



Integrating evolution, cognition and design: extending Simonian perspectives to strategic organization

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Abstract

Several streams of research in strategic management and organizational theory build upon the early work of Herbert Simon. Yet, as content analyses of articles published in leading management journals show, key ideas from his later years are for the most part either neglected or misinterpreted. We bring to strategic organization three constructs from Simon's later work and make a case for their use in future research in strategic organization in general and entrepreneurship in particular: docility, a fundamental behavioral assumption in lieu of opportunism or embedded networks of trust; near-decomposability, an evolutionarily robust structural feature that permeates nature's designs; and artifacts, products of human design that reshape local environments and/or help select between them to create and achieve human purposes. Each of these constructs embodies a uniquely Simonian integration of evolution, cognition and design. Together they enable us to conceptualize empirical phenomena as thick three-dimensional reality rather than abstractions entailed by any one of these perspectives alone.

Key words • altruism • behavioral theory • decomposability • design • strategic management

Several notable scholars of strategic management and organization theory have observed and utilized important connections between issues in strategic organization and the behavioral ideas of Herbert Simon, James March and Richard Cyert. For instance, Rumelt et al. (1994: 2) note that 'much of the modern stream of thinking about [strategic] management has its origins in the Carnegie School's "behavioral" model of the firm'. Winter (2000) uses Simon's ideas on satisficing and dynamic aspiration levels to suggest an ecological and evolutionary perspective. The learning perspective developed by March (1991, 1992) and Levinthal and March (1993) also, not surprisingly, incorporates the heart of the ideas of the behavioral theory of the firm, as well as the Carnegie School's inspirations from cognitive science. Even the transaction cost-based (or governance-based) view of strategic organization is explicitly built on behavioral views of

bounded rationality, and maintains the Carnegie spirit of seeing strategic organization as an inherently interdisciplinary enterprise (Williamson, 1999).

Scholars in the tradition of dynamic capabilities have pointed to ideas on learning as significant elements in our understanding of organizational capabilities (Teece and Pisano, 1994; Teece et al., 1997: 520). Recently, insights from the behavioral perspective have also been used to develop a critique of the resource-based view of strategy.¹ For instance, Bromiley and his colleagues (Bromiley and Fleming, 2002; Bromiley and Papenhausen, 2003) argue that perspectives based on the behavioral theory of the firm offer important insights into the development of a theory of strategy which can accommodate ideas such as market disequilibrium, firms' behavior and the interaction of firms in markets.

Although Simon's arguments about bounded rationality underpin so many of the fundamental theoretical approaches to strategy, more recent aspects of Simon's work have largely been ignored.² In particular, Simon's unique integration of evolution, cognition and design in specific constructs relevant for organizational decision-making has either been bypassed or narrowly interpreted. Even his ideas explicitly directed toward the field (1993) have not received much attention. Perhaps every science must, sooner or later, outgrow its Newton; we hope to show here, however, that paying attention to the second half of Simon's oeuvre can open up new paths in our scholarship.

We begin by reviewing his later work and explicating three concepts, each of which incorporates an integrated framework of evolution, cognition, and design. The three concepts we will examine are: docility, a fundamental behavioral assumption in lieu of opportunism or embedded networks of trust; near-decomposability (ND), an evolutionarily robust structural feature that permeates nature's designs; and artifacts, products of human design, planned and unplanned, that reshape local environments and/or help select between them to achieve human purposes. Our examination of these three concepts includes citation and content analyses of management literature to show how Simon's ideas have been used (and misused) in the field. We also develop key implications of the three concepts including specific propositions for future research and in particular, a research agenda that connects entrepreneurship to strategic organization.

Simon on strategic organization: key themes and their impact

In 1993, Simon published an article in *Strategic Management Journal (SMJ)* titled 'Strategy and Organizational Evolution'. The abstract of the article, reproduced below, captures the essential themes of his work that are of direct import to strategic organization. It also highlights key ideas that constitute a large portion of his later work, the core of which is listed in Appendix 1:

A business firm's 'niche' or comparative advantage typically has a half-life of years rather than decades. Strategic planning must assure a stream of new ideas that allow the firm to find new sources of comparative advantage. Strategic planning must focus attention on the initial stages of the decision-making processes – opportunities and occasions for choice, and the design of new action strategies for products, marketing, and financing. Product identification and alternative generation are crucial components of strategy. Strategic thinking must permeate the entire organization. Effective identification of employees with the organization's strategy requires their exposure to the basic postulates that underlie strategic plans.

In Figure 1, we combine the key ideas and structure of his argument from the article into a diagram. The figure incorporates themes in his research as they apply to strategic management.

Simon viewed human cognition as being rooted in and shaped by biological evolution, yet capable of designing a world of artifacts that in turn constitute a large part of the environment in which these artifacts evolve. In particular, he developed the three constructs – docility, ND and artifact – that cut across and integrate evolution, cognition and design in human activities. Few scholars would dispute the importance of these three specific constructs, which for Simon embody the linkages between evolution, cognition and design; fewer still would quarrel with his broad conceptualization of evolution, cognition and design as being continually interconnected in all important human activities. Yet when we examine the impact of his 1993 SMJ article on the field, and the use of these three constructs and their attendant concepts, we find a surprising dearth of interest and more misuse than use.

A citation analysis using ISI's Web of Science yielded eight citations to Simon (1993). A content analysis of these articles is summarized in Appendix 2. Five of the articles are theoretical and three are empirical. One of the theoretical articles, Ogilvie (1998) includes the article in its references, but does not actually refer to the article in the text. Two other theoretical papers (Liedtka, 2000; Szulanski and Amin, 2001) focus on 'design.' They suggest reformulating strategic management as a creative activity that emphasizes the generation of alternatives rather than just alternative evaluation. The remaining two (Van Krogh and Roos, 1996; Mehra and Floyd, 1998) refer to specific elements of Simon's focus on 'cognition.' Among the empirical articles, one, Hobday (1998), includes Simon (1993) in a long list of 'renowned' writers who focus on the firm as a unit of analysis. The two others pertain to cognition (McConaughy et al., 2001) and evolution (Ingram and Baum, 1997), with the former offering a passing mention and the latter pointing to his argument for the inherent transience of all comparative advantages. Thus, only two of the articles, Liedtka (2000) and Szulanski and Amin (2001), make a serious attempt to build on Simon's ideas. Neither, however, is published in a mainstream management journal, focuses on his entwined vision of evolution, cognition and design, or mentions the three constructs we wish to highlight for future strategic organization research.

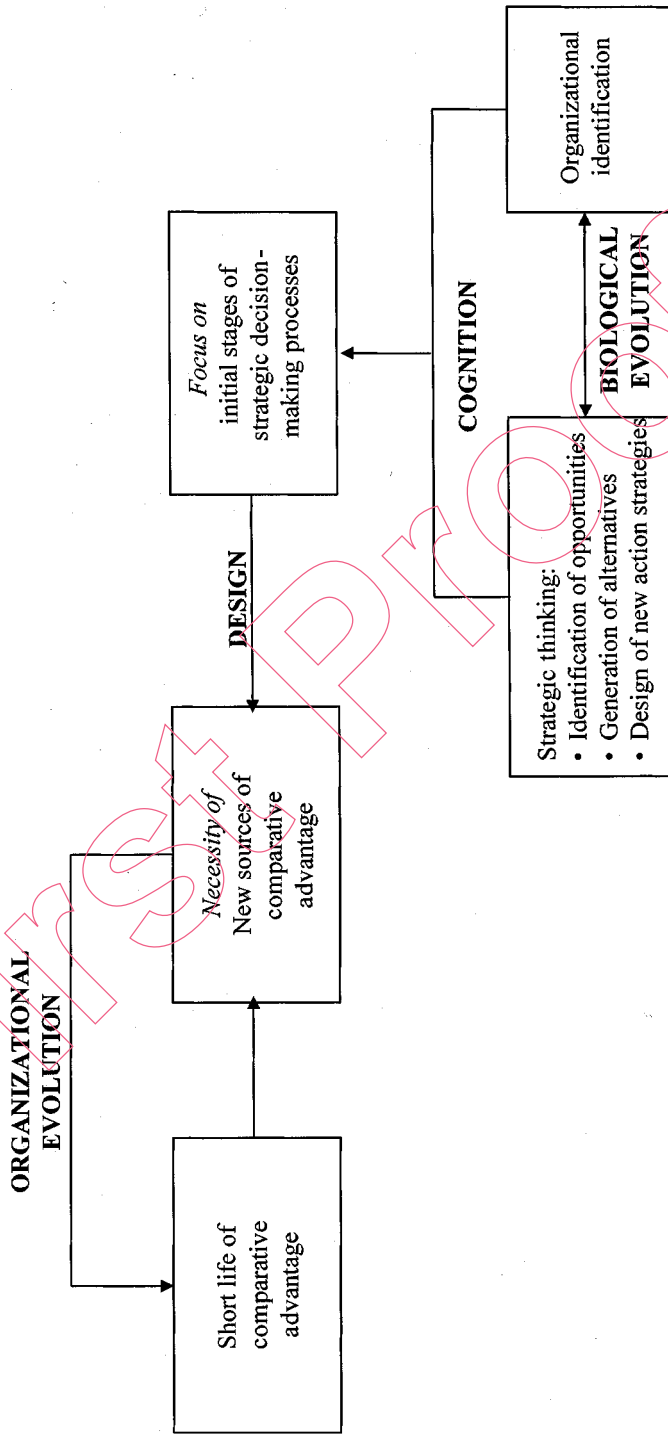


Figure 1 Integration of evolution, cognition and design in Simon's work

Table 1 presents the results of a citation analysis of six top-tier management journals between 1993 and 2003.³ Over 60 percent of all references to Simon's work cite either *Administrative Behavior* (Simon, 1947) or *Organizations* (March and Simon, 1958). And the other 40 percent do not refer to the works we focus on here. Only *Sciences of the Artificial* (Simon, 1969[1996]) appears to have had some impact, accounting for 6 percent of his citations in these journals. Although it is certainly clear that scholars in strategic management and organization theory continue to incorporate Simon's ideas on bounded rationality and satisficing, very few appear to be building on his other work that speaks directly to strategic organization.

