's abilities, and they often generate whole new industries – flat panel displays, iPod and iPhone and downloadable digital content provide examples. Moreover, abundant evidence suggests that addressing the challenges of less affluent markets demands and develops precisely the kinds of innovation all firms will need to compete in a “flat” world (Brown & Hagel_III, 2005; Lewin & Peeters, 2006).

Policy makers attentive to these benefits will instantly appreciate the need to foster their own spikes{ XE "spikes" } while encouraging firms and networks to collaborate across spikes (Ernst, 2007b, 2007a, 2008). Tax and regulatory arrangements should not impede or discourage the workings of global innovation networks. New intellectual property regimes will be needed as well, to assist and recognize how innovation is taking place: collaborative innovation is not at all the same as the simple-product, single-inventor model on which much IP thinking is based. The realities of a global economic arena argue powerfully for harmonized IP, tax and regulatory policies.

Policy makers also have a role to play in supporting the infrastructures of energy, communication, logistics and information exchange to underpin networked innovation activities. Developing nations can play only if they can communicate, and for innovation purposes, that is likely to mean high band-width electronic exchange as well as logistics systems for secure transfer of goods. Computers and computer-controlled design and manufacturing systems need reliable, “clean” electricity. Widespread global exchange of goods demands effective quality control on the manufacturing side – and government involvement will also be central for inspection of food products, assurance of safe and reliable standards, and contract enforcement, no less than in such issues as port security and disease prevention.

Finally, policy makers would do well to reconsider the standard, backward-looking economic data most countries presently collect. Such data do not assist in the discovery of new spikes{ XE "spikes" }, the identification of potential partner firms, or the creation of new networks.

For Academic researchers

The facts of networked innovation and relational networks demand that we redefine "organization theory" and "strategy" in light of where and how economic activity, and especially innovation is happening: in dynamic networks. Limiting theories of organization and strategy to "the firm" is no longer a viable approach (as others have noted: see, for example, (Czarniawska, 2008; Davis & Marquis, 2005). Research to illuminate new modes of collaboration is of course already widespread, yet much organization theory as well as much control theory remains overly fixated "within the boundaries of the firm," despite the increasing fraction of important economic activity taking place beyond and across those boundaries. Construing "organization" beyond "the firm" is an essential first step; considering mutual influence and deliberately orchestrated peer control in place of hierarchical dominance paradigms is a critical second step.

Emerging practices of cooperative networks, network relationships and information sharing point us to promising redefinitions or reconsiderations of old fundamentals. As we have argued here, short-term, economic rationality assumptions about organizational and inter-organizational logics do not serve where uncertainty and futurity reign. Further, even mature industries and well-understood products and processes can and do benefit from more open approaches, as new business models and improved managerial practices emerge. These, too, are appropriate targets for academic research, looking to the incentive effects of conjoint learning, capabilities development and accelerated innovation, as well as the rationality of non-fixed-pie assumptions.

Academics in North America have been especially adept at generating curricula to reflect new managerial needs, being among the first to design petroleum and aeronautical engineering, computer science and biotechnology courses, for example (Mowery & Rosenberg, 1998; Rosenberg, 1982; Rosenberg & Nelson, 1994). The challenge for supporting networks of creation is similar: old “truths” about the disciplinary silos of the past must give way to new, cross-disciplinary courses to bring forth new insights. The new management curriculum needs to embrace the realities of global collaborative business, relational networks, and their innovation benefits.

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