Complexity, Competitive Intelligence and the "First Mover" Advantage

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1.1 Models of Firm Behavior

In the following paper we explore some of the ways in which competitive intelligence and game theory can be employed to assist firms in deciding whether or not to undertake international market diversification and whether or not there is an advantage to being a market leader or a market follower overseas. In attempting to answer these questions, we take a somewhat unconventional approach. First, we're going to look at what some of the most recent advances in the physical and biological sciences can contribute to the ways in which we understand how firms behave – how they grow, change, adapt and plan for the future. Much of this material will draw on chaos theory (nonlinear dynamical systems modeling), complexity science, evolutionary biology and statistical mechanics, subjects not usually thought of as central to the study of international business.

Then, we will propose a formal methodology for competitive intelligence. Indeed, not just a formal mechanism but a formal meta-framework as well. Following our discussion of this formal mechanism for dealing with competitive intelligence we will turn to a paper by Paul Hofer which sheds new light on how to interpret game theoretic models of first and second mover advantage.

There are several reasons for taking this approach. The first is that we hope to draw upon some problem solving tools which will let us approach various aspects of firm internationalization which may be opaque or difficult to handle using conventional methodologies. Second, because we are looking at firm decision making, particularly decision making which may involve anticipating the behavior of one's rivals under conditions of substantial uncertainty, we need to employ some tools which will let us model our rivals' behavior, particularly when that behavior is either not very well understood or is ill-defined (Arthur, 1994b) and takes place in an environment where differences across firms and industries may be substantial (i.e., assumptions of similarity or homogeneity may be unlikely to hold true). Finally, insofar as competitive intelligence has generally remained outside the scope of formal academic analysis, and the game-theoretic approach which we employ is more nearly congenial to emerging quantitative models of firm internationalization (McKelvey, 1999; Joliet and Hubner, 2002; Ruigrok and Wagner,) it is simply more convenient than not, to employ this kind of quantitative approach rather than the more familiar, qualitative approach to globalization and international market entry (Porter, 1979, 1990, Slater and Olson, 2002; Gupta and Govindarajan, 1991; Dunning 1981, 1993; Cavusgil, 1993; Yeniyurt, Townsend and Cavusgil, 2003).

This is not to say that the vast majority of previous studies on firm internationalization have not aimed at analytic rigor or have not carefully employed a variety of quantitative measures (generally drawn from inferential or descriptive statistics) in order to formulate their arguments. However, these studies have typically been fundamentally empirical in their nature and approach. That is, they collect various data sets from firms and industries operating in the multinational environment and seek to correlate various behaviors exhibited by these firms. From a strategic perspective, such studies provide little guidance or insight for the decision maker who must anticipate and outmaneuver the firm's rivals and who must undertake a decision to enter or avoid a foreign market in order to secure a competitive advantage with respect to those rivals.

In addition, this approach is, itself, not unproblematic. Caldart and Ricart (2003) note, following Marikides and Williamson, that "There is still considerable disagreement around some key and longstanding research questions such as whether diversification can be used to build long-run competitive advantage and, if it is the case, how and when." Nor is this the only area of contention. A recent study by Joliet and Hubner (2003) argues that much of the literature using return on equity as a measure of the success of international diversification is in error due to an inaccurate specification of the internationalization index and an improper aggregation of industries with different entry barrier and product differentiation levels. While their incorporation of psychic distance into the market metric represents a significant positive step in the direction of improving measures of systematic risk in international investments, this approach to internationalization decisions remains far from complete. Moreover, at least from a modeling perspective which seeks to explain firm behavior under a diverse array of circumstances, one of the most problematic aspect s of the purely empirical approach is an over-reliance on homogeneity among multinational firms and within global industries. Industry homogeneity may act as a normalizing operator across country differences (Grinold, Rudd and Stefek, 1989), and actor homogeneity may vastly simplify the problem of analyzing firm decisions, but these same assumptions may then render the model unrealistic at best and uninformative at worst (Barney, 1991). At the very least, the purely empirical approach is likely to present a complex, conflicting set of imperatives for the decision maker considering international diversification.

1.2 Agent-Based Modeling: Mapping the Decision-maker

Agent-based modeling, particularly in the context of dynamic fitness landscape models, offers an alternative framework for analyzing corporate strategy decisions, particularly in the context of firm internationalization and new market entry. While we agree with Caldart and Ricard (2004) that corporate strategy is not yet a mature discipline, it is not our intention to claim that agent-based modeling is either a complete discipline or that it can solve all of the problems of corporate strategy. However, agent-based modeling can help solve a number of problems which pure empirical research, or research which depends upon homogeneity assumptions cannot readily solve. Working with "local rules of behavior" (Waldrop, 1992; Berry, Kiel and Elliot 2002; Bonabeau (a) 2002; Bonabeau (b) 2002; Farmer, 2001) agent based modeling adopts a "bottom up" approach, treating each individual decision maker as an autonomous unit. It is a methodology sharing features with Nelson and Winter's evolutionary economics insofar as it depends on computational power to model multiple iteration interactions of the model and as Edward Lorenz demonstrated as far back as 1963 (Gleick, 1988) even simple "couplings" between agents can give rise to very complex phenomena.

Agent-based modeling also gets around excessive assumptions of homogeneity because it allows each agent to behave according to its own rules. Perhaps more importantly, agent preferences can evolve and agent-based systems are capable of learning, Agent based modeling is also useful for capturing emergent phenomena as well as for recognizing phenomena which appear random at the local level, but which produce recognizable patterns at a more global level (Bonabeau (a) 2002).

