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strategic partnership: collaboration, alliances & the coordination spectrum

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INTRODUCTION AND MOTIVATION

Recent developments have increased the importance of 'collaboration' among companies in supply networks. Several drivers stand out among others, in particular:

- Supply chain integration now plays a strategic role in industry – ranging from competitive necessity to potential source of competitive advantage.
- Close relationships are being recognized as requirements for successful supply chain integration.[1]
- Increased outsourcing and supply network redesign require and are emphasizing the necessity of coordination among the parties that comprise the supply network.

For many, the new requirements for close relationships and coordination translate into heightened need for collaboration among companies.

SUPPLY CHAIN INTEGRATION: CLOSER RELATIONSHIPS REQUIRED

As suggested above, having an integrated supply chain is increasingly being seen as a competitive weapon and a potential source of competitive advantage. A critical requirement for creating an integrated supply chain is creating and maintaining close relationships with other companies in the supply network.

This need is apparent in Prof. Hau Lee's framework characterizing supply chain integration as having three key dimensions: Information integration; Coordination; and Organizational linkage. Each of these dimensions calls for deeper, more engaged interaction among the companies of a supply network ranging from coordinating the use of information, to coordinating work processes and resources, and finally to creating a "tight linkage of the organizational relationships between companies" including communication channels, performance measures, shared and/or aligned incentives, shared risks and gains.[2]

OUTSOURCING: COORDINATION REQUIRED

The increasing market turbulence and competition (in terms of quality, cost and service level), the reduction in product life cycles, the increased variety of products, and services and technology evolution have lead companies to search for higher flexibility, in terms of mix, volume, products and technologies. Because of the difficulty to develop and manage all these different technologies and competencies, many organizations have redesigned their internal company supply chain by outsourcing various parts of their supply chain activities.

> 'THE REQUIRED CLOSE RELATIONSHIPS AND COORDINATION AMONG COMPANIES ARE POPULARLY REFERRED TO AS COLLABORATIONS, PARTNERSHIPS, AND OCCASIONALLY AS ALLIANCES'

This popular trend in industry to outsource components of business operations entails narrowing business scope in order to reduce working capital requirements and focus the remaining operations on core competencies. The result is that previously vertically integrated businesses have become dependent on outside organizations[3] to fulfill demand.

Often, a connected set of flows across the functions of a single economic entity are replaced by the same flows among separate, independent companies in a business-to-business relationship, each business having separate objectives, goals, measures, and financial fate. Frequently, a company may find it more effective to use other firms with special resources and technical knowledge to perform these business functions. Even if a firm has the resources to execute a particular task, another company could be better suited to perform that task simply because of its location, its resources, its expertise, its ability to exploit economies of scale, and/or its ability to bear risk thus reducing costs.

This new dependence on external companies further increases the need to coordinate processes and build close relationships as the success of each company is now connected to the performance of the others in the network. Ultimately, these independent companies are turning to close relationships as ways to approximate the benefits of vertical integration (control, economies of scope, relatively uninterrupted flows across the business) without the onus of ownership, management, and capital investments.

ISSUES

The required close relationships and coordination among companies are popularly referred to as collaborations, partnerships, and occasionally as alliances. These terms are not consistently used in industry, with many different definitions that are often lacking in clarity and consistency.[4] The lack of common terminology leads to confusion and failure to develop a deep understanding of the underlying concepts. We propose a way to segment and classify the various types of collaboration among customer-supplier (dyadic) relationships[5] using economic and coordination theory as a foundation.

DESCRIBING CLOSE RELATIONSHIPS ALONG A SPECTRUM OF COORDINATION MECHANISMS

It may be useful to start refining the definitions of the various terms and their use by starting with the definition of coordination developed by Malone and Crowston,[6] where "Coordination is managing dependencies between

Figure 1: Spectrum of coordination mechanisms
(Adopted and synthesized by authors from various referenced authors)

Markets				Hierarchies	
Markets	Alliances (Hybrids)			Hierarchies	
Transactional Relationships	Information Sharing Alliances	Collaborative Operations Alliances (Design, Engineering, Logistics)	Collaborative Network Alliances	Partnerships	Vertical Integration

activities." They further state explain that collaboration is only one type of coordination.

