CORPORATE STRUCTURE, ADAPTATION AND PERSONALITY TYPE

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Introduction

In 1998, physicist Theodore Modis developed a refinement of the BCG Growth-Share matrix using a seasonal metaphor and sigmoid growth curves.[4] An important element of this treatment is that it examines the firm as a dynamical system. One implication of this treatment is that firms proceed through a life cycle process, which like the seasons is defined by macroscopic regularity but local randomness.[5] While Modis' idea is hardly new, it brings the mathematical rigour of statistical mechanics and the insights of population biology to bear on questions of firm niche and market structure which are often finessed by other authors concentrating solely upon decisionmaking within a limited time horizon where "ceteris paribus" conditions obtain.[6]

The same kind of problem is found in formal economic analyses which attempt to avoid the non-linearities necessarily induced by feedbacks between producers, consumers, markets and intermediate contractors and contractees (to borrow the process language of Williamson).[7]

While we regard the structure of the firm as central to its economic performance, this is not the primary focus of this particular paper. We quite agree with Ronald Coase' 1937 article where he raises the problematic nature of the economic view that:[8]

> In view of the fact that while economists treat the price mechanism as a coordinating instrument, they also admit the coordinating function of the "entrepreneur," it is surely important to enquire why coordination is the work of the price mechanism in one case and the entrepreneur in another. The purpose of this paper is to bridge what appears to be a gap in economic theory between the assumption (made for some purposes) that resources are allocated by means of the price mechanism and the assumption (made for other purposes) that resources are allocated by means of the price mechanism and the assumption (made for other purposes) that this allocation is dependent on the

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[4] Theodore Modis, Conquering Uncertainty, McGraw-Hill, 1998

[5] See Edgar Peters, "Chaos and Order in the Capital Markets", John Wiley and Sons, 1992, Chapter 1.

[6] (a) Oliver Williamson, (1996) in The Mechanisms of Governance, describes this process when he compares the emergence and subsequent treatment of M form vs. U form organizations, with the M form providing endogenous control over transaction costs. He notes that once this idea is taken seriously then this means that organizations are amenable to analysis as are institutions, which creates a new "center of gravity" in economic analysis, that which is institution- centered rather than production-functioned centered. Williamson also points out (p. 362) that "the proposition that institutions matter in economics (as distinguished say, from sociology) is alien to the idea that economics could and should operate out of an 'institution free' core (b) Sidney winter describes a similar shift in focus, along with the pedagogical resistance which accompanies it in his 1999 address on evolutionary economics, and the analysis of the organization as a storehouse and user of technology as compared to traditional "production function economics" (http://www.econ.yale.edu/alumni/reunion99/winter.htm)

[7] For a complete description of why this type of analysis is structurally destined to fail, see David Reaume, "Walras, complexity, and Post Walrasian Macroeconomics," Beyond Microfoundations: Post-Walrasian Economics, Cambridge University Press, ed., David Colander, Cambridge University Press, (1996). Reaume discusses several reasons why doing statistical approximations of imputed Taylor expansions can be very misleading. Perhaps the most striking issue is that even for some very simple quadratic and cubic functions one can easily have second order terms which are not only larger in absolute value than first order terms, but of the opposite sign. Thus truncating a Taylor series expansion, which is what any good econometrician will do, can be extremely misleading.

[8] Ronald Coase, "The Nature of the Firm" (1937) in The Nature of the Firm: Origins, Evolution and Development, Ed. Sidney Winter and Oliver Williamson, Oxford University Press, 1993, p. 20

> entrepreneur-coordinator. We have to explain the basis on which, in practice, this choice between alternatives is effected.

