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How Do We Define Value Chains and Production Networks?

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Note to conference participants: This paper is meant to address the following two questions contained in the outline for the Bellagio Value Chains Workshop: A) "How should we define a value chain?" and B) "What accounts for the observed differences in value chains?"

1. Introduction: Why Value Chains?

This paper is intended to contribute to the process of building a set of tools that will help us advance the debate on the shape and trajectory of global economic integration. Discussion of global-scale economic trends is inherently a large and unwieldy topic. Tools are needed to block out some of the "noise" and allow us to focus on what is important, but we must choose carefully. Those studies that rely solely on macro-level statistics such as trade and investment cannot help but render invisible the detailed contours of the world economy. This is especially of true when we seek to understand the role of personal and firm-to-firm relationships and the influence of power and politics on the development process, things that many of us clearly hold to be crucial aspects of political economy and to the crafting of effective economic development policy. At the same time, smaller-scale studies of national economies and localized clusters of industrial activity forfeit a comprehensive view of the larger, cross-border structures that exist, or are coming to exist, in the world economy. For this reason, my own work has gravitated toward an industry-level approach. Industry-level analysis of economic activity, especially one that uses a "value-chain" approach, works well in studies of cross-border economic integration because it takes a significant but still manageable slice the world economy as its object of study. What is revealed in studies of industry value chains are the concrete actors in the global economy as well as the linkages that bind them into a larger whole.

A key strength of the industry-level approach is that it is geographically "scalable," that is, what is observed at the local level often has some direct relationship to what is seen at the national, regional, and global levels. To be sure, industries are profoundly influenced by the local and national institutional environments in which they are situated, but it is also true that firms often—and more to the point, increasingly—buy, sell, and operate subsidiaries outside of their home locations. It is precisely the connections, or "linkages," between firms and subsidiaries operating in and among different locations that provide us with the comparative insight that allows us to judge, however imperfectly, the impacts that local and national institutions have on the process of economic development, and the differences and similarities between the value chains and production networks that comprise various industries. I believe that it is the nature of the network linkage itself—its information load, connection mechanism, governance style, power dynamics, and geographic reach—that should be our central research subject. What is clear is that macro-level statistics, while they can help us to gain a rough idea about the volume and location of economic activity, provide no insight into the nature of value chain and production network linkages. We must instead rely on the painstaking collection of qualitative field data, which, when used in combination with quantitative data on trade and investment, can begin to reveal an emerging set of global-scale economic patterns.

Still, the limitations of restricting the value chain approach to the industry-level are real. If we see patterns emerging in the value chains of one industry, do they suggest a larger trend or are the patterns particular to the industry under study? Do the different capital, technological, and human resource requirements of various industries mean that each will make an unique contribution to the process of global-scale economic integration or are there overarching trends that can be discerned? Taken together, research that has in one way or another used a value chain approach has shed light on the emerging global-scale contours of a wide range of industries. I believe enough work has been done to allow us to begin to take the next step of attempting to compare our findings and perhaps even to craft general theoretical arguments. The Bellagio

conference, as well as the ongoing IDS network, has provided us an exciting forum in which to begin this conversation.

Before we begin the conversation in earnest, however, we must first agree on a common language. What is included or excluded when we use the phrase "value chain?" Do we need additional terms to denote the full range of possibilities? Can we agree on a typology of value chains that will make the debate more efficient by grouping sets of observed practices under common headings? Obviously, we must agree on what the critical dimensions of value chains are before we can have a discussion on how various industries and various places differ along them. In section three of the paper I lay out one possible set of critical value chain dimensions: organizational scale, geographic scale, productive actors, and governance style. Clearly, there is no one "right" way to talk about value chains. It is my hope that we can agree at least about which terms are interchangeable and which denote quite different practices, and thus begin an more fluid conversation even if we each move forward with our own "favorite" set of terms. Prior to this discussion, however, another, perhaps even vaguer term needs to be specified, that of "globalization." Section two takes this on. What I have set down below should be seen—in combination with the contributions from other participants—merely as a point of departure for our discussions in Bellagio.

2. What is Globalization?[1]

The Need for a Broader Analytic Framework

The following discussion of globalization is informed by a serious academic debate centered on the degree and nature of integration in the world economy (see Dicken, 1998 for a recent review). Some of the positions in the debate can be roughly mapped along the lines of academic discipline. Economists, who tend to downplay national difference in their search for universal understanding of how capitalist economies work, tend to make the claim that the process of globalization is highly advanced, pointing to the rise of trans-national corporations, the liberalization of trade regimes, and the near elimination of barriers to international currency and equity trading as evidence (Reich, 1990; Ohmae, 1990; Burtless et. al., 1998). Political scientists and sociologists, steeped in a comparative analytic approach, have responded with evidence of the durability of national political and economic structures even as the world economy becomes more interconnected (Koechlin, 1995; Berger and Dore, 1996). Geographers, who tend to look at the spatial aspects of the economy in its finest grain, point to places such as Silicon Valley and the Detroit metropolitan region as evidence that sub-national regions are the optimal scale at which to organize highly efficient and innovative production complexes, a claim that, at first blush, would appear to run counter to the process of globalization (Schoenberger, 1994; Storper, 1994, Cox, 1997).[2] How can it be that scholars come up with such seemingly contradictory views?

The answer lies in the fact that the process of globalization is an ongoing one. In any process of transformation that began long ago and will never completely be finished,

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[1] This section is drawn from Sturgeon and Florida (1999).

[2] Of course there are many exceptions to the rough divisions I make here; all disagreement does not take place between disciplines. For examples of dissenters from economics, sociology, and geography, see Tyson (1991), Gereffi (1994), and Dicken (1992) respectively. Charles Sabel, a political scientist, is well known for his work on the economic organization of sub-national regions (Piore and Sabel, 1984; Sabel, 1989, 1992) and therefore widely cited by geographers.

characteristics that reflect more or less advanced aspects can be readily identified and highlighted depending on what one is trained to look for. If one wants to locate evidence of a globalized economy, it is easy to find in the rapid integration of world financial and securities markets. If one looks for evidence of the continued importance of the nation-state as an entity, that too is easy to find in persistent tariff and non-tariff barriers to trade at the levels of the nation-state and the trade bloc. If we look for industrial excellence emanating from spatially concentrated clusters of lead firms, specialized suppliers, and industry-specific labor markets, examples abound.