In its simplest form, an agent-based model consists of the various agents or actors and their relationships to one another. Agent-based models are microscopic, then, rather than macroscopic and agent preferences are programmed at this microscopic level. This allows for a very broad range of simulation, including market or strategic situations where agents possess little or no information or behave in a random or unintelligent fashion (Farmer, Patelli and Zovko, 2005). At the heart of this type of model is the fundamental fact that in many complex phenomena it is easier to accurately describe the behavior of individual actors than to attempt to characterize the aggregate behavior of the entire system. Bonabeau cites as an example the fact that "it is more natural to describe how shoppers move in a supermarket than to come up with the equations that govern the dynamics of the density of shoppers. Because the density equations result from the behavior of shoppers, the ABM approach will also enable the user to study aggregate properties. ABM also makes it possible to realize the full potential of the data a company may have about its customers: panel data and customer surveys provide information about what real people actually do. Knowing the actual shopping basket of a customer makes it possible to create a virtual agent with that shopping basket rather than a density of people with a synthetic shopping basket computed from averaging over shopping data." (Bonabeau, 2002b)

While the foregoing may seem relatively obvious, Bonabeau the physicist is also reminding us of Brian Arthur's point (echoed by Barney and others) that random perturbations and network externalities cannot be "averaged out" across the system (a fundamental weakness of regression analysis when network effects are present) because they will create positive feedbacks and path-dependent lock-in over multiple unstable equilibria. As we have discussed elsewhere, Epstein and Hammond also provide a simple agent-based case in "Non-explanatory equilibria" which illustrates the dangers of assuming that an equilibrium point is necessarily a solution to a problem (Epstein and Hammond, 2003). Perhaps more to the point for the current analysis, agent-based modeling also provides a framework where we can model the behavior of the individual decision maker and where game theoretic models take on particular significance as descriptors or rule driven behavior rather than as mere analogies for various behavioral patterns (Snidal et al, 2003). When we look at Nash Equilibrium strategies, optimal strategies for second mover advantage and the use of disinformation in competitive intelligence, this point will take on particular significance.

For those interested in the more technical details of agent-based modeling, Bonabeau's National Academy of Sciences presentation as well as a number of working papers from the Santa Fe Institute will illuminate the specific mechanics of the process. Another rich set of examples on the use of agent-based models can be found in J. Doyne Farmer's work on economics and finance at the Santa Fe Institute. Writing in *Developments in Quantitative Investment Models* in 2001, Farmer began his exposition with the sentence "As far as I know, no-one currently uses agent-based models for investment." One has to bear in mind that this is Farmer speaking not as a physicist, nor as the McKinsey Professor at the Santa Fe Institute (although that title certainly appears on the opening page of the article) but as a finance practitioner and officer of Prediction Company. In fact, Farmer, Arthur, Martin Shubik and others had already been using agent-based models to simulate stock market behavior for a number of years. What is more interesting, however, is that less than two years later, Farmer and colleagues Lazlo Gillemot, Giulia Iori, Shareen Joshi, Supriya Krishnamurthy, Fabrizio Lillo, Eric Smith and Ilija Zovko had used a combination of statistical mechanics and agent-based modeling first to solve clustered volatility in futures markets (using some 16 million trades on the London Futures Exchange as data points) and then in stock markets more generally (Farmer 2002; Farmer and Joshi, 2002; Smith, Farmer, Gillemot and Krishnamurthy, 2003; Lillo, Farmer and Mantegna, 2003; Iori, Daniels, Farmer, Gillemot, Krishnamurthy and Smith, 2003; Daniels, Farmer, Gillemot, Iori and Smith, 2003; Lillo and Farmer, 2004).

1.3 Adaptive Landscapes – Modeling the Firm and Its Environment

As we noted earlier (Joliet and Hubner, 2003) industry and firm specific factors have recently come to be seen as playing increasingly important roles in the performance of international market entrants. Comparing earlier regression studies which found country specific factors to be a greater determinant of risk than industry specific factors (Lessard, 1974, 1976; Skolnik, 1974), Cavaglia, Brightman and Aked developed a factor model to compare country vs. industry effects on securities returns in a more contemporary setting and obtained a conclusion which was quite different. While the conclusion is, to some degree, industry specific (particularly with respect to the IT industry), they found that in many cases, industry specific factors were a more important determinant of extraordinary returns and investor exposure than country factors (Cavaglia et al, 2000).

As indicated previously, regression analysis may not be the best research tool when dealing with heterogeneous actors, or for settings in which industry or firm specific factors play a dominant role. Where then can we look for a set of tools which might, perhaps, be better suited to the analysis of problems possessing these characteristics? One answer is given by Caldart and Ricart in "Corporate Strategy Revisited: A View from Complexity Theory". In characterizing "corporate strategy at a crossroads), Caldart and Ricart, following the authors mentioned earlier, also cite the overall ambiguousness of studies on not just international diversification, but, following Barney, on diversification strategies in general (Warren, 2003, elaborates Barney's resource-dependent methodology to come up with a typology of competitive strategy problems based almost entirely on resource constraints). Their conclusion is that "as a result of the persistence of mixed results on such important lines of research, there is increasing agreement around the idea that new approaches to the study of the field would be welcomed". How warmly such approaches are welcomed is something which, in part, remains to be seen. As recently as 1999, both Brian Arthur (Jaworski, Jusela and Scharmer, 1999) and Sidney Winter (Winter, 1999) were still explaining the extraordinary resistance initially encountered by the new paradigm, but much has changed in the ensuing six years. In any case, they concentrate on the applications of Stuart Kauffman's rugged fitness landscape paradigm to problems of business strategy.