Much of the subsequent work in Williamson and Winter's collected volume is designed to answer that question through the explanation of the mechanics of transaction costs. In a broader sense, those who have followed Nelson and Winter's evolutionary economic theorizing, particularly through the annual conferences held by the Danish Research Unit for Industrial Dynamics (DRUID)[9] will already be familiar, not only with the importance of institutions, but also with the ways in which the emergence of new technologies and shifts in the duration of product life-cycles have fundamentally altered the dynamics of economic production and hence our methods for analyzing economic transactions, firm behavior, market growth and firm and market failure.[10]

What we wish to draw upon in the current analysis is a typology of organizational structure which follows the dynamics of the product life-cycle. We don't deny that the complex bundled mix of products and services by many companies in the technology sector aims to create a diversified portfolio of assets where the primary risk is market risk rather than business risk, but for the sake of argument, and certainly for the sake of simplification, we are going to look at the type of corporation or corporate division whose production substitutability is rather inelastic. Such a firm will then typically follow either Henderson's success cycle (new product, star, cash cow) or Henderson's disaster cycle (new product, star, problem child).

However, absent the introduction of new technology, the firm, or the division will eventually wind up in the "dog" position of small market share and small growth (whether it has arrived at this position through an economic harvesting of economic rents or not).[11] For the sake of generosity, we will confine our attention primarily to those organizations (best-case). Here, even a diversified firm, following a well-designed product substitution strategy of nested S-curves for each of its technology goods and services packages will still have to cope with "the coordinating function of the entrepreneur" and the embedded structure of the institution as it seeks to maximize brand loyalty, market share and profits.[12]

Changes in the nature of markets from capacity driven manufacturing of items to uniquely bundled solutions (goods and services, often on an ongoing basis) has brought about in the 21st century a new character to the exchange of value and the function of markets. Economics, with its near Laplacian determinism already had difficulty explaining many of the ordinary characteristics of markets (particularly financial markets).[13] Twentieth century economic orthodoxy certainly does not possess a

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[9] See particularly, papers from the 2001 Conference held at the University of Aalborg honoring Richard Nelson and Sidney Winter.

[10] See also Richard Nelson and Sidney Winter, "Evolutionary Theorizing in Economics", Journal of Economic Perspectives, Volume 16, Number 2, Spring 2002, pp. 23-46.

[11] See Bruce Henderson, "The Product Portfolio of the Boston Consulting Group", "The Rule of Three and Four" and "Sectoral Competition" in Perspectives on Strategy from the Boston Consulting Group, Ed. Carl Stern and George Stalk, Harvard Business School Press, 1998.

[12] See Modis, "The Beginning of Chaos" (p. 58), "Natural Growth Alternating with Chaos" (p. 62), "If Summer is here can Fall be far behind" and "The profitability of old customers" (pp. 73-78) and S-Curve mathematical formulations, pp. 169 ff.

[13] See J. Doyne Farmer, "Physicists Attempt to Scale the Ivory Towers of Finance", Computing in Science and Engineering, December, 1999 http://www.santafe.edu/sfi/publications/Working-Papers/99-10-073.pdf

methodology which can cope with the complexity of self-organizing, emergent technology flows containing multiple feedback loops. As Harrison White explains:[14]

> Most markets today regulate production flows of goods and services, rather than exchanges of existing stocks as in traditional sorts of markets. ***Persistent directionality in continuing flows of intermediate goods is indeed the hallmark of our economy***. So three roles, not just buyer and seller, are involved in the commitments that producers in each given market make each period. Each producer firm guides itself into a niche along a market profile from watching actions of its compatriots. That profile is sustained when it offers tradeoffs of quality versus volume that are equally attractive downstream to buyers. Economists have not as yet agreed on how to characterize the process and structure through which particular firms actually constitute a market. So they largely pass over particular firms by settling for a stylized story of pure competition where buyers don't distinguish between different firms' qualities of product.
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> On the other hand, analysts of firms' histories and strategies, as well as structures, usually pass over particular markets and focus on various relations among, and orientations by, firms. ***Neither of these approaches has been able to provide a plausible account of a production economy, because neither is able to explain how markets and firms interdigitate as they co-evolve in networks of flows.*** As in other articles in this issue, complexity emerges from network interactions. But here the constituent 'actions' depend upon interpretive understandings, joint and several, and this has to guide the elicitation of parameters and the handling of path dependencies and other indeterminacies…Networks of relations define social space and forces. ***Each connection to some degree entails and warrants other connections in that locale. This field of local forces induces also effects of longer range computable in terms of patterns of structural equivalence***…Each producer firm is of course eager to optimize net returns over the costs it incurs upstream. But ***the key intervening influence is search by producers to reduce uncertainty in outcomes from their commitments***. Network ties can insure some degree of habitual placement but thereby also limit options in adapting to changes downstream in the uncertain world of business.

