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Overview:	The dynamic, everchanging environment of our physical world require strategies that are emergent, and based upon complexity sciences



Dynamic organisation environments and developing complexity based strategies to search for simple rules for greater effectiveness

A great deal of research shows fundamental tension between too little and too much structure (Davies, et al, 2004). This tension is mostly caused by the tradeoff between organisational flexibility and efficiency that is central in dynamic markets. Some of the interesting findings in this regard suggest, an inverted U-shaped relationship exists between performance and the amount of structure. Additionally, this relationship seems unexpectedly asymmetric, i.e., it is better to have too much structure than too little. Second, increasing unpredictability is associated with less optimal structures. Moreover, when environments are very unpredictable, there is a very narrow band of optimal structure, called the “edge of chaos” (EOC). Lastly, increasing velocity of change raises performance while increasing complexity lowers it. Surprisingly, increasing ambiguity diminishes the value of skill.

Emerging theories suggest how organisations can adapt by building on the insights of complexity science. A adage of strategy and organisational theory debates the amount of organisational structure shaping performance in dynamic environments, with research findings suggesting a fundamental tension between possessing too little and too much structure (Burns and Stalker, 1961; Henderson and Clark, 1990; Uzzi, 1997). On the other hand, entities having too little structure seem to lack leadership and guidance to generate efficient behaviors (Sine, Mitsuhashi, and Kirsch, 2005). Thus organisations having too much structure are too constrained and lack flexibility (Miller and Friesen, 1980; Siggelkow, 2001; Rivkin and Siggelkow, 2003). This tension creates a dilemma for organisations competing in dynamic environments as success requires both



efficiency and flexibility. Some studies show that high performing organizations resolve this tension by using a moderate amount of structure to improvise a variety of innovative solutions (Brown and Eisenhardt, 1997). Overall, this is suggestive of an inverted U-shaped relationship between the amount of structure and performance at work, and has been observed in diverse research streams, e.g., Weick's (1976) whose loose coupling ideas focus on the benefits of moderate intra-organisational connectivity in that loosely coupled units are responsive enough to remain coordinated, but possess enough separateness to act innovatively and independently as well (Orton and Weick, 1990; Schilling and Steensma, 2001; Gilbert, 2005). Other research emphasises moderate connectivity among parts of an organisation (Hansen, 1999; Galunic and Eisenhardt, 1996, 2001; Rivkin, 2000). Similarly, studies in Taiwan, found most innovative groups were those with semi-linked operating and director relationships allowing shared access to financial resources among affiliates (Chi-nien, et al, 2005). Moderate amounts of external connectivity are also beneficial (Hargadon and Sutton, 1997; Owen-Smith and Powell, 2003).

The tension between too little and too much structure is also observed in research on improvisation, which is concerned with how partial structure guides behavior in real-time (Weick, 1998; Miner, Bassoff, and Moorman, 2001). Miner and colleagues (2001) further clarify how simple heuristics guide improvisation in the product development context. This tension is particularly pertinent for strategy in dynamic markets where change is not only common, but also critical for performance (Teece, Pisano, and Shuen, 1997). For instance, Mintzberg and McHugh (1985) note how a balance between more structured "deliberate strategy" and less structured "emergent strategy" enable innovative and yet ultimately coherent performance in turbulent landscapes (e.g., of Yahoo able to adapt due to its simple rules - Rindova and Kotha, 2001).



Despite this wide recognition of the tension-dilemma of too much versus too little structure, a number of issues remain (e.g. when is it too much) thus still unable to ascertain the underlying theoretical logic that links the tension between too much and too little structure, environment, and performance. The following ideas will hopefully shed some light on this topic. Structure can be defined as any specific and regular pattern of organisation such as roles, linkages, and rules (Lawrence and Lorsch, 1967; Galbraith, 1974; Scott, 2003). The range of optimal structures varies inversely with unpredictability (in unpredictable environments, there are very narrow ranges of optimal structures with catastrophic drops on either side that is likely to be punishing to manage). Additionally, other important aspects of market dynamism such as velocity, complexity, and ambiguity, have their own effects on performance.

