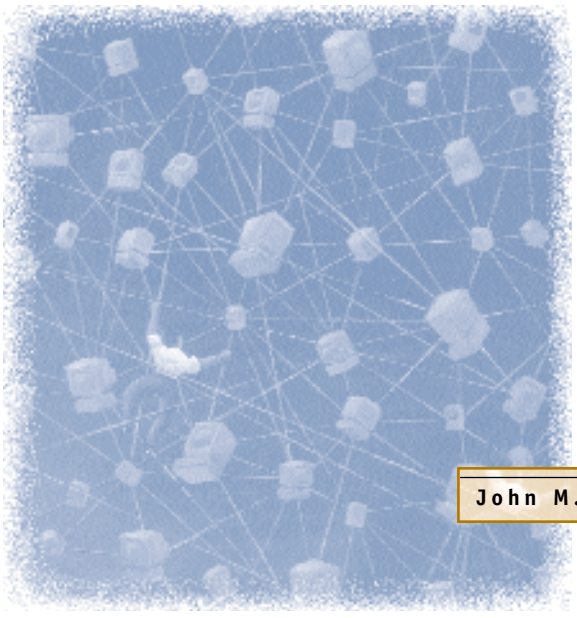

DYNAMICS OF EXCHANGE IN NETWORKED MARKETS

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An introductory assertion: all markets are networks, so market dynamics shift when network properties shift. Amid much attention to the acceleration of existing business practice in the connected economy, other deeper changes are reshaping the economic and thus commercial landscape. Pricing, for example, is becoming a highly dynamic, interactive process involving negotiations with multiple currencies (opinion, privacy concessions, referrals, as well as money, goods, and services) among multiple parties extending beyond buyer and seller. The implications for pervasive networking for commerce extend far beyond pricing, segmentation, and other activities of the firm into areas such as alliance-building, option assessment, and the pursuit of adaptability. Our purpose is to explore how networks affect markets, and how the Internet and its successors will reshape the nature of exchange in its complexity, time horizon, and potentialities.

Changes in the nature of markets and exchanges portend significant challenges to conventional business practice. With the potential shift from the firm (General Motors, for example) to the market (the automotive network currently in development) as the primary unit of analysis and execution, there is an accompanying shift from internal business process improvement as the key tactic for operational advantage to managing the many interfaces of internal

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Networks are the backbone of the connected economy. As these networks have become more pervasive, the nature of markets have begun to change as well. How networks affect markets and how the Internet and its successors will reshape the nature of exchange is an important issue for business, and society today.

processes with extra-firm market dynamics. Among these, understanding and leveraging the power of market-clearing means that market efficiency—a characteristic of a system, not an entity—replaces the formerly obvious paths of internal optimization, forecasting, proprietary advantage, and local input-output (i.e., mechanical) efficiency as commercial imperatives.

Markets and Emergent Behaviors

The rapid growth of online auctions and exchanges is accompanied by a new dynamism that introduces what are known as emergent properties, which are behaviors of a complex system that cannot be inferred from the characteristics or behaviors of the system's component parts. Rather, it is the interactions among a system's components that give rise to emergent properties, and although the components, or agents, themselves might be governed by specific and known rules or strategies, the sum of their actions does not follow in any linear way from these rules. Thus, emergent properties can neither be predicted nor designed with precision. A few very simple rules can give rise to emergent behavior that is itself far more complex. In its nonlinearity and lack of predictability, emergence challenges the deterministic models of business management that dominated industrial economies.

Nonlinearity is a common characteristic of many complex systems and the properties that emerge from them. Outputs do not reliably track causal trajectories (collections of behaviors add up to something other than the predicted sum of those behaviors). Network effects are beginning to get serious attention from economists, among them Stan Liebowitz and Stephen E. Margolis, who note that:

> Direct network effects have been defined as those generated through a direct physical effect of the number of purchasers on the value of a product (e.g., fax machines). Indirect network effects are "market mediated effects" such as cases where complementary goods (e.g., toner cartridges) are more readily available or lower in price as the number of users of a good (printers) increases.[1]

It's important to note that network effects cause the locus of value to shift from an artifact—the fax machine as a collection of components—to a set of relationships. The value to the user is in what the machine is allowed to do by all the other machines out there, rather than in the cleverness and craftsmanship of the machine's manufacturer. Industrial economics values work done in the past; network economics values past and potential combinations of connected assets. When we consider the power of the Internet in contrast to fax machines, it becomes clear that the potential emergent effects of this networked market are just beginning to be explored.