The variety of perspectives is actually quite useful in revealing the myriad aspects of globalization, but problems arise when discipline-specific myopia results in the debate becoming unnecessarily polarized or disjointed. Moreover, since economists tend to wield the greatest influence in both academic and policy circles, the voices of political scientists, sociologists, and geographers tend to be overwhelmed and the important roles of state policy and sub-national agglomeration economies are too often left under-examined. The project we need to undertake is the building of an analytic framework that allows for all the seemingly contradictory evidence (none of which, in my mind, is mutually exclusive). Such a project is necessarily interdisciplinary. It would address some of the knottiest problems that currently exist in modern social science: developing a framework for thinking about economic processes along the entire geographic and organizational scale of analysis, from the individual firm to the global industry; from the local, to the national, regional, and global economies.

The Globalization of Markets Vs. the Globalization of Production

For economists writing on the subject of economic globalization, a key question has been the degree of uniformity that has developed across national economies. The underlying hypothesis is that the more that national economic systems come to resemble one another, the fewer barriers will exist to the flow of resources to their most efficient use, and the further the world economy will become integrated, or globalized. The usual assumption is that government policies that restrict or subsidize international trade and investment flows, alter exchange and interest rates, or protect local industry from foreign competition interfere with cross-border price signals, impeding the flow of goods, services, and capital to their most efficient uses around the world. This literature pegs the advance of globalization to the continued rise of a global free trade regime (see Rodrik, 1997 and 1999, for a critique).

A key question for political scientists is the degree that national economies are being eclipsed by larger political and economic structures such as multi-country regional trading blocs and the WTO (Luard, 1990; Gill, 1992; Hirst, 1995; Kothari, 1995). Is the role of the state diminishing? The traditional role of the state has been to seek advantage in the world economy by setting trade policy, usually to protect local firms, which are sometimes state-owned. While tariff barriers have been lowered on average, non-tariff barriers to trade such as local content rules, quotas, and "voluntary" export restraints have increased (Dicken, 1998). Even as the reduction of non-tariff barriers to trade move to the center of WTO negotiations, the authority of the state to set trade policy seems alive and well, particularly in high-profile industries such as automobiles and apparel, which are often excepted under trade liberalization agreements.

In addition, the aggregation of trade authority into fewer hands under the E.U. and the setting up of regional-scale trade regimes under NAFTA, MERCOSUR, and perhaps AFTA, have encouraged more companies to pursue *regional global* production strategies (with at least one plant located within each major trade bloc) where it is possible to serve an entire bloc from a single point, ensuring market access *and* adequate economies of scale (Sturgeon, 1999, Sturgeon

and Florida, 1999). As trade becomes freer within trade blocs, trade between blocs may become less so (Johnson, 1991; Emmerij, 1992; Hirst and Thompson, 1992).

So, it is clear that globalization cannot simply be equated with free trade, especially in the automotive and apparel industries, were we can point to many instances where trade restrictions—or their threat—have hastened the globalization of production. For example, the establishment of production by Japanese automobile firms in the United States since the late 1970s has been in direct response to trade friction in the sector. Likewise, trade restrictions and local content requirements in many developing countries have long been the central force behind the establishment of local production capacity by foreign firms in a wide range of sectors. Many of the investments in emerging economies during the past several years have been undertaken to gain market access. Still, globalization, in popular usage, most often refers to trade liberalization and the globalization of markets.

To begin to make sense in this gap in the debate, we can say that free trade leads the to globalization of *markets*, while restricted trade leads to the globalization of *production*. When we use this framework it becomes clear that globalization can advance along several routes at the same time. On one hand, free trade can lead to globalization in the sense that markets for finished products will be more globalized in a world of increasingly liberal trade rules. On the other hand, in a world with persistent trade restriction in finished goods, firms will increasingly globalize production to serve local markets. The argument then emerges is that globalization appears to advance regardless of how quickly freer trade regimes do or do not develop. State policy, it seems, can only be effective in choosing which aspect of globalization will advance the fastest: markets or production. It is precisely the tenacious and unremitting character of globalization which feeds the popular notion that the advance of world-scale economic integration—whether desirable or not—is inevitable.

A Working Definition of Globalization

How do we define the term globalization? On the broadest level, the term globalization refers to the growing *global-scale inter-connection and integration of human activity.* These inter-connections are expressed in many areas of society and economy.

Some observers have noted a world-scale homogenization of consumer preferences for things such as western style dress, consumer goods, and entertainment, arguing that globalization is creating a single world culture (Roland, 1992). Perhaps most notable has been the emergence of the "world teenager;" young people who, under the influence of global advertising and mass media (e.g. MTV), seem to wear the same clothing, listen to the same music, eat the same fast food, and aspire to many of the same personal goals regardless of location (Hassan and Kaynak, 1994; King, 1997). Critics of the "one world" thesis point to the persistence of cultural differences; some argue that increased global-scale inter-connection and interaction, by exposing each person to an increasingly diverse array of cultural expressions, creates the experience of a more heterogeneous world, not a more homogeneous one (Smart, 1994; Waters, 1994). What is clear is that persistent heterogeneity is not incompatible with increasing inter-connection.

In the arena of *economic integration*, the term globalization also encompasses a wide range of phenomena, including:

1) The cross-border integration of **wholesale and retail financial markets** (Capoglu, 1990; Frankel, 1994; Sobel, 1994).

2) Increased global-scale **market competition** (Audretsch and Claudon, 1989; Stopford and Strange, 1991) and **wholesale and retail trade** (Smeets, 1990, Krugman and Venables, 1995).