This dynamic interplay suggests an adaptive view of organisations and strategies, importantly it suggests complexity logic to aid in explaining adaptation in the context of the trade-offs between flexibility and efficiency in dynamic environments. The structure challenge highlighted appears across a few organisational studies (Amabile, 1996); group problem solving (Bigley and Roberts, 2001; Okhuysen and Eisenhardt, 2002), organisational transformation (Tripsas, 1997; Galunic and Eisenhardt, 2001). Business units, for example, can autonomously experiment and adapt to their environment (Tripsas, 1997; Schilling and Steensma, 2001; Gilbert, 2005) and shield other units from the turbulence experienced (Cameron, Kim, and Whetten, 1987; Krackhardt, 1992; Tushman and O'Reilly, 1996). Collectively, this research demonstrates how structure influences organisational outcomes (Weick, 1993; Eisenhardt and Tabrizi, 1995; Hatch, 1998; Weick, 1998; Miner, et al., 2001).

This research indicates that starting with too much structure works adversely in terms of innovative outcomes, conversely, however the problem of having too little organising structure can be dangerous (Weick's (1993)). From a network research viewpoint, it



seems to suggest that an organisation's network of relationships creates unique structural constraints and opportunities, which in turn profoundly effect organizational outcomes (Galaskiewicz, 1985; Powell, 1990; Fligstein, 2001). Computational studies find that these networks are easily searchable and tolerant to high degrees of connectivity error because of built-in redundant connections (Albert, Jeong, and Barabasi, 2000; Watts, Dodds, and Newman, 2002). Taken together, research in network sociology illustrates that moderately structured networks produce superior outcomes for both organisations and networks.

Studies of strategy in dynamic markets (Mintzberg and Waters, 1982; Mintzberg and McHugh, 1985; Burgelman 1994), are also concerned with the effects of structure on performance, with early work focusing on the importance of the balance between "deliberate strategies" (top-down, coherent, and organised), versus "emergent strategy" (arising spontaneously, bottom-up, and less structured).

Similarly, Burgelman (1996) describes the simple-rules strategy at Intel (e.g., adherence to the rule allowed Intel to shift from DRAMs to microprocessors without the explicit intervention of the firm's senior executives). Rindova and Kotha (2001) reveals how Yahoo! managers used three partnership rules to help capture new opportunities in the emergent Internet industry (e.g., basic service or product must be free; do a deal only if it enhances the customer experience; and make no exclusive deals). These three modest rules provided coherence and direction about the alliance process, yet did not prescribe the types of alliances that needed to be formed, allowing managers flexibility to pursue a variety of partnerships depending on the opportunities, migrating the company from a search engine to interactive services such as auctions and e-commerce.



These case studies indicate moderate structure to be associated with high performance. Thus, an emerging perspective on strategy in dynamic markets suggests that, as markets become more dynamic, success is likely from loose capabilities that remain purposefully simple (Eisenhardt and Martin, 2000).

Complexity theory seeks to understand how system level adaptation to the environment emerges from the actions of its agents (Anderson, 1999; Eisenhardt and Bhatia, 2002). A counter-intuitive feature of complexity theory is that systems composed of a few simple structures give rise to adaptive behavior (Prigogine and Stengers, 1984; Reynolds, 1987; Kauffman, 1989; Langton, 1992). By condensing learning about the environment into simple structures (simple rules or schemata) such systems create a balance of order and disorder, enabling adaptation (Holland, 1992; Gell-Mann, 1994). Kauffman (1993) notes, systems exhibiting such behaviors, often called complex adaptive systems (CAS).

Several features of complex adaptive systems are particularly useful in understanding the tension between too much and too little structure, i.e.. the adoption of simple rules or schemata for effective adaptation. An example is Reynolds (1987) computer simulation, highlighting systems composed of very simple rules could produce the adaptive flocking behavior that is observed in bird migration (rules were simple in that the number of rules was small – i.e., only 3 rules to produce the behavior; each rule guided only a few, direct actions such as, if too close to another bird, then the bird should move away by a fixed amount).



