

New Applications and Strategies for Enterprise Architectures

Emerging Concepts in Net-Centric Architectures

E-Gov EA Conference 2004

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Leading Illustration:

How do birds flock together and fly in such a dynamic, ever changing and re-organizing patterns without an enterprise architecture?

In this 15 minute presentation, we discuss emerging concepts in net-centric architectures, including the concepts of using complex systems theory and biological models as a window to view the nature of complex information networks.

The notion of using these metaphors to help us understand the complexity of our enterprises has gained considerable visibility in recent years and is rapidly becoming the leading candidate to help us understand emergent properties of complex inter-networks.

Presented by: Tim Bass, President, Silk Road (www.silkroad.com)

Emerging Concepts

- Information networks are complex systems and the complexity is accelerating.
- The dynamics of complex internets are dominated by the notion of self-organization and emergent behavior.
- Structured EA approaches must evolve.
- Promising new net-centric concepts are emerging.

Complexity in our inter-networks is accelerating and at the very least, increasing. The way we do business changes with the changing dynamics of emergent network behavior.

Many well-respected researches and business experts have come to the conclusion that traditional approaches to viewing IT systems and enterprise architectures fall short in grasping the overall situational awareness and an understanding of powerful market forces.

Much of the research has gravitated toward the application of complex systems theory and the (unpredictable) emergent properties of these systems, including information networks.

When viewed from this perspective, traditional structured EA approaches are evolving.

Complexity theory offers a promising path toward understanding how net-centricity will effect our future and the future of EA in the net-centric environment.

Net-Centric EA Issues

- **Unpredictable:** EA ROI is inherently unpredictable.
- **Interdependent:** Critical information assets are controlled by multiple cooperating organizations.
- **Inadequate:** Business and mission lifecycles are orders of magnitude shorter than EA lifecycles.
- **Emergent:** *The Enterprise* is a boundless self-organizing information ecosystem. Emergent properties are also unpredictable.

The dynamics of information networking is complex and unpredictable. In most, if not all cases, the return-on-investment (ROI) for most large net-centric capital expenditures cannot be predicted.

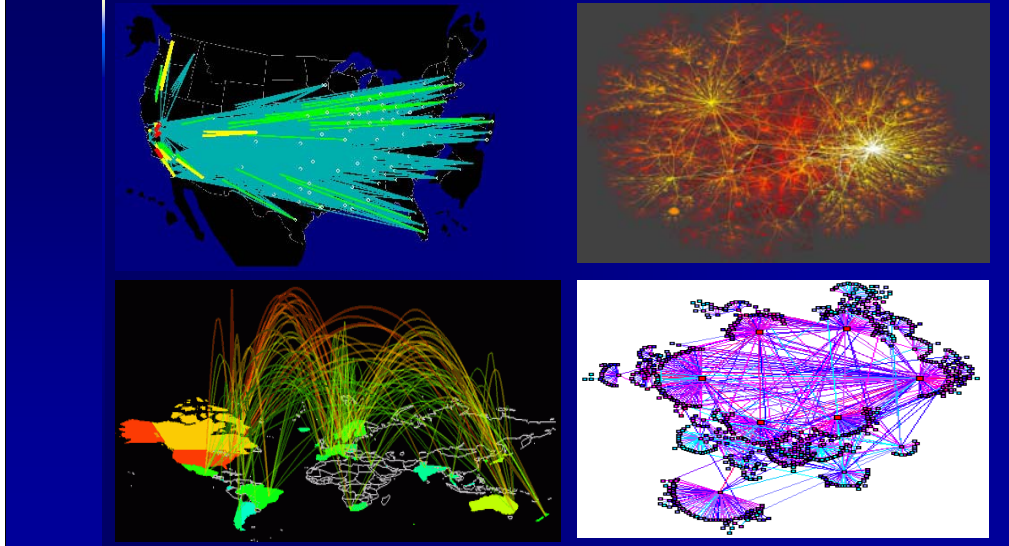
One of the reasons for the inherent unpredictable nature of these IT investments is that the net-centric environment transforms the very nature of business and human relationships. The health of one business is dependent of the health of other businesses. This interdependency supports the notion of 'business ecosystems' and/or 'information ecosystems'.

By definition, is not possible to predict the emergent behavior of complex systems.

This fact is further complicated by the fact that the lifecycle for many business and mission processes are much shorter than EA lifecycles.

How do we begin to 'get our arms around' this increasing complexity?

Emerging Complex Systems Approaches



There is an emerging school-of-thought that begins to look at self-organizing characteristics of complex biological systems.

The figure in the upper left corner (Becker, Eick, Wilks) represents a 'traditional' view of network connectivity using color and line thickness compactly convey statistical data . The figure in the lower left hand corner represent a view of Internet traffic flows between fifty countries, as measured by the NSFNET backbone in 1993 (from Cox, Eick, and Taosong, 3D geographic network displays, ACM Sigmod Record, 25(4), 50-54, December 1996).

Note: Both of the graphs above represent traditional network connectivity and not complex information flow and business processes.

The figure in the upper right hand corner represents a view of the Internet in 1999 (Albert, Jeong, and Barabasi, Nature, 401 130 (1999)). The figure in the bottom right hand corner represents the information connectivity of over 800 million web documents (by S. Lawrence, 1999) collected by a net-crawling software robot.

These colorful figures represent a small handful of a very large body of knowledge that attempts to understand the emergent properties of complex inter-networks.

Where is all of this research leading us?

