

# Navigating the Complexity Space

Denise Easton and Lawrence Solow  
Complexity Space Consulting

[dgeaston@complexityspaceconsulting.com](mailto:dgeaston@complexityspaceconsulting.com)  
[lsolow@complexityspaceconsulting.com](mailto:lsolow@complexityspaceconsulting.com)

## 1 Abstract

The purpose of this article is to offer a new frame of reference for exploring how organizations can move away from a reliance on mechanistic and predictive models of change and improvement toward a new model of complex adaptive behavior. The authors will compare and contrast the assumptions and embedded behaviors of organizations in two different paradigms: as linear “machines,” and as complex adaptive systems.

The concept of the Complexity Space will then be introduced, and its three core elements, Ecosystem Dimensions, Impact Variables and the Adaptive Change Cycle described. Finally, a case study demonstrates how successfully navigating the Complexity Space offers a new paradigm for organizational development and change in complex environments. The paper posits that adopting a non-linear emergent approach rather than a linear/mechanistic one, positions organizations to reap the benefits of adaptive, agile and sustainable thinking, planning and acting as they operate in increasingly complex times.

## 2 Introduction

Why are we still surprised by the existence of the “Black Swan” in our business systems? Has anyone started to notice that the Black Swan is starting to turn grey? Nassim Taleb in his widely popular book, The Black Swan, The Impact of the Highly Improbable distinguishes between extreme scenarios that can be modeled (Mandelbrotian Grey Swans) and those that cannot (Black Swans) [Taleb 2010]. However, he does so within a mathematical construct that strives for predictability.

Consider working in a system where the scenarios that challenge the functioning and management of our business systems are not predictive, are unseen, and in a constant state of emergence. These are the Grey Swans of business and are ever present within today’s organizations. We contend that businesses are operating in an

evolving and dynamical construct – The Complexity Space – and a new set of competencies is required for identifying and understanding the Black and Grey Swans.

Complexity has entered the mainstream media and the boardroom. Capitalizing on Complexity, IBM’s annual survey of 1500 CEO’s, brought the issue of complexity front and center as a dominant business challenge. Their clear acknowledgment that “a rapid escalation of “complexity is the biggest challenge confronting them” and that “their enterprises today are not equipped to cope effectively with this complexity in the global environment,” [IBM 2010] presents a challenge for those helping organizations understand and manage in the Complexity Space.

The authors suggest that there is an opportunity for businesses to shift their prospects for long term success in three ways. The first is by being prepared to understand and adapt to unanticipated consequences. The second is to be ready to respond to emerging opportunities. The third is recognition by business leaders that their organizations are operating in a complex environment and there is a need to implement business practices that are based on the nature and properties of Complex Adaptive Systems (CASs).

When businesses refer to complexity, it is often associated with the inner workings of an organization – its structural components. With a CAS, complexity refers to the manner in which the system behaves relative to its structure; its aggregate behavior cannot be reduced or understood from its component parts [Holland 1995]. Characterized by nonlinear dynamics (small changes can have BIG effects) and emergent properties (system attributes cannot be explained by the mere sum of the parts) the CAS metaphor is directly applicable to a wide range of systems --gardens, human beings, weather systems, and groups of people, including all organizations [Social Innovation Group, 2011]. The power of a CAS is a result of its ability to allow a massively entangled group of diverse individual “agents” the freedom to be adaptable and resilient. It is this dynamic that enables a CAS to undergo spontaneous self-organization, keeping the system healthy and adaptive. This is a very different metaphor then that of a machine.

Why are business systems complex? Consider today’s business environment. Multiple locations, a distributed work force, global customers, interdependent markets, etc. The number of details or moving parts frequently obscures cause and effect relationships, making purely “rational” decision-making ineffective. Classical management theory, firmly rooted in a linear and mechanistic view of an organization, continues to have a loyal following because of its core principle that it is possible to find “one best way” to perform and manage tasks. The popularity of machine metaphor due in large part to its:

- Physicality (can be seen and touched);
- Ability to be assembled and disassembled (fixed);
- Operated relatively easily (controlled); and
- Highly predictive nature.

This is a hard act to follow. In comparison, a non-linear and emergent view of organizations requires a significant change in how to conceptualize organizations. Who wants to embrace a management theory that focuses on:

- Patterns and relationships among the parts of the system which are often unrecognized or invisible;
- Actions on behalf of unpredictable humans which often emerge without authority; and
- Systems and subsystems that exist in a far-from-equilibrium state and are never wholly stable?