From the economics literature, there are fundamentally two alternative coordination[7] mechanisms for coordinating among business operations: markets and hierarchies. Markets represent cases where economic actors (both firms and final users) coordinate with each other in order to sustain the exchange of goods or services among themselves. Hierarchies entail cases where an entity coordinates through ownership of production resources, maintaining the authority to exercise and impose as one single entity its own decisions through a system of incentives and disincentives (awards and punishments).

The industrial economics literature identifies a third type of coordination mechanism between markets and hierarchies. This is the so-called hybrid, quasi-market or intermediate mode of organization. In hybrids, the firms coordinate with each other through some integration activities often including long-term contracts, without committing to a particular hierarchic model (through, for example, merger or acquisition).

Hybrids have been referred to in multiple terms. De Maio and Maggiore call them partnerships, in which the transaction also entails cooperating and collaborating together to improve both actors' performances (De Maio and Maggiore, 1992). Similarly, Simchi-Levi calls them strategic alliances (Simchi-Levi et al., 2000) where many forces drive companies towards collaboration seeking win-win situations between companies. Lynch calls these relationships alliances, and differentiates between partnerships by suggesting that partnerships imply legally binding obligations (Lynch, 1993).

All coordination mechanisms taken together, they form a continuum or spectrum of relationships that can also be observed in practice. Several academics have characterized these in various ways: Ellram identifies four levels of coordination between market and hierarchy: short-term contract, long-term contract, joint venture and equity interest (Ellram, 1991); Macbeth and Ferguson write about product life relationship, shared destiny, minority share-holding, strategic alliance and joint venture as intermediate types of relationship (Macbeth and Ferguson, 1994). Rice and Hoppe[8] derived a set of three distinct coordination activities[9] required for coordinating between different companies of a supply network including coordinating connected information and information systems, coordinating logistics process and operations, and coordinating network-level decisions and tradeoffs (balancing financial commitments (benefits, investments, operational costs, equity) and risks).

Synthesizing these varying definitions and conditions, we propose segmenting the Market Mechanism – Hybrid – Hierarchy spectrum of alternative coordination mechanisms into six groups – Transactional Relationships, Information Sharing Alliances, Collaborative Logistics Alliances, Collaborative Network Alliances, Partnerships, and Vertical Integration. Each of these categories or segments has different characteristics which are presented in Figure 1.

The six categories or segments of coordination mechanisms can be described in the following ways:

Transactional Relationship

The simplest and most fundamental market coordination mechanism, transactional relationships entail only buy-and-sell activities in a traditional arms-length relationship. The activities are typically accomplished in single transactions purchasing products using open market processes to buy products at market prices. Examples of this include buying directly from vendors in retail outlets, through online marketplaces (including but not limited to auctions), and via catalogs. The goals and the objectives of the two parties involved in the transaction might not match; for this reason the relationship is not exclusive – the buyer could find other suppliers and the seller could find other customers.

Alliance

We propose using this term in general to describe the hybrid relationships. These market coordination mechanisms are not pure market mechanisms in that they entail more than buy-and-sell transaction activities. In alliances, two companies share some common interest, exchange value through buy-and-sell activities, and also perform some coordination activities.

This is typically a multi-dimensional and goal-oriented relationship between two firms in which both organizations do some sharing, ranging from passive information to sharing both risks and rewards. Similarly, there are varying degrees of shared goals, and a broad range for time horizon and level of commitment. These will be expanded in the respective sections below.

Depending on the coordination activities performed, the alliance falls into one of two categories:

- Information Sharing Alliance – This entails only passive information sharing as a coordination activity. Examples of this are practices such as order tracking or inventory visibility. E.g. Lucent Technologies shares information about inventory levels and forecasts with over 300 suppliers through its web-portal.
- Collaborative Operations Alliance – This entails information sharing and active process coordination in one or more domains – product design, engineering, and/or logistics (supply chain). Some of the likely activities include process improvement, planning (such as vendor managed inventory or CPFR). E.g. Lucent Technologies collaborates on

forecasts with 25 suppliers (not 300) through its web-portal).

