THE LOGIC OF ALLIANCE FADS:
Why Collective Competition Spreads

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Alliances often seem to spread in waves. In many businesses, a period of increasing alliance formation has been followed by a slowdown. In the global airline industry, for example, the formation of alliances increased dramatically in the 1990s and a number of distinct alliance groups ("constellations," as defined below) had been formed by the end of the decade (see Figure 1).

Figure 1: Spread of Alliances in Airlines, 1980-2000

Source: Compiled from data in Wilma Suen, "Firm Power and Interdependence in International Strategic Alliances," PhD thesis, Tufts University, 2001. Includes only alliances of major airlines and constellations.

Similar booms, often followed by declines in alliance formation, seemed to have occurred in other industries, although no comprehensive data exist to show this conclusively. In the early 1990s, there were waves of alliance formation in the telecommunications, computers, health-care, and commercial real estate industries, to name a few examples. Biotechnology alliances were most popular in the mid-1980s. Earlier, the late 1970s and early 1980s saw alliance waves in the automobile, aircraft, and chemicals industries. Historical data on the foreign operations of large U.S. manufacturing firms indicate an increase in the use of joint ventures in the late 1950s, followed by a sharp decline in the 1960s (Gomes-Casseres, 1988).

These observations raise two related questions. First, why did firms in these industries increase their use of alliances at about the same time? This clustering of firm behavior causes the rate of alliance formation to rise for the industry as a whole. Second, why did the rise in alliance formation come to a halt and even decline after a few years? Just as the rises in alliance formation of firms in an industry are typically correlated, so too seem to be the declines. As a result, we see the formation of alliances wax and wane in the industry.

Gomes-Casseres (1996) suggested some possible explanations for this pattern. In this story, competitive and technical changes in an industry cause some firms to adopt alliances, which their rivals were then likely to copy. Furthermore, this process was accelerated because firms had an incentive to pre-empt their rivals in forming alliances. The wave of alliance formation continued until slowed down by a scarcity of remaining potential partners. Aside from these “external” forces on alliance formation, there were also “internal” drivers and constraints, rooted in the workings of each firm’s alliance network. In particular, the growth of a firm’s alliance network first yielded

economies from specialization and later generated governance costs that limited further growth. This article develops these ideas further by identifying three sets of mechanisms behind the spread of alliances and evaluating the arguments on field data from two industries.

The structure of this paper is as follows. The next section introduces a series of theoretical arguments that may explain the dynamics of alliance waves. The section after that reviews briefly two industry case studies of alliance formation. The last section evaluates the theoretical explanations in the light of the case evidence. The conclusion presents implications for managers and scholars.

The data used in the paper comprise 177 alliances in the reduced instruction-set computing (RISC) industry and 74 alliances in the personal digital assistants (PDA) industry. Both industries were fields of intense technological and commercial innovation and rivalry that emerged in the late 1980s and blossomed in the early 1990s. During this period, there were five major players in the RISC industry (IBM, Hewlett-Packard, Motorola, Sun Microsystems, and Mips Computer Systems) and six in the PDA industry (Apple, Hewlett-Packard, AT&T, Sharp, Casio, and Amstrad). Details on data collection methods are in the Appendix.

Terminology and Units of Analysis

The term "alliance" is used here to cover a range of inter-firm agreements that are deeper than arm's length but fall short of merger. Whether they take the form of a joint venture, a joint R&D project, a marketing agreement, or some other form, therefore, alliances defined here as an organizational mechanism to govern an incomplete contract between two separate firms without giving either firm

complete control over decision making. (Gomes-Casseres, 1996; Contractor and Lorange, 1988; and Hart and Holmström, 1987).

For most of the discussion that follows, the units of analysis are "constellations" or groups of firms linked together through alliances, and which compete collectively against other groups and against single firms. These competing constellations of allies are conceived of as being sub-groups in a larger fabric of competition and collaboration in the industry (Nohria and Garcia-Pont, 1991; Hagedoorn and Schakenraad, 1992; Duysters and Hagedoorn, 1995). In many industries in which alliances have proliferated, these groups of allies have become the relevant competitors, not the single firms that compose them. Competition in these industries increasingly takes the form of group versus group, not firm versus firm (Gomes-Casseres, 1996; Silverman and Baum, 2002; Rowley et al, forthcoming).

In the group-based competition sketched here, traditional single firms and multi-firm constellations represent simply different ways of organizing and controlling a set of capabilities (cf. Richardson, 1972). The constellations gather capabilities from their members and control these collectively in a decentralized and loose fashion; single firms develop capabilities internally (or buy them outright from others) and then control them in a more unified and tight fashion. Alliances between member firms, in this view, are the glue that holds together the constellations and that allocate decision rights inside the group.

The forces that drive or limit alliance formation, therefore, depend on the dynamics of how constellations grow and behave. Much like firms, constellations encounter opportunities for expansion and limits to their growth (cf. Penrose, 1959/1995). But when constellations grow, they

do so by forming new alliances; when they have reached limits to their growth, they form fewer alliances or even dissolve some. In this sense, the discussion that follows constitutes a first step toward a theory of the growth of constellations.

The Dynamics of Alliance Waves

A wave of alliance formation in an industry can be divided into two phases, each of which might be influenced by a different set of forces. In the "expansionary" phase the rate of alliance formation in the industry is high and the stock of alliances rises. Unless every firm is limited to one alliance, the average size of the alliance portfolio of firms in the industry will also rise in this phase. In the "contractionary" phase the rate of alliance formation is lower than before; it may be zero or even negative (that is, alliances already formed are dissolved at a faster rate than new ones are formed). In this phase, the stock of alliances in the industry grows more slowly than before, or even declines; the average size of the alliance portfolios may do the same.

A comprehensive theory to explain alliance waves, therefore, must account for both the expansionary and contractionary phases. This does not mean that the same set of factors operates in both phases. Even so, a set of factors that explain the expansionary phases may also imply corollary, or mirror-image, explanations for the contractionary phase (Cf. Greve, 1995). Alternatively, a supplemental set of factors may be at work in the latter phase that has no precursor in the early phase of the wave.

