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Managing Complexity

"I think the next century will be the century of complexity"

- Stephen Hawking, 2000

To compete in today's economic environment, companies need to become adaptive businesses, capable of responding quickly to changing customer demands. The business environment is complex as it is characterized by countless interactions among the various 'agents' (employees, suppliers, customers, competitors) resulting in non-linear relationships between their actions and the outcomes. Technology adoption is only one way in managing complexity. What is required is a rethink on management and organizational strategies.

Managing such complexity by traditional management techniques of "command and control", where enforcing control over agents' actions and outcomes would suppress innovation and creativity. A new management approach based on **complexity science** advocates a shift from the "command and control" style of management to a "sense and response" style. This implies a shift in building skills to predict and control outcomes to the ability to recognize patterns and adapt quickly.

Complexity Science constitutes an emerging interdisciplinary field of investigation into the behavior of a wide range of systems in the natural and physical worlds. Complexity science is the study of systems composed of many and varied parts that interact, typically, in complex and non-linear ways. Businesses can be understood better through viewing them as "complex adaptive systems".



We can learn from ants

The phenomenon wherein a group of ants find a food source is a wonderful example of using the power of evolution as put forth in biology to tackle complexity. As the ants begin their trail, they secrete a substance known as pheromone. Each ant is guided on a particular path based on its concentration of this pheromone. As the number of ants following a particular path increase, the concentration of pheromone on the path increases as well, further making the path more attractive for more ants to follow. This way the ants can effectively move around obstacles in its path and quickly adapt their movements to reach the food source. This is a perfectly engineered scenario where **each agent working towards its individual goal actually drives the organization closer**

A few aspects of complex adaptive systems...

"The whole is more than the sum of its parts."

-Aristotle, *Metaphysica 10f-1045a*

Complexity science recognizes that systems cannot be understood simply by understanding the parts - **the interactions between the parts and the consequences of these interactions are equally significant**. Hence systems are looked at in their entirety, recognizing that many phenomena are more than the sum of their parts.

A complex system can be thought of to comprise multiple agents acting in parallel. While each agent follows a simple set of rules, the patterns in outcomes of the system can be novel and unpredictable.

Complex adaptive systems tend to move toward the edge of chaos when provoked by a complex task. The idea is that bounded instability is more conducive to evolution than either stable equilibrium or explosive instability.

"Complexity is the prodigy of the world.
Simplicity is the sensation of the universe.
Behind complexity, there is always simplicity
to be revealed. Inside simplicity, there is
always complexity to be discovered."

-Gang Yu

In a business context, there is tremendous value in viewing organizations as complex adaptive systems. Companies like Xerox, Hewlett Packard, Shell, Southwest Airlines, Proctor & Gamble, & Citicorp are notable examples of those having utilized the power of complexity science to build more flexible and responsive organizations. In business systems, the agents are diverse: consumers, employees, companies, associations, governments, etc. **The emergent properties of these agents include behavior such as consortium formation, monopolies, market places, product promotions, obsolescence, product lock-in, inventory pileups, ordering delays, and glitches.**

Some concepts from Complexity as applied to business:

- **Self-organization:** Self-organization refers to the creative, self-generated, adaptability-seeking behavior of agents in a

towards its larger goals. This idea can be used to model organizational behavior as well as complex systems such as supply chain networks.

More Resources

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complex adaptive system.

- **Emergence:** Emergence refers to the macro-level patterns arising in systems of interacting agents. Emergent phenomena cannot be deduced from knowledge of behavior of individual parts and is not reducible to the parts alone. Emergent complexity is driven by a few simple patterns that combine to create infinite variety.

The typical case is the emergent outcomes seen in organizations when the employees self-organize into teams directed to achieving a shared vision.

- **Co-evolution:** An organization continuously evolves with its customers, partners and competitors, and constitutes part of the environment for other systems. This simultaneous and continuous change is referred to as co-evolution.

An example of these phenomena in action is the **classic case of**



competition between VHS versus Beta cassettes when VCRs became a household item. VHS and Beta initially

started out by selling at the same price and with equal market shares. Early fluctuations of these shares were primarily due to chance and corporate initiatives and the market was tilted towards the VHS format, by a small margin. Subsequently, the number of VCRs compatible with the VHS format increased. This increased the value of having VHS cassettes, and hence the value of owning a VHS compatible VCR. Thus, a small gain in market share for VHS cassettes resulted in amplification of owning VHS recorders, which in turn led to more VHS cassettes being sold. VHS suppliers thus achieved lock-in and dominated the market, though the Beta format was probably the superior technology.

What does this mean for the manager?

"It's much more effective to allow solutions to problems to emerge from the people close to the problem rather than to impose them from higher up."

-Roger Lewin

The organizations for tomorrow will be structured more on the lines of networks of specialists, similar to a group of performing artistes. What is required is to produce a viable, robust, adapting organism that would survive and prosper in an unknowable variety of future environments, running on a few simple principles and values. Thus,

identify underlying patterns, unravel hidden relationships and recommend areas for improvement that can improve ROI and reduce costs.

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the focus needs to be on flexibility, learning and development of new knowledge instead of specific solutions. This can be achieved by taking a cue from nature, which relies on the power of evolution, rather than the power of prediction to create species, which can survive subsequent generations according to the requirements, lay down by the environment.

"The use of complexity theory metaphors can change the way managers think about the problems they face. Instead of competing in a game or a war, they are trying to find their way on an ever changing, ever turbulent landscape. Such a conception of their organizations' basic task can, in turn, change the day-to-day decisions made by management."

-Lissack, 1996

Through building an environment conducive to creative abrasion, diversity in the workforce, provocative leadership, and decentralized decision-making, managers can harness uncertainty to nurture creativity and innovation. Managers need to guide self-organization, and steer the organization to the edge of chaos. **It is only at the edge of chaos that an organization will be able to innovate and successfully adapt to changing needs, by co-evolving with their customers and partners.** The reinforcing mechanisms to allow employees to self-organize and generate emergent outcomes would be the corporate vision, culture and organizational values.

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