

STRATEGIC GROWTH OF FIRMS IN THE DIGITAL ECONOMY: A SIMONIAN RESEARCH AGENDA

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ABSTRACT

Strategic growth of firms, in the words of Herbert Simon, is within the framework of decision making under “massive and unending uncertainty.” In the rapidly changing digital economy, the cycle of winning and losing and asset redistribution intensifies as the speed of information exchange increases. It is thus more necessary than ever to find explanatory theories to describe, model, and predict the emerging market structures of the hypercompetitive digital economy. In this paper, we draw upon several Simonian models of bounded rationality in decision making and propose a research agenda for strategic growth of firms in the digital economy. The agenda consists of three major topics: (1) skew distributions in the digital market competition, (2) empirical laws of information use, and (3) a framework of strategic information systems. Some ongoing projects related to the agenda are discussed.

INTRODUCTION

“Strategic decision making is a chapter in the topic of decision making under uncertainty—in fact, massive and unending uncertainty.”

Herbert Simon (1993a: p. 134), 1978 Nobel Laureate in Economics

In the rapidly changing digital economy, the cycle of winning and losing and asset

redistribution intensifies as the speed of information exchange increases. As a result, the sizes and performances of business firms increasingly resemble skew distributions. That is, a few businesses, such as eBay and Amazon, dominate the market while a large number of smaller companies struggle to survive. The study of strategic growth of firms is indeed within the framework of decision making under “massive and unending uncertainty.” It is thus more necessary than ever to find

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explanatory theories to describe, model, and predict the emerging market structures of the hypercompetitive digital economy (Porter 2001; Clemons, Dewan, and Kauffman 2001). There is a rich literature of theories of strategic growth of firms (for examples, Barney 1986; Bettis and Hitt 1995; D’Aveni 1994; Porter 1980, 1985). So, which theory is most appropriate for us to draw upon to model strategic growth of firms in digital economy?

According to Simon, the “appropriateness” here is determined by three major factors. First, the theory shall take into account the surroundings where strategic decision making processes operate (Simon 1993a, 1996): (1) The outer environment of market evolution and, more importantly, (2) the inner environment of organizational evolution. Second, the theory shall be based on two empirically grounded, crucial considerations (Simon 1977): (1) The result derived from the theoretical model should be similar to the observed empirical phenomena in the outer (for example, skew distributions discussed earlier) and inner environment; and more importantly, (2) the generating mechanism provided by the theoretical model should be plausible and explanatory; otherwise, the model must be refined to better represent the real world. Third, the theory shall help us design the strategy as an artifact interfacing the outer and inner environment of the business.

In this paper, we model Simon’s approach to strategic growth of firms graphically in Figure 1. The left column of Figure 1 shows two of the three fundamental elements described above: evolution of the surrounding environment (represented as boxes) and strategy as an interface between the outer and inner environment of the business (represented as a dashed circle). The changes in the evolutionary business environment (both outer and inner) impose the constraints on the interface. A well-designed strategy shall be able to detect and adapt to the changes. Simon (1996) coined such a view of theory development as Science of the Artificial. Within the outer and inner environment are the empirical phenomena which are explained by the models of bounded rationality on the right

CONTRIBUTION

This paper enriches the information systems (IS) literature in three significant ways. First, it provides a thorough review of the empirically grounded works of Herbert Simon on strategic growth of firms in the industrial economy and shows how they may be adapted to address growth strategy issues in the digital economy. Second, this is the first study to tie together four seemingly separated works of Simon—artifact design, strategic decision making, skew distributions, and organizational evolution—and show how they may be used as a research guide for exploring the striking empirical regularities recently reported in the interconnected, digital economy. Third, the study also provides a sound framework of strategic information systems consisting of four empirically grounded components: future shape systems, near decomposability systems, docility systems, and symbol and signal systems. This research is expected to be very helpful for researchers interested in the areas of strategy and the Internet, strategic information systems, and global electronic commerce.

column of Figure 1. Those exploratory, empirically grounded models were successively refined over the years and are reviewed in the next section, where a Simonian research agenda of the strategic growth of firms in the digital economy is also proposed. The agenda consists of three topics of significant importance: (1) explanations of the skew distributions in the hypercompetitive outer environment of the market and their strategic implications for firms in the digital economy; (2) explanations of the striking regularity of the empirical laws of information use in the inner environment and their implications for the organizations; and (3) strategic information systems design based on the Simonian research agenda. The three topics are discussed in detail in this paper and followed by the conclusion.

