

Early Detection Capabilities: Applying Complex Adaptive Systems Principles to Business Environments

Cory Costanzo and Ian Littlejohn, *TKG Consulting Pty Ltd*

Abstract

In today's complex business world, change seems to be the only constant. Companies are spending vast amounts of time and resources responding to changes in the business environment. What if they could see changes in their environment earlier and respond quicker? Organizations need the ability to monitor for and detect early indicators that signal change in the system. Methods that take a complex adaptive systems approach to understanding a business environment are able to map, represent, and identify the participants, environmental forces, and behaviors that are present in the system, the nature of the interactions, and the resulting relationships that are present. This mapping, when conducted for a framed complex adaptive system within a particular context (be it marketplace or organizational), provides an organization with unique insight into the system within which it operates. The methods discussed in this paper integrate human-based sense-making activities with the use of narrative knowledge base technologies and visualization software to assist organizations in the analysis, understanding, and subsequent strategy formulation regarding opportunities and threats that emerge as the result of the ever-changing nature of complex adaptive systems.

Keywords

Behavior; business environment; change; complex adaptive systems; early indicators; environmental forces; innovation; insight; knowledge base technology; narrative; ontology; organizational change; participants; pattern recognition; risk management; sense-making; strategy; visualization; weak signals.

Overview

In today's complex business world, change seems to be the only constant. The influence of the Internet on global markets, the rapid emergence of new international markets, the scarcity of natural resources, the global ramifications of innovation, introduction of new business models, and the ever-increasing sophistication of consumers are just a few of the factors that can lead to unanticipated changes in business operations. As a result, companies are spending vast amounts of time and resources responding to changes in the business environment. What if they could see changes in their environment earlier and respond quicker?

Organizations require an ability to monitor an environment and detect early indicators or "weak signals" that point towards change. Early detection of change provides improved strategy formulation and decision-making capabilities within organizations, creating a powerful business intelligence competence for identifying opportunities and threats within the business environment. Examples of how we've applied complex adaptive systems methods in organizations and the benefits that clients have received include:

- *Corporate program implementation* – improved rollout of internal corporate initiatives due to understanding of user-base concerns
- *Customer relationship management* – insight into customer service and experience by understanding the context within which service delivery is experienced
- *Market analysis* – Improved market research and insight into previously "impenetrable" marketplaces and their customers
- *New product development* – Understanding the context and

situational use of products to provide input into the design of new products, anticipating and delivering on customers' existing and emerging needs

- *Strategic redesign* – refocusing of corporate and business unit strategy to direct resources towards business-critical strategic initiatives.

In applying methods to the understanding of complex environments, the focus on mapping the system is primary. Mapping the system provides organizations with the ability to identify early indicators that represent both threats and opportunities to an organization. Early indicators point towards impending change in the marketplace or within an organizational environment. To map the system, an understanding of the following elements is required:

1. The *participants* within the system and their associated relationships and interactions
2. The dominant and influencing *forces* within the system and their respective relationships
3. The stable, emerging, and changing *behaviors* present in the system.

In this paper, we will discuss:

- Why treating the business environment as a complex adaptive system allows us to create an early detection capability
- Why understanding the participants, forces, and behaviors (together with the relationships involved) allows us to better understand the environment
- How, once we have created a mapping of the complex system, we can then detect changes in the environment to provide an early detection capability.

Leveraging Principles of Complex Adaptive Systems

If we view the business environment as a complex adaptive system, we can use the principals of complexity to provide a means for mapping the business environment – thus providing us with a better mechanism for detecting changes that yield opportunities or identify threats in an environment. In complex adaptive systems, we have many participants who are both independent and interdependent, and they are continually interacting. Each participant pursues a strategy to achieve its goals within the context of its environment. Through the interaction that is shaped by the environmental forces at play with other participants, information is exchanged and feedback is received by the participants. The participants in the complex adaptive system will then decide whether to continue to pursue their existing strategy or to change to another strategy.

To be able to understand the complex adaptive system that is the business environment, we need to first understand who the participants are in the system and what interactions are involved. Interaction patterns emerge and can be analyzed to identify the behaviors that are present in the system. This leads to the development of relationships between the system's participants. These participants also have the ability to influence and shape the forces that are present in the system – often resulting in significant impact on the other system participants.