- Collaborative Network Alliance – This entails information sharing, active process coordination, and making network-level financial decisions and tradeoffs (including mutual investments in joint assets, balancing financial risk and rewards). Examples of this are where a customer and supplier share some of the costs for relationship-specific assets such as a dedicated warehouse that would normally be the sole responsibility of only one of the parties. E.g. Chrysler and Toyota may serve as the best examples in practice today as Dyer has illustrated .[10]

We purposely choose not to use the term 'partnership' to describe hybrid relationships (or 'partners' to describe the parties), as this term implies some measure of a legal commitment or obligation. Specifically, the term implies that two parties will be making a commitment that entails sharing risk and rewards equally; the term "has strong legal implications regarding your ability to incur legally binding commitments on the part of your partner, and vice versa."[11] One large corporation was sued by a supplier who's orders were cancelled after the supplier made significant capital investments because the customer indicated it wanted to create a partnership with the supplier. [12]

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Information Sharing Alliance

This alliance describes a relationship where market buy-and-sell transactions are augmented with passive information sharing (mainly performance and outcome information rather than process information). The firms maintain their respective information and planning systems and incorporate information from the other firm as possible. This may represent a case where the firms are in the early stages of developing a more meaningful relationship, or where the firms have limited commonality in goals. The information is shared with the expectation that this information may improve their connected processes without significant commitment or risk taken on by either firm. Due to the limited commitment and exposure, this relationship represents typically a short-term commitment.

Collaborative Operations Alliance [13]

This alliance describes a relationship where the exchange of value occurs through some market buy-and-sell transactions but also long-term agreements regarding material flows, or through collaborative work on product design or engineering. The agreements and transactions are augmented with active information sharing (likely some efforts towards common information systems and planning processes) and supply network process coordination and improvement activities (the firms decide to collaborate on inventory management, demand fulfillment, forecasting, new product development, and/or marketing activities; and these are only few examples). The two firms share some stated common goals, and there may be some dedicated resources committed by each firm to create and maintain a high degree of integration. Due to the goals commonality and the kind of information shared and resources committed, this relationship presents typically a medium-to-long term commitment. Such a commitment and collaboration often lead to strategic benefits for both partners.

We introduce the descriptor 'collaborative' to this relationship because unlike the previous relationships, this alliance calls for active engagement between the firms, working towards some shared common goal.

Collaborative Network Alliance

This alliance describes the most committed level of alliance, where the exchange of value occurs mainly through long-term agreements and includes financial, resource and/or risk sharing. The agreements are supported with fairly open and active information sharing, supply network process coordination and improvement activities, and making network-level financial decisions and tradeoffs (including mutual investments in joint assets, balancing financial risk and rewards). As with the collaborative operations alliance, the two firms share some stated common goals, but the level of commitment in terms of dedicated resources and risk sharing is significantly higher and more complex. Most importantly, the two firms make mutual investments in dedicated assets to improve their supply network and develop creative agreements and arrangements in order to balance the risk across the firms. Due to the common goals, dedicated resources and mutual investments, this relationship presents a long-term commitment. Such a commitment and collaboration are often intended to create shared strategic benefits for both firms.

The level of process integration may be described as virtual integration and seamless. We introduce the descriptor 'network' to this relationship because unlike the previous relationships, this alliance calls for the firms to make decisions on their respective supply network designs rather than being limited to process coordination and integration.

Partnership

As we categorize coordination mechanisms, we place partnerships squarely in the domain of hierarchies. We consider partnerships as hierarchies in the sense that partnerships (as we define them) entail some equity ownership. The equity ownership enables the equity owner to coordinate by exercising some control by virtue of owning some of the business.[14] This would include joint ventures and cases where the ownership is less than 51 per cent (which is the cusp of being able to exercise full control).

The partnership would also entail all of the previously described activities for Collaborative Network Alliances, except the

level of commitment is significantly higher. Goals and objectives of the two companies are so similar that the financial structure of the relationship changes – the two firms sharing equity interests are no longer two completely separate entities. For this reason collaboration and integration become even stronger and the firms share their destiny. Some examples can be found in subsidiaries, joint ventures, and equity interests cases.

One could argue that companies with less than 51 per cent ownership may not be able to exercise full control and therefore the relationship would not technically qualify as a pure hierarchical coordination mechanism[15] where control through ownership is the critical coordination benefit of ownership. We consider that the part owner will be able to exercise some control and therefore consider it a type of hierarchical coordination mechanism, although we recognize that this may not always be the case. In those cases, the relationship may be best described by the kind of activities undertaken between the firms, rather than by the type of ownership structure.