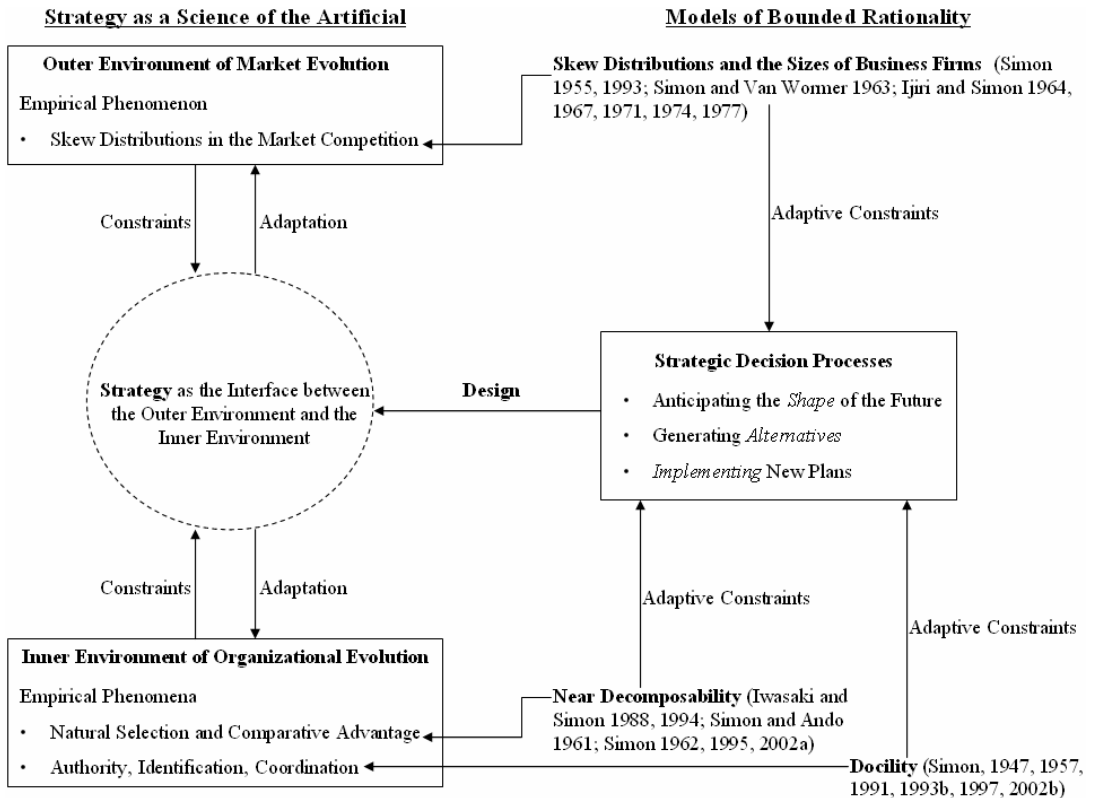


Figure 1. The Simonian Approach to Strategic Growth of Firms

A SIMONIAN RESEARCH AGENDA OF STRATEGY IN THE DIGITAL ECONOMY

In this section, we review the three models of bounded rationality of Simon on the right column of Figure 1: skew distributions and the sizes of business firms, near decomposability, and docility. Their implications for strategic decision processes are discussed. Based on Figure 1, we then propose a Simonian research agenda of strategic growth of firms in the digital economy.

Skew Distributions and the Sizes of Business Firms

The size distributions of business firms exhibit highly skewed phenomenon. One of the commonly cited striking regularities in the family of skew distributions is the Pareto (1909) law; that is, if the firms are arranged in order of size, the logarithm of the firm's size decreases linearly with its rank. Guided by a

five-step process of “scientific discovery” (Simon 1977), Simon and his colleagues (Ijiri and Simon 1977) developed successive theories providing explanatory justifications for skew distributions exhibited in industrial firms. This evolutionary process of theory development is grounded in Simon's models of bounded rationality (1982, 1997). That is, the theory developer as a decision maker is bounded by both inner (mental) and outer (environment) constraints in all their complexity, thus focusing on a few empirically grounded data at a time and looking for a “good enough” explanation is a very nature thing to do (Simon 1947).

Simon's first explanatory theory of the size distribution of business firms (Simon 1955) stated that the firm grows based on the following assumptions, where $f(n,k)$ is the number of different firms that have exactly the size of n at the time k :

1. Gibrat's law (1931): the probability that the growth opportunity at the $(k+1)$ -st time is taken up by a firm that has the size

of n is proportional to $n \times f(n,t)$, that is, to the total number of sizes of all the firms that have exactly the size of n ;

2. New Entry of Firm: there is a constant probability, α , that at the $(k+1)$ -st time the growth opportunity is taken up by a new firm; that is, a firm that has not occurred in the first k time periods.

Gibrat's assumption is tested by a simple and direct way (Simon and Bonini 1958): If we construct on a logarithmic scale a scatter diagram of token frequency for the beginning and end of the time interval in question, then if the regression line has a slope of 45 degrees and if the plot is homoscedastic, then the underlying assumption holds. The U.S. data (in 1955-1956) tested satisfied Gibrat's assumption. With regard to the second assumption of new entry, a simple time series data on new firms' rate of entry can be examined.

