Innostructure: Managing Innovation as Business-Critical Infrastructure

Ron Fulbright, University of South Carolina Upstate, 800 University Way, Spartanburg, SC 29303; E-mail: rfulbright@uscupstate.edu

ABSTRACT

The last few years have seen increasing interest in organizational innovation—changing an organization to enhance its ability to sustain innovative thinking and problem solving. Most companies plan to increase spending on innovation this year continuing a five-year trend. However, executives report not being satisfied with the return on investment in innovation. We argue that the wrong metrics are being used because innovation is not being treated as a business-critical infrastructure. We propose a high-level architecture for an infrastructure supporting organizational innovation—the innostructure—and describe how performance of this infrastructure can be monitored and optimized.

INTRODUCTION

In 2004, the former Chairman of the Federal Reserve, Alan Greenspan, observed that the new paradigm of *globalization and innovation* represented a "one-time shift" in national and international economics (Greenspan, 2004). Globalization, the extension of the division of labor and specialization beyond national borders, is driving companies to be competitive in new ways. One response is the acceleration of the pace of innovation. Companies too slow to react to the changing marketplace are out-performed by more agile, sometimes foreign, companies. As a result, chief executives are spending on innovation and are trying to feel their way into an unknown future. According to the Boston Consulting Group (BCG), 74% of companies will increase spending on innovation in 2006, roughly the same as the 72% in 2005 and up from 64% in 2004 (Andrew, 2005), (Andrew, 2006).

However, the BCG studies also report that most executives are not satisfied with the return on investment in innovation spending. Reasons cited for this disappointment include:

1. difficulty in gauging costs and returns
2. development times that are too long
3. lack of coordination within the company
4. not enough insight into customers
5. risk-averse culture in the corporation.

We maintain the primary reason for the disappointment in gauging returns (#1) is that a direct measure of payoff from spending on innovation is not an appropriate assessment measure. We believe innovation should be woven into the fabric of the company itself as a business-critical infrastructure like information technology resources are today. No company today would be considered a serious company if it did not have telephones, fax machines, e-mail, computers, etc. The day is fast approaching when a company without an infrastructure supporting innovation, something we call the *innostructure*, will not be considered a serious company. Such an integration addresses the disappointment in coordination (#3).

History is replete with examples of corporate spending on fads and popular buzzwords enjoying popularity for a few years only to be lost in the rush to the future. We fear interest in innovation will wane accordingly due to the perceived lack of immediate results. This will not only be unfortunate, but a critical mismanagement of something we understand to be a critical business resource—innovation.

Our belief is that innovation is the emergent behavior of the complex adaptive system of humans, information, knowledge, wisdom, and market forces. We propose here the best way to architect the innostructure that supports this innovation is as a scale-free network of collaborators—something we call the *innovation metanetwork*. The metanetwork is an open collaborative system allowing customers and other outside parties to collaborate with company employees, addressing the disappointment in knowing customers (#4).

Constructing the innovation metanetwork as an emergent, scale-free network allows its performance to be monitored, measured, and controlled by objective metrics thereby replacing the troublesome metrics in #1.

WHY THE GLOOM?

The fact that most executives continue to increase spending on innovation while not being satisfied with the results is seemingly a paradox that begs for an explanation. Looking at the studies, we offer that the executives' expectations are misplaced. The executives appear to expect immediate and quantifiable impacts to the corporate bottom line (Andrew, 2006b). We maintain this is not the most effective way to measure corporate innovative effort.

As an illustration, consider what would happen if the CEO of the company wanted to know what the return on investment was in purchasing a new network router. Imagine if it were necessary to measure and report the increase in corporate sales attributable to the new router. It would be easy to show how effective bandwidth might increase and one could point to statistics showing reductions in network latency. Everyone would agree the new router was a good thing to have and no one would argue for its removal.

However, did the router increase corporate profit? The router, its installation, and the metric-gathering cost the company a non-zero amount of money. So to be profitable, does the router have to recoup its own cost in terms of increased sales? If so, how would you determine that an increase in sales would not have happened if the router had not been purchased?

The problem, of course, is there are many more things, other than the new router, that must happen for corporate sales to increase. True, increased network speed, because of the router, may allow a salesperson to respond to more customers and, therefore, close more sales. But because so much else goes into closing the sale, the contribution of the router is obscured.