I define as "drivers" of the alliance wave those factors that cause the rate of alliance formation to rise in the first phase; "limits" of the alliance wave are those factors that reduce the rate of formation

in the second phase. Based on existing schools of thought on organizational change, we can identify three possible broad drivers of the alliance wave: (1) exogenous changes in the environment; (2) institutional bandwagons; and (3) competitive bandwagons. These same schools of thought might also yield limits of the alliance wave, as just noted. In addition, we will consider a fourth, supplemental set of factors: organizational limits to growth. These drivers and limits are distinct from each other, but they are not mutually exclusive.

Responses to Exogenous Change

In theory, the simplest explanation of an alliance wave is that all or most of the firms in an industry react independently to an environmental change which they all face and which clearly favors the formation of alliances. Classic organizational fit theories would support such an argument (Thompson, 1967). Yet evidence that would neatly fit such a theory is hard to find. First, most firms in an industry do not face exactly the same environmental forces and certainly do not interpret these forces in identical ways. Second, there is usually more than one possible response to a given environmental change, causing firms to choose different strategies even when they face the same external changes. Third, the nature of an environmental change is seldom clear-cut from the start; more often, change evolves from competing trends that only become clarified in time. This is particularly true of discontinuous changes, that is, changes that do not grow gradually and predictably out of preceding conditions.

The process by which firms in an industry respond to discontinuous environmental changes, therefore, is almost always fraught with ambiguity of various sorts. Indeed most modern theories of

organizational change--including the bandwagon theories discussed below--begin by assuming ambiguity and uncertainty in the environment. Furthermore, the decision-making process itself is usually modeled on assumptions of bounded rationality and incomplete information. As a result, organizational change is driven by as process of experimentation to find a fitting response to the emerging environmental conditions. The classic statement of this approach is Nelson and Winter's (1982); a recent collection of papers along these lines is summarized in Ilinitch, D'Aveni, and Lewin (1996).

Alliances are attractive tools in such organizational experimentation; our definition above implies that alliances are open-ended and constantly in flux. This characteristic accounts for the notorious "instability" of alliances. As a result, the combinations formed by firms linked through alliances are also constantly changing and, in this sense, unstable. But paradoxically, this instability can be a source of strength, allowing firms to respond more rapidly to changes in their environment than single firms.

These arguments lend themselves readily to an explanation of the dynamics of alliance waves. In the expansionary phase of the wave, alliances can be seen as experimental, transitional forms that provide early information about new technologies and markets, and that represent options that the firm may choose to pursue further as environmental trends become clarified. In the contractionary phase, firms would cease using alliances for experimentation because the nature of the environmental change has been clarified and better long-term responses to the change have been found. (Alliances based on other motivations may remain, of course, but the rate of new alliance formation is likely to decline with the reduction in uncertainty.)

Notice that the fact that many firms will use alliances as a response to discontinuous environmental change does not violate the assumptions of ambiguity in the nature of the change and in the optimal strategic response. This ambiguity makes it unlikely that many firms will commit to the exact same strategic course of action. Alliances, in this view, are not a specific course of action but a mechanism that allows the firm to manage the ambiguity by keeping its options open. Thus, even if firms have different information about the environment and face different strategic options, they might still use alliances as intermediate steps in the strategy formulation process.

Two propositions follow from these arguments:

> *Proposition 1: The rate of alliance formation in an industry will rise following the emergence of a discontinuous environmental change, particularly when the nature and strategic implications of this change are uncertain.*
>
> *Proposition 2: The rate of alliance formation in an industry will fall when the uncertainties regarding an earlier environmental change are resolved.*

Institutional Bandwagons

The literature on institutional bandwagons suggests a second and different explanation for alliance waves. This school of thought holds that when faced with the ambiguities in strategy formulation described above, firms will tend to imitate each other for a variety of reasons. The driver in this model is "mimetic isomorphism," which may have a number of underlying causes (DiMaggio and Powell, 1983). While the initial impetus to an institutional bandwagon may well be a change in the environment, as in the preceding arguments, the mechanism that causes firms to react in unison to this change is different according to this theory. Furthermore, the mechanisms in the institutional bandwagon literature are different from those in the competitive bandwagons models discussed

below. This basic distinction between types of bandwagons draws on Abrahamson and Rosenkopf (1993, 1997).

The forces driving imitation in institutional bandwagon models are of three kinds. In bandwagon models based on learning, firms gather information by observing the behavior of others and imitating more successful behaviors. The uncertainty regarding the environmental change is thus resolved not through one own's experimentation but through the experimentation of others. The fact that an increasing number of firms adopt an innovation, therefore, suggests that the returns to the innovation are positive, and leads other firms to adopt the innovation too.

This learning bandwagon shares features with the experimentation model described above, except that the firms in the bandwagon learn by "vicarious experimentation" instead of direct experimentation (Gomes-Casseres and Leonard-Barton, 1997). The two propositions above are consistent with the learning bandwagon model, except that there is an added element: Firms are likely to follow each other in search of the best areas in which to experiment.

Theories of management "fashion" assume an altogether different mechanism driving imitation. In these models, firms imitate each other because of socio-psychological motives (Barley and Kunda, 1992; Abrahamson, 1996). Pure fad theories are an extreme example of such behavior (Abrahamson, 1991). Indeed, some in the business press have called alliances a fad--a temporary, aesthetic fashion without economic rationale (See for example, The Economist, 1990).

In more complex fashion models, imitation is driven by socio-psychological forces. The actions of leading firms in an industry and the views of "fashion setters" grant legitimacy to certain strategic responses, which then become more attractive to firms. Societal expectations and the collective

beliefs of managers are thus shaped by these opinion leaders as well by the sheer number of firms adopting a response. (Haverman, 1993; Abrahamson, 1996.)