Here, White has introduced a plethora of concepts from chaos theory and complexity science, not all of which can be easily modeled even with the most advanced tools of statistical mechanics. A critical distinction which he has failed to make involves his usage of the term coevolution. The concept of coevolution was originally developed in game theory by John Von Neumann[15] (1944) and was subsequently adapted by Stuart Kauffman (1969) to Sewall Wright's "fitness landscape concept". The fully developed model was subsequently presented by Kauffman with the assistance of physicists J. Doyne Farmer and Norman Packard (Kauffman, 1993).

The most important characteristic of coevolution is that it posits a dynamic environment (fitness landscape) which itself is altered by the behavior of the entities co-evolving (cooperating, competing, interacting symbiotically or parasitically). As McKelvey (1999) notes, there are some critical differences between social cohesion models (of which White's theory represents one variation) and the more powerful,

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[14] Harrison C. White, How Businesses Mobilize Production Through Markets: Parametric Modeling of Path dependent Outcomes in Network Flows, ISETR and Department of Sociology, Columbia University http://216.239.37.104/cobrand_univ?q=cache:BrrDdOBe-B4C:www.santafe.edu/~cmg/netdyn/WHITE-Mkt_net_firm_5-02.pdf+product+life+cycle+theory+of+the+firm&hl=en&ie=UTF-8

[15] John Von Neumann and Oskar Morgenstern, Theory of Games and Economic Behavior, Princeton University Press, 1944.

nuanced NK rugged fitness landscape[16] (Kauffman 1993,1997). The first difference is that Kauffman's model is a reductionist model and that if the NK network is constructed properly, then it is possible to assign value to the variables N and K (which in the NK model are the only variables: ***N***, the number of parts and ***K***, the number of connections), and make precise mathematical determinations about the behavior of the system at different levels of ***N*** and ***K***. One can then rather easily demonstrate how at specific levels of ***N*** and ***K*** (or at approximate levels, since N and K are integers and phase transitions may take place at values between integers) the network will go through a phase transition--either freezing up or moving into total chaos. The NK Boolean network can map this type of transition which is so critical to understanding industry evolution, especially under conditions where there are abrupt discontinuities caused by technology shocks.[17] Social cohesion networks on the other hand lack the mathematical structure to capture this dimension of the complex adaptive behavior of technologies and markets.

Kauffman naturally takes as the central locus of his evolutionary dynamics as the state on the edge of order and chaos. This is a state where molecules, firms, products and strategies are most likely to evolve more efficient forms (higher fitness). Also, techniques like "patches" and "simulated annealing" can help companies avoid 'sticking points" on the evolutionary landscape as well as enable them to move from local maxima to global maxima.[18] Moreover the criticality of the phase transition is self organizing, also referred to as ***self organizing criticalities, thus adding another dimension to Kauffman's model.***[19]

While White's analysis raises some interesting points, his model does not really have the analytical power to track the kinds of organizational change we wish to analyze. Nor can he capture in the ***changes in flows*** the progression through the product life-cycle which Modis has characterized as Spring, Summer, Fall and Winter business seasons.

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[16] For those not entirely familiar with Kauffman's modeling of competitive dynamics using random Boolean NK networks, see (a) "What's Under the Hood, A Layman's Guide to the Real Science" Chris Meyer, Ernst and Young center for business innovation, http://www.cbi.cgey.com/events/pubconf/1996-07-19/proceedings/chapter%2010.pdf (b) See also, Torsten Reil ,An Introduction to Complex Systems , Department of Zoology, University of Oxford torsten.reil@zoology.oxford.ac.uk Reil argues that "A second major discovery made in complex systems such as Boolean Networks is that of self organising criticality. If the Random Boolean Network is in the complex regime (K=2 or 3), changes in the initial conditions will most of the times have no affect on the particular attractor that is finally reached. Sometimes, there is a minor effect though, and the final attractor configuration is slightly different. In very cases, finally, the attractor type reached is radically different. (You can try this out in the applet, though chances are that you won't witness the last case because it is so rare). Interestingly, this behaviour seems to be mirrored in many real life systems. It can be observed in the form of the size of avalanches breaking off a sandpile onto which sand grains are repeatedly dropped. Again, most of the avalanches are small, some are larger, and very few are very large. Finally - on a very much larger scale - it has been suggested that this phenomenon can also be observed in the size of extinctions over evolutionary time. Most of them are small, and very few are large.