3) Increased **foreign direct investment** (Dunning, 1993; Levy, 1993; Nunnenkamp, 1994).

4) Increased cross-border **contracting and global-scale production networks** (Kogut and Kulatilaka, 1994; Gereffi and Korzeniewicz, 1994; Bonacich et. al., 1994; Sturgeon 1997, Borrus and Zysman, 1997).

5) The formation of **international joint ventures and strategic alliances** for R&D (Budd, 1995; George, 1995; Bowonder and Miyake, 1995).

We must view the process of economic globalization in all of its complex manifestations: finished goods trade, intermediate goods trade, FDI, cross-border contracting, etc. In this paper I focus on global-scale inter-firm production networks. In my view, it is especially the growing importance of inter-firm production networks (i.e. the globalization of the supply-base) that differentiates the current round of international investment from past rounds (Sturgeon and Florida, 1999).

Is there any justification in forgoing the well established academic term *internationalization* for the more recent term *globalization*? While both internationalization and globalization refer to the geographic spread of production, we can make a clear distinction between the terms through the example of the automotive industry.

Firms internationalize when they invest in new "offshore" production capacity that is operationally discrete from domestic capacity. GM's investments in Europe are a good example. These operations were begun, in the 1920s, with acquisition of local European firms (Opel and Vauxhall) that continued to develop, manufacture, and sell a set of products that were almost completely distinct from those developed and produced by the parent company's home operations. Until recently there was little or no integration at the level of components, platforms, or models.

Firms globalize when they attempt to integrate key day-to-day functions on a global scale, such as component sourcing, vehicle development, new model introduction (the Big Three's investments in Mexico are a good example). As such, globalization does not necessarily include the establishment of new offshore capacity, since efforts can be made to upgrade and integrate existing offshore operations with domestic operations (GM's current effort to coordinate vehicle development at its Opel, Lansing, and Saturn divisions is a good example, as is the move to current models at older plants in Brazil). In practice however, many companies are simultaneously establishing production in new locations *and* trying to build globally integrated organizations, so the term globalization can be safely assumed to include both dispersion of production and the centralization and coordination of corporate control, product development, and component sourcing.

Dicken (1998, p. 5) makes a similar distinction between internationalization and globalization:

- *Internationalization processes* involve the simple extension of economic activities across national boundaries. It is, essentially, a *quantitative* process which leads to a more extensive geographic pattern of economic activity.
- *Globalization processes* are *qualitatively* different from internationalization processes. They involve not merely the geographical extension of economic

activity across national boundaries but also—and more importantly—the *functional integration* of such internationally dispersed activities.

Because the rise globalization is a *qualitative* change in how the world economy operates, it is inherently difficult to measure in a precise way. Suffice it to say that at some point when transportation and telecommunication costs are low enough, information systems are functional and ubiquitous enough, and the global supply-base is capable enough, globalization can be expected to supplant internationalization as the dominant mode of world-scale economic organization. I believe that if we have not crossed such a threshold yet, we soon will.

3. How Do We Define Value Chains and Production Networks?

Organizational Scale

Analysis that takes the entire chain of productive activities into account has been variously referred to as value chain, commodity chain, value network, activities chain, production network, and input-output analysis. While these terms have a great deal in common, an important distinction can be made by contrasting the various "chains" to the various "networks," where a "chain" maps the vertical sequence of events leading to the delivery, consumption, and maintenance of a particular good and service, while a "network" maps both the vertical and horizontal linkages between economic actors, i.e., recognizing that various value chains often share common economic actors and are dynamic in that they are reused and reconfigured on an ongoing basis. This distinction, which is essentially one of organizational scale, is presented in Table 1.

I propose the term value chain be used to denote a particular, product-based thread of activity that, at a given moment in time, runs through a larger constellation of activities and dynamic configurations embodied in a production network. A value chain can be thought of as a sub-set of a production network, a simplified snapshot taken within the much more complex and dynamic set of activities encompassed by the network. To suggest that a value chain is a more static and limited conceptual tool than a production network is not diminish its usefulness. It is important to have a tool that will allow the distillation of the essential steps taken to get a particular product to market. Within such a snapshot the concrete activities of the key players can be made extremely clear. But it is also important to have a larger, related concept that captures they dynamic and exceedingly complex nature of productive activity.

Table 1. Value Chain/Production Network Organizational Scale

Name	Definition	Other names
1) Value chain	▪ sequence of productive (i.e., value-added) activities leading to end use	▪ supply chain ▪ commodity chain ▪ production chain ▪ activities chain ▪ pipeline
2) Production network	▪ two or more value-chains that share at least one actor (network linkage)	▪ value network ▪ input-output matrix ▪ supply-base

Spatial Scale

A second crucial dimension of value chains and production networks is spatial scale. Gereffi's (1999) differentiates his concept of "global commodity chains" (GCCs) from Poter's (1990) concept of "value chains," in part, by stating that GCCs embody an explicit international dimension. On the other end of the scale, work on industrial districts (Piore and Sabel, 1984) has drawn attention to the tendency for specialized industrial clusters to form at the sub-national, and even local level. Industrial districts are related to value chains and production networks because they often rely on groups of smaller firms that tend to specialize in a particular component, process, or service required to bring a product to market. In such a system, the international nature of the network can be entirely absent, or exist only as a trade link when final products are exported. Clearly, then, the concepts of value chain and production network can be conceptualized without any international dimension whatsoever. Still, it is the combination of industry reorganization—into new value chain and production network configurations—with the process of economic globalization that has resulted in some of the most dynamic examples of recent industrialization. I'm thinking here of cases such as Taiwan's electronics industry, which has come to manufacture a substantial share of the world's personal computer and personal computer-related products in close coordination with lead firms and component suppliers from the United States and Japan. Moreover, many Taiwanese electronics firms are located in the Hsinchu Science Park in an arrangement that looks very much like an industrial district. What is exciting about such examples, on the theoretical level, is that the concept of the industrial district can be neatly "nested" within arguments about globalization, as long as the global aspect of the analysis takes a strong value chain and production network approach. This approach proves the dichotomy of the global vs. the local that has been put forward by some (Sabel, 1989; Shoenberger, 1994) to be false and instead sees the local as *situated in* the global. Within this framework, we can posit that some global-scale value-chains and production networks act as mechanisms to weave together various specialized industrial clusters, giving rise to a *network of clusters*.