While these theories may help explain alliance formation in the expansionary phase of a wave, their predictions about the limits to alliance formation are less clear. Any bandwagon process can end at a point of saturation, when all firms have adopted the strategy. This limit does not imply a reversal of the incentives for adoption and is not unique to institutional bandwagons. On the other hand, if the imitation process were a pure fad, the incentives for adoption will, by definition, be reversed. More complex socio-psychological theories would require a major shift in industry norms for the trend to reverse itself.

The propositions to come out of the institutional bandwagon models are the following:

Proposition 3: Firms will imitate the alliance strategies of leading firms in an industry.

Proposition 4: Alliance drivers and limits are shaped by industry and societal norms.

Competitive Bandwagons

In competitive bandwagon models, imitation is driven by immediate economic pressures: firms imitate not opinion leaders, but their direct rivals. These models derive from theories of the economics of industrial organization (Tirole, 1988), and have so far received less attention in the organizational literature than have the neo-institutional theories summarized above (but see Abrahamson and Rosenkopf, 1993; 1997). In some discussions of institutional bandwagons, broad macro-economic trends are given a role in sparking a basic demand for new management fashions (Barley and Kunda, 1992; Abrahamson, 1996). But firm-level economic pressures are not the driver of imitation in these discussions as they are in true competitive bandwagon models.

Three generic processes can drive competitive bandwagons. First, close rivals may imitate each other's strategies in an effort to gain parity and reduce the risk that any of them will either surge ahead or fall seriously behind the others (Abrahamson and Rosenkopf, 1990); Knickerbocker, 1973). Second, the bandwagon may be driven by the existence of network externalities that raise the returns to a strategy as it is adopted by more and more firms (Abrahamson and Rosenkopf, 1996; Katz and Shapiro, 1985). Third, firms may rush to adopt a new strategy (and may even try to pre-empt each other in doing so) out of a fear that their rivals may foreclose them from adopting the strategy at a future date (Caves, 1991; Scherer, 1980; Knickerbocker, 1973).

Each of these generic processes might be at work in the first phase of the alliance wave. In particular, alliances may help firms to: (1) match the capabilities of rival groups; (2) pursue first-mover advantages; and (3) pre-empt rivals in an effort to lock them out of new markets.

Matching capabilities. In oligopolistic imitation, firms follow each other's strategic moves to avoid falling behind. The reasoning in alliance formation is as follows. Assume that constellations A and B are rivals, and that A expands its group by adding members that bring new capabilities to the group. If B decides not to follow and A's new strategy generates advantages, then B falls behind. Of course, if A's strategy fails, B has a chance of moving ahead. But if B follows by expanding its own group, then the two rivals are likely to stay close competitors, regardless of how the strategy turns out. When competitors are averse to risk, they are likely to choose the follow-the-leader strategy, which lowers their chances of either moving ahead or--more important--falling behind their rivals. (cf. Nohria and Garcia-Pont, 1991).

Managers of firms are often assumed to be risk averse, because they may lose their jobs if they fail.

Managers in multi-firm constellations are probably no different. Indeed, because constellations involve mutual commitments among members, it may well be more difficult for them to get all members behind a risky strategy than to seek to conserve the conditions under which their alliances were formed. Constellations, in other words, may be strategically more conservative than firms, and so are even more likely than firms to imitate each other's moves. These considerations lead to the following prediction:

> *Proposition 5: When constellations are close rivals, they will tend to match each other's moves, including imitating each other's alliance strategies.*

The pursuit of first-mover advantages. The value of first-mover advantages in certain contexts is well documented. When an industry has high economies of scale, high customer switching costs, or steep experience curves, competitors can be expected to try to establish a dominant market share early.

In pursuit of such first-mover advantages, firms that insist on competing singly can invest in marketing campaigns or use penetration pricing. These strategies typically take time to yield fruit, particularly if the firm needs to win market share from established players. Constellations have an additional option--they can simply partners that can bring market share to the group. As a result, alliances can be used to shorten the time needed to establish a lead position. Or they can help latecomers rapidly erode the position of the lead firm. Alliances may thus quicken the race for first-mover advantages. This reasoning suggests the following proposition:

> *Proposition 6: The more important are first-mover advantages in a business, the more rapidly will alliances spread during the early stages of industry growth.*

Pre-emptive alliance strategies. In many strategic games, it may not matter much who moves first--a

follower may even be able to learn from the mistakes of a leader. But in alliance formation, there are often substantial advantages to pre-emptive strikes, because the set of opportunities for collaboration at any point in time is finite. The opportunities for collaboration are limited by the number of potential partners, which usually have varying capabilities. Pre-empting a rival in forming an alliance thus gives a firm the widest choice among partners and the greatest chance of ending up with the most attractive one.

Logically, the extent of this type of strategy depends on how much less attractive the second-most desirable partner is and on how many potential partners are left after the first alliance is formed. In fields with only a few attractive partners, we can expect more preemptive alliance formation than in fields where there are many potential partners of roughly equal capabilities. In addition, in the early stages of the spread of alliances through an industry, the incentives for preemptive moves may be less than in later stages, when the threat of partner scarcity looms larger. Paradoxically, this effect may accelerate the spread of alliances even as the choice of partners dries up.

More than imitation is at work here. A constellation may execute a pre-emptive alliance not because it is in a rush to match the existing capabilities of a rival, but because it wants to keep the rival from assembling that set of capabilities in the first place. Pre-emptive alliances, in other words, are intended to make it more costly or impossible for a rival to imitate one's moves.

A firm's incentive to form alliances preemptively is thus likely to depend on its expectations about its rivals' moves. The more likely it appears that a rival will form an alliance, the greater the incentive to preempt. This tendency, too, can accelerate the spread of alliances: the formation of alliances breeds the expectation of further alliances, which leads to preemptive alliances by firms

that would otherwise remain single. This yields the following expectation:

> *Proposition 7: When alliances promise substantial advantages to a set of close rivals AND attractive partners are scarce, the rivals are likely to try to preempt each other from forming partnerships.*

Limits to the competitive bandwagon. As in the drivers discussed earlier, competitive bandwagons, too, imply eventual limits to alliance formation. The contractionary phase of the alliance wave may arise out of an “overcrowding” of the field. The simplest case of this type of constraint occurs when the pool of eligible partners diminishes because of the boom in alliance formation itself. Or, the still-available partners threaten to increase conflicts of interest among group members if they were to join the group. I call this form of saturation in the industry "strategic gridlock" because it tends to limit the strategic flexibility that alliances typically offer a firm.