Emerging Concepts: Biological and Social Models

- Self-organization
- Small world theory & hubs
- Keystones, dominators, niche players
- Information ecosystems and markets

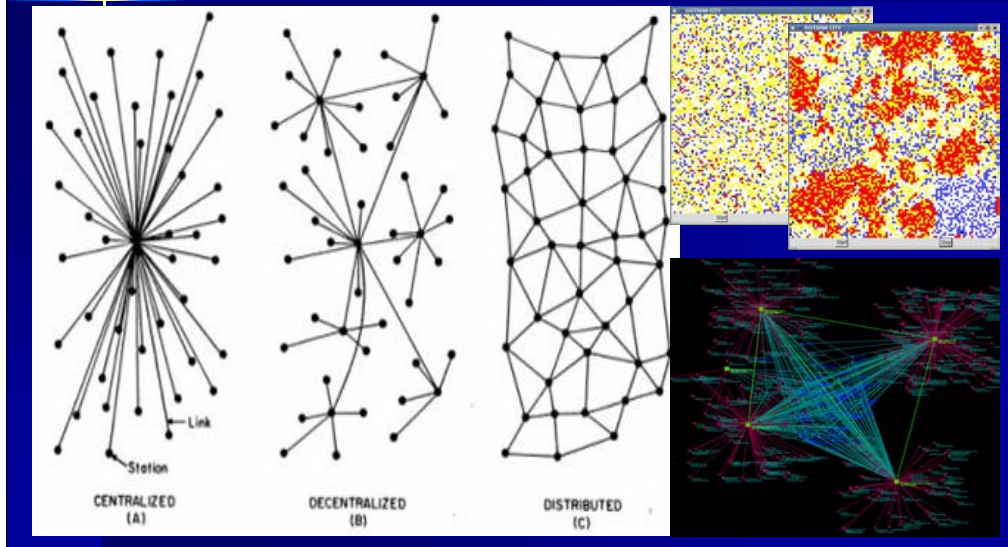
The leading emerging concepts for net-centric architectures are based on complex systems theory. They tend to look toward complex, self-organizing biological models (ants colonies, flocks of birds, genetics, insect swarming, etc.) to help us understand the underlying dynamics of complex networks.

Scale-free networks, small world theory, hubs in nature, business ecosystems, all of these schools-of-thought are thought to hold keys to our understanding of net-centric architectures. Subjects we can only briefly introduce in a 15 minute talk!

The concepts may seem a bit abstract and futuristic. On the other hand... the future is now! This helps explain why there is so much interest and research into the domain of complex systems theory and IT business models.

In a nutshell, and because of a lack of time today, these slides only scratch the surface in the state-of-the-art for concepts that are beginning to influence enterprise architecture thinking in the net-centric environment.

Emerging Complex Systems Approaches - Hubs



Baran's networks, the three textbook figures on the left, provide a basis to view the more complex self-organization that occurs in complex networks.

The figure on the upper right represents a model of criminal activity. These types of models are also used to help us understand emergent criminal behavior such as terrorism.

Most of the body of literature on the subject points to the importance of hubs, including naturally occurring hubs. In this brief 15 minute talk, we can only introduce the emerging concepts. We should realize, however.....

Complex systems theory and biological models help us understand the significance of naturally occurring hubs and how they effect business ecosystems.

References: Good Starting Points!

- Zmud, Robert W., "*The Designing Organization in the Netcentric Economy*," Netcentricity Symposium, Decision and Information Technologies, R.H. Smith Business School, University of Maryland, March 30 and 31, 2001.
- Iansiti, M. and Levien, R., "*Keystones and Dominators: Framing the Operational Dynamics of Business Ecosystems*," November 2002.
- Iansiti, M. and Levien, R., *The Keystone Advantage*, Harvard Business School Press, Boston, Massachusetts, 2004.

It is only possible to scratch the surface on how complexity theory influences the future of net-centric architectures. For the interested conference participant, here are three excellent references that are a great place to start.

The first two references are available on the net in PDF format and can be easily found with Google.

The last reference is a recently published hardcover book, available from your favorite bookseller.

Closing Remarks

- Promising new concepts for EA are emerging.
- **Business Ecosystems:** One school-of-thought is to leverage complexity theory and biological models (expending resources to leverage the ocean waves and tides).
- **Beware of Reductionism:** Another school-of-thought mandates the reduction of accelerating inter-networked complexity (expending resources to stop the #\$\$*! ocean).
- **Keystone Strategy:** It appears likely that embracing Keystone Strategies, including leveraging the benefits and (unpredictable) emergent properties of complex systems, will improve overall robustness, productivity, agility and innovation of your mission, business and/or enterprise.
- **Network Power:** Instrument the network to leverage the power of the network for EA activities. Validate your EA models!

There are many concepts that are emerging that effect how we view enterprise architecture in the net-centric environment.

Lt. Gen. (R) Donahue reminded us the importance of a capabilities-based approach for the dynamic organization of information to effect outcomes.

Betsy Appleby provided us insights into how the concepts of complex inter-networking apply to sense-and-respond architecting in the net-centric environment and the DISA NCES program.

John McManus shared with us his experience instrumenting the NASA network to build and validate their EA models; highlighting the importance of validating EA models with network-based tools.

There are many emerging concepts for net-centric architectures supported by a large (and growing) body of knowledge in the application of complex systems theory to the business of IT and e-Government.

I hope you have found this topic of interest. I thank all the panel members for sharing their knowledge and experience with us as well as the conference organizers for inviting us to share this topic with you.

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A copy of this presentation can be found on-line:

<http://www.silkroad.com/events/>

Thanks Again!

Tim Bass