1.3.1 Kauffman's Dynamic Fitness Landscape Approach

The choice of Kauffman's approach is hardly random. Earlier studies by Michael Lissack (Lissack 1996, 2002) and Bill McKelvey (McKelvey, 1999) demonstrated both strong practical management applications stemming from Kauffman's work as well as a strong theoretical connection to the strategy literature, established when McKelvey applied Kauffman's NK Boolean Dynamic Fitness Landscape to Michael Porter's value chain. Fundamental properties of Kauffman's model include, first, a type of complexity with which we are already familiar – one which is easily described by agent based modeling: A complex system is a system (whole) comprising of numerous interacting entities (parts) each of which is behaving in its local context according to some rule(s) or force(s). In responding to their own particular local contexts, these individual parts can, despite acting in parallel without explicit interpart coordination or communication, cause the system as a whole to display emergent patterns, orderly phenomena and properties, at the global or collective level (Caldart and Ricart, 2004).

In more specific terms, Kauffman explains that "a fitness landscape is a mountainous terrain showing the location of the global maximum (highest peak) and global minimum (lowest valley)", where the height of a feature is a measure of its fitness (Kauffman, 1995). What is interesting about the fitness landscape model is that it is a dynamic rather than a static model. Kauffman argues that real fitness landscapes and environments are not fixed but are constantly changing. The change is a product of the activities of the various species on the landscape. In this sense there is a remarkable degree of congruity between the fitness landscape metaphor and many models of product/market competitiveness. In business terms, firms exist on a fitness landscape where they are affected by the behavior of other firms (an ideal situation for the application of game theory and an environment in which the experienced game theorist will immediately search for a Nash equilibrium) and at the same time each firm's behavior "distorts" or impacts the fitness landscape in which all firms interact, giving rise to such nonlinearities as feedback loops, persistence and dampening (engineers will recognize these features as characteristics of dissipative systems).

The NK Boolean Fitness Landscape is, in some ways, relatively easy to characterize, in the sense that one has only to be concerned with N the number of parts in the organism (firm) and K the number of connections between those parts.[1] At low values of N, the landscape is said to be "highly correlated" and the fitness peaks would consist of gently rolling hills, with one large peak. At K=0 (sometimes referred to "The Kilimanjaro Effect") a single fitness peak dominates and this corresponds to the classical equilibrium solution. At the other extreme (K=N-1), the landscape is extremely jagged, with many high peaks but with small moves being sufficient to move an organism (firm) off the fitness peak (and quite possibly into oblivion). At intermediate levels of N, the landscape possesses varying degrees of jaggedness and there are a number of possibilities (often expressed as the function of a search algorithm) for obtaining higher degrees of fitness. However, as N and K increase, the number of fitness optima available to players (competitors) goes down rapidly and the chance of being trapped on a suboptimal peak (a central problem addressed by Lissack as well) substantially increases.[2]

1.3.2 McKelvey's Coevultionary Pockets

While the full scope of McKelvey's study is too complex to address here, his subject matter and his conclusion are both worth noting. McKelvey's main interest is to look at intense competition in "co-evolutionary pockets", taking "K" as the measure of internal co-evolutionary density. He then looks at "C", which is a measure of external co-evolutionary density, specifying the number of co-evolutionary elements which are interdependent between competing firms. Using the stochastic micro-agent assumption, he uses basic statistical mechanics to develop scalar values for each of the elements in Porter's value chain. The problem which he sets, in the co evolutionary context, is to find the optimal values of N, K and C for a firm following Kauffman's reasoning that "too much complexity has an effect on the competitive advantage of co evolutionary systems that severely limits their adaptive success." (McKelvey, 1999)

Because of the presence of interdependent co-evolutionary elements, there are multiple Nash equilibria in McKelvey's model. Among McKelvey's findings are the following (McKelvey, 1999):

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[1] For a thorough mathematical characterization of NK Boolean Fitness Landscapes, the reader is directed to "The Structure of Rugged Fitness Landscapes" in Kauffman, The Origins of Order, (Oxford University Press, 1993). Here, physicists J. Doyne Farmer and Norman Packard have applied a rigorous statistical mechanics treatment to the model, allowing Kauffman and his readers to draw a number of novel causal conclusions.

[2] Kauffman (1993) describes the adaptive process in co-evolutionary pockets as follows:

> Adaptive evolution is a search process—driven by mutation, recombination and selection—on fixed or deforming fitness landscapes, An adapting population flows over the landscape under these forces. The structure of such landscapes, smooth or rugged, governs both the evolvability of populations and the sustained fitness of their members. The structure of fitness landscapes inevitably imposes limitations on adaptive search. On smooth landscapes and a fixed population size and mutation rate, as the complexity of the entities under selection increases an error threshold is reached…the population "melts" from the adaptive peaks and flows across vast reaches of genotype space among near neutral mutants. Conversely on sufficiently rugged landscapes, the evolutionary process becomes trapped in very small regions of genotype space…the results of this chapter suffice to say that selection can be unable to avoid spontaneous order. The limitations on selection arise because of two inexorable complexity catastrophes…each arises where the other does not. One on rugged landscapes, trapping adaptive walks, the other on smooth landscapes where selection becomes too weak to hold adapting populations in small untypical regions of the space of possibilities. Between them, selection is sorely pressed to escape the typical features of the system on which it operates.

(1) As K increases, the proportion of firms reaching Nash equilibria increases irrespective of the value of C;
(2) Under high C conditions…if the opponent does not change its K, a firm that increases K will increase its fitness
(3) When Nash equilibria are encountered, fitness levels of low K firms are higher than fitness levels of high K firms, independent of values of C;
(4) Overall average fitness of all firms in a co-evolving system is highest when C and K themselves co-evolve similarly.

He then concludes "that a firm should focus on opponents who are themselves keeping C at moderate levels—around eight by Kauffman's findings—so it can match its opponents Cs but still keep a rugged landscape (i.e., a moderate K), thus assuring that "coupled dancing" will be prolonged and Nash equilibria, should they occur, will do so at high fitness levels. McKelvey also offers an explanation for this phenomenon which is strikingly similar to Porter's 1997 discussion of "destructive competition" arising from an excessive pursuit of operational effectiveness. Both authors find that trying to do too much is likely simply to exhaust the focus and resources of the corporation. Trying to do too little is essentially asking to be left behind.