What happens if one of the assumptions is violated? How much would the theory still describe the striking empirical phenomena adequately? Successive refinements of the theory are needed to answer the questions. A major refinement includes the empirically grounded autocorrelated growth phenomenon (Ijiri and Simon 1964). Here, the second assumption of new entry of firms at a constant rate of α remains the same. The first assumption of Gibrat's law, however, is significantly refined. If in a particular time period the industry grows by the enlargement of an existing firm rather than by the addition of a new one, the probability of any existing firm experiencing this growth is a weighted average of $1-\alpha$. The weight of each individual firm depends on how recently it experienced growth. The assumption here is that a firm that has experienced recent growth is more likely to grow again in the present than is another firm that experienced growth a relatively long time ago. The strength of this industry recency effect, or growth potential, is measured by a number γ between 0 and 1. In an industry with $\gamma = 0$, neither current size nor past growth give any advantage in current growth.

In addition to this autocorrelated growth element of individual firms, a further refined model—incorporating the share of the growth of the industry—was proposed (Ijiri

and Simon 1967) and supported by the empirical growth data of large U.S. firms in the period of 1958 to 1962. Besides allowing for serial correlation of growth, another stream of successive refinements (Ijiri and Simon 1971, 1974) of Gibrat's assumption is to include the occurrence of mergers and acquisitions. This kind of research has significant implications for the governmental antitrust policy on business concentration. One final note on Simon's successive refinements is the refinement of entry of new firms (Simon and Van Wormer 1963) allowing for a decreasing entry rate of new firms. An interesting observation of this refinement is that a substantial decreasing rate of entry of new firms will help us explain the curvature departures of the Pareto distribution plotted on a log-log scale.

Comparative Advantage and Near Decomposability

In the course of studying skew distributions and the sizes of business firms, Simon observed some empirical phenomena on comparative advantage. Let us consider, as an example, the model proposed by Ijiri and Simon in 1967 on business firm growth. The explanatory assumptions in the model decompose the growth rates into an industry-wide factor and a factor peculiar to an individual firm. The explanatory assumptions are supported by the growth rates of large U.S. firms from 1958 to 1962. On closer examinations of the empirical data, one may make the following observation:

A firm that experienced an unusually rapid growth in the first 4-year period could expect a greater-than-average growth in the second 4-year period. But the logarithm of the ratio measuring the excess would be, on the average, only one third as large during the second period as during the first. Thus, a firm that doubled its share of market ... in the first 4 years could be expected, on the average, to increase its share of market by about 28 percent in the second 4-year period ... Rapidly growing firms "regress" relatively rapidly to the average growth rate of the economy. (Ijiri and Simon 1967: pp. 354-355)

Due to this "regression" phenomenon, Simon (1993a) concludes that the "half-life" of

rapidly growing firms is typically short (for example, in the case of large American firms from 1958 to 1962, the half-life is less than 4 years).

What are the reasons for the “half-life” phenomenon? Simon’s (1993a) arguments stand on the notion of organizational evolution. In the evolutionary processes of natural selection, organizations survive and thrive based on their continuous abilities to innovate and adapt to changes; otherwise the momentary innovative successes of firms will be gradually copied or phased out due to environmental changes. Strategic questions of innovation and adaptation to changes shall thus be framed with respect to the evolutionary theory of organizations (Chandler 1962, 1990; Nelson and Winter 1982; Nelson 1991). Modeling the evolution of organizations is a complex task. Simon (1997) believed that three components play significant roles in the evolutionary process: (1) organizational structure (briefly reviewed in the next paragraph); (2) motivation of people (briefly reviewed in the next section); and (3) deployment of information technology (discussed in detail as part of the research agenda).

The study of near decomposability as an enduring organizational structure capable of adapting to the changing environment and gaining in “fitness” has occupied a long span of Simon’s research career (Iwasaki and Simon 1988, 1994; Simon and Ando 1961; Simon 1962, 1995, 2002a). According to Simon (1996), an organizational structure of near decomposability will satisfy the following properties: (1) the interactions within any subsystem are strong and rapid; on the other hand, the interactions among the subsystems are weak and slow, but not negligible; and (2) the short-term behavior of each subsystem is approximately independent of the short-term behavior of the other subsystems; and the long-term behavior of each subsystem depends in only an aggregate way on the behavior of the other subsystems. Nearly decomposable systems are enduring artifacts for organizational evolution (Simon 2002a). A good example of nearly decomposable organizational structures is a franchise organization such as McDonald’s (Augier and Sarasvathy 2004).

Motivation and Docility

Simon’s scientific process of discovery is well grounded in empirical data and is evolutionary in nature, as demonstrated by his 1977 monograph with Ijiri on skew distributions and the sizes of business firms. As the competitive market evolves, there are always opportunities to enhance the theories with explanatory assumptions (supported by empirical data) to explain the skew distributions in the new environment. However, there is a limit in doing so; since the skew distributions, although interesting, are nonetheless the marginal properties of organizations performing and competing within markets. To further understand how the process evolves, one needs to shift the attention from market economy to organizational economy (Simon 1991). The very first thing to study the organizational economy is to start with, once again, the empirical data used in the explanatory assumptions.