We think a similar phenomenon is happening with those who are attempting to measure return on investments in innovation spending. The expectation seems to be that a tool will be purchased, someone will use it to produce the next great product, and the company will make a fortune all because it "invested" in the tool. This "eureka" scenario may very well happen, but more likely, and more realistic, is that use of the tool will incrementally improve something in the enterprise which will enable something else to happen, and so on, until ultimately, the effect snowballs to a threshold where a true bottom-line impacting event occurs.

If this is true, the disappointed executives are looking at the wrong metrics. We believe innovation must be infused throughout the organization as a strategic infrastructure component. Therefore, the metrics one uses to measure success of that infrastructure should be oriented toward measuring the infrastructure itself rather than some ultimate application of the infrastructure.

WHY COMPANIES MUST INNOVATE

We begin by modeling an enterprise as a hierarchy shown in Figure 1. This is a visualization we have developed, called the Vendible Model, for in-class discussion of alternative sourcing (Fulbright, 2004)

Enterprises are modeled on the basis of the amount of resources produced internally versus the amount of resources purchased from external entities. The vendible line defines the boundary between internally sourced resources, the strategic regime, and externally sourced resources, the commodity regime.

Figure 1. The Vendible Model depicts the vendible line partitioning an enterprise into a part that cannot be outsourced, called the strategic regime (above the line), and a part that can be outsourced, called the commodity regime (below the line).
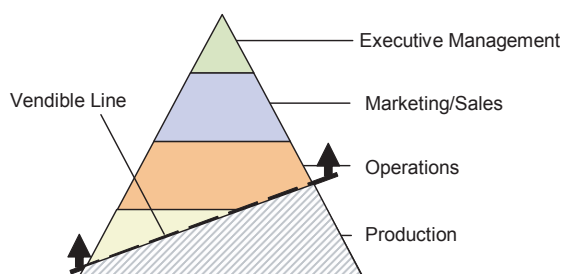
Resources of higher strategic value are depicted near the peak and the resources with lower strategic value are near the base. In general, the lower-valued resources get outsourced quicker than the higher-valued resources. This causes the vendible line to sweep upward as commoditization consumes more and more of the enterprise. However, the vendible line never reaches the top because if it did the enterprise would cease to exist. The entire enterprise would have been outsourced. On the other hand, the vendible line never reaches the bottom because no enterprise produces every resource that it needs. Even the smallest company buys something from a supplier be it paperclips, electricity, water, or any other commodity.

Vendible Model analysis shows us something important about enterprises: there is something in any enterprise that will never be outsourced. We call this core set of resources the *strategic kernel* and it represents the very essence of the enterprise itself.

What is contained in the strategic kernel? To answer that, we must first recall the definition of commodity as being a good or service that is traded primarily on the basis of price, and not on differences in quality or features. In other words, commodities are those things that are decidedly *not unique*. Since non-unique resources become commodities and fall below the vendible line, what remains in the enterprise are the resources that make the enterprise unique. The way an enterprise stays unique is to do something that no other enterprise is doing or can do. This is the very definition of *innovation*. The conclusion is not very surprising: companies must innovate to stay ahead of the competition. Leading companies in every industry already invest substantial amounts of resources in research and development departments. However, what is a new response to Greenspan's global economy is how companies will innovate in the future.

Globalization is leveling the playing field and allowing companies all over the world to compete in previously inaccessible markets. Companies are competing against a larger and more diverse group of competitors than ever before. However, something else is happening that is even more important. The time required for the concept-to-product cycle is getting shorter. A few decades ago, a company's new innovation could put it several years ahead of its competition. By the end of the millennium, this lead time had shortened to several months. Globalization, communication technology, information technology, culture, social, and political forces are pushing us into the knowledge age where innovative lead time will be measured in weeks. The large research and development department, that many companies have today, is not likely to respond fast enough for this future marketplace. Companies that do not become leaner, more agile, and continually adaptable will lose out to those companies that do. Being able to *continually* adapt will require companies to distribute its capacity for innovation throughout the company and create a corporate-wide culture of innovation.

To achieve this, a company's innovation quotient must be built into the fabric of the company itself, touching every job, every employee, every department, and every business practice. What we are describing here is the need for a new infrastructure for innovation. We call this the *innostructure*.

We in the industry have seen this kind of thing before. One time relegated to the data processing center, the infusion of IT infrastructure into companies has turned most employees into information workers, and has done so by distributed information resources throughout a company. We expect the same thing to happen to innovation. The infusion of innostructure will turn more and more employees into *innovation workers*.

