An Introduction to Complexity and how it influences Risk

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Complexus
Intelligent Risk Thinking

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Risk Engineering Body of Knowledge

Opening Thought

Our working world is not getting any simpler, only more and more complex…

What is Complexity?

The Science of Complexity

"Complexity" is a relative term that can be applied to a broad range of circumstances.

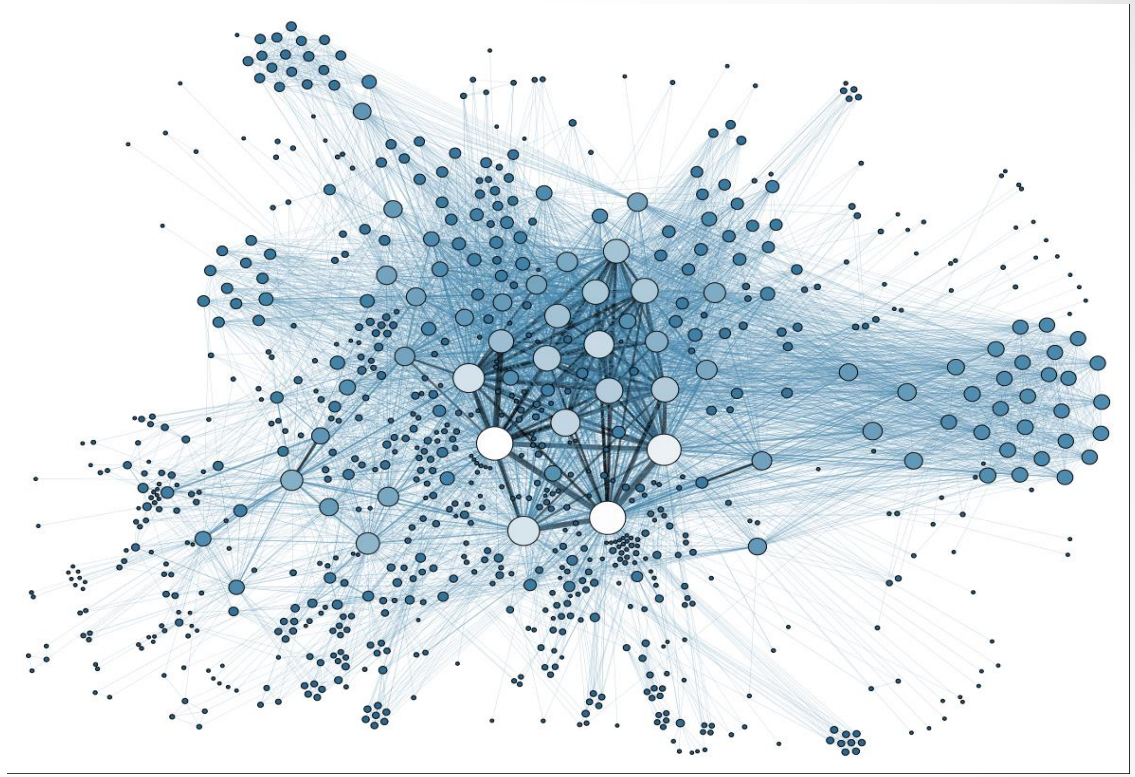
The formal study of complex phenomena is known as the *Complexity Sciences* and includes *Chaos Theory, Systems Thinking, Resilience Theory, Network Theory, Social Theory, Computational Theory* and the like.

The Complexity Sciences offers a valid means to improve the control of complex operating environments, as well as their specific challenges (e.g. risks).

Exploring a Complex Systems' View of Complexity

What is a truly Complex System?