Simon’s early research work on motivation of people was summarized in *Administrative Behavior* (Simon 1947), where he identified organizational identification, or loyalty, as a motivating force for organizational behavior. Interestingly, the motivation study has also been guided by the empirically grounded scientific discovery process. Consider, as an example, his study of the distribution of executive salaries. Simon (1957) introduced two empirically grounded explanatory assumptions: (1) there is a relatively constant span of hierarchical control in organizations, and (2) there is a “rule of proportionality” held between the salaries of executives and their immediate subordinates. With these two assumptions, Simon was able to explain the Pareto law exhibited in the compensation data of executives.

In the last two decades of his life, the study of motivation had produced an important theory of docility to explain the empirical phenomena of authority, identification, and coordination (Simon 1991, 1993b, 1997, 2002b). Docility, according to Simon, is “*the tendency to depend on suggestions, recommendations, persuasion, and information obtained through social channels as a major basis of choice.*” (1993b, p.156) In

addition, "... *people exhibit a very large measure of docility*. ... 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." (1993b, p.157)

Designing the Artifact of Strategic Decision Processes

The box on the right hand side of Figure 1 with three arrows point to it summarizes the Simonian approach to designing the artifact of strategic decision processes. First of all, Simon (1993a) considered three skills vital for strategy decision processes (depicted as a box):

1. Anticipating the shape of an uncertain future: What and how much attention shall we devote to things in and outside the industry which might impact the company significantly? What expertise shall we acquire to adapt to changes, especially those that originate outside the industry?
2. Generating alternatives for operating effectively in changed environments: What are the possible alternative actions of response we may take? How can these alternatives be designed? Can we simulate those alternatives with computer programs?
3. Implementing new plans rapidly and efficiently: How can managers carry out and, more importantly, disseminate the new plans? How will the new plans be accepted? Will people use the plans? Will their decisions be shaped by the implemented plans? What are the unexpected consequences on the interconnected decision makers?

In order for the strategic decision processes function effectively, they also have to incorporate three adaptive mechanisms responding to the constraints imposed by the environmental evolution. The arrow pointing from "Skew Distributions and the Sizes of Business Firms" to the "Strategic Decision Processes" box, with the phrase "adaptive constraints" attaching to it, indicates the adaptive responsiveness of the strategic decision processes to the constraint of the

market evolution. Similarly, the two arrows pointing from "Near Decomposability" and "Docility" to the "Strategic Decision Processes" box indicate the adaptive responsiveness of the strategic decision processes to the evolving organizational constraints.

A Simonian Research Agenda of Strategy in the Digital Economy

Regarding the complex networked organizations in the digital economy, Simon (2000: p. 752) said: "Current developments in electronics, notably the development of the World Wide Web and e-markets, and the enhanced abilities of organizations to manage geographically dispersed activities, provide new opportunities of unknown magnitude for coordination at a distance. Today, we have very little experience with these new developments, both in their current forms and their potential." Thus, the networked, digital economy opens a new challenge for researchers interested in strategic growth firms in the new economy. Guided by Simon's extensive body of research reviewed above, we propose a research agenda of strategic growth of firms in the digital economy as is shown in Figure 2. The figure, a graphical model of Simon's work, is an extension of Figure 1. There are three significant contributions in the proposed agenda shown on the right column of the figure:

1. We draw upon Simon and his colleagues' theories of Skew Distributions and the Sizes of Business Firms in the industrial economy to explain the skew distributions in the hypercompetitive outer environment of the digital market.
2. We seek to explain the striking regularity of the empirical laws of information use in the inner environment and link the explanations to Feldman and March's Information as Symbol and Signal (1981).
3. We propose a strategic information systems framework as an alignment of the design artifact of strategic decision processes with four adaptive mechanisms responding to the constraints imposed by the environmental evolution.

The three contributions are respectively discussed in the following three sections.

SKEW DISTRIBUTIONS IN THE DIGITAL MARKET COMPETITION

Skew Distributions in the Digital Economy

There are abundant publications on the observations of striking empirical regularities in the recent literature of networked organizations in the digital economy (Barabasi 2003; Buchanan 2002; Watts 2003). Specifically, complex and interconnected social networks exhibit hubs (i.e., connected nodes) and connectors – “nodes with an anomalously large number of links” (Barabasi 2003: p. 56). Few hubs (such as eBay and Amazon) have many nodes connected and, on the other hand, many hubs have few connectors. This Pareto-like phenomena have indeed excited the network research community. Various models have been proposed, such as the scale-free power law (Barabasi and Bonabeau, 2003), to explain this “new” striking empirical behavior in the complex (social or Internet) networks (Watts 2003).

Simon’s thought process of refining explanatory theories based on assumptions well grounded in empirical data evidently has been valuable to researchers. For example, in their study on the forces generating and limiting concentration under Schumpeterian competition, Nelson and Winter (1978) enhanced Simon’s stochastic models of the sizes of business firms with the findings that the development of concentration in the industry is significantly affected by the growth potential rate, the effectiveness of technological efforts, and the restraints on growth as firms grow large. Similarly, Sutton (1998) has drawn from Simon’s work in a study of the evolution of technology and market structure. More recently, Okoli, Chen, and Chong (2002) and Chen, Chong, and Chen (2001) show that Ijiri and Simon’s 1977 monograph can provide us insights and foresights on how to tackle this new research opportunities in the networked, digital economy.