Finally, McKelvey addresses the question of complexity catastrophe itself, "Lower levels of K (relative to N) create moderately rugged landscapes composed of a few high and precipitous local optima peaks. As levels of K increase, the number of peaks increases but their height diminishes, with the result that the landscape appears less rugged, with less differentiation between the plains and the local optima peaks. The lesson for a notebook computer firm, for example, seems to be, Create a rugged landscape to heighten access to local optima having higher fitness peaks, by keeping internal co-evolutionary interdependencies relatively small (K_2 to 8) even though the number of value chain competencies, N, in your co-evolutionary pocket, is rising. But if C is increased then the upper bound on K also increases." (McKelvey 1999)

This is a very simplified treatment of McKelvey, and one should keep in mind that his is largely a mathematical exposition which depends on the rigorous assignment of scalar values to Porter's value chain followed by a rather complex computational simulation designed to test an extensive range of fitness levels. Much of the novelty of his approach is in the ways in which he can demonstrate the system "tuning" out lower fitness firms, whether by the invisible had of the market or by the visible hand of strategic planning (McKelvey, 1999).

2.1 Firm Rivalry and Competitive Intelligence

One might legitimately ask why the authors have taken such a long way around in getting to the role of competitive intelligence in firm competition. One reason is because modern research on firm strategy and competition strongly suggests that competition actually works according to rather different mechanics and dynamics than those suggested by traditional explanations. A second reason is that within the complexity paradigm, it appears that competition on rugged fitness landscapes is dominated by Nash equilibria and that Nash equilibria are instrumental in tuning co-evolutionary pockets, as well as setting fitness levels.

This, however, is not the only surprise on the competitive landscape. While most Fortune 500 companies gather some competitive intelligence, and many hire one or more consultants for a particular product or operating unit, the vast majority of strategic decisions at Fortune 500 firms do not appear to be informed by competitive intelligence. On the surface, this would suggest that, at the very least, top decision makers do not generally place a very high weight on competitive intelligence, or at best, they feel that they can either obtain necessary information on a case by case basis, at worst, the information which they require is illegal (this can just as easily be the result of outmoded anti-trust provisions as it could be from any intentional wrongdoing) or simply that the information is either unreliable or irrelevant. The relatively low usage of competitive intelligence by Fortune 500 firms suggests that there is very likely something as much wrong with competitive intelligence collection and production as there is with a decision-making process which places a relatively low priority on formal data gathering (Johnson, Gilad and Fuld, 1999).

One element of the problem most likely resides in the late emergence of competitive strategy as a separate discipline within the academic study of business. Formal strategic studies of any kind are a late arrival in the Western world. While strategy texts in the orient date from pre-Christian times, the earliest formal Western texts on military strategy (as opposed to individual treatises on weapons or personal combat) date from the late 18th century (Howard, 1972), with fully developed, authoritative works only appearing after the Napoleonic wars (Codevilla, 2002). Rumelt (1994) notes that until the mid-1970's, corporate strategy was not actually a formal academic discipline, but was instead, generally taught by either a visiting lecturer who was a retired CEO or simply by the most senior member of the business department. While the discipline has evolved greatly over the past thirty years, it is still, in the words of Caldart and Ricart (2004) "far from being mature". The many changes in the nature and approach of corporate strategy which have taken place during the last thirty years may have undermined some of the confidence which corporate management might otherwise place in the discipline. Combine this with the fact that "competitive intelligence" appears to have grown up as a quasi-independent discipline, often taking the form of a cottage industry developed by former military and clandestine intelligence personnel with little or no formal academic business training, one can hardly be surprised at the lack of general acceptance for competitive intelligence. To the extent that technology is the handmaiden of this field, one must then reflect upon Fuld's observation that of the five competitive intelligence software packages he tested, none performed as claimed and two did not work at all (Fuld, 1999).

In short, while competitive intelligence, sounds like it could be a tool for competitive advantage, there is little in the way of formal argument or evidence to make a compelling case. We believe that it is precisely this lack of formalism – lack of appropriate formal definitions, more importantly, lack of a formalized set of activities and finally, lack of a formal evaluative framework which robs competitive intelligence of its ability to make a clear and positive contribution to the competitive position of the firm.

3. 1 Competitive Intelligence: An introductory Definition

McGonagle and Vella (1990), among the earliest authors seeking to define competitive intelligence (CI) in a formal fashion define CI programs as being:

> A formalized, yet continuously evolving process by which the management team assesses the evolution of its industry and the capabilities and behavior of its current and potential competitors to assist in maintaining or developing a competitive advantage" (Prescott and Gibbons 1993). A Competitive Intelligence Program (CIP) tries to ensure that the organization has accurate, current information about its competitors and a plan for using that information to its advantage.

While this is a good "boilerplate" operational definition, it does not, in fact, address the deeper question of how we determine if performing the activities of competitive intelligence does, in fact, convey a competitive advantage to the firms so engaged. Even at the simplest level of the process, such general definitions provide little guidance for the evaluation of either the type or magnitude of the value creation involved. In the context of the present discussion, the problem is additionally complicated by the need to identify the impact of competitive intelligence on the internationalization process (at the firm level). The evaluative challenge becomes even more complex when it becomes necessary to assess the value of accurate competitive intelligence for firms whose advantage in international markets is subject to network externalities. Under these circumstances, measuring the role and performance of competitive intelligence becomes one of the central problems of Competitive Intelligence. Can competitive intelligence raise a firm's overall fitness? Can competitive intelligence be used to drive a competitive advantage in product and market diversification? In the following section, we suggest a meta-framework (Competitive Intelligence Meta-Analysis, or CIMA) which lays out the criteria which a formal system of competitive intelligence must meet if it is to accomplish these goals.