[17] For a thorough treatment of this subject see Paul Windrum and Chris Birchenhall, "Technological diffusion, welfare and growth: technological success in the presence of network externalities," 2002, http://www.merit.unimaas.nl/publications/rmpdf/2002/rm2002-028ab.pdf

[18] See Michael R. Lissack "Chaos and Complexity: What Does That Have to Do with Knowledge Management?," in Knowledge Management: Organization, Competence and Methodology, ed. J. F. Schreinemakers. Wurzburg, Germany, Ergon Verlog. 1: 62-81. Also available at http://www.lissack.com/writings/knowledge.htm

[19] Stuart Kauffman, At Home in the Universe, Oxford University Press, 1997.

Beyond the BCG Growth-Share Matrix – A Seasonal Metaphor for the Corporation

Modis' seasonal dynamic, with its cyclical structure and changing seasonal ideals, can provide a very useful typology of leadership. In describing the nuances of the relationship between ideal performance and seasonal demands, Modis captures a critical dynamic of the evolving business environment. In this context, Winter, the most difficult and chaotic of seasons, must allow the free flow of ideas and a process in order for the company's decision makers to listen and to obtain maximal input while gathering all relevant ideas for a new product line launch.[20] Modis suggests that the Winter managers need to be flexible and entrepreneurial. Spring, the season of Henderson's "stars", requires the artful evaluation and presentation of ideas. Summer, the time of the "cash cow", requires the logistical guidance for a well-ordered, self-sustained organization. Summer organizations have often lost or re-deployed their Winger engineers and face the thread of further cutting into margins by hanging on to an excess bureaucracy.
Fall, characterized by market maturity and decreasing returns mandates strategic efficiency and expert cost control skills to stay ahead of declining value, while new teams (soon to become the Winter Trail Blazers) often find it difficult to focus on a new value creating activity for the next cycle, even when they are given the opportunity to undertake a wide range of search strategies.

In defining a business paradigm for leadership, it would then appear that the seasonal variable is an essential component of the formula. But what drives the change of climate in business? In a non-static environment there are certain observations of action, reaction, and interaction that might lead us to consider elements of human behavior and social dynamics? Charles Handy provides some insight on these questions by the way he treats the Sigmoid growth curve.

The Paradox of Success

Handy argues, that the sigmoid curve "describes the normal life cycle of almost anything, anybody, or any organism: ***a period of learning or investment***, in which inputs exceed outputs, ***followed by steady growth*** that inevitably ***one day peaks*** and turns into decline. The only variable is the length of the curve, the time it takes to reach the various points on the curve."[21] This process, however, leads inevitably to what Handy characterizes as "***the paradox of success***". In order to revitalize a product, a market or an organization, one must start a new curve before the present curve has finished its natural life cycle.[22] The paradox appears because when an organization is doing well its managers are particularly resistant to change. If the organization waits until it has exhausted most of its growth potential, and the need for change is obvious, it then faces the problems of inadequate resources, discredited leadership and low morale.

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[20] Ibid., Modis, Conquering Uncertainty

[21] Charles Handy, "Elephants and Fleas: Is Your Organization Prepared for Change?", Leader to Leader, The Peter F. Drucker Foundation for Nonprofit Management, No. 24, Spring 2002.