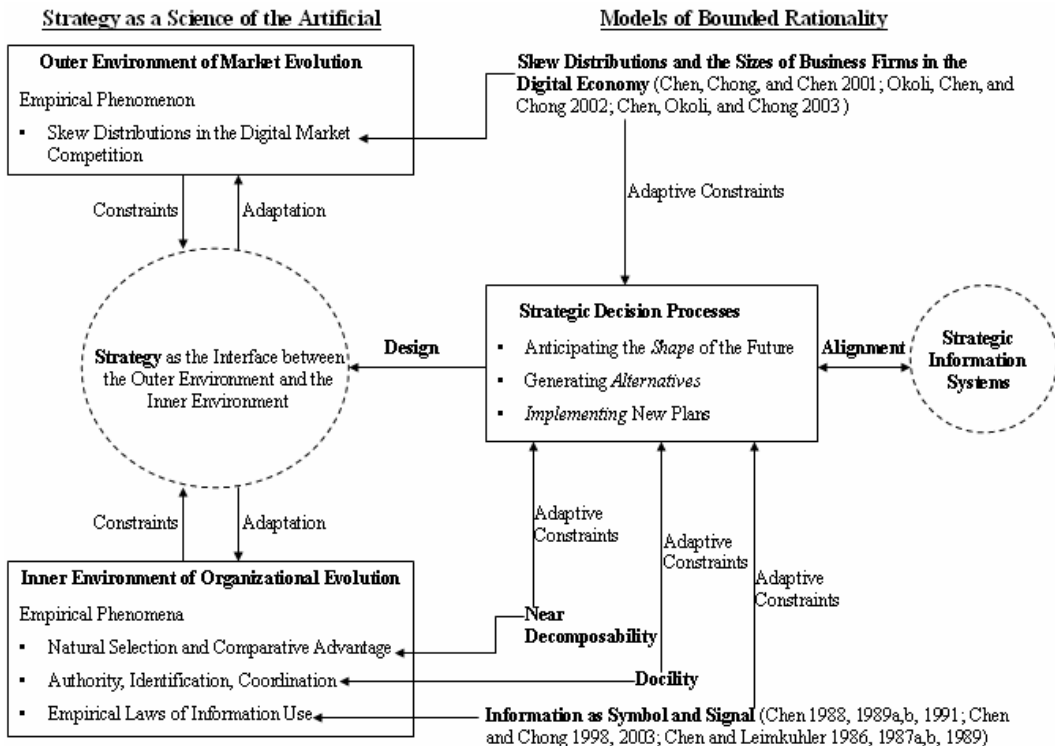


Figure 2. A Simonian Research Agenda of Strategic Growth of Firms in the Digital Economy

The understanding of skew distributions phenomenon in the digital market competition through the explanatory models of the sizes of firms provides us a background against which strategic decision making for firm growth take place. As an illustrative example, in the following we show how such an explanatory model can be simulated to help the decision makers anticipate the *shape* of the market competition, generate *alternatives*, and eventually help *implementing* strategic actions.

Simulation of Strategic Firm Growth

Consider Ijiri and Simon’s (1964) model of firm growth to explain the skew distributions of the market competition. The two principle parameters of the model are (1) the rate of new entry of firms into an industry; and (2) the industry growth potential. For IT-based franchising businesses in the information age, the latter parameter seems to represent the strength of network effects in an industry (Achrol and Kotler 1999). In the presence of network effects, a firm’s products are more valuable to customers when there is a large customer base. Therefore, the more recently customers have acquired the product, the more likely new and repeat customers are to acquire products from the same firm. This network effect is reflected in Simon’s model, in that a firm that has recently grown is more likely to grow again in the immediate future

than firms of the same size that have not grown so recently. One of the most notable effects of the information age has been to increase the incidence and strength of such network effects (Porter 2001).

To demonstrate how the firm growth model can help a research agenda such as ours, we report here the preliminary results of a simulation study of a skew-distributed industry that illustrates the model graphically, and that gives a more concrete basis for discussing how to relate the parameters of the model to firms using franchising as a growth strategy. Ijiri and Simon (1964) describe the details of the procedure. For this demonstration, we simulated the growth pattern of 250 firms in 1,234 periods of unit growth, with α (rate of entry of new firms into an industry) = 0.2 and γ (industry growth potential) = 0.95.

For an industry perspective on the growth of business firms under the effects of the Internet, we plot the percentage cumulative number of firms on the horizontal axis, and the percentage cumulative assets on the vertical axis. In our simulation, 74.2% of the assets resided in 26.0% of the firms (this point is circled in Figure 3). This demonstrates that our simulation was a good representation of phenomena that manifest a Pareto 80-20 skew distribution.