3.2 Competitive Intelligence Meta-Analysis.

If we now return to McGonagle and Vella's definition of competitive intelligence, we can argue that of necessity, CIMA must:

- Define the CI "Industry" and specify the activities which are appropriate to the industry, including the ways in which such activities can be strategically organized and directed. This is particularly true with respect to the kinds of internationalization decisions which we discussed above. In modeling such activities, we feel that the CI analyst would do well to adhere to Richard Rumelt's (2002) structural criteria of consistency, coherence, feasibility and advantage. As an extension of Rumelt's approach, the definition of the CI industry needs to include the legal and regulatory framework under which CI activities are undertaken, international trends in CI, as well as technological developments in the means of performing, delivering, implementing and enhancing CI.

- Explain how the conditions underlying competitive advantage in a particular industry or cluster of industries affect the nature, cost and value added utility of CI. The competitive setting of an industry as explained by Porter (1990, 1996) and others, provides important determinants of competition and boundary conditions for the utility of CI. These factors have also been explained elsewhere by the authors in the context of the evolution of corporate strategy and some of the lessons which one can draw from recent developments in chaos and complexity theory (Fellman 2001).

- Asses the evolution of the CI industry. As indicated above, this analysis needs to be sensitive to environmental trends as well as to defining the kinds of competitive pressures which determine the industry's strategic frontier (Porter, 1996). Performing this analysis on the Competitive Intelligence industry itself is the critical benchmarking process of CIMA. Porter's (1996) analysis is also useful in assessing whether a particular set of CI activities possesses or engenders first, second or third order "strategic fit".

- Assess the capabilities and behavior of current and potential CI practitioners. This analysis should consist of several parts. The first task should be primarily a definitional exercise delineating what, in fact, constitutes the performance of CI and what does not. Such an analysis could be expected to resemble to some degree the various formal definitions of intelligence activities as stated in legislation and Executive Orders (Compilation, 2002). Once CI activities are formally defined, it should then be possible to assess the competitive positioning of different groups engaged in CI activities.

Most importantly, and here is where we diverge from virtually all previous authors, ***it*** is critical to ensure that the process by which CI is defined is formal rather than Ad Hoc. This is an inherent relational property shared between CI and CIMA. An underlying goal of the formalization of this process is to ensure that CI evolves adaptively and is a robust element of value creation within the firm.

As we have already argued, without such rigorously grounded first principles, the present, largely ad hoc, definition of CI may lead those attempting to pursue competitive advantage through CI in an unrewarding, self-limiting or even value-destructive direction.

Another question whose answer will frame much of the subsequent discourse is whether CI can actually be developed into an academic discipline, which can prosper in business schools or universities academic departments. For some areas of CI, especially those related to traditional security concerns, this may not be so great a problem. However, in high technology fields, particularly where either intellectual property rights are at issue or the success or failure of a move towards internationalization is dependent upon obtaining accurate information about existing network externalities and their likely course of development, the approach to the CI discipline is absolutely critical.

3.3 Are there "Standard" Tools and Techniques for all Competitive Intelligence?

In a fashion similar to that faced by traditional intelligence analysts, each business organization's CI unit must also face the complexities of choice in sources of raw data. In its simplest form, the question may revolve around whether the organization should use government sources, online databases, interviews, surveys, drive-bys, or on-site observations. On a more sophisticated level, the organization must determine, to draw from the analysis of Harvard Professor and former Chairman of the National Intelligence Council, Joseph Nye, whether the issues it addresses are "secrets" to be uncovered or "mysteries" which require extended study of a more academic nature. In addition

Each business organization's CI unit must choose if and when to deploy "shadowing" and CI countermeasures (defensive CI). These kinds of issues involve a variety of tradeoffs, including choices of intelligence sources and the tradeoff between expenditure on CI and expenditure on other aspects of product research, development, production and marketing.

Not all CI tools and techniques are appropriate for all CI objectives. Hence the CI unit (in-house or outsourced) must use careful judgment in determining the firm's relevant CI needs and in that context, what are the most appropriate tools and techniques for obtaining that information. Many of the factors which determine the specific tools and techniques appropriate for a given firm depend upon the endogenous and exogenous constraints upon the firm. These may include factors such as the particular CI needs of the firm, time constraints on the firm's decision makers and the decisional process, financial constraints and limitations, including the level of resources available for CI, and staffing limitations (McGonagle & Vella, 1990). CI tools and techniques will also be influenced by the likelihood of obtaining the necessary data, the relative priorities of the sequencing of raw data, as well as the time and cost constraints surrounding the analysis and production of finished intelligence reports (Godson, 1980).

Although government sources have the advantage of low cost, online databases are preferable for faster turnaround time. Whereas surveys may provide enormous data about products and competitors, interviews would be preferred for getting a more in-depth perspective from a limited sample. Therefore, human judgment is an essential element of the decision regarding which CI techniques to deploy in a specific situation. However, basing these choices upon individual judgment is, by definition, ad hoc rather than formal, and thus a challenge to CIMA.