The *difference that makes a difference* is that even though it may be inconvenient, business organizations are operating consistent with their inherent nature as a complex adaptive system, not as a machine. The research and learning about natural systems from complexity scientists offers a new way to speak about the fundamental dynamics of human systems and business systems. “Companies in a fast-changing business environment need to be able to produce constant innovation, need to be constantly adapting, and need to be in a state of continual evolution, if they are to survive” [Lewin, 2002].

To meet Lewin's challenge, this paper introduces The Complexity Space, a theory, model, and set of tools synthesized from the complexity sciences, Human Systems Dynamics, and business management theories. The authors will explore the three core elements of the Complexity Space: **Ecosystem Dimensions**, **Impact Variables** and the **Adaptive Change Cycle** and discuss their applications for assessing and influencing complex systems and the agents that populate them.

### 3 Rooted in Complexity Science

Complexity science is foundational to the existence of The Complexity Space. Complexity science is a highly interdisciplinary approach that is rooted in mathematics, the physical, biological and social sciences, and most importantly on the inherent non-linear dynamics of certain kinds of systems. Building the bridge for an organization to view itself as an emergent, non-linear system requires a fundamental understanding of three core elements of complexity science:

**1. Chaos theory** explains the behavior of dynamical systems that are highly sensitive to initial conditions created by nonlinear phenomena.

**2. Nonlinear Dynamical Systems** concentrate on the study of phenomena such as attractors, bifurcations, chaos, fractals, catastrophes, and self-organization, all of which describe systems as they change over time.

**3. Complex Adaptive Systems (CAS)** consist of agents who act and react based on self-generated stimuli, and the actions of other agents from either inside or outside the system [Dooley, 2004].

The work of two influential scientists elevated the field of systems theory as a method of conceptualizing the development and evolution of *all systems*. The biologist Ludwig von Bertalanffy offered a definition of systems that encompassed the essential attributes of how systems work:

- Initially as a set of elements positioned in interrelation among themselves;
- That interacts with their environments;
- Where they can acquire qualitatively new properties through emergence; and
- Finally, resulting in continual evolution [Bertalanffy, 1969].

Gregory Bateson's contribution to the field was his further application of systems theory/cybernetics to the social/behavioral sciences, including but not limited to biological evolution, ecology, art, social organization, communication, cultural transmission, learning, character and personality. His concepts offered a coherent and integrated explanation of these diverse phenomena in terms of complexity science. [The Institute for Intercultural Studies].

Complexity Science rapidly co-evolved across many disciplines and continues to serve as a convergence point for a dynamic academic field that focuses on the study of non-linear, complex adaptive, self-organizing, and agent-based systems. During the concluding decade of the twentieth, an even wider range of scientific and social scientific disciplines explored and expanded the field.

Stuart Alan Kauffman, an American theoretical biologist and complex systems researcher, emphasized that the complexity of biological systems and organisms might result as much from self-organization and far-from-equilibrium dynamics as from Darwinian natural selection. [Kauffman, 1995]. As physical, social, biological, and computer scientists sought to understand systems that change in ways that are not amenable to the linear cause and effect models, they termed their work as nonlinear dynamics. M. Mitchell Waldrop [1992], Roger Lewin [1992], and Johnson [1995] each published foundational works on complexity theory that offered expanded and emerging theoretical perspectives that continue to influence the inquiry and application around complexity.

In summary, complexity science offers something that most management theories do not, a basis for understanding the fundamental characteristics, deep nature, structure and patterned behavior of organizations. The opportunity to penetrate the future DNA of organizations requires new and accessible metaphors to help explain the conditions and opportunities for action, when patterns replace predictions and adaptation replaces control.

## **4 The Complexity Space emerges from Human Systems Dynamics**

Human Systems Dynamics (HSD) is singularly focused on the complex behaviors and influence of “human agents” as they work and play together in groups, families, organizations, and communities. The power of HSD is derived from an approach that is fundamentally holistic in design, allowing for multiple “patterns” to exist, adapt and change across time and space.

The Human Systems Dynamics Institute was founded in 2002 by Glenda H. Eoyang. While the foundational theory of HSD integrates the contributions of complexity science, the work by Eoyang and other Associates focuses on developing new concepts and tools to better understand and influence the everyday dynamical interactions of people in organizations and groups. Acknowledging that human systems do not naturally operate in strict “cause and effect” ways, HSD concentrates on the interconnected actions of individuals who have the freedom to act in unpredictable ways that change the context for themselves and others.

HSD offers a set of iterative questions that create the framework for evaluation and change of organizations:

- What are the patterns operating in the organization at the present time? (When you can see and understand the pattern, you can begin to focus on the path for change)
- How do we see them?
- What do we do when we find them?
- How can we use them?
- How do we change them?