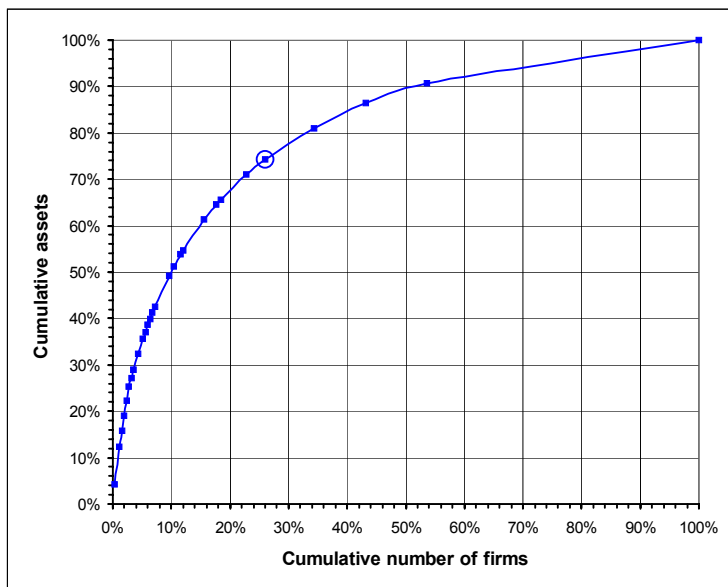


Figure 3. Skewed Distribution of a Simulated Industr

To use the plotted data to determine the industry values of α and γ , we must fit the actual data to the model to derive these parameters. To determine α , we could simply divide the total number of firms by the total number of units of growth at the end of the observation period, or we could try to estimate a dynamic functional form that represents the rate of entry at any given point in time. For this calculation, we would need to take into account the theoretical determinants of barriers to entry (Porter, 1980). Computing γ would involve observing the state of the industry at each point in time, dynamically calculating the value of γ at each point, then obtaining an average value that is representative of all the time periods. While the concept of α (rate of entry into the industry) is relatively simple, γ is a complex, rich parameter that can capture network effects as an aspect of the attractiveness or profitability of different industries.

For competitive strategy, we need to observe the individual performance of each firm. Table 1 traces the growth patterns of the 18 largest firms, all those that ended up with at least 15 units. The numbers under the periods indicate the cumulative amount of growth the

particular firm experienced by the end of the indicated period. Each of the firms experienced growth that ranged from a hundred to five hundred periods. While this was an imperfect approximation of reality in process, the end result of our simulation corresponded closely with what we would expect: We found that only three of the first ten firms (the early movers) made it to the top 18. While four of the firms that ended up in the top ten (the 1st, 2nd, 21st, and 49th) were among the first fifty entrants, the top firm at the end of the simulation was the 180th entrant, and the 201st entrant tied with the 1st entrant for second place.

To compute individual firm's competitive advantage from our actual data, we could follow a backward derivation procedure similar to what we describe for calculating γ above. However, rather than aggregating the results and calculating an industry-wide γ , we would compute an individual γ_i for each firm. γ_i seems to represent an index of individual competitive advantage in comparison with the other firms in the industry. Such an index would be valuable when evaluated against Porter's (1996) principles of strategic positioning.

Table 1. Growth Pattern of 18 Largest Firms in a Simulated Industry of 250 Firms

Entry order	Period ending at time													Rank order of size	
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1234		
1	36	50	50	50	50	50	50	50	50	50	50	50	50	50	2
2	21	21	21	21	21	21	21	21	21	21	21	21	21	21	10
8	4	19	19	19	19	19	19	19	19	19	19	19	19	19	14
21	3	14	17	20	36	36	36	36	36	36	36	36	36	36	7
49		1	33	42	42	42	42	42	42	42	42	42	42	42	4
51			21	21	21	21	21	21	21	21	21	21	21	21	10
87				7	18	18	18	18	18	18	18	18	18	18	15
91				1	5	14	19	24	24	24	24	24	24	24	8
93				2	15	20	22	22	22	22	22	22	22	22	9
100					5	19	20	20	20	20	20	20	20	20	12
126						8	20	38	40	40	40	40	40	40	6
131						1	14	17	17	17	17	17	17	17	16
173								3	13	16	16	16	16	16	17
180									13	44	52	52	52	52	1
194									3	13	15	15	15	15	18
198										16	20	20	20	20	12
201										9	31	50	50	50	2
204										4	15	34	41	41	5

Guided by the above-mentioned Simonian research agenda, various collaborative research projects on franchising and the Internet are being conducted between the International Franchise Forum at Louisiana State University in U.S. and the School of Economics and Management at Tsinghua University in Beijing and School of Management at Fudan University in Shanghai. For examples, see Chen, Chen, and Justis (2001); Chen, Chen, and Chen (2002); Chen, Okoli, and Chong (2003); and Chen, Justis, and Yang (2004).