In the old model of commerce, a customer gave money to the supplier in exchange for a widget or service. Today's most innovative business models are significantly more complex, multidimensional exchanges of economic value among groups of people. What can be referred to as "serial barter" is practical in today's networked world —bit-based information flows faster than paper, and algorithms can do much of the logistical heavy lifting that would have swamped accounts payable clerks and similar functionaries.

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These properties of emergence—quite foreign to the world of extraction and manufacturing, less unknown in financial services or entertainment—have far-reaching implications on current business strategy and practice. Readiness for action, in such an environment, takes on discernibly different characteristics from a situation in which the past was presumed to serve as some sort of guide to the future. In the domain of operations, given the speed of fickle demand shifts in connected markets, forecasting becomes less and less satisfactory as a basis for action. In the traditional realm of marketing, meanwhile, the speed of news propagation intensifies from individual to individual and among interest communities in ways that neither broadcast nor point-to-point (such as telephone) modalities can mobilize. Rumors and bad news travel fast, taking on lives of their own. The urban legend surrounding the Neiman-Marcus $250 cookie recipe is one simple example. Wherever an observer looks, the emergent properties of networked markets shake the experiential and intellectual premises of business executives.

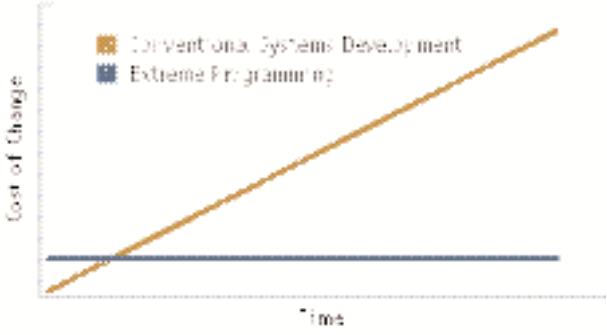
Extreme Responses: Let Networks Create Value

Presented with a world in which what (and how much) goes in often tells the observer strikingly little about what comes out, how are leading-edge businesses responding? There is a growing recognition of the importance of reaction time, of modularity, of changing time horizons. At the same time, economic value that previously was assumed to be synonymous with revenue is beginning to be recognized as having many incarnations. This recognition allows for the possibility of more complex exchanges of value, almost the sort of serial barter that has frequently been assumed away by conventional understandings of the place and limitations of fiat money.

The world of software engineering provides a series of important lessons that will be felt in other domains. According to a new school of thought known as Extreme Programming, software is never "done," nor is it predictable in its evolution.[2] As a result, software projects of this persuasion begin not with a set of parameters but with the expectation that definitions of quality will be learned (that is, allowed to emerge) by building and iterating the application. The future, nonlinear as it is, is assumed to be unknowable until it happens and not as a deviation from an underinformed plan. Project management consists largely of creating a loosely coupled, modular environment that is easy to change; it allows good ideas a place to land rather than be put into a queue of expensive change orders that "break" an existing architecture. The goal

Figure 1

Traditional vs. Progressive Software Development



Source: Cap Gemini Ernst & Young analysis

is to keep the cost of change low and constant over time in contrast to traditional software that gets more expensive to change every day. Today, paradoxically, when the most is known about building a good application, the least can be done about it (see figure 1).

Such a system is possible only when there is a robust network of talent to exploit the capability of a technical infrastructure based on common standards for interconnection. That is, there is a willingness to act in the present with little understanding of the final outcome; it's a matter of allowing creativity to happen rather than planning for it to fit in predictable places. The same dynamic is at work economically. The notion of doing the right thing at the right time, based more on intuition than detailed past research, fits both the entrepreneurial tenor of our times and the power of the network to make good—if nonlinear—things happen.