In Table 2 we summarize the results of a keyword search of articles published in the same six management journals.⁴ In these journals, the keywords 'docility', 'ND', and 'artifact' appeared in a total of 11, 5 and 76 articles, respectively. In *SMJ*, there is only one mention of ND and none of either docility or artifact. While the term 'artificial' fares better, with 10 appearances in *SMJ* and 67 overall, a closer look at these articles is less heartening. The great majority of citations to Simon's *Sciences of the Artificial* consist of tangential mentions, few referring directly to specific ideas in the book. We now turn to a qualitative content analysis of each of these concepts and their impact on strategic management. Notably, despite the strong integrative force in all of Simon's work that weaves these three constructs together, no single article mentions them jointly.

When we included a variety of concepts related to the three main constructs (e.g. identity, identification, modularity) in the keyword search, the citation count increased considerably. But closer inspection of the articles suggested the following.

- 1 Scholars interested in issues relating to altruism and organizational identification ignore docility.
- 2 ND is almost always interpreted as 'modularity'.
- 3 Roughly half the articles related to design mention *Sciences of the Artificial*.

Our conclusion from this examination of the literature is that docility, ND and artifact have, for the most part, been neglected in strategic management and organization theory.

One possible reason for the scant attention paid to the ideas we are highlighting here could be the relatively limited role allotted to individual decision-making in current strategic management and organization theory. Scholarship in strategic organization is overwhelmingly driven by structural perspectives such as evolutionary economics, organizational ecology, industrial organization and a variety of sub-disciplines from sociology, including network theory and social movement theory. For example, notions of role and network structures that are central in the work on markets by White (1981) have different conceptions of information from that of Simon and the Carnegie School. Similarly, notions of isomorphism frequently invoked in studies of adoption/diffusion and competitive behavior were not derived from work on managerial decision-

Table 1 Analysis of citations to Simon in top management publications, 1993–2003

| Title of cited work (co-authored by Simon) | Year | Journal | SMJ | AMJ | AMR | ASQ | MS | OS | Total | % |
|---|------|------------|-----|-----|-----|-----|----|----|-------|-----|
| Organizations | 1958 | Book | 25 | 30 | 51 | 37 | 9 | 33 | 185 | 41 |
| Administrative Behavior | 1947 | Book | 13 | 9 | 27 | 16 | 3 | 15 | 83 | 19 |
| Sciences of the Artificial | 1969 | Book | 2 | 1 | 1 | 5 | 8 | 8 | 25 | 6 |
| With Dearborn – Selective Perception | 1958 | Sociometry | 2 | 6 | 8 | 3 | 0 | 2 | 21 | 5 |
| A behavioral Model of Rational Choice | 1955 | OIE | 5 | 1 | 4 | 6 | 2 | 1 | 19 | 4 |
| Architecture of Complexity | 1962 | APS Proc | 2 | 1 | 1 | 3 | 4 | 1 | 12 | 3 |
| Organizations and Markets | 1991 | JEP | 2 | 1 | 5 | 2 | 0 | 2 | 12 | 3 |
| Bounded Rationality and Organizational Learning | 1991 | Org Sc | 1 | 4 | 3 | 2 | 0 | 2 | 12 | 3 |
| Models of Man | 1957 | Book | 1 | 0 | 3 | 3 | 3 | 1 | 11 | 2 |
| On the Concept of Organizational Goals | 1964 | ASQ | 1 | 1 | 1 | 0 | 0 | 2 | 5 | 1 |
| With Ijiri: Skew Distributions and the Sizes of Business Firms | 1977 | Book | 3 | 0 | 0 | 0 | 0 | 1 | 4 | 1 |
| Rational Choice and the Structure of the Environment | 1956 | Psych Rev | 0 | 0 | 0 | 2 | 1 | 0 | 3 | 1 |
| With Ericsson – Protocol Analysis | 1984 | Book | 0 | 2 | 1 | 0 | 0 | 0 | 3 | 1 |
| With Newell – Human Problem Solving | 1972 | Book | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 1 |
| A Mechanism for Social Selection and Successful Altruism | 1990 | Science | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 |
| Rationality as Process and as Product of Thought | 1978 | AER | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 |
| Designing Organizations for an Information-rich World | 1997 | Bk. Chap. | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 0 |
| The New Science of Management Decision | 1960 | Book | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 |
| What is an 'Explanation' of Behavior? | 1992 | Psych Sc | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 |
| With Chase – Perceptions in Chess | 1973 | Cog Psych | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0 |
| With Guetzkow – The Impact of Certain Communication Nets | 1955 | Mgt Sc | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 |
| With Prietula – The Experts in Your Midst | 1989 | HBR | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 |
| Models of My Life | 1991 | Book | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 0 |
| Theories of Decision-making in Economics and Behavioral Science | 1959 | AER | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 |
| Other articles, cited only once | | | 59 | 59 | 110 | 85 | 34 | 71 | 448 | 100 |
| Total | | | 59 | 59 | 110 | 85 | 34 | 71 | 448 | 100 |

Table 2 Key word search of articles published in top-tier management journals, 1993–2003

| | Individual concepts | | | | | | | | | | |
|-------|---------------------|----------|-------------|----------|----------------|----|------------|----------|------------|--------|--|
| | Docility | Altruism | Opportunism | Identity | Identification | ND | Modularity | Artifact | Artificial | Design | |
| AMI | 1 | 5 | 2 | 9 | 9 | 0 | 0 | 14 | 2 | 12 | |
| AMI% | 9 | 13 | 9 | 18 | 9 | 0 | 0 | 10 | 1 | 18 | |
| AMR | 2 | 17 | 4 | 7 | 9 | 0 | 2 | 28 | 9 | 14 | |
| AMR% | 18 | 43 | 18 | 14 | 9 | 0 | 5 | 20 | 6 | 21 | |
| ASQ | 6 | 7 | 1 | 16 | 25 | 0 | 1 | 12 | 9 | 19 | |
| ASQ% | 55 | 18 | 5 | 32 | 24 | 0 | 3 | 9 | 6 | 28 | |
| MS | 0 | 1 | 2 | 6 | 32 | 2 | 20 | 8 | 25 | 58 | |
| MS% | 0 | 3 | 9 | 12 | 30 | 40 | 51 | 6 | 18 | 87 | |
| OS | 2 | 4 | 9 | 8 | 8 | 2 | 8 | 10 | 12 | 19 | |
| OS% | 18 | 10 | 41 | 16 | 8 | 40 | 21 | 7 | 9 | 28 | |
| SMI | 0 | 3 | 2 | 1 | 15 | 1 | 8 | 0 | 10 | 13 | |
| SMI% | 0 | 8 | 9 | 2 | 14 | 20 | 21 | 0 | 7 | 19 | |
| Total | 11 | 40 | 22 | 50 | 105 | 5 | 39 | 76 | 67 | 140 | |

Abbreviations

- ND Near-decomposability
- AMI Academy of Management Journal
- AMR Academy of Management Review
- ASQ Administrative Science Quarterly
- MS Management Science
- OS Organization Science
- SMI Strategic Management Journal

making and bounded rationality. Finally, notions of inertia and age-dependence, central to many contemporary studies of industry and firm evolution, entered the field through very different routes from Simonian cognition.⁵

Simon, however, continued to be adamant about the role of the individual's mind and intentions, even if they are shaped and influenced by biological evolution and social and cultural norms. For example, in a paper honoring March, he stated, 'All learning takes place inside individual human heads; an organization learns in only two ways: (a) by the learning of its members, or (b) by ingesting new members who have knowledge the organization didn't previously have' (Simon, 1991a: 125). This did not mean that he thought social perspectives were invalid; in fact, he emphasized their value in the very next paragraph. But he was explicitly unprepared to minimize the role of the individual or the impact of individual cognition on strategic organization. He recognized the role of the individual even in shaping and creating the larger socio-political and economic environment through the artifacts s/he designs. A closer examination of his theorizing in this regard can clarify his position.