[22] In layman's terms, Handy argues that the second curve must be started before the first curve "peaks". To be more precise, the second curve (or the n+1th curve in a scaled series) should be started before the first derivative (the rate of growth) peaks (Modis, p. 49)

A significant number of management studies have documented the organizational difficulties posed by change.[23] While academics, consultants and other authors have argued both the positive benefits of change, without a clear paradigm for change in business, the advocacy of change often winds up as little more than a half-hearted reconciliation to the inevitable. Even where an author provides apparently clear guidelines for change, the process of organizational growth and adaptation may be hampered by outdated management principles and practices. Consider, for example, the micro-economic theory of the firm. Eric Beinhocker provides a cogent summary of the linear statics, which underlies much of traditional management thinking: "Many of the most successful and widely used strategy tools today…owe their origins to ideas developed in the 1950's in a field known as the theory of the industrial organization. Industrial organization theory, which is concerned with industry structure and firm performance, is in turn based on microeconomic theory."[24] The essential problem here is that such an approach is ill-suited to evolutionary dynamics and this is all the more true when one is looking at technologies which include network externalities.[25]

The essence of Beinhocker's argument can be found in the firm's maladaptation to processes governed by complex, non-linear processes. At exactly the point where the firm should be shifting resources in order to create a series of positively sloped nested S-curves, "in modern strategic analysis, a company looks at its position in the current industry structure, considers the shocks and changes that are occurring or might occur, and then develops a point of view on how the industry is likely to change and what that means for its own strategy.[26] The problem with this approach is that it presumes that industry structure is known and that future states of the industry are predictably knowable. Such a presumption is problematic in the extreme in industries such as microprocessors or software, where product life-cycles are extremely short, industries with network externalities or characterized by increasing returns (and therefore path dependent lock-in as well as multiple unstable, unpredictable or as Paul David calls it *non-ergodic solutions*, and there is an explicit presumption that firms behave in a strictly rational fashion.[27]

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[23] (a) See, for example, Ronald A. Heifetz and Marty Lisky, Leadership on the Line: Staying Alive Through the Dangers of Leadership, Harvard Business School Press, 2002, (b) See also Eric Flamholtz, and Yvonne Randle "Changing the Game: Organizational Transformations of the First, Second and Third Kinds, Oxford University Press, 1998 and (c) Charles Handy, The Age of Paradox, Harvard Business School Press, 1995.

[24] Eric D. Beinhocker, "Strategy at the Edge of Chaos", The McKinsey Quarterly, 1997, No. 1

[25] For the most comprehensive treatment of this subject see W. Brian Arthur, Increasing Returns and Path Dependence in the Economy 2nd Edition, University of Michigan Press, 2002. See also C. Antonelli, "Path dependence, localized technological change and the quest for dynamic efficiency", in Antonelli, C., Foray, D., Hall, B. and Steinmueller, E. (eds.), Frontiers in the economics of innovation. Essays in honor of Paul David, Edward Elgar, Cheltenham.

[26] Ibid., No. 23

[27] Ibid., No. 13 J. Doyne Farmer argues, "Modern economic theory assumes bounded rationality. Equilibria are dynamic, driven by agents' changing perceptions of each others' actions. Allowance is made for the possibility of reasonable excess profits for agents who perform services, such as reducing risk or processing information. The behavioral economists have presented evidence of irrational behavior and market anomalies that historically would have allowed excess profits. Anecdotal evidence suggests that some individuals might indeed make statistically significant excess profits. It is fair to say that the physicists studying these problems tend toward the more radical end of the spectrum. While bounded rationality is a nice idea, it is only part of the story. *People are not identical finite-capacity calculating machines differing*

An Alternative Approach: Henderson and Modis on Leadership

Boston Consulting Group founder, Bruce Henderson argues that, "***the essence of leadership is the ability to change the organization's conception of ideal performance***. The strength of leadership can be measured by the rate at which these ideals are changed. The quality of leadership is reflected by the wisdom used in choosing the new ideals. The initial test of leadership skill is in the choice of the inescapable compromise between speed of change and security of the leader's ability to lead."[28]

Among the most important aspects of Henderson's analysis is the fact that the organization itself is ***necessarily*** subject to change. Moreover, various progressions of change may each embody a separate and unique concept of the ideal. In this context, each ideal may ordain its own unique set of actions, reactions and interactions.