The idea of loose coupling as a response to the increased speed and complexity of networked interaction requires both hard (system-based) and soft (cultural) change within the business enterprise. The benefits, however, help define the era. The old model of commerce was tightly coupled: customer gave money to supplier in exchange for widget or service. Today's most innovative business models have complex, multidimensional exchanges of economic value among groups of people. Peter can pay Paul, who provides information to Jane, who offers execution capability to Sue, who serves Peter. Such exercises in what is effectively serial barter are now practical because a) bit-based information flows faster than paper and b) algorithms can do much of the logistical heavy lifting that would have swamped accounts payable clerks and similar functionaries.

Sun Microsystems' Java venture capital fund, discussed elsewhere in this journal, provides a useful example of an effort to address networked markets (for network-aware software) whose sponsors could barely guess what would happen when they began. Sun's free distribution of StarOffice, a software suite that delivers the same functionality as Microsoft's office applications, shows a similar willingness to trust the emergent properties of a networked market: by giving away the software to end users, Sun can build the user base for a platform, entice other application software providers to strengthen the platform, and create switching costs for users once Sun launches StarOffice and associated network storage services as a new way of handling information. It is quite conceivable that royalties, user fees for data storage, and developer licenses could constitute a robust revenue stream for Sun, more than making up for any "losses" suffered from the lack of revenues on StarOffice. More important, the product can help change users' definitions of what constitutes a "computer," paving the way for wider adoption of the information appliances that might tip the competitive scales away from Microsoft and toward Sun.

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The increasing use of stock options as compensation serves as a different example of a networked market whereby a series of exchanges spread risk and share reward in a nonlinear path. If Company A gives its employees stock or the option to buy stock in advantageous circumstances, and the stock does well, two things happen: employees are compensated for their contribution not by the legal entity called Company A, Inc., but by the behavior of investors in financial markets, and Company A is able to utilize the talents of its workers without "paying" for the full value of those talents. Effectively, stock compensation both outsources compensation and breaks the time-bound nature of the wages-for-hours industrial employment model; reward is not synchronous with effort.
Just as in the StarOffice case, economic value is put into a network (in this case, by employees) with no clear sense of what the reward will be or when it may happen.

Less Extreme Managerial Responses: Differential Pricing

Participating in value-creating networks in a good-faith effort, trusting that reward will come, is not practical for most managers or investors with real-life (that is, non-software) decisions to make. Three pricing techniques are drawing increasing attention, each of which exploits a different characteristic of networked markets; these are yield management, bundling, and versioning. All three techniques gain in importance as networked markets reveal pricing information, threatening whatever competitive advantage was gained by customer ignorance of alternative providers' pricing.[3] Still more threateningly, many researchers have predicted a world in which software bots seek out low-price providers, reducing commerce to an endless series of profitless price wars.[4] Our contention, however, is that dynamically changing differential pricing as effected by these three practices, among others, will render many of the price-war predictions moot.

Yield Management

Anyone who flies is familiar with two phenomena: the fact that seemingly every seat on the airplane was sold for a different price, and the curious practice of selling more seats than are physically available on the aircraft that results in an auction in which volunteers are offered increasing levels of compensation for giving up their seats and taking alternative flights. The practice of yield management, which aims to maximize the profitability of time-delimited inventory

Bundling and versioning are both important elements of networked markets. Bundling works well with readily reconfigurable bit-based information goods, effectively reintroduces information asymmetry in open environments and reinforces the role of the intermediary, and leverages knowledge of information. Versioning allows for the same information to be presented in a variety of ways, each of which has value for some group of customers. The product is identical, but the accompanying set of services and non-software accessories vary. The point is to get customers to sort themselves into different groups according to their willingness to pay.

article abstract

(known in the grocery business as the "sell it or smell it" problem), was pioneered by airlines and has since spread to hotels. On the horizon, restaurants are experimenting with selling prime seatings at a premium, while service providers like beauty salon operators, automobile service shops, massage therapists, and others are looking at ways to price their offerings both by quality of service rendered and the time of the appointment. Intuitively, a personal trainer is most likely in higher demand at 6 p.m. than at 10 a.m., yet the price rarely reflects the proportionately higher demand for the after-work slot. The principles of time-sensitive reward and punishment are well known in financial markets, where 12-month certificates of deposit pay better than 30-day CDs: consumers pay for flexibility and are rewarded for locking into longer commitments.