Thus we are able to map the business environment and represent it as a complex adaptive system by understanding:

- Who are the participants in the system?
- What is the nature of participant interaction and the resulting relationships?
- What are the prevailing environmental forces?

This mapping, when conducted for a framed complex system within a particular context (be it marketplace or organizational), provides an organization with unique insight into the system within which it operates.

Applications for Early Detection Systems

An early detection capability (which when applied, we refer to as Early Detection Systems) provides an understanding of the marketplace or organizational environment from the context and perspective of the participants within that environment. A mapping is created of the environment in regards to:

- *Participants* within the system and their associated relationships and interactions.
- Dominant and influencing *forces* within the system and their respective relationships.
- Stable, emerging, and changing *behaviors* present in the system.

Early Detection Systems can be deployed in a number of settings to support the intelligence requirements of an organization. In decision-making levels of an organization, Early Detection Systems inform strategic formulation, design, and implementation, highlighting opportunities for both internal and external innovation and identifying focus areas for the application of risk management competencies. Early Detection Systems can be used for environmental scans of business

environments, market research and analysis, development of customer insight, and business opportunity development. Internal to the organization, the Early Detection System can be used to understand issues around corporate culture, to evaluate workforce issues and problems, and to support and assist corporate program implementation and initiative rollout.

Conceptual Model for Early Detection Systems

The conceptual model for an Early Detection System is grounded in the mapping of the business environment as a complex adaptive system and encompasses four primary modules.

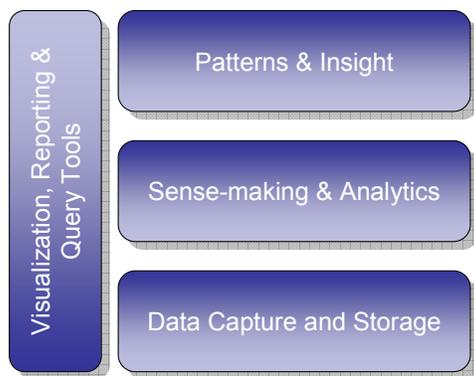


Figure 1 - Conceptual Model Modules for an Early Detection System

Data Capture and Storage

In an attempt to properly understand the environment, we need to focus on gathering data that provides context for the environment in question. One of the best sources available to provide context is the narrative data that is collected from representatives of the

environment. When people share an experience with others, it provides detailed and relevant context of the situation as it has been experienced. For example, a person's story or experience will include: why things happened, how they happened, and who was involved. From a complex adaptive systems perspective, this provides important information about the participants that were present, the interactions that occurred, and the prevailing environmental forces at the time. Narrative data can be gathered through interviews, focus groups, and online surveys. Although narrative data provides an important source of data for mapping complex adaptive systems, additional forms of unstructured data can also be collected from sources such as newspapers, magazines, media broadcasts, websites, reports, etc.

Unstructured data needs to be stored differently to structured data and is commonly stored in a new generation of narrative knowledge base technology that can account for both forms of data. Additional information (metadata) can also be tagged to this material and can include categories such as: source, author, date captured, and other user or business-defined tags. The narrative knowledge base provides an important central storage capability that allows users to access, retrieve, and work with the captured data.

In an Early Detection System, key data elements are captured for each of the unstructured data pieces. This includes the agents ("participants"), the main topics, and the main behaviors that are present in the data. Additional information, such as facts and events, can also be entered and used for subsequent analyses.

Sense-making and Analytics

A combination of system tools and participant-based workshop techniques are used to assist with sense-making activities. These activities help participants rapidly make sense of large volumes of data. Data is clustered into classes and sub-classes, and elements of the complex system emerge as a result of participant interpretation, definition and prioritization. Activities and techniques aim to understand the following aspects of the complex system:

- Major *participating agents* ("*participants*")
- *Strategies* employed by the participants
- Dominant and influencing *environmental forces*
- Stable, emerging, and changing *behaviors*.

It is important to understand the relationships between the different entities in the complex system:

- What are the relationships between participants in the system?
- What are the relationships between the dominant and influencing forces?
- What are the relationships between the participants and the forces?