What is needed is a value chain and production network typology that covers the entire range of spatial scale. Table 2 presents such a scheme, with value chain and production network structures increasing in scale from local, to domestic, to international, to regional, and finally to global. The term "region" is somewhat problematic in that is has historically been applied to arrangements both at the sub-national and supra-national levels (e.g., the San Francisco Bay *Region* on one hand and the NAFTA *Region* on the other). In Table 2 I try to resolve this by denoting sub-national arrangements as "local" and reserving the "regional" label for supra-national trading regions. The term "global" is also problematic because of its totalizing character. For a value chain or production network to qualify for the "global" label does it need to be everywhere, in every country, in every "region," or every continent? Obviously not. In Table 2 I try to clarify this in two was. First, instead of using the term "global" in an unmodified manner, I instead use "global-scale," which denotes geographic reach, but not any necessary volume of activity or total geographic coverage. Second, I set the condition that activities must—at least—be integrated across the "triad" regions of Asia, Europe, and North America in order to qualify for the global-scale moniker. The reason for this is empirical. Elsewhere (Sturgeon, 1999b), I have argued that we are seeing the emergence of set of "global suppliers" whose customers have demanded that they have—at least—a presence in each of the three largest market areas. It is also true that many of these large suppliers operate facilities outside of the "triad" as well, but there is a real risk that places outside of these three dominant regions, such as South America and Africa, will be rendered invisible in discussions of "global-scale" value chains and production networks. In working to reduce this risk, we would do well to follow the lead of

researchers such as Dolan and Humphrey (1999), who document the fresh vegetable value chains that connect farmers in Africa to large retailers in the UK.

Table 2. Value Chain/Production Network Spatial Scale

Name	Scale of Operations	Other Names
1) Local	▪ commute area, SMSA	▪ industrial district ▪ specialized industrial cluster ▪ regional economy
2) Domestic	▪ single country	▪ supply-base ▪ national system
3) International	▪ more than one country	▪ cross-border production network
4) Regional	▪ confined to a multi-country trade bloc (e.g. NAFTA, EU, MERCOSUR, ASEAN, AFTA)	▪ regional production system
5) Global-scale	▪ actors integrate activities across—at least—each region of the "triad"	▪ global commodity chain ▪ global production network

Productive Actors

A third crucial dimension of value chains and production networks that could benefit from a better-specified terminology is that of the productive actors. How do we talk about the different kinds of firms that participate in value chains and production networks in a way that minimizes confusion and maximizes our analytic leverage? This is an especially vexing problem when industry-specific terms are applied to more general arguments. An example is the term "original equipment manufacturer," which is widely used in both the motor vehicle and electronics industry. In motor vehicles, the term is applied to firms such as Ford and Toyota because these are firms that develop and assemble (i.e., manufacture) vehicles that are based on "original" designs. Suppliers, which are typically referred to as belonging to first, second, or lower "tiers," in have historically provided parts and sub-assemblies according to the design specifications spelled out by the "OEM." In this industry, retaining the use of the OEM moniker for firms such as Ford is still a tolerable practice because, thus far, the "OEMs" have retained a significant portion of manufacturing in final assembly. Still, first tier suppliers have increasing taken on a greater role in the conceptualization and design of major vehicle systems and sub-components (or "modules"). In this system we might ask: "where in the value chain is the originality of products determined?" If a consumer makes a choice a to purchase a vehicle largely based on the attributes of its interior—the seats and other "comfort systems"—it may well be due to the innovative "original" design and manufacturing activities of large interior systems suppliers such as Lear, Johnson Controls, or Delphi.

In the electronics industry the situation is even more extreme. Many "brand name" firms are retain their OEM moniker even as they completely abandon their in-house manufacturing and sometimes even product design activities. Thus we are left with the bizarre situation of referring to companies such as Dell Computer, which has no internal manufacturing capacity and does very little detailed design work in-house, as an OEM. It is interesting to note that the use of the term OEM grew up at a time when one could be relatively certain that a firm that designed and marketed a product was the same firm that manufactured that product. The point is that the locus of activities in a value chain can shift faster than the industry-specific terminology, leaving anachronistic and inaccurate terms such as OEM in wide use. This is more than a semantic problem. The false homogeneity of a term that is used across several industries, such as "OEM,"

misleads us into grouping firms with what might be important analytical differences, such as Dell and Ford, into a single analytic category.

But there is an opposite problem as well, one of false heterogeneity. There are industry-specific terms that are different, but denote roughly the same scope of activities. The problem here is that the heterogeneous terms that are used in specific industries might mask similar patterns of value chain and production network structure that exist or are emerging across industries. An example are the various terms that are used to refer to highly competent suppliers that take on a entire sub-sets of related activities for their customers. In the realm of manufacturing services, there are a group of suppliers that have emerged in many industries that provide complete bundles of manufacturing-related services for their customers, including investment in production facilities (in both domestic and international settings), component and material sourcing, the manufacturing process itself, quality assurance, in-bound and out-bound logistics, etc. Such firms are referred to as contract manufacturers in the electronics and pharmaceutical sectors, full-package suppliers in the apparel sector, and systems or first-tier suppliers in the motor vehicle sector, even though they occupy similar terrain within the value chains and production networks of their respective industries. Even within the world of electronics contract manufacturing, the terms differ by location. The term contract manufacturer is widely used the United States and Singapore, and the term OEM supplier is widely used in Taiwan. Again, the danger with the false heterogeneity of industry-specific and place-specific terms is that we will miss the larger trends that may be emerging in the structure of value chains and production networks across various industries.