An entity comprising of an advanced number of highly energised & interconnected, contributing parts



Natural Systems

- The Weather
- A Rainforest
- A Food Chain
- The Human Brain
- An Immune System

Man-made Systems

- Social Networks
- Political Systems
- An Economy
- Major Projects
- Large Organisations

The Complex Systems Maturity Scale

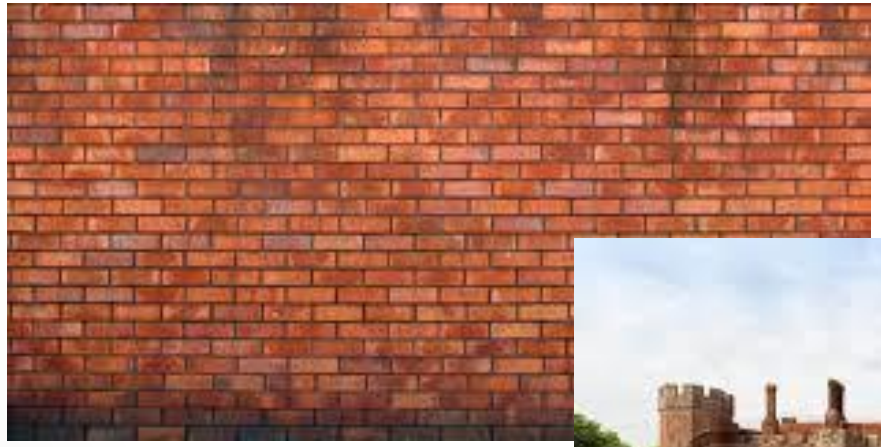
Simple Obvious System

Simple Ordered System

Complex Physical System

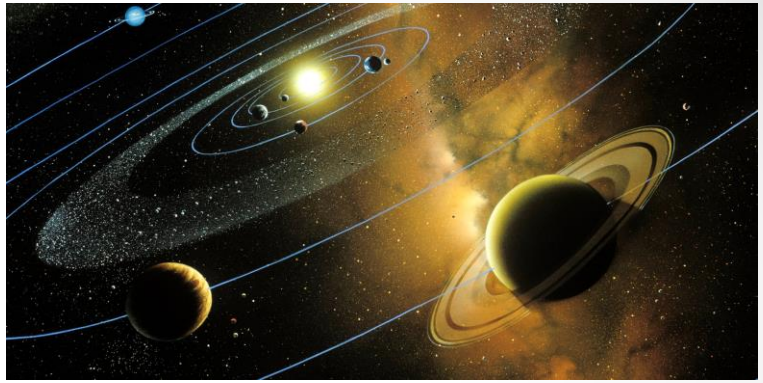
Complex Adaptive System

Simple Systems | *Complex Systems*



New Rules & Behaviours Emerge!

Primary characteristics of Complex Systems



1. Consist of an advanced number of interdependent contributing parts, systems & relationships *(highly integrated)*
2. Are continually responding / adapting to the emergence of new environmental signals *(highly energised & dynamic)*
3. Tend to behave in a non-linear fashion *(are potentially chaotic)*

The 8 habits of highly complex systems

Complex Systems Phenomenon #1

"The Butterfly Effect"

States that a seemingly insignificant change in one systemic relationship can ripple and compound though all the other inter-connected relationships to create momentous, possibly even uncontrollable, impacts elsewhere within the system

Complex Systems Phenomenon #2

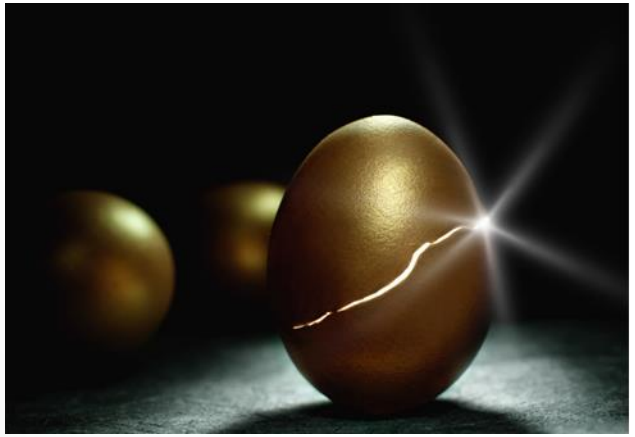
"The Edge of Chaos"

States that a complex system is a highly energised entity, which at all times is no more than a transition or two away from descending into wild disorder (chaos) and thus should be considered to be an inherently chaotic entity

Complex Systems Phenomenon #3

"Emergence"