The work of HSD has been embraced by a cross-section of social scientists and practitioners who work with and within complex systems of people. Seeking to establish a continued inquiry and guide for adaptive change, HSD opens up the possibility for small and large actions leading to sustainable change by respecting the patterns as they emerge and the humans that influence them.

## **4.1 Why Complexity Theory, Human Systems Dynamics and Business Systems are a natural fit.**

An organization at its core is a sophisticated social arrangement which pursues collective goals, attempts to control its own performance, and consciously or unconsciously, constructs “boundaries” that separate it from its environment. It is also a group of independent but interrelated humans who are continually striving to find their appropriate place within the organization.

How do you manage within this environment?

That answer begins with the recognition the real power of the complexity lens is the fact that there is no one correct or “best” answer. Instead, it posits there are a number of useful ways to understand and influence the emerging and adaptive nature of the organization and the agents that make it a living, breathing organism. “In other words, when we speak of businesses as complex adaptive systems we are not speaking of a metaphor or a technique; rather, we are saying that by understanding the characteristics of complex adaptive systems in general, we can find a way to understand and work with the deep nature of organizations” [Lewin, 2002].

Even as business organizations are looking to complexity science to provide an alternative view of how to address their chaotic and complex environments, we recognize that these same organizations are reluctant to venture away from Newton’s mechanistic model. The dominant metaphors for preferred organizational design are right out of the linear playbook. Bureaucratic hierarchies, centralized control, discipline, division of labor, organizational charts, standardized tools and procedures, emphasis on planning rather than improvisation, and minimal relationships to those outside of the organization remain as embedded models of successful control, influence and behavior [Morgan, 1997; Plsek, Lindberg and Zimmerman, 1997]. “That dominant thinking yields business strategies that will inevitably fail whenever the nonlinearity of organizational life is at all important” [R. Stacey 1996].

“This perspective utilizes the dominant paradigm of science, the view of a clockwork universe that was prevalent for much of the 18th and 19th centuries. It consisted of parts that worked together in a deterministic way. Given initial conditions, one could predict with accuracy where any system would be a second, or a millennium, from now. Under this paradigm, the world is viewed as both deterministic and reductionist. In the 21st century, we are just beginning to recognize its limitations” [Grobman, 2005].

The Newtonian perspective assumes that all can be explained by the careful examination of the parts. Yet that does not hold true for many aspects of human behavior. We are continually reminded of how the outcome of a situation is not explained by simply combining individual parts to a whole. The spontaneous self-organization of community members, in response to a natural disaster or crisis often appears without an official plan or process. “In these contexts, we find groups of people create outcomes and have impacts which are far greater than would have been predicted by summing up the resources and skills available within the group. In these cases, there is self organizations in which outcomes emerge which are highly dependent on the relationships and context rather than merely the parts. Stuart Kauffman calls this Order for free’ and Kevin Kelly refers to it ‘creating something out of nothing’ “[Zimmerman, 1999].

## **5 The Complexity Space**

The Complexity Space has emerged as construct to describe the world in which complex human organizational systems operate. When the goal is to guide businesses to be more flexible in order to see, react to, and influence what is out of their direct control, the metaphors for understanding this new paradigm are fundamentally

different. The authors look to a simple but robust comparison of two divergent views of how to “see” an organization -- either as a machine or as a garden to begin the process. The frustration of business leaders reveals itself as they begin to understand why “the best people, the best plans and the most efficient processes” often fail to achieve “expected” change and improvement.

In this context three questions serve to guide and integrate the critical dimensions of the Complexity Space that will be introduced:

1. How do business organizations expand their practices to leverage a complexity space approach to people, process, products and strategies?
2. How do organizations focus on a simple way to build a practice of applying complexity theory for business?
3. How is it possible to recognize, influence and create new adaptive practices in an organizational context?

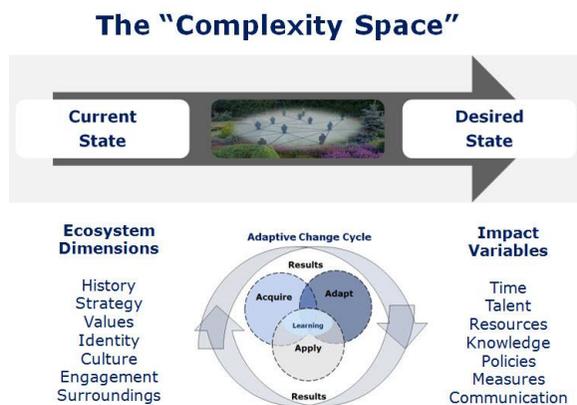
## 5.1 Components of the Complexity Space

Three key components of the Complexity Space Model set the conditions for influencing the “current state” of an organization in order to achieve a “desired state” – in other words getting things done for growth, profitability and change.