EMPIRICAL LAWS OF INFORMATION USE

Information as Symbol and Signal

The study of information use is also part of Simon's legacy. Regarding the information-rich world in which we live, Simon wrote: "a wealth of information creates a poverty of attention" (Simon 1971: p. 173). On the matter of attention, Feldman and March (1981) argued that the use of information is highly symbolic, since it is embedded in the social contexts. That is, at both individual and organizational levels, symbols produce belief which triggers the discovery of new symbols. Thus attention shall be paid to the dynamic signaling processes of the symbolic value of information. Exploring the information use in such a view of dynamics of symbols and signals renders a big challenge to researchers. Guided by the empirically grounded thought processes of Simon, our immediate questions are: What do empirical data of information use reveal? Are there striking regularities of information use? How to model those striking regularities? What are the implications for strategic decision processes?

Striking Regularities of Information Use

Striking empirical regularities occur in a large class of information resources of different varieties (Chen and Chong 2003). For examples, in a software program such as Microsoft Word, few functions are used much more often than the others; and in the web information retrieval process a relatively large number of queries seem to center around a small proportion of web pages. The distribution of usage reveals a pattern of

"significant few" (the frequently used ones) and "trivial many" (rarely used) groups. The simplest way to describe this empirical phenomenon is the 80/20 rule, that is, 80% of information use involves only 20% of resources. More sophisticated ways of describing the empirical regularities include Zipf's law of Word Frequency (Zipf 1949), Lotka's law of Scientific Productivity (Lotka 1926), and Bradford's law of Information Scattering (Bradford 1934). Each law has a different focus on how data are arranged in terms of observation and class; and researchers have found that many phenomena that have observation-class relationship show similar distributions (Chen and Leimkuhler 1986).

The striking empirical regularities have been applied to many areas of information systems design. A classic example for Zipf's law is Shannon's study (1951) of the vocabulary size of printed English; it also has been reported in the design of programming languages and command languages (Chen 1991), speech recognition (Chen, Chong, and Kim 1992), software metrication (Chen 1992), and more recently, web usage (Watson, Shi, and Chen 1999). However, these empirical regularities only reveal a crude approximation of the data. Take the 80/20 rule as an example. The measure might be 85/35 (85% of queries are requested from 35% of users, for instance), 88/40 or 95/25, or any of several other pairings, depending on which point on the curve we select to analyze. We often choose the unique point where these two numbers add up to be 100 in order to identify different distribution patterns (e.g., 70/30 or 90/10). Thus, we must address two questions: First, under what conditions, are the empirical laws true? Second, are the empirical regularities static or dynamic? That is, if the 80/20 rule is correct at the time of analysis, will it be true over time? The 80/20 rule and other empirical laws tell nothing about either the past or the future.

Modeling the Striking Regularities of Information Use

Guided by Simon's five-step process of "scientific discovery" (1977), Chen and his colleagues have developed successive theories providing explanatory justifications for the striking empirical regularities exhibited in information use (Chen 1988, 1989a,b, 1991;

Chen and Chong 1998, 2003; Chen and Leimkuhler 1986, 1987a,b, 1989). Briefly, two major contributions can be identified:

1. Through the notion of an “index” approach, various striking empirical regularities are proven to be mathematically equivalent (Chen and Leimkuhler 1986; 1987a,b). Thus, researchers shall focus on the empirical law of the most practical implications for the practitioners, i.e., Zipf’s law (1949).
2. Comparing with other leading theories (such as multinomial urn model, Markov chain, and Mandelbrot-Shannon (Mandelbrot 1953), The Simon-Yule model (Simon 1955) and its successive refinements are shown to be the most promising to model the use of information.

Implications for Strategic Decision Processes

Similar to the study of skew distributions phenomenon in the digital market competition, the explanatory models of information use help us understand the dynamics of information as symbol and signal and provide us a background against which strategic decision making for firm growth in the digital economy take place. In the digital economy, companies need to look beyond simply building a web site and treating it just as another channel of marketing and sales. Instead, companies should look for innovative strategies that harness the Internet to transform the business processes into “Edge companies” that focus mainly on the touchpoints they have with customers and suppliers (Baker 2001). Thus, the design and performance of the web sites as the major touchpoints become a crucial part of the decision making processes of “Edge companies”.

In the literature of web design and performance evaluation, many striking empirical regularities of information use have been observed with Zipf’s law (1949) as the most cited empirical distribution for web site activities (Watson, Shi, and Chen 1999). It has been shown (Watson, Shi, and Chen 1999) that Ijiri and Simon’s (1964) model, adapted to the domain of web management, provides a robust dynamic model of web user access patterns:

1. Based on the historical data of web information use, they provide a method to estimate the parameters α (the rate of accessing new web pages) and γ (the influence of past accesses on a new selection) in the model.
2. With the two parameters α and γ estimated, they show that the generation of web page requests in the web servers can be simulated quite accurately using the algorithms developed from the model.
3. The performance of leading web cache policies can be analyzed and evaluated with respect to the two estimated parameters α and γ .

Thus, the two parameters α and γ are the major drivers of the user behaviors of information use. A sound web strategy of “Edge companies” shall carefully incorporate Ijiri and Simon’s (1964) model into its web sites design and monitoring processes so that those web pages with the most symbolic implications have the most signaling opportunities in the organization. A comprehensive study of such a web strategy is ongoing.