Conclusion

Important research literature, suggest a moderate amount of structure leads to higher performance (Kauffman, 1993; Gell-Mann, 1994). The logic that underlies these observations and are consistent with research in organisational studies, network sociology, strategy, and complexity theory, all suggesting over-structured systems constrain behavior by impeding improvisational response to dynamic environments (Weick, 1976; Reynolds, 1987; Langton, 1992; Kauffman, 1993), while systems that are under-structured lack the coherence to efficiently respond to changes in these environments (Brown and Eisenhardt, 1998; Weick, 1998). This points to the existence of an optimal level of organisational structure. Simpler structures are useful because they are applicable to a broad array of opportunities (Brown and Eisenhardt, 1998; Rowley et al., 2000), and enable improvised actions for capturing opportunity (Miner, et al, 2001; Rindova and Kotha, 2001). Conversely, as environmental dynamism decreases, more structure seem to become more effective (Miller and Shamsie, 1996). In these settings, managers can have complicated or dense structures because change takes place infrequently and often incrementally (Tushman and Anderson, 1986; Miller and Shamsie, 1996; Siggelkow, 2001). The environment as a dynamic flow of opportunities are characterised by key dimensions of, velocity, complexity, ambiguity, and unpredictability ((D'Aveni, 1994; Grant, 1996; Eisenhardt and Tabrizi, 1995; Rindova and Kotha, 2001). Where:

- ① Velocity: rapidity of information or opportunity flow (e.g., Hickson, et al., 1986; Eisenhardt, 1989; Eisenhardt and Tabrizi, 1995).
- ① Complexity: degree of features that must be successfully executed such as institutional norms (DiMaggio and Powell, 1983; Dill, 1958; Tyre and Orlikowski, 1993).
- ① Unpredictabilit: the degree of dissimilarity of opportunities (Dess and Beard, 1984; Baum and Wally, 1999).



- ① **Ambiguity:** the degree of difficulty to interpret opportunity, thus being equivocal, and difficult to perceive (March and Olsen, 1976; Hickson, et al., 1986; Santos and Eisenhardt, 2006).

Organisational rules can be perceived as structure, e.g., the modeling of organisational rules for capturing opportunities. Eisenhardt and Sull (2001), propose five types of rules: boundary, priority, how-to, timing, and exit rules. These rule types also appear in empirical research (Bingham and Eisenhardt, 2005), and also appear in the literature on dynamic environments (Burgelman, 1994; 1996; Gersick, 1994; Galunic and Eisenhardt, 1996; Brown and Eisenhardt, 1997; Rindova and Kotha, 2001; Miner et al, 2001). Each rule informs what actions are taken with respect to opportunities, e.g. which opportunities are chosen (boundary rules); in what order (priority rules); implementation or execution (how-to rules); number opportunities to tackle at a time (timing rules); when to halt (exit rules). This is likened to having a framework of rules, wherein which efficient and flexible action occurs (Weick, 1998).

Making the rules work

Boundary rules informs leaders which opportunities to pursue, thus defining the scope of opportunities within which firms operate (Santos and Eisenhardt, 2005). March & Simon (1958) cites pharmaceutical companies using such rules for drug development opportunities, often even framed as in/then statements e.g., “If the drug development opportunity is (1) within cardiology, and (2) has at least a \$90 million/year projected market, and (3) for which at least one senior scientist has related experience, then consider the opportunity.”



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An example of a priority rule is Intel's rule for allocating manufacturing capacity weighed against their semiconductor products (opportunities), according to profit margins (Burgelman, 1996). How-to rules specify the actions for executing the opportunities, and are most visible in a variety of opportunities embedded in areas such as manufacturing, sales, mergers and acquisitions. Effective operationalisation of how-to rules (i.e., heuristics specify actions for executing opportunities), captures the idea that certain actions are specified by the rules, whilst others are left open to real-time improvisation (Brown and Eisenhardt, 1997; Miner, et al., 2001). Timing rules inform the number of opportunities a firm can attend to at any point, and are found in several studies of organisational processes in dynamic environments, e.g., Brown and Eisenhardt (1997) found managers use timing rules to pace the execution of multiple product development opportunities according to a temporal rhythm, such as say, 1 new product every 9 months. Similarly, Gersick (1994) finds that entrepreneurs use timing rules to delimit the opportunities that are simultaneously addressed.