These breakdowns indicate essential strategies for CI countermeasures, and counter-countermeasures. One methodology for assessing the effects of CI countermeasures, and counter-countermeasures is Game Theory. While we treat these details at length elsewhere (Fellman and Wright, 2003, 2004; Fellman, Post, Wright and Dasari, 2004), we can look, in simplified terms at a matrix of offensive and defensive strategies, such as:

Game Theory Matrix for CI Unit and Target

	Target Uses Counter	Target Doesn't Use Counter
Unit Uses Tactic	**Mixed Results**	**Good Data**
Unit Doesn't Use Tactic	**Bad Data**	**Mixed Results**

The matrices grow larger when one considers various CI tactics, various counter-measures, and various counter-counter measures. Once numerical weights are assigned to outcomes, then there are situations in which the matrix leads formally to defining an optimum statistical mixture of approaches. Imagine the benefits to a CI unit in knowing precisely how much disinformation they should optimally disseminate in a given channel? This is a powerful tool in the arsenal of the sophisticated CI practitioner.

In evaluating a firm's CI needs, it is traditional to conduct a "CI Audit" in order define the firm's needs and to set a baseline for establishing a formal CI process. The audit typically includes decisions about whether to create an in-house CI capacity or to outsource some or all CI functions, and at this point it also becomes necessary to distinguish ***formal*** CI goals, procedures, and policies. As Rumelt (1998) and Porter (1996) suggest, these objectives should be formulated with an eye to consistency, coherence, consonance and feasibility with the goal of improving the firm's competitive performance, particularly by raising the level of strategic fit along its value chain. At this point the firm must also address issues of organizational structure, budgeting, and the relative priorities and scheduling of its CI goals. In terms of internationalization, the CI process should be evaluated as a mechanism for creating higher order ***strategic fit*** in the value chain (Porter, 1996). Hamel and Prahalad's question "Do you really have a global strategy?" (Hamel and Prahalad, 1985) now becomes "Does your internationalization strategy take advantage of network effects, does it increase strategic fit and do you have a CI system which can verify, monitor and update this strategy and the strategic behavior of competitors?"

4.1 The Formal CI Process—Organizational Behavior and Sources of Error

Beyond this, the firm's CI group, whether internal or external must address the problems not only of raw data collection, but far ore importantly, must deal with the transformation of that data into a finished intelligence product. This requires stringent internal controls not only with respect to assessing the accuracy of the raw data (Godson, 1980) but also a variety of tests to assess the accuracy and reliability of the analysis in the finished product (Codevilla, 1992). Throughout the processes of collection, transformation, production and dissemination, rigorous efforts are needed to eliminate false confirmations and disinformation (Hilsman, 1956). Equally strong efforts are required to check for omissions and anomalies (Codevilla, 1992). Critical to this process is a clear understanding of first principles and an evaluative process which is not merely consistent but which embodies a degree of appropriateness which serves to maximize the firm's other value creating activities (Rumelt, 1994, 1998).

4.1.1 Omissions

Omission, the apparent lack of cause for a business decision, makes it hard to execute a plausible response. While most omissions are accidental, there is a growing body of evidence that in a rich organizational context "knowledge disavowal"--the intentional omission of facts which would lead to a decision less than optimally favorable to the person or group possessing those facts--plays a significant role in organizational decision making (Deshpande and Kohli, 1989). Following the framework of rational choice theory and neo-institutionalism (Knott and Miller, 1988) it is clear that every business decision has both proximate and underlying causes. As Lebow so elegantly points out (1981, 1989) even large-scale historical events can often be much more directly traced to individual decision makers than conventional wisdom would have us believe. Avoiding omission must then take two forms. The first approach is basically a scientific problem, typically expressed in applied mathematics as the twin requirements of consistency and completeness. The second approach to omissions is more complex and requires an organizational and evaluative structure that will, to the greatest extent practicable, eliminate omissions which arise out of either a psychological or an organizational bias.

4.1.2 Institutional Arrangements

Between the profound and persistent influences of institutional arrangements (Allison's "bureaucratic micropolitics") and the often idiosyncratic nature of corporate decision making (Donaldson, 1984) even when decisions are perceived as merely the decisionmaker's "seat-of-the-pants" ad hoc choice, these decisions generally have far broader causes and consequences. Simon (1997) and March and Simon (1992) provide an elegant analysis of "Satisficing", a common decisional pitfall arising from bounded rationality which both pushes and encourages organizational leaders to make suboptimal decisions. Lebow, Jervis and Stein (1989), following the work of psychologist Irving Janis (1972), also provide an elegant typology for both the unmotivated (cognitive) and motivated biases which play heavily on decision makers facing difficult choices and complex tradeoffs. Among the many decisional pitfalls they cite are bolstering, particularly in the instances where psychological pressures lead decision makers to focus almost entirely on a desired outcome rather than on the combination of probability and outcome.

4.1.3 Additional Problems

Other problems associated with the decision process are procrastination, hyper-vigilance, framing and inappropriate representativeness. All of these tendencies must be rigorously guarded against during both the collection and the production stage of competitive intelligence. Again, to the extent which it is practicable, the finished product of CI should be presented in a way which minimizes the possibilities of its misuse in the fashions indicated above. To some extent these problems are inescapable, but there are a host of historical precedents in traditional intelligence which should offer some guidelines for avoiding some of the more common organizational pitfalls (Fellman, 1990). Perhaps the most important guidepost here is the fact that policy makers almost invariably prefer raw intelligence rather than the finished product. A major reason for this is that they are then free to draw all the psychologically comforting but scientifically defective conclusions from the raw data which a properly evaluated finished product would preclude them from doing (Heuer, 1999).

4.1.4 Anomalies

Following the above arguments, anomalies -- those data that do not fit -- must not be ignored any more than disturbing data should be omitted. Rather, anomalies often require a reassessment of the working assumptions of the CI system or process (McGonagle & Vella, 1990). In traditional intelligence, anomalies are often regarded as important clues about otherwise unsuspected behavior or events. In the same fashion, anomalies may represent import indicators of change in the business environment. There is also a self-conscious element to the methodology of dealing with anomalies. In the same way that anomalous data can lead researchers to new conclusions about the subject matter, the discovery of anomalies can also lead the researcher to new conclusions about the research process itself. It is precisely the anomalies that lead to a change of paradigm in the scientific world (Kuhn, 1996). Since conclusions drawn from data must be based on that data, one must never be reluctant to test, modify, and even reject one's basic working hypotheses. Any failure to test and reject what others regard as an established truth can be a major source of error (Vella & McGonagle, 1987). In this regard, it is essential to CI practice (collection, analysis and production) that omissions and anomalies in the mix of information (and disinformation) available in the marketplace be dealt with in an appropriate fashion.