Paradoxically, the environments most conducive to alliance formation are also those where strategic gridlock is most likely to be encountered. First, non-arm’s length transactions between firms are most likely to occur when there are few possible suppliers and buyers (Williamson, 1975). Second, the logic of building an effective alliance group often requires including members that bring to the group specific capabilities that are not readily or widely available. Consequently, as different firms build competing groups, the partners with desirable capabilities gradually become unavailable. These two conditions, therefore, both increase the incentive for alliance formation and limit the pool of attractive partners. This reasoning can be stated as follows:

> *Proposition 8: The formation of alliances in an industry will slow with the decrease in the number of non-allied firms.*

Organizational Limits to Growth

The three basic drivers of alliance formation described above--exogenous change, institutional bandwagons, and competitive bandwagons--each implied limits to the alliance wave that were external to firms and constellations. In addition, the growth of constellations can be limited by internal organizational factors that reduce the net benefits of adding new members.

In the early stages of a group's growth, the addition of members tends to support specialization and division of labor (Smith, 1776; Stigler, 1951; Rosenberg, 1994). But as the size of a group increases, the added benefit of a new member diminishes because of increased duplication. At the same time, new costs and risks arise with growth because greater organizational effort will be needed to deal with rising internal conflicts.

A scarcity of management capacity is frequently emphasized by practitioners as a constraint on alliance formation. Negotiating each agreement requires great effort, and major alliances require the continual, direct, and personal involvement of top management. These demands on management increase with the size of the group and the complexity of member interactions. Edith Penrose (1959; 1995) argued many years ago that demands on management limit the size and complexity of a single firm. In her view, the finite size and capabilities of the top management team limit the amount of new activity a firm can take on. These limits to growth also apply to an alliance group, and are perhaps accentuated by the personal bases of many interfirm partnerships (Kanter, 1994).

Furthermore, a large number of players makes cooperation more difficult, due to higher levels of conflict within the group (Oye, 1986). The earliest studies of international joint ventures found that conflicts of interest between multinationals and local partners increased the costs of using joint ventures (Stopford and Wells, 1972; Franko, 1971). Similar conflicts of interest can arise whenever

an alliance is part of a group of operations of one of the partners, but represents a self-contained venture for the other partner. Conflicts may also arise when one of the partners has another alliance--that is, with a third firm--that influences the goals of the first alliance. Whatever the root causes, such conflicts of interest will add to the coordination costs of the group.

These arguments lead to the following proposition:

> *Proposition 9: Coordination costs among firms in a constellation increase with a group's size, thus reducing the effectiveness of the group and limiting further expansion.*

Alliance Fads in the Computer Industry

Given the newness of our topic, this paper aims to develop arguments and hypotheses, not to test them rigorously against data. The ideas were developed from field-based research in the computer industry, in particular in the fields of reduced instruction-set computing (RISC) and personal digital assistants (PDAs). The arguments in this paper will be evaluated against examples from these two cases. (See Appendix for data collection methods.) The reader does not need to know the technical details of these industries, except for the following simplified facts and patterns.

Reduced Instruction-set Computing

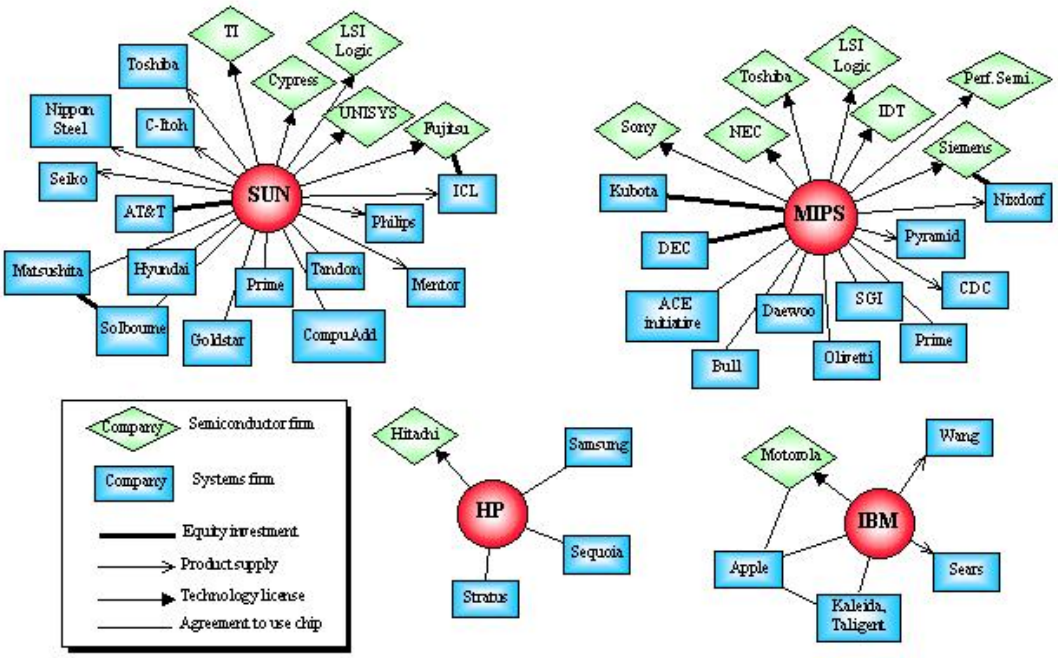
RISC technology appeared on the market in the early 1980s as an alternative to existing microcomputer technologies and promised more powerful and cheaper computers. But, regardless of the promises of greater performance, the shift to RISC was anything but smooth. RISC computers required a new style of microprocessor chip, new software, and new systems. For the most part, the new architectural and software standards based on RISC were incompatible with the older

technologies popularized by IBM, Apple, Intel, and Microsoft, and thousands of smaller hardware and software firms.