Vertical Integration

Finally, vertical integration represents a pure hierarchy – ownership of all the value-adding entities and exercise of that ownership to coordinate activities among the entities. This solution enables the owner to coordinate the supply network through control. By virtue of having a controlling interest in the firms, the owner may exercise full control over all the activities performed and the objectives become all the same.[16] The costs of acquiring or merging another company could be very high and the efforts in making the cultures compatible could be such high as well. Due to the characteristics of this relationship, the time-horizon is very long because the switching costs related to the integration are relevant.

It is important to note that in literature and in practice, authors and business leaders often speak about strategic alliances and partnerships as though they have the same meaning. As suggested before, we believe, like Lynch[17], that partnerships describe relationships where there is some shared ownership, and that alliance is the more appropriate descriptor for close relationships where there is no common or shared ownership. This may seem like hair-splitting, but it is not uncommon for two organizations to interpret 'partnerships' in very different terms, leading to relationship damage and lost opportunities. Parties behave differently when there is some measure of ownership, as well as the party has greater ability to coordinate as an owner.

CHARACTERISTICS OF COORDINATION MECHANISMS

To further delineate the alternative coordination mechanisms, and in particular the alliances, we have developed a matrix that characterizes many of the salient differences among the alternatives. Important ways that we have segmented the coordination and alliance types are:

- Degree of common goals between the two firms,
- Time horizon of the relationship between the two firms,
- Structure of the relationship between the two firms,
- Description of the relationship between the two firms,
- Activities by coordination method between the two firms, and
- Instruments for coordinating and balancing cost, benefits and risk between the two firms.

See Figure 2 for a matrix outlining and describing these various factors.

INSTRUMENTS FOR MEDIATING RISK

The instruments for coordinating and balancing cost, benefits, and risk in a relationship represent an important way for companies to potentially develop more tangible deep relationships. Associated with different types of coordination mechanisms, the various instruments provide alternatives to the firms for mediating risk across the two firms in a formal and predictable way. (By mediating risk, we mean the process of balancing costs, benefits, and risks associated when buying or selling a good or service). Given that the inherent limitation in coordinating between two firms is that they are separate economic entities, reducing the risk that each firm bears in working together may provide valuable benefits that have yet to be quantified. For this reason, we believe it is useful to examine the various ways of mediating risk, particularly in the cases where firms are intent on collaborating in meaningful ways, yet still independent and separate entities.

For transactional relationships and information sharing alliances, price is the only mediation instrument. All risk associated with producing a product for a customer is built into the price of the product. The price will increase as the firm takes on increased risk when making products that require dedicated investments or when the volume falls below economic order quantities.

In collaborative alliances (collaborative operations alliances and collaborative network alliances), these instruments play

Figure 2: Characteristics of Various Coordination Mechanisms

	Transactional Relationships	Information Sharing Alliances	Collaborative Operations Alliances	Collaborative Network Alliances	Partnerships	Vertical Intergration
Goals	Different	Some shared interest in improving process	Some similar goals to improve logistics flows & new products	Some similar goals to improve network operation	Some, most goals are common	All goals are common
Time Frame	Short-term, as long as the transaction	Short-term, as long as the process	Medium-to-Long-Term, dependent on shared investment in mutual assets and processes	Long-Term	Long-Term, limited by structure of ownership (possible to sell minority share)	Long-Term
Structure	Two seperate entities	Two seperate entities	Two seperate entities	Two seperate entities, some shared assets	Multiple entities with equity	One Owner
Description of Relationship	Competitive arm's lenght relationship	Passively collaborative - sharing information only	Actively collaborative - mutual efforts to improve common processes	Make joint investments in assets and resources	High level of risk sharing and active collaborative effort	One integrated entity
Activities by Coord Method	Buy and Sell Products & Services	Buy and Sell Prods/Svcs Passive Info Sharing	Buy and sell Prods/Svcs share info, Active Coord & Plng systems & Processes	Long-Term agreements, Share key info, Active Coord, Mutual Investments & Balanced Risk	Run the Business with other Part Owners (Partners)	Run the Business as Owner
Instr. for Mediating Risk	Price	Price	Price, Long-Term contracts, Contingency Contracts, 'Hostages'	Shared goals, Long-Term & Contingency Contracts, 'Hostages'	Partial Control via Partial Ownership	Control as Owner