4.2 Countermeasures

Similarly, it is essential that CI Counter-countermeasures incorporate an appropriate methodology for dealing with anomalies and omissions (intentional or accidental). An important element of this process is developing the institutional capability to detect the "signatures" of competitors' attempts to alter the available data. CI counter-measures should be designed with the primary goal of eliminating the omissions and anomalies which occur in the mix of information and disinformation available in the marketplace.
Included in this category are:

False Confirmation: One finds false confirmation in which one source of data appears to confirm the data obtained from another source. In the real world, there is NO final confirmation, since one source may have obtained its data from the second source, or both sources may have received their data from a third common source.

Disinformation: The data generated may be flawed because of disinformation, which is defined as incomplete or inaccurate information designed to mislead the organization's CI efforts. A proper scientific definition of disinformation requires the mathematics of information theory, which the authors detail elsewhere.

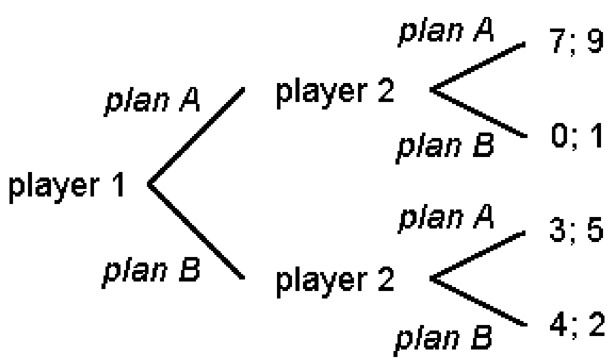
Blowback: Blowback happens when the company's disinformation or misinformation that is directed at the target competitor contaminates its own intelligence channels or CI information. Inevitably, in this scenario, ALL information gathered may be inaccurate, incomplete or misleading.

5.1 First Mover Advantage: Can Competitive Intelligence Help With Firm Internationalization?

Having seen some of the difficulties in determining whether international diversification actually creates value, we are, instead, going to limit ourselves to a "mid-range" question. That question is, can competitive intelligence help gain the firm a competitive advantage during the process of firm internationalization? We believe that it can, but perhaps not in the way that one might intuitively expect. To explain why, we turn to a somewhat neglected article from 1998 by game theorist Paul Hofer. We provide a close reading of Hofer here because we feel the importance of his work here demands more than a brief summary or even a modest synthesis. Hofer first provides an example of a game in normal form with an independent Nash equilibrium:[3] In this setting,

		player 2	
		plan A	plan B
player 1	plan A	7; 9	0; 1
	plan B	3; 5	4; 2

He then modifies the payoff matrices as shown below, giving the advantage to whoever moves first (and thus forcing the exposition of the game from normal to extensive form):



Hofer then modifies the payoff at the extreme lower right from 4;2 to 4;10 producing the following structure, which contains not one but two Nash equilibria:

Because the player which moves first can determine which Nash equilibrium the game arrives at, Hofer defines this kind of situation as a true first mover advantage. On the other hand, he argues that the traditional approach to second mover advantage is fallacious, although once one rules out the conventional, mathematically flawed explanations, there is another kind of second mover advantage (also informed by the Nash Equilibrium) which is real and which we can relate to competitive intelligence.

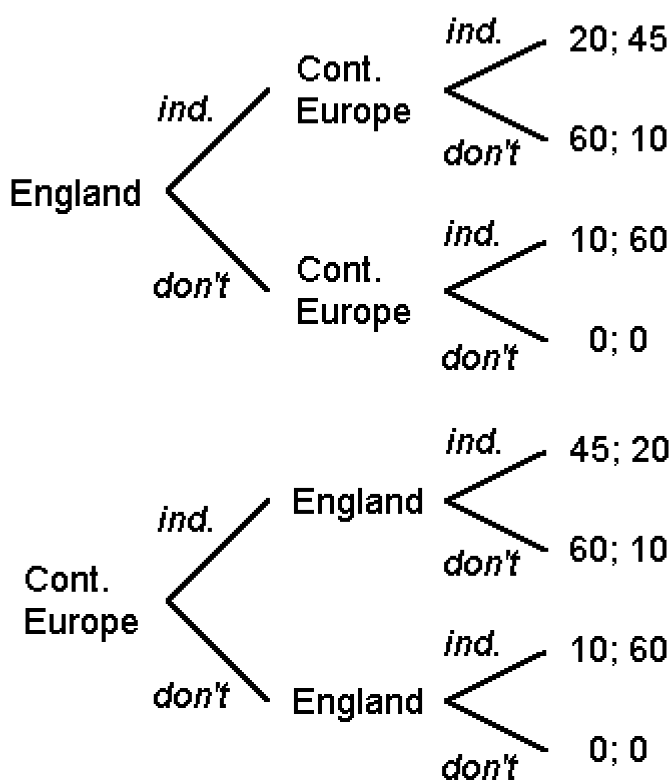
[3] Some readers may not be familiar with *independent* Nash equilibria in consequence of the simplified fashion with which the Nash Equilibrium is often described in the business school context. However, even before he begins his constructive proof of the nature of Polytope decision spaces, Nash notes that "The notion of the equilibrium point is the basic ingredient in our theory." And that, "This notion yields a generalization of the concept of the solution of a two-person zero-sum game. It turns out that the set of equilibrium points of a two-person zero-sum game is simply the set of all pairs of opposing "good strategies". The independent Nash equilibrium is then, a pair of opposing good strategies which (characteristic for "normal form" games) does not require either opponent to anticipate the strategy of their rival.