We need to link our terms, not to firms, sectors, or places, but to the specific bundles of activity that firms are engaged in. Table 3 summarizes my attempt to do this, based largely on my experience in researching the apparel, electronics, and motor vehicle industries, but it is clear that more input is needed from those familiar with industry-specific terms that denote supply-chain position in a greater number of industries. In Table 3 I start with the integrated firm, which engages in the entire range of value chain activities, from product strategy through to component manufacturing (retailing, historically, has been not been an activity widely engaged in by integrated firms). Large, diversified, globally-operating integrated firms can bee seen as production networks unto themselves. Such firms were identified Alfred Chandler (1977) as "modern corporations" but, due to the rapid vertical disaggregation of many of these firms and the poor performance of those who have retained their integrated stance, more recent commentary has labeled them "dinosaurs" (Fine, 1998).

In recent years, integrated firms such as Ford and IBM have been aggressively shedding large segments of their vertical enterprises. In the late 1990s both Ford and GM spun off the bulk of their component divisions as independent suppliers named Visteon and Delphi. In the same period, IBM's logic semiconductor division was renamed IBM Microelectronics and began to sell semiconductor technology to the open market that had previously been exclusively used in IBM products. IBM also spun off its largest product-level manufacturing group and an independent electronics contract manufacturer named Celestica. In 1999, three years and eighteen acquisitions later, Celestica's 20,000 employees generated US$5.3B in revenue by serving a wide customer base including Cisco Systems, Dell Computer, EMC Corporation, Hewlett-Packard, IBM, Lucent, Nortel Networks, and Sun Microsystems from thirty-one manufacturing sites in the US, Canada, Mexico, the UK, Ireland, the Czech Republic, Thailand, Hong Kong, China, Malaysia, and Brazil.

Table 3. Value Chain/Production Network Actors

Actor	Scope of activity	Other names	Firm examples
1) Integrated firm	▪ product strategy ▪ product definition ▪ design ▪ manufacturing ▪ sub-assembly ▪ component mfg., ▪ marketing, sales, and distribution	▪ modern corporation ▪ dinosaur	· Acer branded and "X-BUs" · the "old" IBM · the "old" Ford
2) Lead firm	▪ product strategy ▪ product definition ▪ product design ▪ end user sales ▪ end user marketing	▪ brand-name firm ▪ OEM ▪ anchor firm	· Dell · Gap · Smart/Daimler · the "new" Ford · the "new" IBM
3) Turn-key supplier	▪ complex parts and services ▪ process R&D	▪ system supplier ▪ OEM supplier ▪ first-tier supplier ▪ contractor ▪ full-package supplier	· Celestica, Acer OEM, TSMC · Dana, Delphi · Ryder Integrated Logistics · Arthur Anderson
4) Retailer	▪ Sales ▪ Marketing ▪ value-added packaging and system integration	▪ marketer ▪ distributor ▪ reseller ▪ value-added reseller (VAR)	· Amazon.com · Sears
5) Component supplier	▪ discrete elements (component parts and services)	▪ lower-tier supplier ▪ specialized supplier ▪ sub-contractor ▪ commodity producer	· Intel, Microsoft · BF Goodrich

It is this split, between those firms that define and market products, such as the Gap, Dell Computer, Ford, and Daimler's Smart Car division (the Smart Car is almost assembled almost entirely of supplier-manufactured systems and sub-assemblies), and those firms that provide a wide range of customers with global-scale production services, that has lead me to the next two categories of value chain actors presented in Table 3, the lead firm and the turn-key supplier. Lead firms are so-called because they usually initiate the flow of new products through the value chain and help to drive the organization and geography of their production networks by demanding that their suppliers engage in new activities and invest in new places. Such a role is usually associated with a great deal of power. In rare cases, however, the locus of power can lie elsewhere in the chain, with large retailers such as Walmart or even component suppliers such as Intel and Microsoft, for example. When retailers take on the role of setting product strategies, participating in product development (e.g., by selling private labels) and building and directing their own production networks, as many have done (Gereffi, 1994), I would argue that that they have joined the ranks of other lead firms in the apparel industry such as Nike and the Gap—firms that have increasingly, conversely, come to sell products through their own retail outlets. This last point brings up two important caveats to the scheme presented in Table 3, that a given firm's scope of value chain activities are not static, and that the activities of large firms can and do span categories without necessarily earning them the label of integrated firm.

Turn-key suppliers are so-named because they provide a full-range of services without a great deal of input by lead firms. Lead firms provide instructions, perhaps, on *what* to make, but it is almost entirely up the supplier *how*, and sometimes even *where* products are made. I derive the term turn-key form the electronics industry, where highly functional contract manufacturers, particularly those that take the financial and operational responsibility for in-bound and out-bound inventory flows, are referred to as "turn-key contractors." The term is inherently somewhat awkward but even worse, there is some danger of false homogeneity. In factory construction, companies that build fully-equipped production facilities, and even hire workers in some cases, are said to be providing their customers with a "turn-key facility." In the realm of corporate computer systems, system integrators and value-added resellers that purchase, install, and integrate hardware and software for their customers are said to be providing their customers with a "turn-key enterprise computing system." While the meaning of the phrase "turn-key" in these two examples is very similar to the meaning in the electronics case (factories, computer systems, and manufacturing services are all provided to their customers in a ready-to-use form; just turn the key), the industry-specific contexts of electronics manufacturing, factory construction, and computer systems, can distract from the topic at hand and lead some audiences away from the topic at hand: value chains and production networks. It would be better to find a new term that captures the highly functional and financially powerful character of the new breed of—increasingly global—suppliers that have grown up to serve the new breed of lead firm. One interesting thing to note about turn-key suppliers is that they have grown, in part, by widening their activity range in the value chain. This allows them to provide a "full-package" of goods and services (or, as is often said in the electronics sector, a "total solution") to their customers. Thus, as many lead firms have "deverticalized" by outsourcing activities previously performed in-house, a set of large and highly functional turn-key suppliers has grown up to serve them by integrating vertically—within strict limits, allowing the aggregation of unprecedented economies of scale and scope (Sturgeon, 1999).