Almost from the start, alliances and constellations were important in the RISC industry. They helped the lead firms penetrate markets, spread their technology, and promote their standard worldwide. Sun and Mips, in particular, developed large constellations, each composed of ten to twenty important allies and over a hundred partners connected more loosely to the lead firms. IBM and HP had smaller constellations; but they too competed using multiple partners. Motorola had its own constellation early in the battle, but later dissolved it and joined with IBM. Digital did the reverse--it started as a Mips ally and then broke off to form its own group. Further details about this industry and its technology can be found in Gomes-Casseres (1996).

The spread of alliances in RISC. After Mips introduced the first commercial RISC chip in 1985, HP and Sun followed quickly, because the new technology promised to increase the power of workstations. Sun already had a large constellation of allies, which for the most part stayed with Sun as the company made the transition to RISC. Rivalry among Mips, IBM, and HP thus led them to pursue similar strategies--in this case, to form similar types of alliance groups. Because of this pattern, the composition of the constellations in terms of the mix and sizes of members were closely matched. The pace and character of alliance formation in this industry, therefore, seemed to be driven in part by imitation among competitors. The competing constellations in this field in 1992 are shown in Figure 2.

Figure 2: RISC Constellations, 1992



Early on Mips had recognized that Sun's advantage in engineering and technical applications was difficult to surmount. Mips thus emphasized workstations for commercial applications, a field in which Sun was not very active. At the time, personal computers built with traditional Intel or Motorola chips were used in commercial applications. Over time, therefore, the Mips strategy became one of introducing RISC to the personal computer market.

The Mips constellation expanded rapidly in 1991-1992, driven by the pursuit of first-mover advantages in RISC personal computers. Together with 18 partners, Mips launched the Advanced Computing Environment (ACE) initiative in 1991. This initiative brought together PC giants like Compaq and Microsoft and aimed to develop a common RISC architecture that could challenge

Intel. The ACE constellation exploded in size, reaching over 200 by early 1992; for the first time, adherents of Mips substantially outnumbered those of Sun.

After the rise of ACE, other RISC constellations, too, became more aggressive in acquiring new members. Sun already had a large constellation, and did not change its behavior to match that of Mips. But IBM and HP did; both expanded their use of alliances in 1991-1992, just when ACE was growing rapidly. HP and IBM also established new organizations to govern their RISC constellations at about this time. And both began to target the personal computer industry, as ACE was doing.

IBM had earlier tried and failed to promote its RISC architecture without the aid of any allies. In 1990 it surprised the industry by forming the PowerPC constellation, with Apple and Motorola as core partners. Multiple motivations lay behind these alliances; the threat of ACE's growth was one. Apple, for one, went in search of a RISC partner to match the moves of its PC rivals in ACE. It conducted an extensive evaluation of all the RISC technologies available, and settled on IBM's. Partly because Motorola had been a close Apple ally for years, it too joined the new group.

The IBM group then grew to become the successor of ACE in challenging Intel. The PowerPC constellation grew rapidly, in part by attracting members that broke off from other constellations. Bull and Wang, for example, were among the first to leave ACE and join IBM. Olivetti, which had left ACE for DEC's Alpha, switched to IBM's group in 1994.

Limits to alliance formation in RISC. The growth of an alliance group was nowhere as rapid as in the case of Mips. In this group, as a result, organizational limits arose early and with a vengeance, leading ultimately to the fall of ACE. First, Mips could not attract certain partners that were already

tied to other competitors. Second, Mips managers were burdened by the management time and effort required to manage their large and complex group. Third, the costs of rationalizing the group increased with growth, in part because of the different goals of the partners.

In theory, collective governance structures of alliance groups can alleviate the management burden on individual companies, and to some extent they did so in the RISC industry. The 88Open organization, for example, took over many of the RISC group governance tasks that otherwise might have fallen on Motorola. The Precision RISC Organization did the same for HP, as did the PowerOpen Association for IBM, and SPARC International for Sun.

But Mips faced an insidious version of this problem and was not able to manage it successfully. This small company at the center of a huge constellation was pulled in different directions by its many partners. One of the strengths of the Mips group was the diversity of its membership; together these firms helped Mips penetrate markets as varied as personal computers, graphics workstations, and fault-tolerant computers. But this diversity also led to conflicting demands on the Mips chip designers, and helped delay completion of a key chip. That delay contributed to the collapse of ACE.