An Event Timeline is developed that displays the current situation's environment and the events that lead up to the current situation. An ontology of concepts and relationships is extracted and built from the data. The knowledge base is updated with the resulting ontology, including the identified participants, environmental forces, and behaviors and their respective relationship analyses.

Visualization, Reporting, and Query Tools

Fundamental to the ability to monitor for system shifts over time is the initial benchmarking of the system's starting conditions. Application of the early detection method always begins with a framing of the starting conditions present in the system in question. In visualization, we focus on developing a visual format that displays the starting conditions of the system elements and their subsequent relationships. Repeated application of the method will leverage visual-based analytic outputs in providing the ability to record changes and monitor for shifts over time. The visualization of the system transitions provides us with the opportunity for the early detection of changes, giving organizations the ability to leverage opportunities or mobilize in response to threats. Visualization tools provide graphical displays of the complex system that is being analyzed. As data is compiled over time, the visualization tools display the changing nature of the system. This "changing nature" is reflected by using a time bar element to cycle between the current situation and multiple past situations and vice versa. Questions such as, "Which new participants have entered the system?", "Which participants have exited?", and "What are the evolving strategies of the participants?" can be easily visualized, and the changing nature of the relationships amongst the participants over time is displayed. Visual indicators display the number of data points associated with participants, environmental forces, and behaviors at a given point in time. Users can drill down into the narrative knowledge base to view the detail of the data that is summarized in the visualization tools.

Reporting and query tools utilize the ontology to allow further in-depth analysis of the gathered data. Users are able to mine the data using traditional search mechanisms in conjunction with the bottom-up ontology structures that yield an intuitively navigable taxonomy for sifting through the narrative. The process of reading stories and experiences is essential in generating insight for the user who is reviewing the data (see *"Patterns and Insight" below*).

An important indicator for detecting weak signals is the change of behaviors amongst participants within a complex adaptive system. If stable behaviors are maintained, then organizations are able to engage in tactical planning activities that address the application of resources to the current situation, but if behaviors are changing, then organizations will need to be flexible in determining strategies and allocation of resources, potentially finding that new products, services, or business models may be required. Being able to readily identify new and emerging behaviors provides organizations with a very powerful early detection capability.

Patterns and Insight

During the course of the sense-making activities, new patterns representing early detection opportunities and threats begin to emerge from the mapping of the complex adaptive system, the accumulated narrative knowledge base, and the visualized relationship outputs. In addition, members of the team access the narrative knowledge base and, through their own querying and reading of the material, will also identify new patterns. The phenomenon of "connecting the dots"

begins to occur as new insights are generated from the sense-making activities. Insights and patterns that are identified are then captured into the Early Detection System.

The sense-making activities have resulted in a mapping of the complex adaptive environment. Analysis of the participants, forces, and behaviors provide an understanding of the following:

- Which forces are affecting which participants?
- Which behaviors are predominant with which participants?
- Which behaviors are new or emerging?
- Which participants are entering or exist in the system?
- Are there new participants, and, if so, what behaviors are being exhibited?

Many pattern permutations become visible through the mapping of the complex adaptive system. New insight is derived from the patterns of data that come from the analysis of the relationships, the understanding of the stable behaviors, and the visualization of new behaviors as they emerge within an environment. By understanding the nature of behaviors, the influencing forces, and the relationships between participants in a system, early detection of new or changing participant strategies is enabled and can reflect or impact on all levels of the business value chain, including customers, competitors, distributors, and suppliers. This ability leads to a very effective early detection capability to inform strategy, enable innovation, and provide identification of threats for risk management purposes.

Once patterns and insight are generated, additional workshops are run that focus on the

convergence of the identified patterns. The development of new insight provides valuable information that informs the organizational strategy on how to move forward and successfully address patterns that have been identified in the early detection capability. However, although gaining new insight can be exciting and motivating, without taking action and monitoring for results, the insight itself is rendered useless. Thus, the convergence workshops help participants to take their insight and design actions to address patterns, leaving the organization with an action plan that will help address the early indicators before they either harm the organization (threats) or cease to exist as an element of competitive advantage (opportunities).