**Organizational Ecosystem** – the deeply embedded dimensions of the organization and the people who operate in the system, as well as its surrounding environment.

**Impact Variables** – Areas of the organization that can be more readily influenced.

**Adaptive Change Cycle** – a continuous cycle of Acquisition, Adaptation, Application, Results, and Learning that accompanies any and all actions within the ecosystem.



**Figure 1: Components of the Complexity Space**

## 5.2 The Organizational Ecosystem

When business managers acknowledge that they are not really able to control everything that is happening in their spheres of influence, it is essential they become skillful and intuitive masters of adapting to a continuous state of change. It is not simply a matter of efficiently moving from one unanticipated scenario to the next. The real talent is to move from the current state to the desired state with greater agility and fewer surprises.

The critical first step in navigating in the Complexity Space is to surface the underlying patterns and context in which the organization operates. The authors have identified seven dimensions of what they call the “organizational ecosystem.”

These seven dimensions are: history, strategy, values, identity, culture, engagement and surroundings. Each of these deeply embedded dimensions allows greater precision in creating awareness of the environmental “context” and deep structures in which the organization operates. These dimensions are characterized by the following properties:

- Always present
- Operate at multiple layers simultaneously
- Not immediately visible
- Not predictably influenced
- Inputs/outputs not proportional
- Open to external systems

Predictive and guaranteed results become highly improbable in the constantly changing, self-organizing and often unrecognized organizational ecosystem.

## 5.3 Impact Variables

The second area of distinction considers how change takes place within the organizational ecosystem. The Complexity Space model begins to uncover patterns and appreciate the dynamics within them by focusing attention on seven “impact” variables that can be assessed, prioritized, and shifted to move towards desired results. These seven Impact Variables are: time, talent, resources, knowledge, policies, measures, and communication.

In contrast to the dimensions of the organizational ecosystem, these Impact Variables can be distinguished by:

- Always present

- Operate at multiple layers simultaneously
- “Levers you can pull”
- Can be modified directly
- More easily measured
- Shorter feedback cycles

Each Impact Variable can be considered as a possible component of an intentional attempt to influence the activity within an organization. Want to accelerate a new leadership development strategy to identify top talent and succession planning? Provide an aggressive time-frame for results. Hope to change the way research and development funding is allocated? Change the way departments/divisions are held accountable (measured).

Each of these intentional interventions will influence and change significant and insignificant parts of the organizations. Perhaps in the direction desired, perhaps not. Any one intervention cannot help but have some sort of impact on each of the other variables. In the examples above, compressing the time frame may contribute to stress on the talent as important resources are reallocated, causing a need to update the knowledge base and create new policies, adjusting how people and projects are prioritized, and finally shifting the “rumor mill” into a higher gear as staff interpret the meaning of the time compression.

Over time, in conjunction with other intended and unintended actions and reactions, the organizational ecosystem will be influenced as well. “We’ll look back at this with regret” (history). The “story” the organization tells itself and others about being methodical planners of people, project and processes may be questioned. The stress may result in a longer-term feeling of disenfranchisement with its attendant loss of engagement.

It is these unique properties of complex business adaptive systems and the agents that populate them: intended and unintended outcomes; short-term and longer-term influences; the inability to relate the size and frequency of a change to its impact – that makes the third new concept embedded in the Complexity Space so critical.

## 5.4 Adaptive Change Cycle

This final concept is identified by the authors as the Adaptive Change Cycle. The elements of the cycle -- Acquisition, Adaptation, Application, Results, and Learning - provide a critical lens through which to view adaptive change initiatives. In any given situation the cycle often begins with the identification of what new information, competencies, resources, or experience needs to be acquired to address emerging challenges. Integrating that new data with what already exists, then making judgments based on that integration is the essence of adaptation. Without acting on

those decisions, the opportunity to directly (attempt to) influence organizational patterns is significantly diminished.

While acquisition, adaptation, and application activities are occurring throughout the organization, so are results. The results may be no different than they were before, but they are results nevertheless. The remaining element of the Adaptive Change Cycle – learning – is the lynchpin to managing for profitability and growth. It is in the act of noticing the results; the impact on the Impact Variables and organizational ecosystem; the intended and unintended consequences influencing the system – and then integrating the results of that reflection to identify what to “acquire” next.