Exit rules indicate when to stop the execution of an opportunity (e.g., halting or eliminating fading opportunities early on, is critical for firms since it frees up resources for capturing new opportunities (Burgelman, 1994).



References:

Albert, Reika, Hawoong Jeong, and Albert-Laszlo Barabasi, 2000 "Error and attack tolerance of complex networks." *Nature*, 406: 378-382.

Anderson, Philip, 1999 "Complexity Theory and Organization Science." *Organization Science*, 10: 216-232.

Arthur, W. Brian 1994 *Increasing Returns and Path Dependency in the Economy*. Ann Arbor, MI: U of Michigan Press.

Baum, J. A. C., and S Wally, 1999 "Dynamics of dyadic competitive interaction." *Strategic Management Journal*, 24: 1107-1129.

Bingham, Christopher B., and Kathleen M. Eisenhardt, 2005 "Unveiling the creation and content of strategic processes: How and what firms learn from heterogeneous experience." University of Maryland working paper.

Birkinshaw, Julian, and Neil Hood, 1998 "Multinational subsidiary evolution: Capability and charter change in foreign-owned subsidiary companies." *Academy of Management Review*, 23: 773-795.

Bowman, E., and Constance E. Helfat, 2001 "Does corporate strategy matter?" *Strategic Management Journal*, 22: 1-23.

Bradach, Jeffrey L., 1997 "Using the plural form in the management of restaurant chains." *Administrative Science Quarterly*, 42: 276-304.

Brown, Shona L., and Kathleen Eisenhardt, 1998 *Competing on the Edge -Strategy as*



Structured Chaos. Boston, MA: Harvard Business School Press.

Brown, Shona L., and Kathleen M. Eisenhardt, 1997 "The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations." *Administrative Science Quarterly*, 42: 1-34.

Burgelman, Robert A., 1994 "Fading Memories: A Process Theory of Strategic Business Exit in Dynamic Environments." *Administrative Science Quarterly*, 39: 24-56.

Burns, Tom, and G. M. Stalker, 1961 *The management of innovation*. London: Tavistock.

Burt, Ronald, 1992 *Structural Holes*. Cambridge: Harvard University Press.

Burton, Richard M., 2003 "Building Computational Laboratories for Organization Science: Questions, Validity, and Docking." *Computational & Mathematical Organisation Theory*, 9: 91-108.

Burton, Richard M., and Borge Obel, 1995 "The Validity of Computational Models in Organization Science: From Model Realism to Purpose of the Model." *Computational and Mathematical Organization Theory*, 1: 57-72.

Cameron, Kim, M Kim, and D. Whetten, 1987 "Organizational effects of decline and turbulence." *Administrative Science Quarterly*, 32: 222-240.

Carroll, Tim N. and Richard M. Burton Complexity, 1987 "Searching for the Edge of Chaos." *Computational & Mathematical Organization Theory*, 6: 319-337.

Cyert, R. M., and James G. March, 1963 *A Behavioral Theory of the Firm*. Englewood



Cliffs, NJ: Prentice-Hall.

D'Aveni, Richard A., 1994 *Hyper competition: Managing the Dynamics of Strategic Maneuvering*. New York: The Free Press.

Davis, Jason, Christopher B. Bingham, and Kathleen Eisenhardt, 2006 "Developing Theory Through Simulation Methods." *Academy of Management Review*, forthcoming.

Davis, J., J.P., Eisenhardt, K.M, and Bingham. C.B., 2006, *Complexity Theory, Market Dynamism, and the Strategy of Simple Rules*, Working paper edition

Dess, Gregory, and D Beard, 1984 "Dimensions of organisational task environments." *Administrative Science Quarterly*, 29.

DiMaggio, Paul J., and Walter W. Powell, 1983 "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review*, 48: 147-160.

Eisenhardt, Kathleen M., 1989 "Making Fast Strategic Decisions in High-Velocity Environments." *Academy of Management Journal*, 32: 543-576.

