

Introduction to the Basic Concepts of Complexity Science

This introduction to the basic concepts of Complexity science is intended to be easy to understand for all people interested in Complexity and its practical applications, Codynamics.

If you find anything in here that is hard to understand, or you have suggestions for improvement, please email us at info@codynamics.net.

1. What Complexity Is

Complexity is a new field of knowledge based on how groups of living things - people, animals, organizations, communities, the economy etc. - actually behave in the real world. These behaviors are very complex - thus the name Complexity.

Complexity scientists use powerful computer systems to create visual and mathematical models of how living things behave, adapt to their changing environments, and evolve over time.

Businesses and organizations are using this new knowledge to transform the way they work into new patterns of structure, relationships and activities which they find extremely beneficial. From international corporations like Monsanto and Citicorp, to ad agencies and hospitals, membership associations and small retail stores, Complexity is being used by more and more organizations all the time. This is a real revolution - not just another fad, but a whole new way of working and thinking which many people believe will become increasingly widespread in the 21st Century.

What is very interesting about this revolution is that it is based on the *natural* world as opposed to the *mechanical-industrial* world. It turns out that humans' natural way of working together is really much better than the unnatural ways of working which many organizations practice today. For over 100 years the model of an organization as a machine has dominated America and the Western World. This has in many situations been destructive of human relationships, innovation, the fun of work, and in some cases income and profits. Applied Complexity (Codynamics) restores the natural way of working together, and once people make the transformation to the new way, it feels natural and has many benefits.

2. Understanding Complex Systems

Complexity views all groups of living creatures, including people in organizations, as *complex adaptive systems*.

- Any **system** is a group of two or more parts which interact to function as a whole. (The root word *systema* means "organized whole.") The parts of a system are interconnected and interdependent. Every system is composed of subsystems and is nested within larger systems. A person is part of a department, which is part of a company, which is part of a community, state, nation and world. They are all systems. The important thing to understand whenever we talk about systems is that we are emphasizing that everything and everyone are interconnected and the whole has characteristics different from the parts. For example an organization has a "personality" that is more than just a group of people.
- **Complex**, as we have already said, refers to the fact that groups of living things and their behaviors are complicated. (The root word means "twisted together.") Creating computer models of these living beings and their behaviors is extremely challenging and has really only been possible in the past 10-15 years. These models give new insights into how organizations work and how to make them better.
- **Adaptive** refers to the fact that living systems constantly adapt to their changing environments. (Adapt means "fit to.") In organizations people adapt to each other, to customers, the economy, competitors and many other things. They are able to adapt through learning. Continuous learning is very important in Complexity organizations.

3. Environments Are Systems, Too

Living systems are interdependent with their environments. Environments are everything external to organizations which affect them in some way, including customers, suppliers and community. Environments are complex systems, interconnected in complex ways. Organizations also affect their environments through their actions. In terms of the world, the impact of your organization's actions may be slight. But in terms of a customer who is depending on your organization, the impact can be substantial.

4. Feedback Impacts Systems

The primary way a system interacts with its environment or other systems is through *feedback*. When you move your hand, your nerves provide feedback signals to your brain so you know where your hand is. When a customer tells you he likes or dislikes something which your organization is doing, that is important feedback. Feedback in the form of information or signals is essential for an organization to be able to adapt to changes in its environment. Feedback within the organization is also essential for people to adapt to each other. Feedback occurs in two forms: *balancing*, which keeps the system stable

by limiting change (like a thermostat), and *reinforcing*, which intensifies the change or activity.

5. Emergence

Complex living systems exhibit behaviors and characteristics that are different from the behaviors and characteristics of the parts or members. This is called *emergence*. An organization has behaviors and characteristics such as a "personality" and a "corporate culture" that emerge from individual behaviors but take on a "life of their own" and persist even when people come and go. People shape the organization and the organization shapes the people in a continuous feedback loop. Emergence is the source of creativity and innovation - it is unpredictable and sometimes amazing.

6. Self-Organization

One important example of emergence is self-organization. The parts of a complex adaptive system, including people, have a natural capacity to self-organize. No one knows exactly how this happens - it's a "wonder of nature." Birds naturally flock together. Bees naturally form hives. People naturally recognize their interdependence and work together to accomplish shared goals or tasks. They do not always have to be told what to do.

7. Powerful Attractors

As a complex system adapts to its environment, a preferred state or way of doing things is discovered, and the whole system converges on that pattern. This is called an *attractor* or *attractor state*. In human organizations, a desired future state may also be expressed through a *shared vision*. The attractor state may have happened naturally or it may be planned - either way, the organization as a whole is drawn to it. Over time a strong pattern of thinking and working can become so deeply ingrained that it is very difficult to change. If a new attractor state is desired, it must connect with the energies, needs and desires of the people in the system, or it will not last.