Governance Style[3]

Perhaps the most important dimension of value chains and production networks that could benefit from a better-specified terminology is that of governance style. In this sub-section I identify three governance "styles" that play important roles in the reorganization and relocation of industries today: the *authority, or captive production network*, the *relational production network*, and the *virtual production network*. These three governance styles, along with several sub-categories, are summarized in Table 4. Since value chains can be considered sub-sets of production networks, I assume here that they are governed by the same set of rules that govern the production network in which they are embedded. I posit that each type of network governance style results in a different set of advantages and limitations for participating firms, and perhaps by extension, the economic development prospects of the societies in which they are situated.

Authority production networks

As shown in Table 4, authority networks are come in two varieties, *intra-firm* (1a in Table 4) and *captive*(1b in Table 4). Intra-firm networks rely on the on the authority of administrative control for governance, and thus relate to the internal workings of the firm, a subject that about which there is a long and rich stream of literature (Veblen, 1921; Berle and Means, 1932; Burnham, 1941; Arrow, 1964; Chandler, 1977). Given general agreement on

[3] An earlier version of this section appeared in Berger et. al. (1999).

the decline of vertically integrated firm structures, however, I focus here on networks of the *inter-firm* variety. In captive production networks dominant lead firms exert power akin to the managerial control in the vertically integrated firm to coordinate tiers of largely captive suppliers (Schonberger, 1982; Dore, 1986; Sayer, 1986; Aoki, 1987; Sako, 1989; Womack et. al., 1990). For example, production networks led by Japanese firms include suppliers that are likely to be highly dependent on one or a small number of key customer firms. Buyer-supplier relationships are often formed between affiliates of the same industrial group. Lead firms may make equity investments in their suppliers and over time come to dominate them financially. Lead firms often urge affiliated suppliers to adopt specific production technologies and quality control systems and provide the required technical assistance and financial support.

The advantages of such close buyer-supplier linkages are high efficiency, stimulated by technological upgrading in the supply base, close coordination of "just-in-time" deliveries, and flexibility in the face of market volatility, as workers and suppliers are redeployed on short notice. In the context of market volatility, powerful lead firms can oblige their suppliers to cut costs and output in bad times or invest in new customer-specific production capacity in good times. Lead firms support loyal suppliers through hard times and with new business in good times. Captive production networks are a key element of the "lean production system" (Womack et. al. 1990).

The interdependence of captive production networks also has disadvantages, for mutual dependence makes it more difficult and costly to begin and end supplier relationships. While this feature limits opportunism, it also make the overall system less adaptable since the ability to make and break network relationships is constrained. The "porosity" (i.e. ease and speed of information and materials flow) within the confines of the captive network may be high, but the outer perimeter of the network is resistant to linkages with economic actors outside the network, a major weakness in the context of globalization. The negative outcomes associated with captive production networks are the formation of technological "cul-de-sacs," geographic inertia, the development of redundant offshore production systems, excessive accumulations of debt to keep the system running during extended economic downturns, and limitations in the scale and scope of external economies.

Relational production networks

Relational production networks tend to be built through social and spatial proximity and especially through long term contracting relationships between firms. Those networks built largely through spatial proximity I refer to as "agglomeration networks" (2a in Table 4) and those that rely on social proximity alone I refer to as "social networks" (2b in Table 4). Clearly, in many—but not all—cases social and spatial proximity are closely related. Embedding economic relations in social relationships can create authority relationships and behavioral norms of behavior (e.g. trust, reciprocity, reputation, peer pressure) that reduce the threat of opportunism and provide an alternative governance mechanism to the internal hierarchy of the integrated firm on the one hand and pure market relations on the other (Granovetter, 1985). Geographers (e.g. Scott, 1988; Storper and Walker, 1989) have emphasized that relational production networks tend to operate within the bounds of specific localities. The industrial districts of Italy (Brusco, 1982; Brusco and Sabel, 1983; Piore and Sabel, 1984; Brusco and Righi, 1989), the regional supply networks of Germany (Katzenstein, 1989; Sabel, 1989; Herrigel, 1993), clusters of apparel assembly sub-contractors and home-workers in the greater agglomerations of New York and Los Angeles. (Sassen, 1989; Bonacich, et. al. 1994; Gereffi, 1994; Taplin, 1994, 1996), the family-based

business networks of overseas Chinese in East Asia (East Asia Analytical Unit, 1995; Borrus, 1995; Berger and Lester, 1997), and even Silicon Valley (Saxenian, 1991, 1992, 1994; Luethje, 1997; Sturgeon, 2000) are examples of places where robust relational production networks have been in existence for long periods. Relational production networks tend to be embedded in larger socioeconomic systems, in some cases allowing the temporary redeployment of workers to agriculture or the "informal" sector when the demand requirements of buyers change suddenly.

Relational production networks can adapt to volatile markets quite rapidly. The trust, personal, and familial relationships of the community enable individuals and small firms to take on new roles as conditions change. The manufacturing base is often fragmented into a myriad of small subcontractors specialized not only on a single stage of the manufacturing process, but often on a particular sub-process of one stage. Flexibility stems from the local concentration of extremely specialized small firms that can be recombined into multiple configurations according to changing market demand and to the requirements of the lead firms in the network. The highly fragmented organizational structure allows flexibility to meet the requirements of small batch runs, short lead times, fast delivery, and quick market entry and exit.

The drawbacks of relational production networks are high barriers to entry and geographic boundedness. As in the captive network, relational network linkages take a long time to build up, since trust, reciprocity, and shared identities can take generations to solidify. If firms remain small and the industrial structure fragmented, scale economies can fail to develop and coordination costs can be high, especially when buyers are from outside the network. The social embeddedness of the network, while providing flexibility and adaptability, limits the porosity of the network's outer perimeter and binds it to specific locations. For outside buyers to gain access to a relational network's capabilities, intermediary individuals, firms, or institutions must be used (Tewari, 1999). If such intermediaries are not present, relational networks can remain isolated from buyers, financing, and input sources from the outside. (Still, we must consider the possibility that new linkage mechanisms, from information technology to new cross-border intermediaries, could emerge that would allow firms to tap into relational networks without being co-located.)