Monitoring for Change

With the goal of implementing a sustainable capability to address change, a monitoring system for the complex environment is then designed and implemented. This iterative analysis and review process utilizes a sound monitoring plan that is designed and instituted to track the ever-changing nature of the complex system and any initiatives that the organization may undertake in attempting to influence and transition the state of that system.

REFERENCES

Although not directly quotable for the purposes of this paper, there are a collection of sources that have informed our thinking in the design and application of the methods discussed above. They are referenced below.

Primary

Axelrod, R. and Cohen, M. (2000). *Harnessing Complexity: Organizational Implications of a Scientific Frontier*. Basic Books: New York, NY.

Clark, Andy (1997). *Being There: Putting Brain, Body and World Together Again*. MIT Press: Cambridge, MA.

Cilliers, Paul (1998). *Complexity and Post-modernism*. Routledge: London, England.

Kurtz, C.F. and Snowden, D.J. (2003). IBM Systems Journal, Vol. 42, No. 3.

Van Tonder, C.L. (2004). *Organisational Change Theory and Practice*. Van Schaik Publishers: Pretoria, South Africa.

Secondary

Axelrod, R. (1984). *Evolution of Cooperation*. Basic Books: New York, NY.

Bennet A. and D (2004). *Organizational Survival in the New World: The Intelligent Complex Adaptive System*. Elsevier Science & Technology Books: Burlington, MA.

Buchanan, Mark (2002). *Nexus: Small worlds and the groundbreaking science of networks*. W.W. Norton & Company, Inc.: New York, NY.

Cleary, S. and Malleret, T. (2006). *Resilience to Risk*. Human & Rousseau (Pty) Ltd: Cape Town, South Africa.

Gladwell, M. (2000). *The Tipping Point*. Little, Brown, and Co.: New York, NY.

Johnson, Steven (2001). *Emergence: The connected lives of ants, brains, cities and software*. Scribner: New York, NY.

Lewin, Roger (1999). *Complexity: Life at the edge of chaos*. University of Chicago Press: Chicago, IL.

McGee, Kenneth G. (2004). *Heads Up: how to anticipate business surprises and seize opportunities first*. Harvard Business School Publishing: Boston, MA.

Surowiecki, James. *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations*. Doubleday: New York, NY.

Waldrop, M. Mitchell. (1992). *Complexity: The Emerging Science at the Edge of Order and Chaos*. Touchstone: New York, NY.

TKG Consulting

<http://www.tkqconsult.com>
<http://www.tkgsa.com>

TKG Consulting is an international consultancy with affiliates and network partners based in Brazil, Canada, South Africa, and the United States. We specialize in areas of transformation, complexity, and knowledge management. Our network of consultants has many years of industry knowledge and experience working with complex business problems and organizational transformation and change.

TKG Consulting works with organizations by assisting and guiding them through exploration and discovery processes. Our focus is on facilitating processes that allows clients to gain new insight and develop new initiatives to address critical issues and needs both internal and external to the organization. Additionally, TKG Consulting provides knowledge and expertise that can aid organizations in developing strategic implementation capabilities and creating new Knowledge Management platforms and enablers to support transformation.

TKG Consulting provides consulting and training to its clients to help them better understand how to manage and operate in complex environments. This provides the ability to implement solutions that address some of the key themes affecting organizations in today's complex global economy:

- *Transformation and Change*
- *Developing an Organizational Innovation capability*
- *Implementing Strategic Initiatives*
- *Effective use of Knowledge and Information*
- *Monitoring for Change*

At TKG Consulting we believe that the key to success in any environment is to leverage diverse perspectives and bottom-up approaches to inform both strategic and tactical solution implementations. The challenge is unlocking and surfacing knowledge and information in usable, practical ways. Working closely with client project teams, we facilitate processes that allow clients to gain new insight and develop new initiatives to address critical issues and needs both internal and external to the organization.

For further information, please contact:

Cory Costanzo (USA)

*Partner, TKG Consulting LLC
Partner, TKG Consulting Pty Ltd
email: cory@tkqconsult.com
phone: +1 (617) 894-3198*

Ian Littlejohn (South Africa)

*Partner, TKG Consulting Pty Ltd
email: ian@tkqconsult.com
phone: +27 (0)82 82 83 889*