Docility

In two papers and three lectures at Bocconi University in Italy, Simon (1991b, 1993b, 1997) introduced the concept of 'docility' and argued for its validity as an alternate behavioral assumption to opportunism. He defined docility as follows (1993: 156): 'By "docility" I mean *the tendency to depend on suggestions, recommendation, persuasion, and information obtained through social channels as a major basis of choice.*

Docility is thus a bidirectional inter-subjective construct. Unlike the colloquial usage of the term that may mean meekness or malleability, in Simon's definition all human beings are both persuasive and persuadable to varying degrees about various things. Thus 'docility' differs from a charismatic view of a leader and a follower; instead it explicitly emphasizes mutual influence in human interaction.

Evidentiary basis for docility, as opposed to the opportunism–altruism dichotomy

Simon uses arguments from biological and social evolution to establish docility as a more viable and useful assumption than opportunism in human interactions. In his own words (1993: 157),

Because of bounded rationality, docility contributes to the fitness of human beings in evolutionary competition. Furthermore, 'Behaving in this fashion contributes heavily to our fitness because (a) social influences will generally give us advice that is 'for our own good' and (b) the information on which this advice is based is far

better than the information we could gather independently. As a result, *people exhibit a very large measure of docility.*

He uses a computer simulation to show that in a world of boundedly rational and docile individuals, the intelligent altruist will come to dominate the population, and that evolutionary pressures will select out both the naïve altruist and the selfish opportunist.

Of course, Simon is not the only scholar to have argued against assumptions of opportunism in our theorizing. Moran and Ghoshal (1996) called into question the value of dichotomous formulations of opportunism and altruism; and Hill (1990) showed that under normal assumptions of neo-classical economics, the invisible hand of the market will tend to weed out persistently opportunistic behavior. A growing accumulation of empirical evidence (see Rabin, 1998 for a comprehensive review) also inveighs against unvarnished assumptions of opportunism. In fact, what we know about self-interest based on empirical evidence, both in the lab and in the field, suggests the following.

- 1 People are not solely or even predominantly self-interested; nor are they entirely altruistic.
- 2 The same person may be altruistic at certain times and opportunistic at others.
- 3 People who are opportunistic in one domain may be concurrently altruistic in another.

This level of variance both in situated and dynamic terms is further attested to by scholars who have examined the strength of ties in different types of social networks. For example, while Granovetter (1973) and Burt (1992) argued for and gathered evidence on the importance of weak ties in the creation and sustenance of competitive advantages for firms, Larson (1992) and Uzzi (1997) attest to the same advantages for strong ties. Hite (2003) argues the differential advantages of each depend on the stage in the life cycle of the firm.

It is becoming increasingly clear that neither the assumption of opportunism nor embedded networks of trust may serve as universal bedrocks on which to build our theories about human interaction. For such a fundamental assumption, we may need to turn to a construct that is rooted in biological evolution. Docility fits the bill in this regard, for while wealth is not linked to evolutionary fitness, docility is. As Simon points out (1993: 159), 'That economic actors desire only economic gain is a far stronger assumption than that they maximize utility. It is also empirically false . . . What motivates human choice is an empirical question, and neoclassical conclusions that derive from the dubious assumption that economic motives dominate must be reexamined'.

Besides the negative empirical evidence stacked against opportunism, there is also considerable positive evidence shoring up docility. This evidence suggests that human beings are indeed fundamentally prone to seeking and acting upon advice from others. In a recent review of laboratory work in behavioral economics, Schotter (2003: 196) concluded the following.

- 1 Laboratory subjects tend to follow the advice of naive advisers (i.e. advisers who are hardly more expert in the task at hand than they are).
- 2 This advice changes their behavior in the sense that subjects who play games or make decisions with naive advice play differently from those who play identical games without such advice.
- 3 The decisions made in games played with naive advice are closer to the predictions of economic theory than those made without it.
- 4 If given a choice between getting advice or the information upon which that advice was based, subjects tend to opt for the advice, indicating a kind of under-confidence in their decision-making abilities that is counter to the usual egocentric bias or overconfidence observed by psychologists.
- 5 The reason why advice increases efficiency or rationality is that the process of giving or receiving advice forces decision-makers to think about the problem they are facing in a way different from what they would do if no advice were offered.

Both the weight of the empirical evidence and the force of Simon's arguments support the following proposition for future research in strategic organization.

PROPOSITION 1 *While human beings may vary widely in their motivations, including opportunism, altruism and trust, they are fundamentally docile in their behavior – i.e., for the most part, most human beings seek and give advice; further, they use advice from others as a basis for their choices and actions.*

Docility, however, is also compellingly linked to the evolutionary dominance of intelligent altruism over economic or other types of opportunism. In particular, docility results in and is reinforced by group loyalty. One important and strategically relevant form of group loyalty is organizational identification in firms. As Simon (1993: 160) explains,

At the social level, the gradual change and selection of culture traits are producing patterns of information, advice, and resulting behavior that enhance the average fitness of members of the society; and because of docility, social evolution often induces altruistic behavior in individuals that has net advantage for average fitness in the society. Altruism includes influencing others to behave altruistically (1993: 157) . . . Regrettably, the 'new institutional economics' (Oliver E. Williamson, 1985) mostly ignores organizational identification as a powerful altruistic force that conditions both participants' goals and the cognitive models they form of their situations.

The direct link between docility and organizational identity suggests two further propositions.

PROPOSITION 2A *In organizations that create and maintain a strong sense of identity, members will tend to behave in an intelligently altruistic manner. This includes behavior in the absence of contracts and/or embedded networks of trust – i.e. even new members of the organization are highly likely to behave as intelligent altruists.*

PROPOSITION 2B *Organizations that seek to create and maintain a strong sense of identity will fabricate procedures and policies that assume and foster docility and intelligent altruism rather than invest in mechanisms to prevent and overcome opportunism, mechanisms such as formal contracts, and close monitoring of member behaviors.*

In sum, docility reduces certain transaction costs (such as contracting and monitoring costs) and enables strong organizational identities. A strong organizational identity in turn provides specific advantages that make the firm evolutionarily robust within changing environments as a result of the structural feature, ND.

Near-decomposability

Economic theories, as Simon and others have repeatedly argued, ignore multiple and conflicting motives by assuming that they can be collapsed into some ordered measure of economic gain. But as Simon points out, 'Human motives change over time, responding to experience and the surprises of history' (1993: 160). If so, what docile human beings count as important and meaningful, how their changing values and aspirations map on to particular individual and organizational goals (Simon, 1964) and how the mapping processes interact are all important areas for strategic decision-making. In particular, the intersection of changing human motives and changing environments has important implications for the identification and creation of opportunities for firms.

In a world of plural and changing human motives on the one hand, and the necessity for organizational identification on the other, organizational structures that tend to survive over time contain the important structural feature ND (Simon, 1962, 2002). In ND structures, first the short-term (high-frequency) behavior of each subsystem is approximately independent of the other subsystems at its level; and second, in the long run the (low-frequency) behavior of a subsystem depends on that of the other components only in an approximately aggregate way. ND confers evolutionary advantages to organizations because, in ND systems, each component can evolve towards greater fitness with little dependence upon the changes taking place in the details of other components. Yet the overall identity of the organism ensures that such evolutionary advantages translate into survival for the species.

Elements of ND (compared with modularity)

ND is not modularity. Studies of modularity have mostly modeled ND as something in the middle of a continuum consisting of complete decomposability at one end and complete unitary identity at the other. Witness, for example, Schilling (2000: 312):

Modularity is a general systems concept; it is a continuum describing the degree to which a system's components can be separated and recombined, and it refers both to the tightness of coupling between components and the degree to which the 'rules' of the system architecture enable (or prohibit) the mixing and matching of components. Since all systems are characterized by some degree of coupling (whether loose or tight) between components, and very few systems have components that are completely inseparable and cannot be recombined, almost all systems are, to some degree, modular.

Others use more general definitions such as 'a system's performance is dependent not only on the performance of constituent components but also on the extent to which they are compatible with one another' (Garud et al., 2002: 198). Simon's conception of ND differs from the definitions of modularity used in the management literature both in structure and function:⁶

Structure: gradualism or saltation

It is natural to place ND systems somewhere between the two endpoints of totally decomposable systems and totally connected systems. The fact that Simon liked to exemplify ND in terms of matrices (Simon and Ando, 1961) would seem to support this interpretation; diagonal matrices represent the class of totally decomposable systems low-bandwidth matrices are identified with ND systems, and dense/high-bandwidth matrices represent the class of totally connected systems.⁷ This we term the gradualist interpretation; it says that ND is a matter of degree, perhaps even measurable on a ratio scale. It asserts that the difference in the behavioral regimes of two systems at different points of the scale is a smooth function of the degree of ND. In this interpretation, lumpability (Kemeny and Snell, 1960: 123), ND and modularity are roughly interchangeable ideas.