Modis' seasonal dynamic, with its cyclical structure and changing seasonal ideals, provides an exceptional typology for change leadership. In exploring the relationship between ideal performance and seasonal demands, Modis captures the critical dynamic of the evolving business environment. In this context, the Winter metaphor—the descriptor of the most difficult and chaotic season, demands an unprecedentedly free flow of ideas and a process which must be open to listening to ideas from all individuals in the organization.

Spring, which is the season of Henderson's "stars", requires the artful evaluation and presentation of ideas. Summer, the time of the "cash cow", requires the logistical guidance for a well-ordered, self-sustained organization. Fall, characterized by market maturity and decreasing returns mandates strategic efficiency and expert cost control skills to stay ahead of declining value. In defining a business paradigm for leadership, it would then appear that the seasonal variable is a particularly useful component of the formula. But what drives the change of climate in business? In a non-static environment there are certain observations of action, reaction, and interaction that might lead us to consider elements of human behavior and social dynamics. Interestingly enough the real

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only in their utility functions. Equally important is the diversity of viewpoints induced by nature and nurture. Formulating successful predictive models is extremely difficult and requires both hard work and intelligence. To make a good model, it is necessary to specialize, which stimulates diversification of financial strategies. As a result, *financial agents are very heterogeneous*. Some agents are more skilled than others, and the excess profits of such agents are not necessarily reasonable. The behavioral economists are clearly right that people are not fully rational and that this can play an important role in setting prices. But where do we go from there? Despite the idiosyncrasies of human psychology, is there a statistical mechanics that can explain some of the statistical properties of the market, and perhaps take such idiosyncrasies into account? Agent-based modeling offers one approach to addressing these problems. Efforts in this direction range from simple, metaphorical models, such as those of evolutionary game theory, to complicated simulations, such as the Santa Fe Institute stock market model. The SFI model, which was a collaboration between two economists, a physicist, and a computer scientist, was a significant accomplishment. It demonstrated that many of the dynamical properties of real markets, such as clustered volatility and fat tails, emerge automatically when a market simulation allows the views of the participants to be dynamic. It was a good start, but in part because of the complexity of the numerical simulations, it left many unanswered questions.

[28] Henderson, Bruce D., "Leadership" (1968), In Stern, Carl W. and George Stalk, Jr. (eds.), *Perspectives on Strategy: From The Boston Consulting Group*, John Wiley & Sons, Inc. (New York 1998) pp. 238-239.

key to this analysis appears to come from the study of bounded rationality. While initial hints come from works like Edward O. Wilson's Sociobiology[29] or Abraham Maslow's humanistic psychology[30] at least the economic dimension of the answer to this question comes from the consideration of the role in bounded rationality in business and economic decision-making. Brian Arthur deals with this phenomenon extensively in "Inductive Reasoning and Bounded Rationality (The El Farol Problem), noting that"[31]

> The type of rationality we assume in economics--perfect, logical, deductive rationality--is extremely useful in generating solutions to theoretical problems. But it demands much of human behavior--much more in fact than it can usually deliver. If we were to imagine the vast collection of decision problems economic agents might conceivably deal with as a sea or an ocean, with the easier problems on top and more complicated ones at increasing depth, then deductive rationality would describe human behavior accurately only within a few feet of the surface.

[29] Edward O. Wilson, "Man: From Sociobiology to Sociology" in Sociobiology: The New Synthesis, The Belknap Press of Harvard University Press, (Cambridge, MA and London, England 2000)

[30] Abraham Maslow, "Towar a Psychology of Being", 3rd Edition, John Wiley and Sons, 1998.

[31] Paper given at the American Economic Association Annual Meetings, 1994 Session: Complexity in Economic Theory, chaired by Paul Krugman. Published in American Economic Review (Papers and Proceedings), 84,406-411, 1994.