In Business @ the Speed of Thought: Succeeding in the Digital Economy, Bill Gates makes a strong case for the increased need for IT-savvy thinking to permeate all aspects of business (Gates, 1999). He argues that without it, businesses will not remain competitive and not take advantage of the competitive levers provided by innovative state-of-the-art IT technology. Because we view information management's central role as turning information into knowledge, we see information resource management as the point of the spear leading the way to the innostructure.

THE INNOVATION METANETWORK

There are a number of innovation tools on the market and some companies are already employing these tools. The critical factor companies are lacking is the embedding of innovation tools into a sustaining infrastructure that promotes innovation as a way of doing everyday business. Our proposed innostructure is the *innovation metanetwork*.

We take "metanetwork" to mean a network that is superimposed on another network. Companies today have existing information technology infrastructures so any higher-level organization of resources using this infrastructure as a substrate is a metanetwork. The metanetwork supports innovation by facilitating sharing of knowledge and ideas among collaborators.

Visualizing the innostructure as a metanetwork is important because it leads to the identification of two important properties—a scale-free architecture and emergent behavior. These properties imply specific architectural features that can be constructed and measured empirically. This has the decided advantage of giving companies a metric that can be measured, tracked, and optimized—a control parameter.

At the most fundamental level, the metanetwork is a network of collaborators. Collaborators can communicate with each other about a piece of work, called an *opportunity*. An opportunity is a problem to be solved, an idea to be refined, or any other type of collaborative endeavor. Upon receiving an opportunity, a collaborator can either

- refer the opportunity to another collaborator thought to be able to contribute to the opportunity
- contribute to the opportunity
- respond to and refer the opportunity

How the contribution is made and how the piece of work is manipulated is not of concern here. Collaborators may or may not employ various tools in making a contribution. The key to innovation is the ability to explore alternative possibilities without distracting the work down fruitless paths. The way to achieve this is via an open forum promoting analysis, discussion, various viewpoints, and utilization of others' knowledge. This is the role of the innovation metanetwork.

SCALE-FREE NETWORKS

Scale-free networks have proven to be most efficient in promoting information propagation (Barabasi, 2002). This is crucial to support the open and free exchange of ideas in the innovation metanetwork. Scale-free networks are characterized by the existence of a relatively small number of nodes connected to a relatively large number of other nodes. Such highly connected nodes are referred to as *hubs*. An important feature of a scale-free network is the "small-world phenomenon" in which any two nodes in the network are connected together by a small number of links, or "hops."

The airline system is an example of such a network. Cities like Atlanta, Charlotte, and New York are hubs for various airlines. A traveler can get from any departure city to any destination city by taking only one or two flights routed through at least one of the hubs. The Internet is another example of a scale-free network. Internet messages are routed through a relatively small number of switching points arranged in a hierarchy of highly connected hubs, called access points. Because of the small world phenomenon, information can propagate across a scale-free network efficiently.

Another important feature of a scale-free network is its ability to grow to any size without changing the basic architecture or suffering any degradation in information propagation efficiency. Ultimately, the goal of the innovation metanetwork is to develop a collaborative that is highly effective in routing opportunities to the collaborator that can best make a contribution. The hubs in this metanetwork

Figure 2. An efficient, small-world, scale-free collaborative network can be evolved. To seed the process, a set of referrers are initially appointed (i). As the performance of the group is monitored, some appointed referrers will prove to be efficient and others will not (ii). It is likely that individuals not originally appointed will step up and prove themselves to be efficient referrers (iii). Over time, a network of the most efficient referrers will evolve resulting in a maximally efficient, scale-free network (iv).
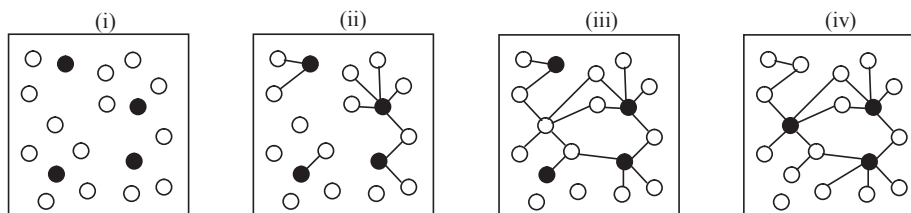
will be those who are very good at routing an opportunity to the appropriate collaborator. A mistake would be to try to identify these key individuals at the outset. Our proposal is to let the metanetwork self-organize. This can be achieved by appointing, at the outset, a number of referrers to act as the hubs and installing a feedback and monitoring mechanism. Initially, all opportunities will be forwarded to this group who will in turn, refer opportunities to others, and so on. The pattern of opportunity referral and the pattern of contributions across all collaborators will be monitored. A collaborator who refers opportunities resulting in contributions and to a wider range of others will be scored higher than one who never refers opportunities or whose referrals do not result in contributions. Collaborators with higher scores will tend to be sent opportunities first. Over time, the highly effective performers will rise and the under performers will be marginalized. As shown in Figure 2, this results in an optimal scale-free network.