But matrices can be deceptive. For example, the existence of the different phases of matter is not obvious if one studies the interaction matrices of solids, liquids and gases. Here we would find that the interaction matrices of gases are indeed denser than those of liquids, and they in turn are denser than solids. The strength of those interconnections, however, is another matter altogether. Here one does not find a gradual change from solid through liquid through gas to plasma. Of course, liquids can be compared with other liquids, and solids with solids or gases with gases, but a liquid and a solid are completely different things.⁸

The point is that the concept of ND survives this example of phases, but that of modeling ND by interconnection matrices really does not. We suggest that Simon's use of matrices to exemplify ND resulted in obscuring one of its essential aspects. Systems (like the phases of an element) are totally decomposable, nearly decomposable or totally non-decomposable. Each state can be characterized by interaction matrices but it is important to keep in mind that there are two factors at play: incidence (who is connected to whom) and intensity (how strong is the connection). While incidence is important, as the many

examples from catastrophe theory and the theory of dissipative systems show, gradual changes to system interactions can result in sudden shifts to new behavioral regimes. This idea, namely that maximally decomposable systems, ND systems and maximally connected systems are, like phases, characterized by entirely different behavioral regimes and that systems can jump in sequence from one to the other, we call the saltationist view of ND.

Was Simon a gradualist or saltationist? His example in the paper with Ando gives a gradualist example and involved arguments about heat diffusing through a set of insulated rooms. As the word 'diffusion' suggests, things happen gradually. But we think this is a case of the example wagging the theory dog. The example tries to illustrate two ideas: the unique behavioral aspects of ND as well as its connection to the two limiting cases. Unfortunately, the example's setting makes it difficult to see why ND is not just an exercise in lumped matrix theory.

It is clear, however, that Simon viewed ND systems as dynamically distinctive, which is difficult to maintain if the gradualism viewpoint holds, for there is no transition point beyond which the systems 'becomes' ND. For example, in a recent article, after presenting the familiar heat diffusion example, he asserts: 'As the example shows, ND systems have very special dynamic behavior' (Simon, 2002). Furthermore, his oft-repeated statements on ND as the key aspect of organizational hierarchies are consistent with the saltationist interpretation. Organizationally speaking, the ND hierarchy is as different from the interconnected network model and the independent agent model as liquid is from solid and gas.

In short, an unfortunate example (heat diffusion) in conjunction with over-reliance on a matrix representation of ND has led to a gradualist interpretation, with ND as a continuous variable between two extremes. The merits of a saltationist interpretation in which ND is to be interpreted as a third limiting case, rather than a continuity between the two, remain to be explored both conceptually as well as formally. Simon (2002) constitutes a useful jumping-off point in that endeavor.

Function: asymmetry in decomposition and recombination.

Besides the structural differences between ND and modularity, there also exist differences in functionality. In almost all uses of modularity in strategic management scholarship, there is an implicit assumption of symmetry between the 'decomposability' of the design and its 'recombinability'. To cite but one example (Langlois, 2002: 25):

Innovation that takes place through change in the modules we can call modular innovation (Langlois and Robertson, 1992: 301–2; Sanchez and Mahoney, 1996: 68–9). This is in contrast to what Henderson and Clark (1990) call architectural innovation, in which the parts remain the same but the architecture connecting them changes. Notice, however, that architectural innovation need not always imply a

change in the system's visible design rules: Legos and Tinkertoys are classic modular systems designed for architectural innovation. Here the architecture – the way the unchanging parts are recombined – can change without a fundamental change in the overall modularization. And, in fact, personal computers also benefit from the mix-and-match capabilities of a modular system that allow one to configure the system to taste as much as they do from improvement in the constituent modules.

In ND systems, in contrast, while decomposability is a necessary condition, recombability is not. Take the case of a franchise such as McDonald's. While the parent organization is decomposable into franchises, each of which can be customized to local environments (serving lamb rather than beef burgers in India, for instance) and closed without major repercussions to the organization as a whole, McDonald's is not constructed out of a collection of random mom-and-pop hamburger joints. That is because the identity of McDonald's matters in a variety of ways to the survival and health of both the individual franchises and the whole organization. Besides obvious gains to scale and substantial purchasing clout with suppliers that help keep costs down, there is an ineffable McDonald's experience that constitutes an important part of every individual franchise's demand function. This crucial role of identity is not a necessary aspect of modular systems. In this view, modularity is a special case of ND in which decomposition and recombination are symmetric properties of the design.

The notion of a unified organizational identity has important implications for designers of ND systems. An understanding of identity tells us where the 'lines of tearing' (to use a term Simon borrowed from the work of the brilliant engineer and eccentric, Gabriel Kron) should be. Every ND system could conceivably have multiple lines of tearing; that is, it can be decomposed in multiple ways into different pieces which the designer can recombine into the whole. Organization, a physicist might say, exists at different scales; and at each scale the system is ND. A passage from Simon (2002: 590) in this regard is revealing: 'The theory of near decomposability has been independently discovered several times and is widely used in engineering and science to facilitate the solutions of large systems of equations, especially those involving a wide range of temporal frequencies: for example in designing large electrical power grids (Kron's method of 'tearing') and in so-called 'renormalization' in quantum electrodynamics. ND systems are close relatives of fractals.'

The human body provides another good example of this asymmetry in terms of decomposition and recombination of parts, since individual organs may be removed or transplanted, but one cannot make a human being by assembling organs or other parts, and that is why it is an ND and not a modular system.

Evidentiary basis for ND (compared with modularity)

The structural property of ND has two implications for the evolution of complex systems.

First, if we begin with a set of simple elements that are capable sometimes of forming stable combinations, and if the combined systems thus formed are themselves capable of combining into still larger systems, then the complex systems we will observe after this process has proceeded for some time will almost all be ND systems. The universe as we observe it today provides ample evidence for this claim. The gradual evolution of the elements from primeval fundamental particles and hydrogen, then the evolution of successively complex molecules and living organisms, has observably produced ND systems with clearly defined particle, nuclear and atomic levels, and a whole sequence of molecular levels above the atomic. Moreover, it has been shown that the time available for the evolution of living organisms on earth is sufficient to produce organisms of the complexity that is actually observed (say, bacterial complexity) if the organisms and their subsystems are ND, but not if they must be completed by an uninterrupted sequence of unions of elementary components (Simon, 1969[1996]: 189).

Second, if we begin with a population of systems of comparable complexity, some of them ND and some not, but all having similar frequencies of mutation, the ND systems will increase their fitness through evolutionary processes much faster than the remaining systems, and will soon come to dominate the entire population. Notice that the claim is not that more complex systems will evolve more rapidly than less complex systems but that, at any level of complexity, ND systems will evolve much faster than systems of comparable complexity that are not ND. The connection between ND and rapid evolution is simple and direct. In ND systems, each component can evolve toward greater fitness with little dependence upon the changes taking place in the details of other components.

Simple mathematics (Simon, 2002) and recent simulations by Marengo et al. (1999) have shown that, if and only if these conditions hold, natural selection can take advantage of the random alterations of components with little concern for countervailing cross-effects between them. More recently, Simon and Sarasvathy (2000) and Sarasvathy (2003) have used evidence from cognitive processes used by expert entrepreneurs to show how they create ND organizations that then survive and grow rapidly into enduring new firms and markets. The evidence consists of think-aloud protocols from 27 expert entrepreneurs who were presented with exactly the same imaginary product and asked to make typical decisions that occur in a startup firm. Received wisdom suggests that these experts would identify the most promising market opportunities for the product and devise strategies to capture leading positions in those markets.⁹ In contrast to this, the subjects often ignored or rejected market research data. Instead they leveraged who they were, what they knew and whom they knew to construct very local and immediately implementable opportunities. They then imaginatively combined these initial segments with contingencies to stitch together meaningful identities that in turn pointed to new markets that neither they nor the market researchers could predict *ex ante*.¹⁰ In sum, the 27 subjects ended up building firms in 18 completely different industries.

Based on our exposition above, we can state the following propositions based on ND:

PROPOSITION 3A Organizations with strong identities that survive for long periods of time will be nearly decomposable.

PROPOSITION 3B Organizations with ND structures will exhibit strong identities.

PROPOSITION 4 Organizations with ND structures and strong identities will grow faster and survive longer than organizations that lack either one or both of these features.

It was not a coincidence that Simon developed his ideas about ND in the context of artifacts and continued to work with both ND and artifacts for 40 years (1962–2002). Even more importantly, he was silent on modularity: a full text search of his entire oeuvre using the keyword ‘modul*’ failed to produce a single instance.

Artifact

Simon’s ideas on ND are intertwined with his conceptualization of the sciences of the artificial. For Simon, an artifact was defined by a pair of environments: an inner one and an outer one (Simon, 1969[1996]: 9):

An artifact can be thought of as a meeting point – an ‘interface’ in today’s terms, between an ‘inner’ environment and an ‘outer’ environment, the surroundings in which it operates . . . Notice that this way of viewing artifacts applies equally well to many things that are not man-made – to all things in fact that can be regarded as adapted to some situation; and in particular it applies to the living systems that have evolved through the forces of organic evolution.