Arthur then explains that rationality works well enough to find minimax solutions at the very top surface layers, but at the level of, say, checkers, there are problems and the difficulties with chess not to mention Go, are simply intractable. He provides two explanations for the failure of rationality:[32]

> There are two reasons for perfect or deductive rationality to break down under complication. The obvious one is that beyond a certain complicatedness, our logical apparatus ceases to cope--our rationality is bounded. The other is that in interactive situations of complication, agents can not rely upon the other agents they are dealing with to behave under perfect rationality, and so they are forced to guess their behavior. This lands them in a world of subjective beliefs, and subjective beliefs about subjective beliefs. Objective, well-defined, shared assumptions then cease to apply. In turn, rational, deductive reasoning--deriving a conclusion by perfect logical processes from well-defined premises--itself cannot apply. The problem becomes ill-defined.

Arthur's own answer will be familiar to readers who have studied the works of John Holland[33], Doyne Farmer[34] or Christopher Langton.[35] He argues that economic agents reason inductively and follow local rules of behavior. First he explains how inductive reasoning by heterogeneous agents leads not to a single equilibrium solution, but rather many possible solutions:

> If the reader finds this system unfamiliar, he or she might think of it as generalizing the standard economic learning framework which typically has agents sharing one expectational model with unknown parameters, acting upon their currently most plausible values. Here, by contrast, agents differ, and each uses several subjective models instead of a continuum of one commonly held one. This is a richer world, and we might ask whether, in a particular context, it converges to some standard equilibrium of beliefs; or whether it remains open-ended, always discovering new hypotheses, new ideas.

Notice that this kind of reasoning is perfectly consonant with the different decisional calculus employed by managers in Winter, Spring, Summer and Fall business seasons. Moreover, it is an evolutionary, dynamic framework:[36]

> It is also a world that is evolutionary--or more accurately co-evolutionary. Just as species, to survive and reproduce, must prove themselves by competing and being adapted within an environment created by other species, in this world hypotheses, to be accurate and therefore acted upon, must prove themselves by competing and being adapted within an environment created by other agents' hypotheses. The set of ideas or hypotheses that are acted upon at any stage therefore coevolves.

Not only is the framework evolutionary but it provides a degree of knowledge structure which was not apparent from White's earlier, insightful but incomplete picture of coevolution.

Inductive Reasoning, Agent-Based Models, Personality Types and Business Seasons

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[32] Ibid.
[33] John Holland and Heather Mimnaugh, Hidden Order: How Adaptation Builds Complexity, Perseus Publishing; (September 1996).
[34] J. Doyne Farmer, "Toward Agent Based Models for Investment", Association for Investment Management and Research, 2001. http://www.santafe.edu/~jdf/aimr.pdf
[35] Artificial Life V: Proceedings of the Fifth International Workshop on the Synthesis and Simulation of Living Systems (Complex Adaptive Systems) Edited by Christopher G. Langton, Taksunori Shimohara
[36] Ibid., No. 31.

One of the most commonly used methods of developing personality profiles has was developed by American researcher Isabel Myers and her mother, Kathryn Briggs. The Myers-Briggs Type Indicator (MBTI) identifies sixteen models of action-attitude behavior. Myers' book, ***The Myers-Briggs Type Indicator***, was published in 1962, the same year the Japanese became interested in this tool for the purpose of improving quality performance. By 1998, the MBTI was considered to be the most widely used self-assessment instrument in the world, administered in over 30 countries, with 19 different language translations available for commercial use.

1.) E = Extroverted (Expressive)	or	I = Introverted (Reserved)
2.) S = Sensory (Observant)	or	N = Intuitive (Introspective)
3.) T = Thinking (Tough-minded)	or	F = Feeling (Friendly)
4.) J = Judging (Scheduling)	or	P = Perceiving (Probing)

Based on answers to the MBTI questionnaire,

one is found to be one of four function types:

Intuitive Types	**Thinking Types**
ESTJ or ENTJ (Extraverted Thinking)	ENTP or ENFP (Extraverted Intuiting)
ISTP or INTP (Introverted Thinking)	INFJ or INTJ (Introverted Intuiting)
Feeling Types	**Sensory Types**
ESFJ or ENFJ (Extraverted Feeling)	ESTP or ESFP (Extraverted Sensing)
ISFP or INFP (Introverted Feeling)	ISFJ or ISTJ (Introverted Sensing)