an important role. Generally, alliances use price, non-price instruments such as contingency and/or long-term contracts, and what are known as 'hostages' in the economics literature. (A hostage is anything that has a low value for the party that is holding it, but a great value for the party bestowing it).[18] The exchange of hostages between firms could prevent possible opportunistic behaviors; for example, the hostage could be an equity investment made by both parties in the case of a partnership or the hostage could be transaction-specific investments made by both parties. Alternatively, the firm that makes an investment in physical assets that are dedicated to the relationship, has created a hostage that the other firm may use to gain leverage unless the investing firm protects themselves before making the investment by arranging for offsetting volume commitments or capital contributions for instance. These 'hostages' may be conditions that already exist or may be conditions that one of the parties attempts to create. Additionally, each party may actively seek out or leverage potential 'hostages' for further non-negotiated mediation. Another example of a hostage is provided by the relationship between a consumer products manufacturer and a 3rd party logistics (3PL) provider, where the 3PL has all the competencies, the distribution channel and the contacts with the manufacturer's customers. These are all very valuable activities for the manufacturer and therefore constitute a sort of hostage in the hands of the 3PL.

Like trust, this appears to be an important method for building close, collaborative relationships; unlike trust, these methods are tangible and provide clear non-price methods for the two firms to not only balance but also possibly reduce risk across the two firms. This may represent a potentially powerful and under-utilized method for building close relationships that calls for further investigation. Instead of using only price to offset the risk that a firm takes when selling its products into a channel, it is also possible to supplement the pricing arrangement with non-price terms, supporting processes and/or contingency contracts. Examples of these include:

- Structuring a sale with a price based on a guarantee volume purchase, affording the customer some flexibility and committed support, while at the same time sparing the supplier from making customer-specific commitments without offsetting guarantees for volume.
- Supporting customer fulfillment with services (such as VMI or CRP) that provide the supplier with some demand visibility and control over inventory, again offsetting risk associated with uncertain demand somewhat.
- Structuring an agreement with committed service levels in exchange for volume of mix commitments,

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possibly also menu pricing for different service levels.

- Structuring an agreement with guaranteed return processes in exchange for guaranteed volume commitment.

The instruments described are explicit and formal agreements, although in practice some of these arrangements are implicit.

An example is offered to illustrate. In many cases a vendor may build a production or distribution facility next to a customer operation with a tacit understanding and expectation that the customer will provide certain levels of volume. This arrangement works well when the customer volume exists and grows, and both firms benefit from highly aligned operations that are effective and efficient. This can be disastrous, however, if the tacit agreement is not honored for a variety of reasons. The reasons for the failure cover a broad range:

- Seemingly innocuous and predictable changes in personnel ("Sorry, that agreement was made with my predecessor, not me."),
- Service failures by the supplier ("You failed to deliver volume per our need, so we are giving half of the volume now to competitor X."), and
- Failures by the customer to provide adequate volume (that were necessary from the suppliers' perspective) to offset the risk taken on by the supplier ("Sorry that we didn't need as much product as we forecast, but we wont pay for the units you produced or for the cost of underutilized labor.").

These cases leave both firms hurt with and little recourse to the problem aside from costly, relationship-damaging legal battles.

Partnerships use the same instruments as alliances with the added instrument of ownership-associated control (power to influence outcomes) and equity (incentive via benefits to owners of the business' performance). Finally, vertical integration uses control and equity ownership to mediate the risk.

We believe further study of this will be a productive exercise and may provide insight into an as-yet-undiscovered key success factor for developing collaborative relationships. Some key questions we are interested in learning about:

- How do collaborating firms in a supply network structure and arrange their relationships and contracts to manage risk & allocate system level benefits? What are the key methods?
- What are the benefits that each specific method produces? What are the appropriate conditions for utilizing the various respective methods?

SUMMARY/NEXT STEPS

We have used the adopted definition that collaboration is but one method of coordination[19], and we have proposed a spectrum of coordination alternatives for practitioners to select from when building and designing their supply network. Furthermore, collaboration was defined in the context of market coordination mechanisms and we offered various alliances as distinct alternatives for building close relationships between two firms of a supply network. Hopefully, the distinctions we have drawn and the terminology proposed are useful, and will enable firms to build deeper relationships with selected companies in their respective supply networks.