The rather unassuming idea of an inner environment designed to fit the needs and demands of an outer environment hides an ontological commitment. For Simon’s artifact this ontological commitment is to bounded rationality. In a profound passage entitled ‘Time and space horizons for design’ in *The Sciences of the Artificial*, Simon wraps up into one evocative image the spatio-temporal context of human life and the sufficiency of our ‘bounded’ rationality to deal with it (Simon, 1969[1996]: 178): ‘Each of us sits in a long dark hall within a circle of light cast by a small lamp. The lamplight penetrates a few feet up and down the hall, then rapidly attenuates, diluted by the vast darkness of future and past that surrounds it.’

One consequence of the ‘fitting’ process between inner and outer environment is that the spatio-temporal regularities in the outer environment get mapped on to those in the inner structure. A startling example of this phenomenon occurs in the existence of topographic maps in the brain (Kohonen, 1982).

The neural segment that corresponds to recognizing signals from one part of the body, say, the thumb, is contiguous with the part that recognizes signals from a nearby part of the body, say the forefinger. In general, spatial contiguity in the outer world is mapped to spatial contiguity in the inner world.¹¹

Design choices

Good design also maps spatial and temporal contiguities in the outer environment to the inner (consisting of the structure of the artifact and the materials with which it is fabricated). As Simon (1969[1996]: 9) notes: 'Whether a clock will in fact tell time depends on its internal construction and where it is placed. Whether a knife will cut depends on the material of its blade and the hardness of the substance to which it is applied.' Here the mapping goes from outer environment to inner. Simon also showed that the mapping can proceed in the opposite direction: 'Thus, if the clock is immune to buffeting, it will serve as a ship's chronometer. (And conversely, if it isn't, we may salvage it by mounting it on the mantel at home.)' Because the human designing the artifact can choose which way the arrow goes (within the constraints of natural laws), the local environment itself is largely an artifact fabricated by the designer.

The importance of ontological commitments to spatio-temporal neighborhoods is that they determine how an idea is embodied in reality. Harking back to our earlier discussion, modularity, as a design choice, makes no such explicit ontological commitments. Modularity is an abstract organizational principle and space/time could be treated in a modular manner (for example, division of labor on assembly lines) just as anything else. ND can be treated as an abstract principle as well, but Simon's development of the idea in the context of artifacts, as we have argued above, was not an accidental one. The Simonian artifact's commitment to boundedly rational embodiment has explicit implications for strategic organization.

The first implication is very much in line with the obvious and well-known prescription in strategy that even when a firm finds itself in a stable niche with substantial market share, such as the Big Three auto companies in Detroit, the leading firm should continually innovate. This is because as Simon (1993) pointed out, in a world of designed artifacts, all competitive advantages are short-lived. But the second emphasizes the counterintuitive and understudied prescription that sometimes a leading firm needs to design the very obsolescence of its own core customer segment. This follows from the fact that the mapping between inner and outer environment is bidirectional. New markets come into existence, not only in response to changes in tastes or technologies, but also by actively changing consumer preferences and educating them about new possibilities. As Schumpeter pointed out (1939: 243), 'It was not enough to produce satisfactory soap, it was also necessary to induce people to wash.' In the example cited above, Detroit can either bet that its core customers will not change their tastes as Tokyo induces Americans to drive hybrids; or it can actively make

obsolete its core segments by working to educate them in the benefits of fuel efficiency. In other words, by taking their market as pre-existent and focusing their entire attention on correct response, the Big Three are overlooking the reality that this a design choice; that they can design markets as well as automobiles.

Evidentiary basis for 'artifacts' as opposed to 'natural laws' in social science

The Sciences of the Artificial is arguably one of the most important works in the social sciences, and perhaps less arguably, one of the most important of Simon's contributions to the social sciences. In fact, through the simple act of renaming 'social' sciences to bring them into the rubric of 'the artificial', Simon emphasizes the human fingerprint, as opposed to that of Nature (with a capital N) or Society (with a capital S) in the world we live in. The human imprint is also visible in the environments in which organizations and markets get created, nurtured and destroyed, in turn creating, nurturing and destroying those very same environments to varying degrees. Simon argued this in several ways, such as (1969[1996]: 4–5):

The world we live in today is much more a man-made, or artificial, world than it is a natural world. Almost every element in our environment shows evidence of man's artifice. The temperature in which we spend most of our hours is kept artificially at 20 degrees Celsius; the humidity is added to or taken from the air we breathe; and the impurities we inhale are largely produced (and filtered) by man. [And then,] One may object that I exaggerate the artificiality of our world . . . I shall plead guilty to overstatement, while protesting that the exaggeration is slight.

The primary goals of designing artifacts, Simon argued, involve creating novelty of one kind or another, be it new technologies, new firms, new markets or even new societies. The opening and closing phrases of his chapter 'Social Planning: Designing the Evolving Artifact' attest to this:

In chapter 5 I surveyed some of the modern tools of design that are used by planners and artificers. Even before most of these tools were available to them, ambitious planners often took whole societies and their environments as systems to be refashioned (1982: 161).

Our age is one in which people are not reluctant to express their pessimism and anxieties. It is true that humanity is faced with many problems. It always has been but perhaps not always with such keen awareness of them as we have today. We might be more optimistic if we recognized that we do not have to solve all of these problems. Our essential task – a big enough one to be sure – is simply to keep open the options for the future or perhaps even to broaden them a bit by creating new variety and new niches. Our grandchildren cannot ask more of us than that we offer to them the same chance for adventure, for the pursuit of new and interesting designs, that we have had (1982: 191).

Integrating evolution, cognition and design through ND artifacts built by docile designers

For Simon, human nature is shaped by biological evolution as well as social selection, boundedly rational and docile; and the enduring artifacts designed by humans have an ND structure. Simon explained the ubiquitous nature of ND systems as an effect of evolutionary mechanisms, but argued the amenability of such evolutionary mechanisms to serve the purposes of human design. In a variety of simple but profound observations such as, 'The idea of final goals is inconsistent with our limited ability to foretell or determine the future. The real result of our actions is to establish initial conditions for the next succeeding stage of action. What we call "final" goals are in fact criteria for choosing the initial conditions that we will leave to our successors' (1969[1996]: 187), Simon synthesized evolution, cognition and design as integral aspects of choice, and as inextricable features of the artifacts that embody those choices.

He showed that ND embodies an intrinsic integration of evolution, cognition and design, and manifests itself in a variety of structures both of natural and artificial origin. Besides the oft cited article 'The Architecture of Complexity' (1962), examples of his work on ND include:

- 1 'How a Mind Resides in a Brain' (1995) in which he showed the nested structure of three levels of cognition – neurological, syntactic and semantic;
- 2 'On the Concept of an Organizational Goal' (1964), in which he showed how goals exist in hierarchies and that means and goals both constitute constraints that manifest themselves differently at different levels of the hierarchy and across different organizational actors
- 3 'Effectuation, Non-decomposability, and the Creation and Growth of Entrepreneurial Firms' (Sarasvathy and Simon, 2000), in which he explained how entrepreneurs stitch together new firms from readily accessible components, thereby building lines of tearing that allow those firms to endure over changing environments; and,
- 4 'Near Decomposability and the Speed of Evolution' (Simon, 2002), in which he used building design (hypothetically of the Mellon Institute building at Carnegie Mellon University) to explicate the fundamental nature of ND as a property common to all multi-celled organisms.

Reprise

Simon's conceptualization of ND is thus essential to his vision of the artifact because enduring artifacts have to incorporate both a strong overall identity and lines of tearing along which their parts may be reworked as the artifacts evolve to adapt to and remake their environments. And docility is both a direct result of the empirical reality of biological and social selection on human nature, as well as a vital ingredient of the ND design of organizations and markets that enables them to facilitate and leverage the benefits of organizational

identification. It is perhaps unfortunate that Simon did not live to work out a comprehensive synthesis of the three constructs of docility, ND and artifact. But he was wont to say with uncompromising optimism (laced perhaps with a big pinch of docility?) that he left his intellectual legacy and its resultant unfinished business in capable hands. We take that as encouragement for future scholars in management to consider this particular piece of unfinished business as an opportunity rather than a misfortune. And in Simon's spirit of adventure, we issue a call to scholars to undertake an intrepid attempt to complete this synthesis. As a first step in this direction, we next examine how an integrated view of evolution, cognition and design may be applied to strategic management and entrepreneurship.

Docility, near-decomposability and artifact: implications for strategic organization and entrepreneurship

The most important implication of this discussion of ND artifacts for future research in strategic organization is Simon's uncompromising insistence that relationships between human action and performance outcomes cannot take the form of laws of invariance beyond the symbol-processing level of human cognition (Simon, 1990).