Virtual production networks

Many American companies have responded to the pressures of international competition by developing their own distinctive model of networked production. I call this a *virtual production network*, because it is based on linking highly innovative but deverticalized lead firms with sets of highly functional suppliers (Sturgeon, 1997, 1999a, 1999b). Turn-key suppliers provide a wide range of production-related services, including logistics, process engineering, component purchasing, manufacturing, assembly, packaging, distribution, and even after-sales service, while lead firms provide the innovative muscle and marketing clout to drive and define the market for new products. In some industries, such as motor vehicles, suppliers perform module and component design tasks as well (Sturgeon and Florida, 1999). The principal difference between American-centered virtual production networks and Japanese-centered captive production networks is the *merchant* character of turn-key suppliers, which is achieved through the development of a large and diverse pool of customers, and the relatively arms-length relationship lead firms maintain with their suppliers, which is achieved by maintaining a small but interchangeable pool of suppliers. To facilitate this system, turn-key suppliers often specialize in a cross-cutting *base process*, one which is used to manufacture products sold in a wide range of end-markets (e.g.,

pharmaceutical manufacture, semiconductor wafer fabrication, plastic injection molding, electronics assembly, apparel assembly, brewing, telecommunications backbone capacity); *base component*, one which can be used in a wide variety of end-products (e.g., semiconductor memory, automotive braking systems, engine controls); or *base service*, one which is needed by a wide variety of end-users (e.g., accounting, data processing, logistics). The key point is that long-term contracting relationships—although they do exist—are not required. Thus, it appears that lead firms in American-centered production networks have increased their reliance on external suppliers while retaining their traditional focus on cost cutting, price-based supplier relationships, and competitive switching.

Production networks that rely on turn-key suppliers are very permeable, allowing buyers easily to connect to and disconnect from a set of merchant service providers with a wide variety of technical and geographically-specific attributes. The result is a highly flexible system characterized by fluid relationships (low barriers to entry and exit), geographic flexibility, low costs, rapid technological diffusion, and powerful external economies of scale and scope. Because the actors in virtual production networks strive to limit interdependence, the ability to switch partners is retained. Thus barriers to entry and exit are lower in the virtual network than in captive or relational network models, resulting in a greater degree of *organizational flexibility*. Since the merchant manufacturing capacity in the virtual network can quickly be turned toward those brand-name firms that win in the marketplace and away from those that lose, the result is *more intensive capacity utilization and lower overall costs.* Like the other models, virtual production networks are embedded in particular locations that support the day-to-day functioning of the network. Low entry and exit barriers, however, enable superior organizational flexibility; and that in turn allows for greater *geographic flexibility and reach*, so discrete geographic clusters of activity can more easily be woven into wider network. As a result, such networks create new possibilities for brand-name firms to implement global-scale production strategies without FDI. In the virtual network, market-creating innovative capacity is kept in-house by brand-name firms while market-supplying productive capacity moves into commodified external economies that can be shared by the industry as a whole, creating large external economies of scale (Sturgeon, 1999b).

There are potential drawbacks of the virtual network model. As suppliers gain in financial strength, technical and operational competence, and geographic reach—and as brand-name firms become extremely reliant on them—they might take the further step of developing their own end-products in competition with their customers (Fine, 1998). This happened in the 1970s and 1980s, when American consumer electronics firms used Japanese electronics firms to manufacture their products. Eventually, American firms such as RCA lost control of product definition and were reduced to affixing their brand names to Japanese designed and manufactured products. These Japanese firms now dominate most consumer electronics markets, and American consumer electronics firms have all but disappeared. Another concern stems from the merchant character of virtual networks. If suppliers work for brand-name firms that are in direct competition with one another, the possibility of technological leakage to competitors and loss of intellectual property arises. A lead firm's experience of outsourcing a product's production only to find a counterfeit version appearing on the market months later is not unknown. Finally, the outsourcing of broad swaths of activities formerly performed in house raises the possibility that brand-name firms will lose process expertise that makes them more astute buyers of external services. Such expertise might turn out to be critical to ongoing success in product development. American automakers have been particularly concerned about retaining their ability to design vehicles

even as they outsource module design to large suppliers and spin off their internal parts divisions as stand-alone merchant suppliers.

Perhaps the best example of a well-developed virtual production system lies in circuit board- and product-level electronics assembly, for which contract manufacturers providing a full range of leading-edge production services have emerged in various geographic locations. The largest electronics contract manufacturers, such as SCI Systems, Solectron, Celestica, and Flextronics, all of which are US-based, offer customers a global-scale network of advanced manufacturing capacity for hire. By utilizing this network in a highly dynamic manner, some brand-name firms, especially large electronic systems firms with deep involvement in international markets, such as IBM, Sun Microsystems, and Hewlett Packard, have gained the ability to reconfigure the geography of their manufacturing operations without the costs, risks, and time commitments associated with setting up new offshore production facilities of their own.