David Keirsey subsequently developed a test which focuses on two sides of personality: ***temperament*** and ***character.*** Temperament was defined as ***predisposition*** or the ***hardwired*** nature one is born with, while ***Character*** was explained as (a contingent) ***disposition,*** the slight colorings create subtle variations in the appearance of temperament in comparison to the **MBTI**, Kiersey's examination tests out as shown below:

Function Types According to Myers	**Intelligence Types According to Keirsey**
Thinking Types	**NT Rationals**
ESTJ or ENTJ (Extraverted Thinking)	ENTJ or INTJ (Coordinator)
ISTP or INTP (Introverted Thinking)	ENTP or INTP (Engineer)
Intuitive Types	**NF Idealists**
ENTP or ENFP (Extraverted Intuiting)	ENFJ or INFJ (Mentor)
INFJ or INTJ (Introverted Intuiting)	ENFP or INFP (Advocate)
Feeling Types	**SP Artisans**
ESFJ or ENFJ (Extraverted Feeling)	ESTP or ISTP (Operator)
ISFP or INFP (Introverted Feeling)	ESFP or ISFP (Entertainer)
Sensory Types	**SJ Guardians**
ESTP or ESFP (Extraverted Sensing)	ESTJ or ISTJ (Administrator)
ISFJ or ISTJ (Introverted Sensing)	ESFJ or ISFJ (Conservator)

Keirsey then draws the following contrasts between Myers' "Function Types" and his "Intelligent Types". In this analysis he attempts to identify the metal states and processes which Jung and Myers treat as the functions of different personality types. Keirsey then attempts to

predict what behaviors these various types will exhibit and what kinds of activities they can master or otherwise perform well (in this sense his is a theory of dispositive skills).[37]

As detailed below, Keirsey acknowledges that varying degrees of Introversion-Extroversion can give further character to a temperament. The same can be said for the Thinking-Feeling characterization. But while looking at the Artisan temperament, Keirsey states that the Feeling Artisan with inkling toward extroversion might be given to performance while the same Feeling Artisan with a disposition toward introversion might take on the role of composer.

Because Keirsey sees temperament as inborn predisposition, his predisposed SP Artisan types will not exhibit as much random variation in their character. The SP trait is fixed. The degree of each of E-I variable is infinite as is the degree of the T-F variable. The Myers' Feeling type, on the other hand, exhibits the one fixed F disposition to be characterized by infinitely varying degrees of the E-I, S-N, and J-P for much more random variation in personality type.

NT Rationals	**NF Idealists**	**SP Artisans**	**SJ Guardians**
E**NT**J Fieldmarshal	E**NF**J Teacher	E**STP** Promoter	E**STJ** Supervisor
I**NT**P Architect	I**NF**P Healer	I**SFP** Composer	I**SFJ** Protector
I**NTJ** Mastermind	I**NFJ** Counselor	I**STP** Crafter	I**STJ** Inspector
E**NTP** Inventor	E**NFP** Champion	E**SFP** Performer	E**SFJ** Provider

In this regard, Keirsey argues that, "The reason for Myers' and my differences is that we start from widely different premises. Myers unwittingly adopted Jung's 19th century elementalism, which assumed that personality could be pieced together from independent elements… I claim an organism never becomes integrated because it is always integrated. It differentiates by a process of evolution into the mature form it is meant to become. **Thus in the view of organismic wholism, with the traits clinging together, cohering-not by association, but by a common origin and a common destiny. The tiny acorn, a fully integrated organism from the start, looks forward to the stately oak tree it is destined to become."**

Despite their methodological differences (**Keirsey coming much closer to the ideas of self-organizing complex systems discussed earlier in this paper**) both the Myers-Briggs Type Indicator® and the Keirsey Temperament Sorter have enjoyed widespread popularity in industrial psychology. The broader scientific question which remains to be answered is whether a personality assessment tool such as The Myers-Briggs Type Indicator® or The Keirsey Temperament Sorter can be a prominent asset in structuring a new business leadership paradigm?

[37] Ibid. 23 p. 341