Yield management is of particular importance in networked markets because it relies so heavily on information flows to work. American Airlines, for example, had a huge advantage in leading the way on yield management in civil aviation because it operated the SABRE reservations network along with its airplanes, ground operations, and gates. One outcome of the profit-maximization thinking behind yield management is the frequent-flier program, another information-intensive effort at price discrimination, in this case using alternative currency as an incentive. We predict that both of these related techniques will spread far beyond their original industry lines as networked markets proliferate.

Bundling

Again, a travel industry example brings the concept home. Tour operators regularly offer price combinations of airfare, hotel nights, cruises, and/or meals that bear no relation to the total of the included items and services purchased separately. While there is a modest economic literature on bundling, in networked markets it is extremely important for three reasons: bundling works especially well with readily reconfigurable bit-based information goods (see versioning, below); bundling effectively reintroduces information asymmetry in open environments and reinforces the role of the intermediary; and bundling leverages knowledge of information about stuff, much as yield management does.

Several implications follow from the usefulness of bundling. First, customers can effectively set their own pricing, if only mentally: in the aforementioned travel example, one customer will more highly value the meals while another really prizes the cruise. Second, bundling introduces a need for both effective cost management (typically achieved through economies of scale) and a broad "menu" of items to be bundled, again often achieved through scale. Thus, there is some indication that providers of point solutions or niche products will fare poorly in competition against vendors with broad product lines and economies of scale with regard to both inventory and operational efficiency.[5]

Versioning

The same information in a given product can be presented in many ways, each of which has value for some group of customers. Consider a Wall Street analyst report: it might be released Monday morning to one group of high-value clients, Monday afternoon to a less valuable group, and Tuesday morning to the rest of us. The information in the report is identical in the three versions; what varies is the exclusivity of the time advantage conferred by each sequential release. Software is another good that is easily presented in versions: a basic package may be available for free download via the Internet, a modestly priced version may include printed documentation and accessories (stylish T-shirts of the Apple variety, perhaps), and a premium product may include telephone technical support. Once again, the product is identical; what varies is the accompanying set of services and non-software accessories.

According to Hal Varian of the University of California at Berkeley, "the point of versioning is to get the consumers to sort themselves into different groups according to their willingness to pay. Consumers with high willingness to pay choose one version, while consumers with lower willingness to pay choose a different version. The producer chooses the versions so as to induce the consumers to 'self select' into appropriate categories." Information goods are extremely easy to version, but the logic applies elsewhere: pickup trucks have millions of potential combinations of options, a given one of which will appeal to a particular buyer who will pay for customizing "her" truck. Networked markets facilitate both the process of customization and the exchange of information among a group of customers about the merits (and relative value) of various options.[6]

Markets for Everything

The rapid growth of networked markets has three implications for commerce. Each challenges current assumptions and offers opportunities for leap-frogging incumbents.

First, there are more currencies for exchange. Opinion, preferences, recommendation (word of mouth), purchasing/behavior history: each of these is being exchanged online in various networked markets. The old need for all dimensions of an exchange to be boiled down to a single price number is being challenged by the high information bandwidth available to essentially any market participant. According to John Sviokla, formerly professor at Harvard Business School:

> Someday we may be able to forget money and move on to some superior way of expressing price. The challenge is that we need an entire grammar of value that is as exchangeable as price. A semantics that allows people from all over the globe to discover locally, nationally or globally what the value is of some "thing" in time and place. These new semantics, largely defined by the customer, are beginning to appear in the capital markets and on the World Wide Web.[7]

Thinking in terms of exchange rather than transactions creates more mental room for concepts involving interactions with multiple dimensions of economic value. Linux, for example, is impossible to conceive of using only supply chain, transaction-driven methods; programmers "irrationally" contributed free work and the product itself is available at no charge. No money changed hands, yet economic value was undeniably created: the very existence of the software proves that the "impossible," unconventional model can in fact work.