Eisenhardt, Kathleen M. and Mahesh Bhatia, 2002 "Organizational Computation and Complexity." In *Companion to Organizations*, Joel Baum (Ed.), Blackwell Business, Oxford UK.

Eisenhardt, Kathleen M. and Christopher B. Bingham, 2006 "Disentangling Resources from the Resource-based View: A Typology of Strategic Logics and Competitive Advantage." *Managerial and Decision Economics*, forthcoming.



Eisenhardt, Kathleen, and Jeffrey A. Martin, 2000 "Dynamic capabilities: What are they?" *Strategic Management Journal*, 21: 1105-1121.

Eisenhardt, Kathleen M. and Claudia Bird Schoonhoven, 1990 "Organizational Growth: Linking Founding Team, Strategy, Environment and Growth among U.S. Semiconductor Ventures, 1978-1988." *Administrative Science Quarterly*, 35: 504-529.

Eisenhardt, Kathleen, and Donald Sull, 2001 "Strategy as Simple Rules." *Harvard Business Review*, Jan-Feb.

Eisenhardt, Kathleen, and Behnam Tabrizi, 1995 "Accelerating Adaptive Processes: Product Innovation in the Global Computer Industry." *Administrative Science Quarterly*, 40: 84-110.

Feldman, M. S., and Brian T Pentland, 2003 "Reconceptualizing Organizational Routines as a Source of Flexibility and Change." *Administrative Science Quarterly*, 48: 94-118.

Fligstein, Neil, 2001 *The Architecture of Markets: An Economic Sociology of Twenty-first Century Capitalist Societies*. Princeton, NJ: Princeton University Press.

Galaskiewicz, Joseph, 1985 "Interorganizational Relations." *Annual Review of Sociology*, 11: 281-304.

Galbraith, Jay, 1974 "Organization Design: An Information Processing View." *Interfaces*, 4: 28-36.



Galunic, Charles, and Kathleen M. Eisenhardt, 2001 "Architectural Innovation and Modular Corporate Forms." *Academy of Management Journal*, 44: 1229-1250.

Galunic, D. Charles, and Kathleen M. Eisenhardt, 1996 "The evolution of intracorporate domains: Divisional charter losses in high-technology, multidivisional corporations." *Organization Science*, 7: 255-282.

Gavetti, G., Dan Levinthal, and Jan W. Rivkin, 2005 "Strategy making in novel and complex worlds: the power of analogy." *Strategic Management Journal*, 26: 691-712.

Gell-Mann, Murray, 1994 *The Quark and the Jaguar: Adventures in the Simple and the Complex*. New York: WH Freeman.

Gersick, Connie J. G., 1994 "Pacing Strategic Change: The Case of a New Venture." *Academy of Management Journal*, 37: 9-45.

Gilbert, Clark., 2005, "Unbundling the Structure of Inertia: Resource vs. Routine Rigidity." *Academy of Management Journal* 48, no. 5 (October 2005): 741-763.

Glynn, Peter, and Ward Whitt, 1992 "The Asymptotic Efficiency of Simulation Estimators." *Operations Research*, 40: 505-520.

Goldfarb, B, David A. Kirsch, and D. Miller, 2005 "Was There Too Little Entry During the Dot Com Era." Working Paper

Grant, Robert M., 1996 "Prospering in Dynamically-competitive Environments: Organizational Capability as Knowledge Integration." *Organization Science*, 7: 375-387.

Hannan, Michael T., and John Freeman, 1984 "Structural Inertia and Organizational



Change." *American Sociological Review*, 49: 149-164.

Hansen, Morten T., 1999 "The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge Across Organizational Subunits." *Administrative Science Quarterly*, 44: 82-111.

Hargadon, Andrew, 2003 *How Breakthroughs happen: The Surprising Truth about how Companies Innovate*. Cambridge, MA: Harvard Business School Press.

Hargadon, Andrew and Robert I. Sutton, 1997 "Technology Brokering and Innovation in a Product Development." *Administrative Science Quarterly*, 42: 716-749.