## 6 Case

Introducing a complexity-based approach to organizational requires a reframing of how the process differs from traditional initiatives. The case that follows illustrates dynamic, particularly the concept that results are not guaranteed and that the process may uncover unexpected and unseen issues.

### 6.1 The Client

The authors were engaged by the COO of a wholly-owned subsidiary of a multinational organization. In 2007 the company was acquired by the parent corporation with the explicit intention of letting it “operate independently” and maintain its “close knit and unique culture.” The original founder of the company and several key executives remained after the purchase and continued to operate autonomously, even though all major decisions required the final approval of the parent. The COO was one of the original officers and was the front-line interface with the parent’s senior executives. It had become evident to the COO that the subsidiary was facing several critical challenges that were impacting the organization’s profitability and ability to maintain its perceived “independence.”

The following three issues were presented by the COO during an initial meeting:

- The firm was experiencing a significant amount of senior management attrition.
- Two consecutive quarters of significantly declining gross revenues were raising questions by the parent and impacting new research and development initiatives.
- Several important strategic alliances terminated their partnership agreements, resulting in lost distribution and sales.

During the initial conversation the client and authors decided to focus on the first business issue, although the COO was not convinced that this was where the conversation should begin. The “difference that made a difference” in this conversation was a question by the authors, “What would make the greatest

difference in shifting the dynamics (patterns) of the organization?” During the ensuing conversation, two significant factors emerged. First, the senior managers were stressed as they shouldered more responsibility covering for the staff shortages. Second, there was a philosophical rift between those wanting to maintain the old culture and those who wanted to create a new one.

## 6.2 Applying the Complexity Space model (CAM)

The context of this “desired state” set the stage for an inquiry into the organizational ecosystem and current state of the Impact Variables. The adaptive change cycle process was evident even in the early stages of inquiry. Both quantitative and qualitative tools were used to acquire a sense of the current organizational context and patterns relative to the desired one, and to identify high leverage issues and opportunities. Data and conversation about both the parent company’s and wholly-owned subsidiary’s history, mission, values, and overall culture provided powerful insights. Recognizing changes in the competitive environment (surroundings) also helped to raise “aha’s” for both the COO and authors

The patterns that emerged indicated a deep desire by the parent company to keep true to the “old” culture of the organization, avoid change by ignoring the reasons behind employee attrition, focus resources on perpetuating previously successful processes, and looking only to the inside for alternative approaches.

At this stage, the client was asked to consider a new framing of organizational patterns, issues and opportunities in light of their executive staffing concerns. It is important to note that although the talent/workforce Impact Variable was identified as the one to change in order to achieve the desired state, doing so required an initial consideration of all the Impact Variables.

By leading the client through a top level exploration of the direct and indirect impact of these interrelated areas, patterns surfaced that provided the key for understanding and prioritizing opportunities for action.

The following action plan was agreed upon:

- *Develop a formal succession plan for the top executives.*
- *Review and revise stated responsibilities and expectation of key managers with input of the parent.*
- *Review current gaps in experience and expertise and adjust current and adjust hiring strategies.*
- *Design a leadership development strategy to focus on a Complexity Space approach for understanding organizational issues.*

With these specific action priorities established, the Complexity Space process moved on to application – efficiently and effectively implementing the suggested changes, thinking through the impact of the change on both the directly impacted

Impact Variables (talent, resources) and the other Impact Variables as well (e.g. “How should we measure success of the new hires?”). As each step of the action was implemented, close attention was paid to the ensuing results, offering the client an opportunity to reflect on the learning relative to the immediate areas of influence and the organization as a whole.

The COO and authors agreed to stay in touch with one another, establishing follow-up meetings that would enable them to assess the impact of the changes not only on the leadership team, but on the larger organizational ecosystem as well. In those meetings, the Complexity Space Model process would iterate, assessing the “new” current state of the ecosystem and Impact Variables, prioritizing the next attempt to positively influence the patterns in support of achieving the organization’s desired goals, and skillfully applying those pattern-shifting changes.

The cycle continues.

## 7 Conclusion

“Complexity 'thinking' is the art of maintaining the tension between pretending we know something, and knowing we know nothing for sure” [Richardson, 2008].

Embracing a complexity-based approach to organizational change and improvement offers insight to identifying, understanding and influencing the *Grey Swans* of business, who clearly swim in the space between knowing something and knowing nothing. Businesses have no choice but to operate in an evolving and dynamical construct which demands a new set of competencies recognizing the complexity and properties of complex adaptive human systems.

As business organizations recognize the advantages of adaptive, persistent and patterned-based management intelligence, *Navigating the Complexity Space* will result in an endless source of potential actions for innovation, sustainability and growth.

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