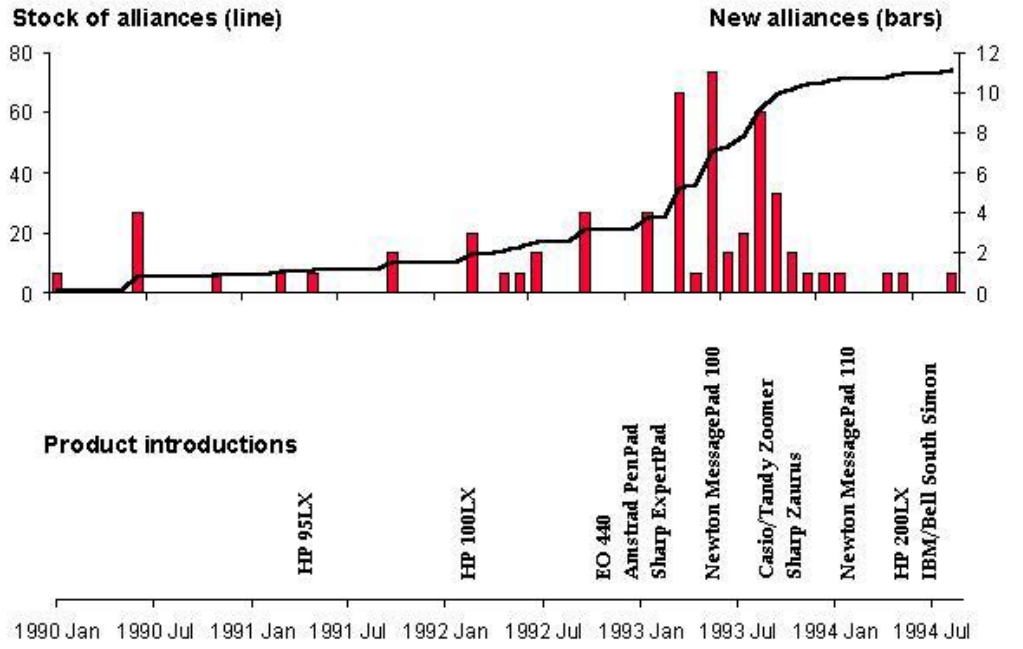
Personal Digital Assistants

PDAs burst onto the market in the early 1990s. These hand-held electronic gadgets were one of the first installments in the emerging business for multimedia products. They were intended to be part cellular phone, part notebook computer, part electronic calendar, part information organizer, and part computer game.

The product concept was not the only thing that was novel--so was the new industry’s structure.

From the start, the business of developing, making, and selling PDAs was conducted through a thick web of alliances. Constellations did not grow gradually as they did in RISC; instead, they arrived full-blown with the first PDAs. As a result, the organization and dynamics of the industry revolved around the patterns of alliance formation and the competitive behavior of constellations. The early history of the industry and details of its products are in Gomes-Casseres and Leonard-Barton (1997). The aggregate pattern of alliance formation in PDAs exhibits a classic cycle of rapid expansion followed by stabilization, as shown in Figure 3. Though we have no comprehensive data for the years following 1994, we do know that several of the alliances were dissolved, suggesting that the aggregate stock of alliances might well have declined.

Figure 3: Alliances and Product Introductions in PDAs, 1990-1994



Alliance Drivers and Limits in Computers

The history of alliance formation in the RISC and PDA industries can be used to evaluate the role of the various drivers and limits identified in the first section of this paper. Of course, the narrow scope of the evidence makes any conclusions tentative and generalizations hazardous. Even so, the data will help illustrate how the theoretical constructs apply and enable a preliminary judgement about the likely dynamics of alliance waves in the computer industry. My interpretation of the consistency between the nine propositions and the case evidence is shown in Table 1.

Table 1

Theoretical Perspectives and Propositions	**Consistency with case evidence**	
	in RISC	**in PDAs**
Responses to Exogenous Change		
1. Alliances are experiments in response to uncertainty	Some	Yes
2. Resolution of uncertainty limits alliance formation	No	Some
Insitutional Bandwagons		
3. Firms imitate industry leaders	No	Some
4. Alliance wave shaped by industry and societal norms	Some	Some
Competitive Bandwagons		
5. Rivals seek to match each other's capabilities	Yes	Some
6. Pursuit of first mover advantages drives alliances	Yes	Yes
7. Partner scarcity leads to pre-emptive alliances	Some	Some
8. Strategic gridlock limits alliance formation	Yes	Yes
Organizational Limits to Growth		
9. Governance costs limit the growth of constellations	Yes	Some

The first section of this paper outlined four distinct sets of arguments that were possibly useful in

understanding the dynamics of alliance waves: (1) organizational responses to exogenous change; (2) institutional bandwagons; (3) competitive bandwagons; and (4) organizational limits to growth. Table 1 suggests that each of these schools of thought is in some way consistent with the case evidence; but the competitive bandwagon arguments receive the most support, and the institutional bandwagon arguments, the least. To justify this conclusion, we need to examine each of the cells in the table. We shall discuss the four sets of arguments in succession.

Responses to Exogenous Change

Alliance formation in both industries appears to be a response to uncertainty in the environment, but in the PDA much more so than in the RISC industry. In PDAs, there was great uncertainty regarding all aspects of the business, including customer demand and product and process technologies. This uncertainty was a function of the immaturity of the field, but also of the fact that the product was to represent a merging of capabilities from different existing industries. Uncertainty and convergence compounded each other, so that, although would-be PDA producers knew that they had to combine technology and components from different industries, they did not know the precise "mix" of ingredients needed for a successful product. As a consequence, they used alliances to experiment with different mixes.

RISC technology, on the other hand, was not wholly new, but was intended to replace existing product technologies in a relatively well-established business. In fact, the technological advance behind RISC was made in the 1970s by IBM, which decided not to commercialize the technology for fear of cannibalizing its existing product lines. Even Mips, which had revolutionized the industry

by issuing the first commercial RISC chip, sought to capture markets from established leaders (Sun, HP, and later Intel) and designed its chip in such a way that it could be manufactured by well-known semiconductor processes. Still, RISC vendors faced uncertainties regarding the best strategies to convince customers to switch to their technology. In this sense, different constellations did experiment with alternative strategies.

The decline of alliance formation in RISC was probably not driven by the resolution of uncertainty as much as by other factors discussed below. Some uncertainty regarding customer switching costs had been resolved (they proved to be high), but this led to a different wave of alliances, such as between Intel and HP, and between DEC and Microsoft. The purpose of these alliances was to help established companies make a smoother transition from the old technologies to the new.

In the PDA field, the hectic experimentation with widely different product designs also led to resolution of some of the uncertainties. This in turn led to the dissolution of several alliance groups (e.g., those of AT&T, Motorola, and IBM). Furthermore, some companies issued new products based on in-house capabilities, as might be predicted by a model that sees alliances purely as information-gathering mechanisms (e.g. Sharp, U.S. Robotics). At the same time, the resolution of uncertainty led new companies to enter the field--companies that learned through "vicarious experimentation" on the sidelines. Some of these new entrants used alliances to design, make, and sell their products (e.g. Microsoft and Philips).

Institutional Bandwagons

The RISC and PDA evidence is only weakly consistent with the propositions based on the

institutional bandwagons model. The most serious difference between the patterns in the data and the predictions of the theory is that the model predicts that leading firms with high social status are the "fashion-setters" in an industry. In RISC and PDAs, as in most other industries, the leading firms in the industry were in fact the *last*, not the first, to form alliances.