Second, there are more parties to any given exchange; the entity to whom one conveys economic value more and more frequently is not the entity that provides the contributor value in return. The combination of more dimensions of exchange and more parties being involved in an exchange means that the complexity of interaction rises exponentially. Essentially, the growth of networked markets means that attempting to explain America Online or Sun Microsystems or eBay using lemonade stand economics fails miserably.

Third, the rise of networked markets shifts the importance of the firm. Marketspaces and market dynamics are proving superior in the capture of competitive high ground when compared to efforts within an enterprise focus (e.g., process improvement). Entrants can't win by internal cost optimization (which remains necessary but is no longer sufficient), but must track with a demand side that moves fast and bargains hard. In many settings, networked markets reinforce Michael Dell's assertion that "assets attract risk" and put suppliers in the position of the wheat farmers selling to Cargill: it's often much more profitable to trade information about stuff than to make stuff, and, as such businesses as SciQuest, Band-X, and Metalsite suggest, better to be the market and take transaction fees than to be the producer. At the same time, everyone can't be a speculator. Tangible goods and services still matter, and networked markets allow for new productive entities—alliances, for example—to emerge as compelling alternatives to the limited liability joint stock corporation as vehicles for getting things done.

Looking Ahead

Returning to the introductory assertion—that because all markets are networks, market dynamics shift when network properties shift—prompts the question: so how are networks changing? We are watching two key developments that could precipitate significant shifts in market behavior. First, mobile network connectivity as made possible by Nippon Telephone and Telegraph's I-mode offering means that markets become even less spatially constrained; in less than six months since the service's introduction, 5 million Japanese customers are accessing a new generation of wireless Internet content. Both in terms of infrastructure for access (as in developing regions, where installing cell towers is cheaper than stringing cable) and in terms of personal mobility, the extension of the Internet through wireless platforms will change markets.

Second, global connectivity is increasing, in part through the potentially explosive adoption of wireless technologies, which means that many markets are getting thicker, increasing the possibilities for emergent behavior: when more suppliers increase variety of offerings, more customers are drawn to a market, and we are witnessing the growth of market size and reach on unprecedented scales. Such phenomena as global capital flows, the rapid increase in stock trading by individuals, and a worldwide Beanie Baby market on eBay portend similarly large-scale markets in the future.

Ever since humans began to trade, networks and markets have evolved in tandem. The developments of the past few years in electronic commerce maintain continuity with the past at the same time that, in their scope and nonlinear behavior, they represent a departure from convention. Culture, economics, and business practice in some ways lag technological innovation, so it is exciting to contemplate the innovations in how people interact that will follow on the heels of the wave of invention to which our generation is witness. At the same time, learning to live in non-deterministic landscapes is as much a personal challenge as it is an economic imperative.

1 http://www.utdallas.edu/-liebowit/palgrave/network.html.

2 See the Extreme Programming website at http://www.extremeprogramming.org/; the main text for the movement is Kent Beck, *Extreme Programming Explained: Embrace Change*," Addison-Wesley, October 1999.

3 Indrajit Sinha, "Cost Transparency: The Net's Real Threat to Prices and Brands", *Harvard Business Review*, March-April 2000.

4 James E. Hanson, Jeffrey O. Kephart and Jakka Sairamesh, *Price-War Dynamics in a Free-Market Economy of Software Agents*, (Thomas J. Watson Research Center); see also Bayers, Chip, "Capitalist Econstruction," *Wired*, March 2000.

5 Scott Fay and Jeffrey Mackie-Mason,"Competition Between Firms that Bundle Information Goods," (November 1998). Presented at the 27th Annual Telecom Policy Research Conference, Alexandria, VA, September 25-27, 1999.

6 Hal R. Varian, "Versioning Information Goods," available at http://www.ksg.harvard.edu/iip/econ/varian.html; see also Varian and Carl Shapiro, *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, 1998.

7 John J. Sviokla, "Increasing the Bandwidth of the Desire: Pricing in the Digital Age" in Clippenger, John, ed., *The Biology of Business: Decoding the Natural Laws of Commerce*, Jossey-Bass, New York, 1999.