Currently in strategic organization, the dominant mode of research is to hypothesize direct or moderated relationships between performance and a variety of explanatory factors such as resources, dynamic capabilities, network structures, environmental changes, etc., and then attempt to corroborate the hypotheses using large-scale quantitative data (Hamilton and Nickerson, 2003). Simon's vision for a science of the artificial argues that there exists a design process that transforms these factors into particular aspects of performance, and that it is the process itself that should be the focus of our research. In the case of resource-based theory, for example, Simon would insist we stick to the true spirit of Penrose (1959), that it is not the resources that matter, but what people do with them.

Put differently, there is a design process that sits in the black box between inputs or initial conditions and performance outcomes. In ignoring the black box, our current studies are akin to old-style stimulus-response psychology of the early twentieth century. In the middle of the century, however, cognitive science emerged. It pushed the frontiers of psychology by painstakingly opening up the stimulus-response black box. Similarly, by looking deep into the design processes at the heart of strategic organization, we can begin to rebuild our field as a science of the artificial. In Simon's (1969[1996]: 113) words: 'a science of artificial phenomena is always in imminent danger of dissolving and vanishing. The peculiar properties of the artifact lie on the thin interface between the natural laws within it and the natural laws without. What can we say about it?

What is there to study besides the boundary sciences – those that govern the means and the task environment?

And in answer to that he suggests: 'The artificial world is centered precisely on this interface between the inner and outer environments; it is concerned with attaining goals by adapting the former to the latter. The proper study of those who are concerned with the artificial is the way in which that adaptation of means to environments is brought about – and central to that is the process of design itself.' (Simon, *op. cit.*)

While his answer does not afford us a simple proposition to test, it does declare the importance of investing in more process studies that describe in greater detail how decision-makers inside organizations actually use the resources they have to adapt to and reshape the environmental constraints they face; and how particular procedures and routines enable or hinder their ability to leverage the circumstances they find themselves leading to the creation of novelty.

The most profound advances in the natural sciences came through close empirical attention to the details of how the universe worked and how life evolved. Years of painstaking data-gathering often preceded and always went hand-in-hand with theorizing and testing. A similar minute empirical focus on how human beings actually act, play, think and work in designing the artifacts may prove similarly productive. An in-depth focus studying design processes may also lead us to better explanations and more useful prescriptions than using high-level coarse-grained data to test hypothesized relationships originating in armchair theorizing.

Applications to strategic organization and entrepreneurship

There is a growing confluence of interest between the fields of strategic organization and entrepreneurship. In recent years, management scholars in general and strategic organization scholars in particular have increasingly investigated entrepreneurial phenomena, including how leading firms fail in the face of newcomers commercializing new technologies (Christensen and Bower, 1996), network structures in the creation and evolution of new firms and industries (Uzzi, 1997), entrepreneurs' use of stories in the resource acquisition process (Lounsbury and Glynn, 2001), and the interaction between institutional determinants and collective action by incumbents in the creation of new modes of industrial organization (Russo, 2001). The first article published in this journal, 'Patterns of Multidimensionality among Embedded Network Ties: a Typology of Relational Embeddedness in Emerging Entrepreneurial Firms' (Hite, 2003), attests further to the centrality to the field of strategic organization of entrepreneurial processes for understanding and explaining problems of origins and existence, in addition to the continuing focus on questions of structure and bounds.

Second, Simon's own interests spanned both strategic organization and entrepreneurship. Towards the end of his life, he supervised a thesis on

entrepreneurship (Sarasvathy, 1998), sponsored a conference on entrepreneurship (a report of which is published in Sarasvathy, 2000) and co-authored papers on the subject (Sarasvathy et al., 1998; Sarasvathy and Simon, 2000). This interest in entrepreneurship is perhaps to be expected given his larger interests in novelty generation, including scientific discovery and the economics of technological change. To describe it in his own words:

What I get from some of the recent discussions is the notion that there might be some considerable merit in sometimes relating the research on entrepreneurship in the sense in which we were talking mostly this morning, with another very strong line of research in economics and elsewhere on technological change and innovation which has always been viewed from the standpoint of the innovation or the economic consequences of the innovation without looking at the details of the entrepreneurial part of the process. (Sarasvathy, 2000: 46)

An illustration: the innovator's dilemma

In the spirit of Simon's continuing interest in both strategic organization and entrepreneurship, we apply the three Simonian constructs to one well-studied problem that straddles both fields and then explore possible research topics in entrepreneurship. The particular phenomenon we have selected involves the old Schumpeterian classic: the destruction of an existing market due to the invention of a new technology. Well-known examples include the automobile overriding horse-drawn buggies; cash-register companies going bankrupt in the face of computers; and the decline of railroads when aircraft were successfully commercialized.

In its latest incarnation it is known by a variety of names including the 'innovator's dilemma' or strategizing in the face of 'disruptive technologies', as exemplified in Christensen and Bower's (1996) study of leading firms in the disk-drive industry. They found that leading firms that invented new technologies failed to commercialize them because, paradoxically, they listened and paid heed to their current customers, who expressed a lack of interest in or unwillingness to purchase products based on the new technologies. Eventually, however, these same customers switched over to the new technologies that had in the meanwhile been commercialized by ragtag entrepreneurial firms. Notably, several of these new firms were started by disgruntled engineers who had been working for the leading firms; when these firms decided not to commercialize the technologies they had helped to invent, they left to start their own new ventures. Leading firms thus lost their markets precisely by doing the right thing; that is, listening to their customers.

Christensen and Bower's work has been furthered in several studies of disruptive technologies that develop a variety of solutions that unpack the problem, and advance new predictions for research and prescriptions for practice. In general, the emphasis in this work on better prediction as the salvation for man-

agers in leading firms is countered rather pointedly by Simon (1969[1996]: 170):

Data about the future – predictions – are commonly the weakest points in our armor of fact. Good predictions have two requisites that are often hard to come by. First, they require either a theoretical understanding of the phenomena to be predicted, as a basis for the predictive model, or phenomena that are sufficiently regular that they can simply be extrapolated. Since the latter condition is seldom satisfied by data about human affairs (or even about the weather), our predictions will generally be only as good as our theories.

A Simonian perspective on the innovator's dilemma¹², would suggest, instead, that the leading firms in the disk-drive industry failed not because of some exogenous and preordained technological trajectory in need of prediction, or some intrinsic nature of the technology (i.e. disruptiveness), but because they ignored or were ignorant of the constructs of docility, ND and artifact. Specifically, while their management was docile in regard to customers, they were not docile in regard to their internal stakeholders. One reason for this might be that they viewed markets as exogenous, rather than artifacts fabricated by human action, and furthermore, by not making an ontological commitment to bounded rationality, they failed to build ND into the structure of their organizations in the form of corporate venturing initiatives. As a result, they incited their innovative engineers to depart and start new firms to pursue the new technologies, rather than spawn spin-offs under their own roof.

In contrast to the disk-drive firms studied by Christensen and Bower is the case of IBM in the 1950s and 1960s. As the historian Olegario (1997: 384–5) records it:

During the 1950s and 1960s, IBM's managerial hierarchy faced the critical problem of building consensus between two very different groups of people: engineers on one side, marketers and professional managers on the other. In the early 1950s, when IBM first entered the electronic computer market, the two sides had come into direct conflict. The marketers and managers, led by Thomas J. Watson, Sr, resisted computers because they represented such a heavy capital investment that the company's financial health might be endangered. Also, should computers be a success, the lofty position of marketers within the firm might be rendered less influential. On the other side were a group of electrical engineers, who were able to convince Thomas J. Watson, Jr that computers would revolutionize the data-processing industry.

Again, in the 1960s (1997: 367):

The company invested \$5 billion in System/360, about three times its revenues in 1960. It hired more than 60,000 new workers, bringing total employment to 190,000 in 1966 and 325,000 by 1970. Developing System/360 put the company under tremendous pressure. It was an all-or-nothing gamble. IBM aimed to replace

existing computers, including the 1401, its best selling product at the time, with a technology that had never before existed in the marketplace. In addition, the new machines were targeted at both the scientific and business markets, which had very different computing needs. The whole 360 strategy alienated many of IBM's own employees, who had a stake in the company's older technologies. Tom Jr and Vin Learson, the executive in charge of the 360 project, had to whip all divisions into line to support the new strategy. Learson, writing to a reluctant colleague, laid down the corporate policy thus: 'By 1967 the 1401 will be dead as a Dodo. Let's stop fighting this.'

Both decisions were made using a complex combination of docile processes. While they were not devoid of existing customer feedback, they were not exclusively predicated upon that feedback; they also paid attention to internal stakeholders. Also, they proceeded without a clearly pre-existing market with well-defined streams of future cash flows and psychologically comforting projections of profit margins. Furthermore, in both cases, IBM leveraged its established customer base and network of relationships to shape and create the market for the revolutionary new product lines that it introduced. ND was incorporated into the strategy-making process by proactively designing the obsolescence of certain current markets while investments were made in what might or might not have been successful markets in the future.

This mode of strategizing makes an ontological commitment to the boundedly rational nature not only of the decision-makers, but also that of the environment and the roots of its change. It takes to heart Simon's exhortation that all sources of comparative advantage have a short half-life. In other words, all niches are transient and therefore can be terminated as well as die natural deaths. So organizations such as IBM sometimes have to have the courage to chop off limbs to nurture innovative new shoots in their place. As Vin Learson eloquently put it, 'We did what Charles Kettering, an engineering genius and president of the General Motors Research Division, always advised against: we put a delivery date on something yet to be invented' (Olegario, 1997: 392).