The wave of alliance formation in RISC began with Mips--a start-up venture with no commercial standing at all. Mips's early partners were big, but were not yet important players in RISC; many were mini-computer firms that were losing market share to stronger workstation vendors (Prime, DEC, Siemens, Nixdorf). The leading firms in the industry were IBM, Intel, and HP. These firms followed, rather than led, the alliance wave; on the whole, they preferred to go it alone.

As a general matter, dominant firms in an industry are usually least likely to use alliances (Gomes-Casseres, 1996). Alliances are much more typical among second-tier firms aiming to catch up with leaders, or second-movers struggling to overcome the advantages of first-movers. These firms, therefore, indeed seek to emulate leaders as the institutional bandwagon model predicts. But the organizational choices they made are different from those made by the leaders, because of the different competitive constraints that they faced. Alliances are a means, not an end; institutional forces here may help explain copying behavior in terms of ends, not means.

The role of institutional forces was probably stronger in PDAs. These products were widely seen as technically advanced, creative, and worthy of wide publicity; RISC, on the other hand, was an esoteric technology of interest only to technical buyers. So, even the leaders in the computer industry wanted to lay claim to the new territory. An ideal way to do that was to declare an alliance with another leading firm in a complementary field. The alliance between IBM and BellSouth is an

example of this pattern. But, again, the pressure driving the bandwagon was the need to introduce a product, not the alliance form itself.

Competitive Bandwagons

The most important pressures driving firms to form alliances in RISC and PDAs appear to have been economic, not institutional. With the exception of the propositions regarding pre-emptive alliances, all the predictions of this model were supported by the data.

Matching behavior. In both RISC and PDAs, rival constellations sought to match each other's capabilities. Success in RISC was thought to depend on a constellation's ability to excel in three parts of the value-chain: (1) the design and production of the microprocessor; (2) the design, manufacture, and sale of the computer system; and (3) the design and production of software. Every RISC constellation eventually had members in each of these fields, and each constellation added members to strengthen its position compared to the others in each field.

The pressure to match the capabilities of rivals was weaker in PDAs, in part because of the uncertainties regarding the key success factors in that industry. Some constellations chose to develop PDAs that looked more like hand-held computers, others developed PDAs that looked like advanced cellular phones, and still others thought of their PDA as a fancy calendar. Depending on their aim, therefore, the constellations assembled a slightly different mix of members. Even so, because PDAs represented the convergence of at least four industries (computer hardware, computer software, telecommunications, and consumer electronics) most constellations had representatives from each of these fields.

First-mover advantages. The pressure to form alliances in pursuit of first-mover advantages was strong in both PDAs and RISC and led to a competitive bandwagon. Experience, scale, standards, and scope are all important competitive factors in the computer industry, and have traditionally led to advantages for firms that were able to reach a critical mass before their rivals (Yoffie, 1997). Based on this experience, most of the PDA players thought that the timing of the introduction of their product to the market was critical. An early introduction, they believed, would boost their recognition and image; more important, it might help them set technical standards that would sustain their market position as the industry matured. Conversely, a latecomer was likely to have to follow design standards set by the first-movers, and might even have to pay royalties for technologies that had become widespread. Many PDA firms saw alliances as a way to get a product to market quickly. Similarly, RISC firms thought that the key to success lay in making their technology a standard in the industry; Mips's explicit goal was to make its technology "pervasive worldwide." This meant that they had to penetrate new markets quickly and decisively, so as to create barriers to entry to latecomers. This logic drove the Mips constellation to expand rapidly.

Pre-emptive alliances. As a general matter, evidence regarding pre-emptive alliances is usually weak, perhaps because it is not often reported in the public record. But pre-emptive alliance did occur in RISC and related fields. Motorola effectively blocked a 1989 licensing arrangement between Mips and Toshiba by intervening to delay conclusion of the contract even after a letter of intent had been signed. Motorola, which had an ongoing joint venture with Toshiba, claimed that it needed help in commercializing its own RISC chip. As it turned out, Motorola and Toshiba never worked together on that chip, but Toshiba had been pre-empted from joining Mips. As soon as the

Toshiba-Mips deal had stalled, NEC jumped at the chance to form an alliance with Mips. Toshiba finally joined the Mips group in 1991.

In PDAs, the fear of being locked out led to a slightly different type of behavior. Because of the uncertainty regarding standards and features, many firms sought to hedge their bets by forming alliances with multiple vendors or that supported multiple technical standards. Their aim was not so much to lock out others, but to avoid being locked out themselves. Sharp, for example, licensed the Newton PDA from Apple, developed another one with Geoworks, and yet a third one using its own in-house technology.

Strategic gridlock. The race to build alliance groups in RISC eventually led to the reduction of available partners, and limited the growth of the constellations. For example, in its efforts to sign up a major Japanese semiconductor partner, Mips found its options limited because of the alliances that Sun and Motorola had with, respectively, Fujitsu and Toshiba. One firm's alliance strategy thus limited the options available to a competitor. HP's options were even more limited than were those of Mips, as it followed Sun and Mips in building a RISC group; still, Hitachi was available. By the time DEC began to look for partners for its Alpha chip, it could only find Mitsubishi, a second-tier semiconductor producer. IBM's early efforts at finding a Japanese partner faced the same fate; only late in 1994 did Toshiba and Hitachi sign up as major allies in the IBM group, and even then, they continued to hedge their bets by maintaining their existing alliances with Mips and HP, respectively. The alliance wave in PDAs came to a halt in part because of similar constraints. By 1994, all the major players were tied up in PDA projects; those that were not, seemed to have made conscious decisions to stay on the sidelines. And, even before that aggregate limit was reached, a version of

strategic gridlock constrained the growth of some constellations. Lotus, for example, had developed one of the most successful early PDAs in cooperation with HP, and wanted to form new alliances to proliferate the standard. HP disagreed and wanted to keep the PDA proprietary; this constellation never grew beyond the its initial size and eventually was dissolved.