8. Small Changes Lead to Large Effects

In a complex system, small changes can lead to larger effects, which in turn lead to ever larger effects. This snowballing effect is one thing that distinguishes living systems from mechanical systems, where small changes only lead to small effects. This is sometimes called the "Butterfly Effect" because a butterfly flapping its wings in India may influence air currents that eventually lead to a windstorm in Chicago. In a Complexity organization, one person may discover something new, other people in the organization may "flock" to this discovery, and in a short time the change has swept through the organization. This is more likely to happen in a Complexity organization where there is a high degree of flexibility and communication, but it can happen in any complex system - often in unpredictable ways. The decisions of a few al Qaida members to seize jet planes and crash them into the World Trade Center had enormous effects on the American economy and ultimately the whole world - far greater than anyone expected.

9. People Are Agents

The living parts (people) of complex systems are called *agents*. An agent is "one who acts, exerts power, and represents the organization as a whole." Agents interact with each other, affect each other, and in so doing are capable of a high degree of creativity and innovation which cannot be precisely predicted. Whether you call your people agents or not, it is important to recognize their power to act as agents and the value of their interacting with each other. In Complexity organizations, taking care of customers and creating innovative solutions are not just the responsibility of specific departments but of all agents.

10. The Importance of Teams

Agents naturally self-organize into small groups such as teams, which allow close communication, cooperation and working as united systems. The interactions among agents is the source of the most creative adaptations and solutions, and this works best in small groups (teams). Teams can be either permanent or temporary. They can be either functional (doing one type of activity such as accounting or sales) or cross-functional (combining multiple talents and skills to serve customers or accomplish projects). Teams can be self-organized or appointed. In general teams:

- Save money and make better use of resources
- Increase productivity
- Improve communication
- Improve decision-making and other processes
- Produce higher quality products and services

11. A New Role for Leaders

Leaders in Complexity (Codynamic) organizations are responsible for creating and nurturing conditions which will enable fast, innovative adaptations to change, not to try too much to control or direct people. Teams of people who are free to create new solutions will enable the organization to adapt much better than rigid control allows. Hierarchies (organization charts) are flattened and control is distributed as much as possible to the teams, not centralized. Managers who are used to controlling people must transform into caring leaders who serve as role models and focus on providing favorable conditions.

12. Learning Organizations

Living systems receive feedback from their environments, which enables them to learn from their experiences. Organizations which learn as a whole through sharing new knowledge are more adaptable and successful than those where people only learn as individuals. Organizational learning is very important in Complexity organizations and allows evolution to higher forms and behaviors. This requires a lot of shared information in a form which is easily accessible to everyone.

13. Experimentation

In fast-changing environments with a high degree of uncertainty, many small experiments are more effective than detailed planning. This is based on the way natural systems learn - through trial and error. Try a new idea and see how it works, then act on the basis of results and either intensify it or try another new idea. Creativity and innovation work best in organizations which accept errors and mistakes as a natural part of the learning process.

14. Caring

The most successful Complexity (Codynamic) organizations have leaders and cultures which encourage genuine caring for people in the system. There is a sense of identity, of everyone being part of one united system, that makes working together more enjoyable. People realize that they are all connected, and helping each other helps the system as a whole. This culture of caring in turn allows people to be more innovative and take more risks because there is less fear of failure. The resulting higher level of creativity and innovation often has a positive impact on the bottom line. In other words, smart organizations know that caring for people is good business.

15. Communication Is Vital

Organizations working as united systems place high importance on continuous communication and information flow, which enhances relationships and cooperative work among people and teams. Continuous communication with customers is just as important as continuous communication with co-workers. This results in a higher level of organization and performance. The best communication occurs when many different forms are used and key information is repeated and accessible in a variety of ways, such as in print, on bulletin boards, via an intranet or web site.

16. A Few Simple Rules

Complexity scientists have discovered that complex behavior can result from a few simple rules. The most creative organizations have a few simple rules which reflect shared values and guide behavior. Too many rules constrict creativity and can lead to resentment. The fewer the rules, the higher the creativity. People are also able to keep a small number of rules in mind, which helps them act on behalf of the organization - as its agents. Four good rules which work well in Complexity (Codynamic) organizations are:

- Share information.
- Trust each other.
- Meet customers' needs.
- Always seek better ways to do things.

17. Diversity Enhances Creativity

The greater the diversity of agents in teams, the more varied the patterns and solutions which emerge from their interactions. Diversity should include if possible different cultures, ages, genders, backgrounds and personalities for the most creative results. Teams which lack diversity tend to think more alike and generate fewer possible solutions.

18. We Are All Connected

The most important thing to focus on in Complexity/Codynamic organizations is *relationships* between people and continuous *communication*. In other words, *connections*. A single living organism has all its parts connected by a central nervous system and a circulatory system. But organizations do not have central nervous systems. To compensate for this and achieve the best results, Complexity and Codunamic organizations connect internally and with their environments (including customers) with continuous, free-flowing communication and caring relationships.