EMERGENT BEHAVIOR
Even though the metanetwork will self-organize, it will be static once the prevailing pattern evolves. Researchers in nonlinear dynamical systems have shown that static systems do not achieve the highest degree of emergent behavior (Langton, 1986) Emergent behavior is the global behavior of a system arising from the complex interaction between the parts of the system and it has been shown that maximal emergent behavior occurs at an intermediate level of system complexity. If the dynamics of the system are tuned downed to a point where interactions are extremely ordered, very little emergent behavior is possible from the static system. Likewise, if the dynamics are tuned to the point of chaos, where interactions are totally random, little emergent behavior is possible. However, when system dynamics are tuned to an ideal intermediate level, between the ordered and chaotic regimes, emergent behavior arises from the system.

Emergent behavior often exceeds the abilities of the individual components and often exhibits qualities that can not be programmed or designed into the components. An emergent system is the classic example of the whole being greater than the some of the parts.

Recent work focuses on modeling human organizations as emergent systems. Following this line of research, we maintain that innovation is an emergent behavior of the complex adaptive system of humans, information, knowledge, and wisdom. Innovation is sometimes the result of individual effort, but more often, the result of collaborative effort and emerges from the contributions of several individuals. Therefore, the innovation metanetwork should promote the highest degree of emergence from the system of collaborators.

To do this, the pattern of referral and contribution that evolves naturally should be retained but not be allowed to remain static. Neither should it be totally randomized. Instead, the prevailing pattern should change slightly and incrementally over time, constantly exploring new routing possibilities. This can be achieved by occasionally routing an opportunity to a collaborator selected at random. This puts an element of chance and randomness into the system and the degree of randomness can be controlled by a single parameter.

What will be observed is that at low values of randomness, the global performance of the innovation metanetwork will be unchanged. As the amount of random routing is increased, emergent properties will be observed until a point where at some value of randomness, the emergent properties will begin to subside. At this point, the randomness will be such that it is beginning to interfere with the operation of

the metanetwork. Tuning the randomness factor to values just below this point will keep the emergent behavior of the metanetwork at its maximum.

An emergent metanetwork will have two great benefits. First, the pattern of referrals and contributions will change and improve over time as the system explores and finds better routing solutions. Second, the amount of innovation arising from the collaborators will be higher than one would expect. This will be because instead of acting like a collection of individual innovators, the collective will be acting like a single super-organism achieving greater results than the individuals are capable of separately.

CONCLUSION
We have argued that increasing an organization's innovation quotient—the ability to sustain innovative thinking and problem solving—is a critical business concern and have offered a graphical visualization of one view of this argument, the Vendible Model. Increasing corporate spending patterns over the last several years bear witness to this observation. The troubling finding, however, is that corporate executives are discouraged by the return on investment in this spending. The explanation we offer is that innovation should be built into the fabric of the organization itself as a business infrastructure component. It is simply not possible to purchase a few innovation tools and expect the company's innovative output to measurably increase. Instead, steps must be taken to turn workers into *innovation workers* where innovation is something they do as a routine business practice. To make this vision a reality, we have argued that a communication and collaboration infrastructure be created, called the *innovation metanetwork*, providing the framework supporting innovative work processes. We feel the innovation metanetwork should be built with two critical features in mind: scale-free architecture and emergent behavior. The scale-free architecture will be evolved over time and insure the metanetwork can grow to any size while remaining maximally efficient. The emergent behavior feature will keep the metanetwork from stagnating and insure that it constantly improves itself over time. A fortunate result of this architecture is that it provides two measures for effectiveness that can be monitored and tracked.

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