As suggested above, one of the ways we have distinguished the various coordination alternatives is by the instruments for making and coordinating financial tradeoffs. We believe this holds promise as a potential key success factor in eliminating inherent and embedded risk in the supply network.

The commonly used term 'partnerships' should be limited in use to cases where there is shared equity ownership in the firm, otherwise alliance may be a more accurate and descriptive term. These alliances are not all alike, and we have proposed three distinct alliances, which if put in practice, may enable firms to more clearly define their interests in collaborating as well as the potential benefits associated with that specific effort.

One other area of study that would likely be productive is the study and identification of key success factors for building collaborative alliances. While collaboration is a commonly used and generally accepted term today, it is unclear how successful companies have been developing successful collaborative alliances, nor are the key success factors clearly identified and understood. This too would be a useful area of study. LS

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Dr. Stefano Ronchi was a visiting student from Politecnico di Milano in Milan, Italy working at the MIT Center for Transportation Studies at the time this research was conducted.

Refences

1 Lee, Hau "Creating Lasting Values in Supply Chain Collaboration" August 7, 2000, "Supply chain integration is considered to be a key element of competitiveness . . . integration requires close collaboration."

2 The framework and quotes provided in this paragraph are taken from Prof. Lee's paper "Creating Lasting Values in Supply Chain Collaboration" August 7, 2000

3 The outside organizations are often either third party contract manufacturers that produce private label products and services to specification, or separate operating businesses that design, produce and market branded products or services.

4 Karl Mandrodt and Mike Fitzgerald, "Seven Propositions for Successful Collaboration" SCMR July-August 2001. In this article, the authors suggest "collaboration can be thought of as the act of leveraging supply chain assets beyond the current set of customers and suppliers to include other significant entities." In their framework, collaboration by definition entails three companies, and alliances only deals with two companies.

5 This work does not address coordination across multiple tiers of the supply network. That topic and its issues are addressed in the Sept-Oct 2001 SCMR article "Supply Chain versus Supply Chain" and in the August 2001 working paper "Network Master and Three Dimensions of Supply Network Coordination" both works by Rice and Hoppe

6 Malone, Thomas W., Crowston, Kevin "The Interdisciplinary Study of Coordination" ACM Computing Surveys, Vol. 26, No. 1, March 1994, p. 90.

7 This work refers to the definition of coordination mechanisms based on the definition of governance structures provided by Williamson: "the institutional framework within the integrity of a transaction is decided" (Williamson, 1979).

8 Rice, James B., Jr. and Hoppe, Richard M. "Network Master & Three Dimensions of Supply Network Coordination: An Introductory Essay" Working Paper August 24, 2001

9 These may be considered a generic set of required coordination activities that are specific to coordinating supply networks.

10 Dyer, Jeffrey H., Collaborative Advantage: Winning Through Extended Enterprise Supplier Networks, Oxford University Press 2000

11 Lynch, Robert Porter, Business Alliances Guide: The Hidden Competitive Weapon, John Wiley & Sons, 1993, page 28

12 Ibid.

13 For the purposes of this article, we are referring to collaborative alliances between two firms in a supply network, or 'vertical collaborative alliances.' Specifically, collaborative alliances between co-customers or co-suppliers (horizontal collaborative alliances), and between SBUs within a corporate holding company are not directly addressed in this article. While there will be some applicable learning, the referenced cases entail different economics and warrant a separate discussion.

14 See comments on the partnership in the previous section entitled Alliance.

15 In some cases, the minority-stake owner may not elect to exercise control, and instead treat this as an investment rather than a way to coordinate. In those instances, one could argue that the relationship is more of an alliance because the minority-stake owner does not coordinate through its control. We do not fully address these instances, although we posit that this would still be a hierarchical coordination mechanism that the company chooses not to exercise. This is also the case where a company has full ownership but is organized as a conglomerate and so does not utilize its capability to control.

16 The case of a holding company may not meet this definition as the owner typically does not exercise control and hence, there is no hierarchical coordination delivered.

17 Lynch, Robert Porter, Business Alliances Guide: The Hidden Competitive Weapon, John Wiley & Sons, 1993, page 28

18 Williamson, O.E., 1983, Credible commitments: Using hostages to support exchanges, American Economic Revoew, 73, 519-40.

19 Ibid. Malon and Crowston