We do not mean to be overly glib with these illustrations of what is unarguably a very complex and ill-understood phenomenon. In fact, our point is rather that, it is precisely because they are complex and ill-understood that we need integrative perspectives such as Simon's. Most existing explanations with regard to strategy-making tend to use only one lens at a time to focus on the phenomenon: evolution, or cognition, or design. Note, for example, Christensen's (Christensen and Bower, 1996) heuristic solution – 'Skate to where the puck will be' – to the innovator's dilemma (cognitive lens); or Barnett et al.'s Red Queen theory (evolutionary lens); or Mintzberg's exhortations against planning, in favor of learning (design lens). The Simonian approach, however, seeks to integrate all three lenses into specific constructs such as docility, ND and artifact, thereby forcing the blurred edges of the earlier isolated approaches to coalesce into a three-dimensional relief that may make it possible for us to conceive

plural solutions and more nuanced hypotheses for future testing. This might be expressly useful, given that many scholars in the field (including those just noted) do endeavor to incorporate more than one perspective in their theorizing about strategy-making at different times in their scholarship (Miller and Shamsie, 1995, 2001).

Research agenda: connecting entrepreneurship and strategic organization

Networks and garbage cans

Theorizing that integrates evolution, cognition and design is crucial to an area such as entrepreneurship, focused on the origins of artifacts as well as on their survival and sustenance. There has been great interest recently in the role of social networks, both in strategic organization and entrepreneurship. Networks have been posited as the *tertius gaudens* that facilitates trust in and legitimation of fledgling enterprises (Coleman, 1990; Burt, 1992). But this literature almost uniformly assumes the pre-existence of networks, and has restricted itself almost exclusively to static analyses of these given networks. Although dynamic analyses have just begun to appear, there has been almost no attempt yet to look at the origins of new networks, a topic of substantial interest to entrepreneurship. Baum et al. (2003) is a notable exception.

Turning the lens of docility and altruism on entrepreneurial action allows us to formulate and address some new questions in this area. For example, how do new networks form? Existing literature would lead us to believe that they form either through enforceable contracts (i.e. transactional networks) or through existing structures of legitimacy such as ties within existing networks of trust (i.e. social networks). Yet, as Cohen et al. (1972) has shown, many important organizational decisions are initiated by the temporal proximity of routine events within garbage cans, that is, in the context of organized anarchies. There is considerable anecdotal and historical evidence in entrepreneurship that new networks that end up creating successful firms and markets do originate in garbage-can processes.

The well-documented and widely studied history of how Josiah Wedgwood met and 'wooed' his invaluable partner Thomas Bentley who opened up the aristocracy and enabled the creation of the Wedgwood brand is a case in point (Koehn, 1997). While Wedgwood was laid up in hospital with a broken leg, he was introduced by his doctor to Bentley. Although the two discovered a philosophical and intellectual affinity as they talked late into the night, Wedgwood had to undertake a prolonged campaign of persuasion to overcome Bentley's objections to becoming involved in his commercial enterprise. Evidence for the chance origin of network structures is also provided by Baum et al. (2003). Therefore, we posit that in a world of docile individuals:

PROPOSITION 5 New networks are as likely to originate in garbage cans as out of well-established well-organized networks.

The role of docility and the resultant garbage-can model of new network creation highlights several questions that have rarely been studied in strategic organization. What are the dynamics of networks? What role does docility play in the creation and evolution of new networks? Do weak ties remain weak for all time and vice versa? If not, what mechanisms exist, besides docility, that change the strengths of ties in a network? How do such new networks create ND artifacts such as new firms and new markets?

Studying the docile nature of entrepreneurs as opposed to either their opportunistic nature or their trustworthiness – by focusing research on how persuasive they are, along which dimensions of a decision/negotiation, and how persuadable they are, along which dimensions – might help us better understand how networks get created and evolve over time in the face of motivational uncertainty, and how such newly formed networks in turn create/destroy value (or not) in economies and societies.

Stakeholders and organizational goals

The role of identity in the design of ND artifacts can also be studied in the context of how entrepreneurs forge together a 'vision' for their firm or even how they create value propositions for particular stakeholders that form the local stable components in the structure of their overall vision. In other words, the much-trumpeted 'lines of tearing' that enable ND systems to survive over long periods of time originate in lines of 'stitching' by entrepreneurs sewing together the fabric of their firms' organizational identity. For example, Sarasvathy (2002) has shown that cognitive models developed by expert entrepreneurs in the creation of successful firms also exhibit patterns of ND. Arguments about how local stable components coalesce can also be found in Fligstein (1996) and Rao (1998).

This 'stitching together' perspective on the architecture of ND entrepreneurial artifacts suggests a reversal of the received wisdom that the 'vision' of the leader precedes and determines who comes on board:

PROPOSITION 6 In nascent organizations, the contingencies of those who come on board will drive the vision and goals of the company; not vice versa.

The above inversion brings to light several additional further questions for future research. Does the 'vision' of the entrepreneur drive decisions on who comes on board? What are the strategic consequences of one over the other for the performance of the resultant firm? If both drivers operate reflexively, under what conditions do they and should they dominate strategic decisions in the emerging organization?

Wedgwood, as we saw earlier, deliberately sought out and sewed together the partnership with Bentley; his vision for creating the brand drove him to bring Bentley on board. In contrast to that, Howard Schultz's coming on board the Starbucks Coffee Company drove its vision from being a specialty store in Seattle's Pike Place market to being an international cultural force enabling it to plant a coffee shop on every street corner. ND, therefore, allows an organization not only to compose 'reactive' strategies that allow it to survive and thrive in a changing environment, but also to develop 'creative' strategies that enable it to reconstitute and even fabricate the environment itself to a certain degree.

Teleology and design

Miller and Shamsie (2001) have shown that the environment that 'selects' fitter individuals is not always independent of the decision-makers, at least in the case of strategic organizational environments. Sarasvathy and Simon (2000) have made the same point in the case of entrepreneurial environments and suggested that it is possible not only to 'adapt' to an environment, or to enact it (Weick, 1979), but to design and negotiate new parts of it into existence, that is, not only to explore and exploit opportunities, but to create them through effectuation (Sarasvathy 2001). This form of effectual design explicitly recognizes that to the extent that the environment consists largely of other individuals and organizations the adaptive landscape for human action is itself a product of human action. In other words, in pragmatically and theoretically important ways, firms and markets are more like artifacts (that is, products of intentional design, however flawed) than natural 'forces.'

Without denying the fact that design can be predictive, purposive and adaptive, as has been widely recognized by management scholars in a variety of domains, effectuation highlights, integrates and explicitly emphasizes the non-predictive, non-teleological, non-adaptive aspects of design. In other words:

PROPOSITION 7 Entrepreneurial expertise and the early histories of enduring firms and markets are as much about fabricating the future through direct control mechanisms as about controlling them through predictions; as much about the creation of particular goals as about achieving extant desires; as much about serendipities, redundancies and exaptations, as about dynamic capabilities and core competencies.

As Simon explained in the section 'Designing Without Ends' in *The Sciences of the Artificial* and March (1971, 1994, 1995) exhorted in his development of a technology of foolishness, the question of making decisions and designing artifacts in the absence of well-ordered structures of preferences or clearly articulated strategic or entrepreneurial 'visions' must be brought center-stage more often in our scholarship. Besides the work of March and his colleagues, the predominant perspective in almost every stream of research into the origins of economic artifacts today – be it organizational design, entrepreneurship, industrial

organization, social networks, population ecology or even social movements – ignores for the most part issues of goal ambiguity and non-predictive control. By drawing upon these neglected threads in Simon and March, we can formulate intriguing new questions for each of these streams under the single overarching banner: where do the decision maker's teleologies come from – be they individual, organizational, or societal? If we start with the assumption that teleologies are not fully pre-existent in the phenomena, and commit ourselves not to impose them on the phenomena ex-post, how would we reformulate our theories, methods and analyses?

In sum, the three oft-neglected but arguably highly potent elements of Simon's work – docility and altruism in organizational identification; plural and changing human motives leading to ND in organizational structures; and, artificiality and design both in organizational strategies and environments – together suggest a fresh integrative approach to strategic organization theorizing in general, and offer the enticing prospect of a variety of novel research questions in entrepreneurial value creation in particular.

Conclusion

In this article, we set out to persuade scholars of strategic organization that there are at least three key ideas in Simon's later work that have great import for our scholarship. Each of these ideas rejects key philosophical dichotomies that have plagued the social sciences for a long time. Instead, they make the boundaries between the dichotomies a design problem in human endeavors:

- 1 Docility rejects the individual versus collective, or the even more pervasive subjective/objective dichotomy and posits the inter-subjective as the key to deciding where to define the fold for particular problems and specific circumstances.
- 2 ND straddles the parts versus whole problem and as we discussed earlier, is all about stitching together and tearing apart for purposes that vary over time and across situations.
- 3 The artifact seeks to tackle the problem of re-drawing the bounds between organism and environment.