Hatch, M. J., 1998 "Jazz as a metaphor for organizing in the 21st century." *Organization Science*, 9: 556-557.

Haveman, Heather A., 1992 "Between a Rock and a Hard Place: Organizational Change and Performance under Conditions of Fundamental environmental Transformation." *Administrative Science Quarterly*, 37: 48-75.

Hayek, F.A., 1945 "The use of knowledge in society." *American Economic Review*, 35: 519-530.

Henderson, Rebecca M., and Kim B. Clark, 1990 "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." *Administrative Science Quarterly*, 35: 9-30.

Hickson, D, R Butler, D Cray, G Mallory, and D Wilson, 1986 *Top Decisions: Strategic decision making in organizations*. San Francisco: Jossey-Bass.



Hill, Charles W. L., and F.T. Rothaermel, 2003 "The performance of incumbent firms in the face of radical technological innovation." *Academy of Management Review*, 28: 257-274.

Holland, J.H., 1992 *Adaptation in natural and artificial systems*, 2nd ed. ed. Cambridge, MA: MIT Press.

Karim, Samina and Will Mitchell, 2000 "Path-dependent and Path-breaking Change: Reconfiguring Business Resources Following Acquisitions in the U.S. Medical Sector, 1978-1995." *Strategic Management Journal*, 21: 1061-1081.

Katila, Riitta and Gautum Ahuja, 2002 "Something old, something new: A longitudinal study of search behavior and new product introduction", *Academy of Management Journal*, 45(6): 1183-1194.

Kauffman, Stuart, 1989 "Adaptation on rugged fitness landscapes." In E. Stein (ed.), *Lectures in the Science of Complexity*. Reading, Mass.: Addison-Wesley. 1993 *The Origins of Order*. New York, NY: Oxford University Press.

Kirzner, I., 1997 "Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach." *Journal of Economic Literature*, XXXV: 60-85.

Krackhardt, David, 1992 "The Strength of Strong Ties: The Importance of Philos in Organizations." In N. Nohria, and R. G. Eccles (eds.), *Networks and Organizations: Structure, Form, and Action*. Boston: Harvard Business School Press.

Langton, C., 1992 "Life at the edge of chaos." C. Langton, et al., (eds.), *Artificial Life II: Sante Fe Institute Studies in the Sciences of Complexity*: 41-91: Addison-Wesely.



Law, Averill M., and David W. Kelton, 1991 Simulation Modeling and Analysis, 2nd ed. New York, NY: McGraw-Hill.

Lawrence, Paul R., and Jay W. Lorsch, 1967 Organization and Environment: Managing Differentiation and Integration. Boston: Harvard University.

Leonard-Barton, Dorothy, 1992 "Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development." Strategic Management Journal, 13: 111-125.

Miller, Danny, and Peter H. Friesen, 1980 "Momentum and Revolution in Organizational Adaptation." Academy of Management Journal, 23: 591-614.

Mintzberg, Henry, and Alexandra McHugh, 1985 "Strategy Formation in an Adhocracy." Administrative Science Quarterly, 30: 160-197.

Mintzberg, Henry and Waters, 1982 "Tracking Strategy in an Entrepreneurial Firm." Academy of Management Journal, 25: 465-499.

Moorman, Christine, and Anne S. Miner, 1998 "Organizational Improvisation and Organizational Memory." Academy of Management Review, 23: 698-723.

Okhuysen, Gerardo Andres, and Kathleen M. Eisenhardt, 2002 "Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility." Organization Science, 13: 370-386.

Orton, J. Douglas, and Karl E. Weick, 1990 "Loosely Coupled Systems: A Reconceptualization." Academy of Management Review, 15: 203-223.



Porter, Michael E., 1996 "What is strategy?" Harvard Business Review, 74: 61-78.

Prigogine, Ilya, and I Stengers, 1984 Order Out of Chaos: Man's New Dialog With Nature. New York.

Reynolds, C. W., 1987 "Flocks, Herds, and Schools: A Distributed Behavioral Model, in Computer Graphics." SIGGRAPH '87: 25-34.