Table 4. Value Chain/Production Network Governance Types

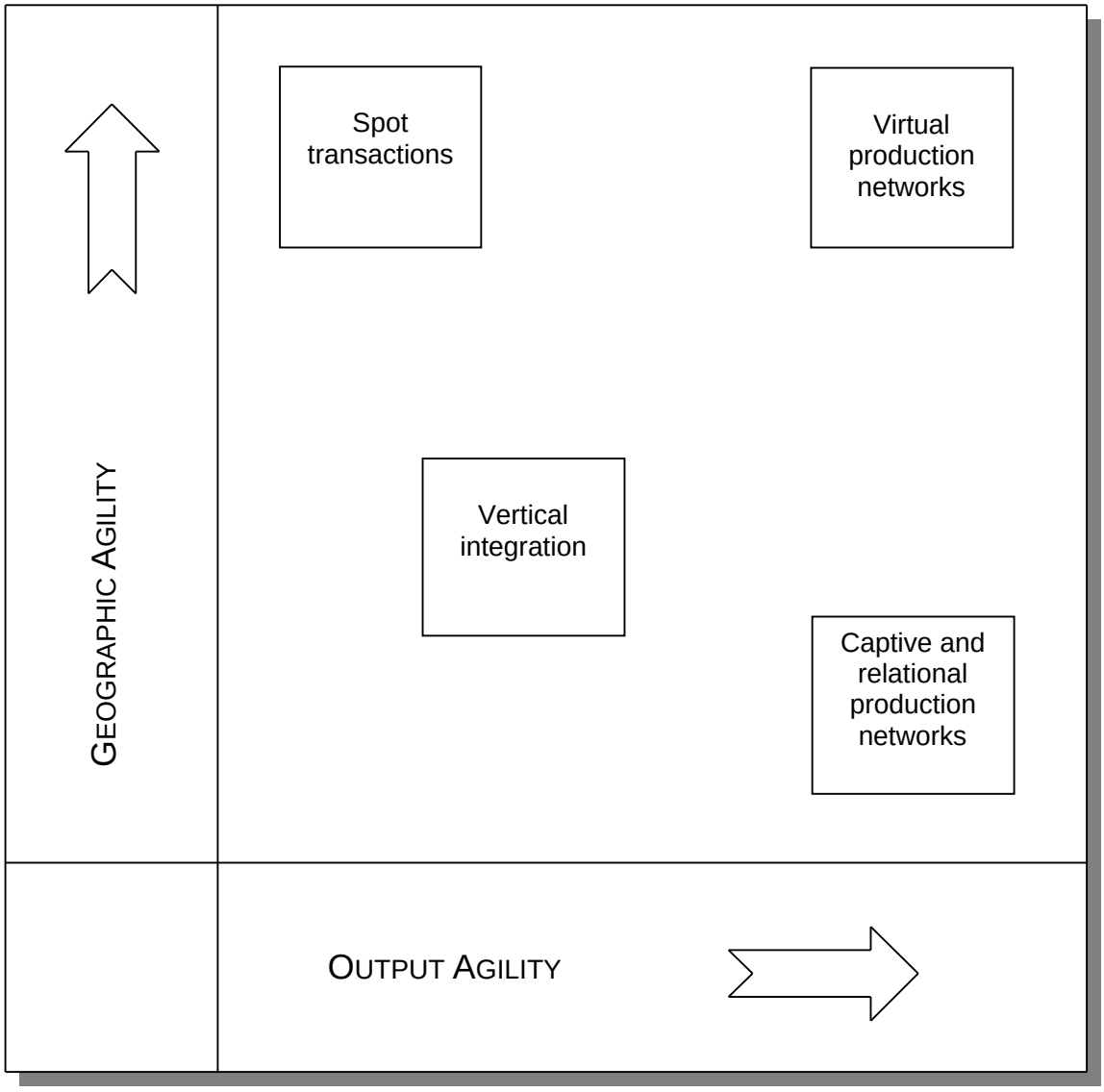
Network name	Basis	Other names	Examples
1) Authority networks	▪ authority	▪ governance	
a) Intra-firm networks	▪ authority of management	▪ vertical integration ▪ producer-driven commodity chains	▪ Acer ▪ the "old" IBM
b) Captive networks	▪ authority of lead firm ▪ long-term relationships	▪ industrial groups ▪ lean production networks	▪ Toyota Group ▪ Japanese ***kiretsu*** ▪ Korean ***chebeol***
2) Relational networks	▪ long-term personal and inter-firm relationships ▪ assumed group characteristics	▪ trust-based networks ▪ personal networks ▪ networks involving repeat transactions	
a) Agglomeration networks	▪ spatial propinquity	▪ industrial districts ▪ industrial clusters	▪ Silicon Valley ▪ 3rd Italy ▪ New York garment district
b) Social networks	▪ social propinquity	▪ ethnic networks ▪ interest groups ▪ culture networks	▪ overseas Chinese ▪ Mafia ▪ Usenet
3) Virtual networks	▪ external scale economies ▪ "promiscuity" of network actors ▪ commodified network capacity ▪ codifiable transfer of specifications	▪ turn-key production networks ▪ agile production networks ▪ buyer-driven commodity chains	▪ Cisco and Solectron ▪ B2B ecommerce ▪ the "new" IBM ▪ Silicon Valley and beyond

One important caveat in regard to Table 4 is that the production network forms presented here are not mutually exclusive; we see ample evidence of interconnection and overlap among various network types. Each network type also captures a major "industrial model" that has been

put forward in the literature on industrial organization and economic performance. Specifically, captive production networks map to the "lean production" model (Womack et al. 1991), relational production networks map to the "flexible specialization" model (Piore and Sabel 1984), and virtual production networks map to the "virtual corporation" model (Davidow and Malone 1992). The benefit of projecting these industrial models into their associated network forms is to draw attention to their dynamic spatial attributes, especially to their performance in and impact on host and home economies when they are projected outward or woven together as global-scale economic systems.

The pressure on firms to reorganize to tap the advantages of production networks is high. While I do not argue that there is one best model in all situations, and the three different governance types presented here each provide a distinct set of advantages and disadvantages for firms that use them, I do believe that the virtual network model has, in recent years, come into its own as a powerful competitive tool for American lead firms and their turn-key suppliers. The main advantage of the virtual network model can be summed up by the term "agility," which is divided in Figure 1 into "geographic agility" and "output agility." Both of these aspects are enabled by the relatively loose governance style of the virtual network, which is enabled by limited interdependence between lead firms and any given turn-key supplier, which is in turn enabled by a heavy reliance on standard technical nomenclatures (when they exist) to specify product and process attributes, as well as on information technology, including digital design technologies and B2B ecommerce tools, to codify—and even automate—the transfer of complex information across the inter-firm link.

Figure 1. Production Network Performance: Geographic vs. Output Agility



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