In each case the problem is one of design, not merely of discovery. Artifacts in a Simonian world are made, not found.

As our citation analysis revealed, the three constructs – docility, ND and artifact – have been almost entirely absent from our thinking and research, even though each intrinsically integrates evolutionary, cognitive and design perspectives in a characteristically Simonian way. As illustrated in Figure 1, this concrete way of grasping reality involves seeing our cognition as shaped by biological evolution and social selection, while at the same time capable of designing the very environments we live in and adapt to. Such a three-

dimensional view, when applied to the phenomena in strategic organization, provides not only useful other explanations for current problems of interest, but also new avenues for scholarship.

We think it is appropriate to conclude our endeavor with Simon's (1997: 61–2) own words on the merits of picking particular features of reality to pay attention to and abstract from in our theorizing:

Whatever the scientific domain we are concerned with, theory always falls short of describing reality in all of its detail. As has often been pointed out, perhaps most eloquently by Milton Friedman (1953), one of the virtues of a good theory is that it abstracts from reality, picking out and retaining just those features that are important and that should be retained in our focus of attention.

But it is hard to agree with one extension of that claim: that 'unreality' of a theory is a positive virtue. When Galileo ignored air pressure in his law of falling bodies, he implicitly limited application of the law to situations where the missing term would not invalidate it. We would not recommend the law, in its simplified form, to parachute manufacturers, nor, I believe, would he. The correct statement about abstraction is that it is useful to abstract a theory by omitting those features that do not significantly affect the conclusions drawn from it in the domain to which it will be applied. Milton Friedman was careful to include this qualification when he made his celebrated defence of unreality, but it has sometimes been forgotten by economists who have followed him. When we criticize theories and when we build new ones we must take into account the uses we intend to make of them.

Acknowledgements

We would like to dedicate this paper to the memory of Herb Simon. Both of us are fortunate to have experienced the depth of his conversation and the warmth of his personal concern. This paper began as an attempt to share our loss, and has brought us here through what Herb would no doubt describe as boundedly rational creatures making satisficing choices at every turn of the Borgesian maze.

Thanks to Jim March and Stuart Read for comments on the ideas in this paper; and to Herb Simon for his conversation that inspired and encouraged us to attempt this. We are also grateful for comments from the editor and anonymous reviewers for *Strategic Organization*. The support of the Spencer Foundation and the Copenhagen Business School is gratefully acknowledged.

Notes

- 1 Perhaps we shouldn't not be surprised by these connections, for they are personal as well as intellectual. Of the contributors mentioned here we should mention: Williamson was a student at Carnegie with March, Cyert and Simon and much of his subsequent work has aimed at working behavioral ideas into the heart of modern economics (Williamson, 1996). Bromiley also was a Carnegie student. Winter, while not a student at Carnegie, had close connections with the Carnegie School and his book with Nelson developed central ideas in

- behavioral theory into modern evolutionary thought. While the connections to Rumelt and Schendel are less obvious, Teece is a 'grandchild' of Carnegie, following many of Williamson's ideas but also developing them into a less mainstream, and more behavioral framework (Dosi, 2002; Teece et al., 2002).
- 2 Although the work of March and Cyert is very closely related to the work of Simon, and independently seminal to several original lines of research in strategic organization, for the purposes of this article we restrict our attention to three pieces of Simon's vast contribution. We fully acknowledge, however, that much of the scholarship that has been inspired by Simon has also been inspired by Cyert and March (Cyert and March, 1963).
 - 3 To construct Table 1, we used multiple databases to find articles from the selected journals that cited Simon. We concatenated the results and, after removing duplicates, counted the number of citations for each article. Finally we listed them in descending order of citation count as presented in Table 1. To conserve space, we do not report articles cited only once, combining them into the category 'Other'.
 - 4 Our procedures for Table 2 were the same as Table 1, except this time we used keyword search, instead of text search.
 - 5 We are grateful to an anonymous reviewer for suggesting this structural bias in strategic organization literature and a rationale for it.
 - 6 We thank Anil Menon for illuminating discussions on these issues.
 - 7 A banded matrix $A = (a_{ij})$ with bandwidth w has $a_{ij} = 0$ for $j > w + i$ and $i < -j$. By definition a low bandwidth matrix is also a sparse one, but the converse is not true. A matrix can be sparse and still have a high bandwidth; for example, the interconnection matrix for a star graph, in which one node is connected to $n - 1$ other nodes.
 - 8 There are unusual states of matter, but they are interesting precisely because they are unusual. Even gels, which seem to ooze indiscriminately between phases, have distinct electrochemical properties from both solids and liquids (Pollack, 2001). But gases are like loosely coupled systems, liquids less so; and solids are like tightly coupled systems.
 - 9 The relevant metaphor here would be a jigsaw puzzle.
 - 10 The relevant metaphor in this case would be a patchwork quilt.
 - 11 As always, the brain refuses to oblige us by making this a general organizing principle. There are non-topographical mappings as well, for example the olfactory system in the cortex. Apparently, the nose knows something that the others don't.
 - 12 See Dew and Sarasvathy (2001) for a more detailed study of the innovator's dilemma.

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Appendix 1 Bibliography of Simon's core work on docility, ND and artifact

Simon, H. A. (1993) 'Strategy and Organizational Evolution', *Strategic Management Journal* 14: 131–42.

Docility

Simon, H. A. (1993) 'Altruism and Economics', *American Economic Review* 83(2): 156–61.

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Near-decomposability

Simon, H. A. (1962) 'The Architecture of Complexity', *Proceedings of the American Philosophical Society* 106: 467–82.

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Artifact

Simon, H. A. (1969[1996]) *The Sciences of the Artificial*. Cambridge, MA: MIT Press.

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Appendix 2 Content analysis of articles citing Simon, 1993

| Citation (author, year, source) | Title | How Simon (1993a) is used | Key Simonian concept |
|---|--|--|------------------------------------|
| Theoretical (in chronological order) | | | |
| Van Krogh, G. and Roos, J. (1996) <i>Strategic Management Journal</i> 17(9): 729–37 | A tale of the unfinished | 'For an application of representationistic assumption of cognition to strategic management, see Simon (1998)' (Footnote on p. 735) | Cognition |
| Mehra, A. and Floyd, S. W. (1998) <i>Journal of Management</i> 24(4): 511–31 | Product market heterogeneity resource irritability and strategic group formation | 'In addition, the need to simplify a cognitively complex problem (Simon, 1993) may cause managers to think about strategy along a relatively small number of dimensions.' (p. 515) | Cognition |
| Ogilvie, D. T. (1998) <i>Journal of Business Research</i> 41(1): 49–56 | Creative action as a dynamic strategy: using imagination to improve strategic solutions in unstable environments | Cited in 'References' section, but not used in the paper | N/A |
| Liedtka, J. (2000) <i>California Management Review</i> 42(3): 8–30 | In defense of strategy as design | 'As Simon has noted, alternative generation has received far less attention in the strategic decision making literature than has alternative evaluation, but is more important in an environment of change.' (p. 22) | Design |
| Szulanski, G. and Amin, K. (2001) <i>Long Range Planning</i> 34(5): 537–56 | Learning to make strategy: balancing discipline and imagination | 'As Nobel Laureate Herbert Simon points out, classical decision theory – which informs strategic planning – is useful to evaluate strategies already created, but has paid little attention to the framing of problems that these strategies are meant to solve or the generation of the different alternatives available.' (p. 545) | Design |
| Empirical (in chronological order) | | | |
| Ingram, P. and Baum, J. A. C. (1997) <i>Strategic Management Journal</i> 18: 75–98 | Opportunity and constraint: organizations' learning from the operating and competitive experience of industries | 'There are also arguments, however, learning from own experience can constrain the organization by leading it into competency traps, where it focuses on perfecting routines that are invariably made antiquated by the changing world (March, 1991; Levinthal and March, 1993; Simon, 1993):' (p. 75) | Changing environment Evolution? |

Appendix 2 Continued

| Citation (author, year, source) | Title | How Simon (1993a) is used | Key Simonian concept |
|--|---|---|----------------------|
| Hobday, M. (1998) <i>Research Policy</i> 26(6): 689–710 | Product complexity, innovation and industrial organization | 'Most of the renowned writers on strategy and management focus quite properly on the single firm (e.g. Chandler, 1962, 1990; Cyert and March, 1963; Simon, 1993) (Footnote on p. 706) | Unit of analysis |
| McConaughy, D. L., Matthews, C. H. and Fialko, A. S. (2001) <i>Journal of Small Business Management</i> 39(1): 31–49 | Founding family controlled firms: performance, risk and value | 'To add to the complexity, because managers also consider personal risks when making decisions regarding firm risk (May 1995), they may use only approximate time frames in their planning rather than the accurate time forecasts called for in financial models.' (p. 34) | Cognition? |

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