Rindova, Violina, and Suresh Kotha, 2001 "Continuous Morphing: Competing through Dynamic Capabilities, Form, and Function." Academy of Management Journal, 44: 1263-1280.

Rivkin, Jan, W., 2000 "Imitation of Complex Strategies." Management Science, 46: 824-844.

Rivkin, Jan W., and Nicolaj Siggelkow, 2003 "Balancing Search and Stability: Interdependencies Among Elements of Organizational Design." Management Science, 49: 290-311.

Roberts, Peter W., 1999 "Product Innovation, Product-Market Competition and Persistent Profitability in the U.S. Pharmaceutical Industry." Strategic Management Journal, 20: 655-670.

Roberts, Peter W., and Kathleen Eisenhardt, 2003 "Austrian insights on strategic organization: from market insights to implications for firms." Strategic Organization, 1: 345-352.

Rowley, T.J., D. Behrens, and David Krackhardt, 2000 "Redundant governance structures: An analysis of structural and relational embeddedness in the steel and



semiconductor industries." *Strategic Management Journal*, 21: 369-386.

Rudolph, Jenny, and Nelson Reppenning, 2002 "Disaster Dynamics: Understanding the Role of Quantity in Organizational Collapse." *Administrative Science Quarterly*, 47: 1-30.

Santos, Filipe M, and Kathleen Eisenhardt, 2006 "Constructing Niches and Shaping Boundaries: Entrepreneurial Action in Nascent Fields." Working Paper INSEAD.

Santos, Filipe M., and Kathleen M. Eisenhardt, 2005 "Organizational boundaries and theories of organization." *Organization Science*, 16: 491-508.

Schumpeter, Joseph A., 1934 *The theory of economic development*, 7 ed. Cambridge, Massachusetts: Harvard University Press.

Scott, W. Richard, 2003 *Organizations: Rational, Natural and Open Systems*, 5th ed. Upper Saddle River, NJ: Prentice Hall.

Selznick, Philip, 1957 *Leadership and Administration*. New York: Harper & Row.

Simon, Herbert A., 1962 "The Architecture of Complexity." *Proc. Amer. Philos. Soc.*, 106: 467-482. 1996 *Sciences of the Artificial*, 3rd ed. Cambridge: MIT Press.

Stinchcombe, Arthur L., 1965 "Social Structure and Organizations." In J. G. March (ed.), *Handbook of Organizations*: 142-193. Chicago: Rand McNally & Company.

Strogatz, Steven, 2001 *Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering*: Perseus Books Group.

Tripsas, Mary, and Giovanni Gavetti, 2000 "Capabilities, Cognition and Inertia: Evidence



from Digital Imaging." *Strategic Management Journal*, 21: 1147-1162.

Tushman, Michael, and Charles A. O Reilly, III, 1996 "Ambidextrous organizations: Managing evolutionary and revolutionary change." *California Management Review*, 38: 8-30.

Uzzi, Brian, 1997 "Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness." *Administrative Science Quarterly*, 42: 36-67.

Uzzi, Brian, and Jarrett Spiro, 2005 "Collaboration and Creativity: The Small World Problem." *American Journal of Sociology* (Forthcoming).

Vermuelen, Freek and Harry Barkema, 2002 "Pace, Rhythm, and Scope: Process Dependence in Building a Profitable Multinational Corporation." *Strategic Management Journal*, 23: 637-653.

Watts, Duncan, Peter Sheridan Dodds, and M.E.J. Newman, 2002 "Identity and Search in Social Networks." *Science*, 296: 1302-1305.

Weick, Karl E., 1976 "Educational Organizations as loosely coupled systems." *Administrative Science Quarterly*, 21: 1-19. 1993 "The Collapse of Sensemaking in Organizations: The Mann Gulch Disaster." *Administrative Science Quarterly*, 38: 628-652. 1998 "Improvisation as a Mindset." *Organization Science*, 9: 543-555.

Weick, Karl E., and Karlene H. Roberts, 1993 "Collective Minds in Organizations: Heedful Interrelating on Flight Decks." *Administrative Science Quarterly*, 38: 357-381.