5.2 Second Mover Advantage: The Traditional View

Hofer's example of the conventional treatment of second mover advantage uses as the setting of the industrial revolution with England being the first mover and Continental Europe being the second mover (a type of explanation familiar to students of political economy).

		Continental Europe	
		industrialise	don't industrialise
England	industrialise	20; 45	60; 10
	don't industrialise	10; 60	0; 0

Hofer then points out that if one examines this game carefully, its form is not different from that of game 1. What is perhaps more significant is that upon close inspection, there is no way to change these payoffs. Whether Britain industrializes first or second, the payoff remains the same (i.e., 20 for England and 45 for Europe):



This means that there is, at least in a scientific or mathematical sense, no meaningful way in which one can define the so-called "second mover advantage". The payoff for industrializing is simply higher for the second player, however, choice is not involved!. Even worse is the fact that if one tries to change the sequence of moves, then the outcome must change as must the equilibrium payoffs. This leads to what Hofer characterizes as "surprising, but irrefutable results". Because this kind of game has only a single Nash Equilibrium, the payoff remains at 20 for England and 45 for Europe no matter who moves first. Thus, mathematically speaking, it is essentially nonsense to speak of a second mover in this context. If one attempts to get around this difficulty by incorporating other factors, such as a postulated learning curve effect, then one can get different numbers, but the different payoffs then generated mean that one is now comparing different games, which is an incommensurability even worse than the initial case (Hofer, p. 4)

5.3 Real Second Mover Advantage

All is not lost, though, because Hofer has discovered an authentic second-mover advantage, which, not surprisingly is defined by its Nash Equilibrium characteristics (no Nash equilibrium, but a solvable game via backward induction so long as the sequence of moves for each player is known). The example which Hofer uses is one where competing firms must decide whether to use common or proprietary technologies. While the example he gives here is actually trivial from a technology point of view, real world choices of technology are of considerable strategic interest and are quite amenable to agent-based modeling, where the application of this methodology has produced some novel and often strikingly counter-intuitive results (Windrum and Birchenhall, 1998, 2001; Fellman and Wright. Hofer's example proceeds as follows (p. 5):

(Suppose) there are two firms, call them Piccolo and Gigantic. They both produce similar products; however, Piccolo has only a small market share, while Gigantic controls a large proportion of the market. Both firms want to bring a new product onto the market, for which they must introduce one of two systems. But Gigantic has rather inferior technology compared to Piccolo. If both firms operate with the same system, then the whole market is in that very system, and can choose between the two technologies. It will presumably favour Piccolo. On the other hand, if the two firms operate different systems, Gigantic's customers are stuck with Gigantic's system and hence have no access to Piccolo's advanced technology, which hence can only be sold to Piccolo's market share. According to this rationale the payoffs in are set:

		Gigantic	
		system A	system B
Piccolo	system A	10; 4	3; 6
	system B	2; 7	9; 5

Fig. 3(a)

Hofer then explains that even in the absence of a Nash Equilibrium, as long as the sequence of moves is know, we can calculate the outcome. If Piccolo moves first, they will choose System A, to which Gigantic will respond by choosing system B. If Gigantic moves first, they will choose System B, which will also be chosen by Piccolo. What is, perhaps, most interesting here is that both players do better (i.e., enjoy a second-mover advantage, or a higher payoff) when they go second. Unlike the counter-factual hypothetical explanation advanced for industrialization, this type of setting possesses a real second mover advantage, precisely because the second mover enjoys a higher payoff than if they had moved first.

6.1 Conclusion: Information and Disinformation In Second Mover Advantage Games

Hofer uses a simple game of "musical chairs" in the Princeton University dining hall to illustrate how one can achieve an optimal payoff by moving second. In the more complex setting of international business, anticipating one's rival is often a function of possessing accurate information. As we mentioned earlier, *disinformation* is one of the most powerful tools available in competitive intelligence. In the case at hand (or for those who chose to read it, Hofer's simplified case) the principal identifier is the lack of a Nash equilibrium. However, there is a second relevant consideration, or identifier which can easily be observed, and that is the presence of mixed strategies. If a competitive situation (which can be accurately characterized by game theory), possesses mixed strategies, then the game will have at least one Nash Equilibrium. This is a direct consequence of Nash's proof where the correspondence of mixed and pure strategies define the combinatorics of his argument (Nash, 1059, pp. 2-3). This leads us to two important conclusions. If we are attempting to formally define a true second mover advantage, then we can immediately rule out any strategic situation with mixed strategies. To satisfy the conditions of a genuine second mover advantage, there must be no Nash Equilibrium, which necessarily means no mixed strategies.

For first mover advantage, exactly the opposite situation obtains. We should be looking for the Nash Equilibria, and we should expect to find mixed strategies. From a competitive intelligence point of view, we may find it highly rewarding to inject a deliberate element of disinformation simply to make it more difficult for our rivals to determine our strategy (Egnor 1999; Billings, 1999; Sato, Akiyama and Farmer, 2002). This is why sophisticated game strategies like Iocaine Powder require a heuristic in the form of either a histogram or a pattern matcher in order to take advantage of an opponent's pattern of strategic moves.

However, the most important message to emerge from all of these various approaches to decision making, whether it be not to engage in too many business sub-unit activities --flatting the fitness landscape, inappropriately mirroring your opponent's behavior, or even "averaging out" fluctuations ins market demand, may simply be "don't waste effort seeking a first or second mover advantage which cannot possibly be there."

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