STRATEGIC INFORMATION SYSTEMS: A FRAMEWORK

Based on the Simonian research agenda of strategic growth of firms in the digital economy discussed above, we propose a framework of strategic information systems in Figure 4. The box in the middle represents the three major tasks of strategic decision processes which are supported by four adaptive information systems responding to environmental constraints:

1. Future shape systems. They are used mainly to support the decision makers to anticipate the shape of the future; that is, identify things which may impact the firm significantly, determine the time attention shall be focused on them, and allocate the resources to deal with them (Simon 1993a). The explanatory models of skew distributions with their generating mechanisms, such as the simulated growth pattern of firms in an industry in Table 1,

are examples of functions to be included in the systems.

2. Near decomposability systems. They are used mainly to help the decision makers to generate alternatives to design the firm to be sustainable in the future market competition. There are two reasoning processes which can be incorporated into the systems as they both create near decomposable systems: effectuation and causation. In her study on Entrepreneurship, Sarasvathy (2001, 2003), a former doctoral student of Simon, developed the theory of effectuation, linking near decomposability to the processes entrepreneurs use to shape the uncertain future by creating and growing enduring firms. Iwasaki and Simon (1994), on the other hand, linked near decomposability to the causal ordering processes in decision making..
3. Docility systems. They are used mainly to motivate people in the firm to implement the new plans and to institutionalize intelligence. Simon (1993a) believed that strategic skills must mold a company's mission statement, permeate the entire enterprise, and be effectively executed by

motivated employees empowered by attention-based information systems. In order to achieve these goals, creation of a strategic planning unit with the strong support from top management is needed. Besides the organizational considerations in planning, the firm also needs to institutionalize intelligence activities so that a steady stream of new sources of comparative advantage can be assured.

4. Symbol and signal systems. They are used mainly to disseminate the new plans effectively throughout the firm so that symbolic requirements and signal opportunities (Feldman and March 1981) will have major influences upon the decision making processes. Simon (1993a) argued that some job rotation may be needed in order to effectively disseminate the new strategic plans throughout the company and keep the planning unit in touch with the real world of operations. The explanatory models of empirical laws of information use with their generating mechanisms, such as the simulated access pattern of web site activities (Watson, Shi, and Chen 1999), are examples of functions which can be included in the systems.

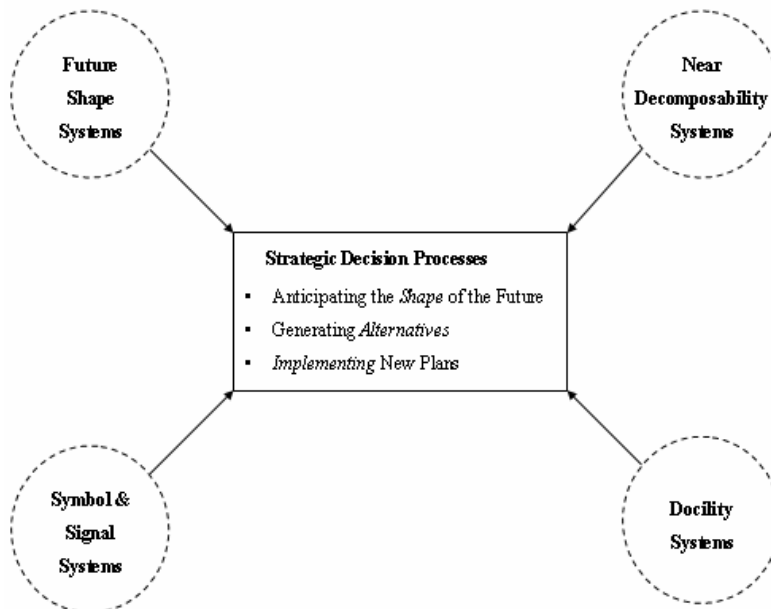


Figure 4. Elements of Strategic Information Systems

CONCLUSION

In his best-seller *Business @ The Speed of Thought*, Bill Gates (1999: p. xiii) wrote: "Information Technology and business are becoming inextricably interwoven. I don't think anybody can talk meaningfully about one without talking about the other." When it comes to the study of strategic growth of firms in the digital economy, Gates' point is very true. This is because issues related to strategy and the Internet are both complex and inextricably interwoven (Porter 2001). Examined closely, however, the real issues of the study are related to strategic decision making bounded by many real-life constraints such as rapid change of information technology and the ever turbulent business environment. Thus, Herbert Simon's *Bounded Rationality in Decision Making* shall be a foundational source for our future work.

Indeed, we showed in this paper that Simon's thought processes are quite helpful in addressing our research goals. Mainly, our study of strategic growth of firms in the digital economy has to be well grounded with empirical facts in the outer and inner environments of the firms and proceed with successive refinements of explanatory models, since we are living in an evolutionary world. Specifically, we propose a research agenda with three Simonian perspectives of strategic decision processes (anticipating the shape of the future, generating alternatives, and implementing new plans) supported by four adaptive mechanisms (future shape systems, near decomposability systems, docility systems, and symbol and signal systems) designed to detect and respond to the outer and inner environmental constraints.

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