Organizational Limits to Growth

Aside from such external constraints, the growth of the constellations studied was also limited by rising organizational costs and conflicts, particularly in the case of RISC.

Mips faced an insidious version of this governance problem when it was pulled in different directions by its many partners. One of the strengths of the Mips group was the diversity and size of its membership; together these firms helped Mips penetrate markets as varied as personal computers, graphics workstations, and fault-tolerant computers. But this diversity also led to conflicting demands on the Mips engineers, and contributed to delayed completion of a new microprocessor. That delay in turn led the collapse of ACE.

Mips also lost control over its destiny as its alliance network grew. Mips began by building its constellation carefully, and initially had great success with this strategy. As its partners came to include giants such as Compaq, Microsoft, DEC, NEC, and Siemens, however, it became unclear who was in control. Particularly after ACE was formed, the strategy seemed to be spinning out of control. From then on, Mips's future depended on ACE, and ACE, in turn, depended on collaboration among a handful of big players. In the end, a series of defections by Compaq, DEC, and others doomed both ACE and Mips.

Organizational limits to the growth of constellations are not absolute limits, but are amenable to being managed. In the RISC field, the collective governance structures of some alliance groups served to alleviate the management burden on individual companies. The 88Open organization, for example, took over many of the group governance tasks that otherwise might have fallen on Motorola. The Precision RISC Organization did the same for HP, as did the PowerOpen Association for IBM, and SPARC International for Sun. Mips did not create such a governance structure for ACE, a fact which may have contributed to the failure of the initiative.

Conclusions

The evidence considered suggests that alliance waves can be driven and limited by a multiplicity of forces. Some pressures for alliance formation stem from the fundamental commercial tasks at hand, others arise out of competitive jockeying among rivals, and still others may be reflections of fashion-like trends. On the whole, we found ample evidence for rational drivers: the "fad" has a definite "logic." Furthermore, we found more evidence that this logic is rooted in economic processes, than in social-psychological factors. The limits to alliance formation which cause an alliance wave to crest can also be found in economic processes. Again, declines in the formation of new alliances in our data do not seem driven by the passing of a fashion; instead, they stem from economic and organizational constraints to growth.

Does this mean that we will see fewer and fewer alliances in the future? I think not. The overall "popularity" of alliances need not fade in the aggregate, even if different waves of alliances crest in one segment or the other. The phenomenon of inter-firm collaboration, in other words, appears here

to stay, even if alliance usage rises and falls in any one business.

This paper has already suggested several avenues for further research. Each of the eight propositions presented can be developed into specific hypotheses and tested with data. Furthermore, the arguments in this paper, taken as a whole, emphasize three features of alliances that have received insufficient attention in the recent literature.

The first of these features is their role in the wider strategic interaction among rivals. This paper explained how important such interaction can be to the formation and spread of alliances. Because of the roles of alliances in strategic positioning, the explanation for any given alliance may not lie solely in its narrowly defined costs and benefits, and the evolution of an alliance may not be predictable from its internal processes. Managerially, too, the function of every alliance must be seen as part of a broader business strategy. Kogut (1988) was among the first to recognize the strategic motivations for joint ventures, and contrasted this with the transaction-cost and learning motivations. The recent literature has focused heavily on the transaction-cost issues and on learning. It is now time for a deeper evaluation of how strategic interaction affects the use of alliances.

The second feature of alliances that deserves attention is an old-but-forgotten one: their risks and costs. In the 1960s, leading American firms like IBM and GM shunned alliances, citing the risks of loss of control and of conflicts of interest with partners. By the 1980s, these same firms have become vocal advocates of alliances. Academic research has reflected this turnabout. Early studies (e.g. Franko, 1971) analyzed in detail the costs of joint ventures; much of the current research tends to downplay costs and risks and overemphasize the benefits of alliances. At the same time, managers are often frustrated by the difficulty of managing alliances and using them effectively. This paper

has shown that the costs of alliances can lead to decline in alliance usage in specific fields. Future research should aim to strike a better balance between the advantages and disadvantages of inter-firm collaboration (e.g., see Suen, forthcoming).

The third feature of alliances that deserves deeper research is their influence on an industry's structure. I have argued that constellations of allied firms represent new units of competition and that the rivalry among them differs from the rivalry among traditional single firms. If so, future research on alliances needs to step back from the trees to see this forest. How do alliances change competitive rivalry in an industry? When are they anti-competitive? Do multi-firm constellations manage capabilities differently than do unified firms? Which has an advantage, when? What are the competitive advantages of groups and of firms competing as part of a group? Questions such as these cannot be answered by studying alliances per se. The proliferation of alliances means that collaboration is now part of the very fabric of competition in modern industry. We need to rethink how alliances affect rivalry and the reverse.

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APPENDIX
DATA COLLECTION METHODS

The RISC data in this paper were collected in three phases. In the first phase, I surveyed press reports using the Predicast PTS PROMT on-line database, searching for articles within the computers and auxiliary equipment (3573) industry classification using twelve key words: alliance, acquisition, collaboration, consortium, cooperative, equity investment, joint development, joint production, joint R&D, joint venture, licensing, and sourcing. This phase of the survey covered the period up to 1990.

The second phase of the survey updated the database through the end of 1992. For that, I used a commercial database developed by Itsunami, a California firm that monitors alliances in the information technology industries. Simple statistics confirmed that the profile of the alliances selected in this second phase corresponded closely to that of those selected in the first.

The third phase of data collection involved field interviews at the major RISC companies. My aim here was to confirm the accuracy of the survey data, to add alliances that were not reported in the press, and, most importantly, to gain insight into the characteristics and motivations for the alliances in the database. At this stage, I also delved deeply into the industry literature and newsletters (e.g. Microprocessor Report and Inside the Computer Industry) to learn about the key drivers of competition and alliance formation in this field. All in all, I interviewed 30 executives at five companies over a period of 3 years, several of them more than once.

The PDA data were collected by myself and Dorothy Leonard-Barton. We followed a similar method as just described. This database yielded 74 alliances, formed between 1989 and 1994.