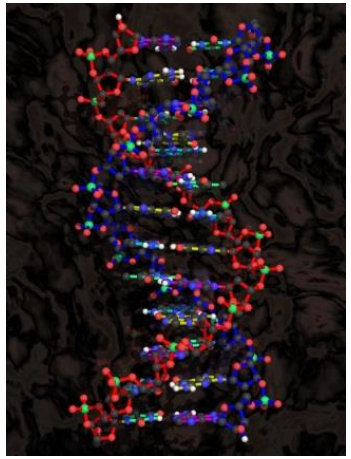
States that a highly complex system will create new emergent behaviours, properties and characteristics that are not an outcome of design



Complex Systems Phenomenon #4

"Sum of Parts"

States that a complex system comprises of an advanced number of internal contributing agents whose total integrated behaviour is so much more momentous and impactful than the combined sum of the individual parts



Complex Systems Phenomenon #5

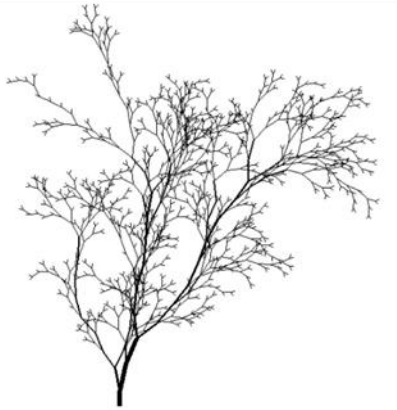
"Strange Attractors"

States that the contributing agents of a complex system, will not necessarily engage with each other through logical means of attraction (e.g. cause & effect)

Complex Systems Phenomenon #6

"Fractals"

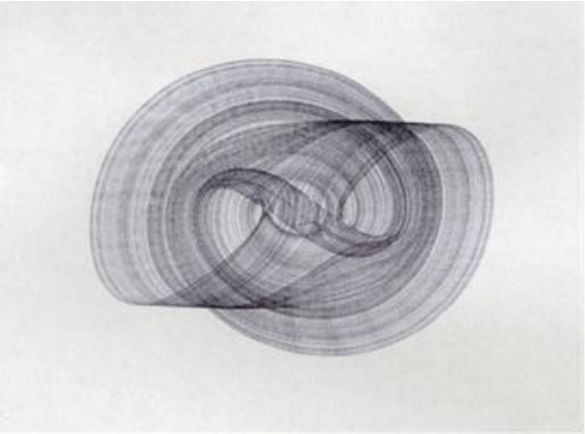
States that although numerous recognisable patterns and relationships may exist within a complex system, their behavioural outcomes will rarely be consistent, logical nor repeatable

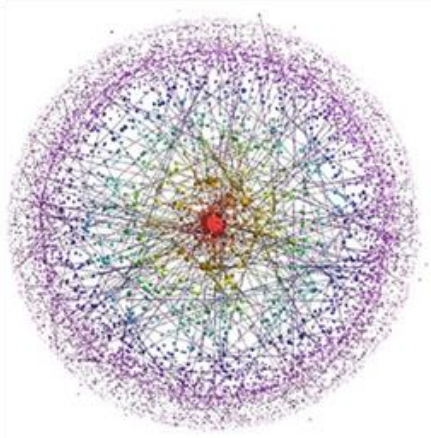


Complex Systems Phenomenon #7

"Non-linearity"

States that a complex system is a highly dynamic and evolutionary entity and thus past performance is not a reliable indicator of future performance

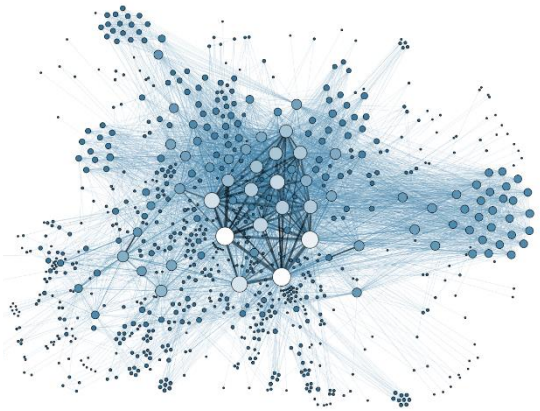




Complex Systems Phenomenon #8

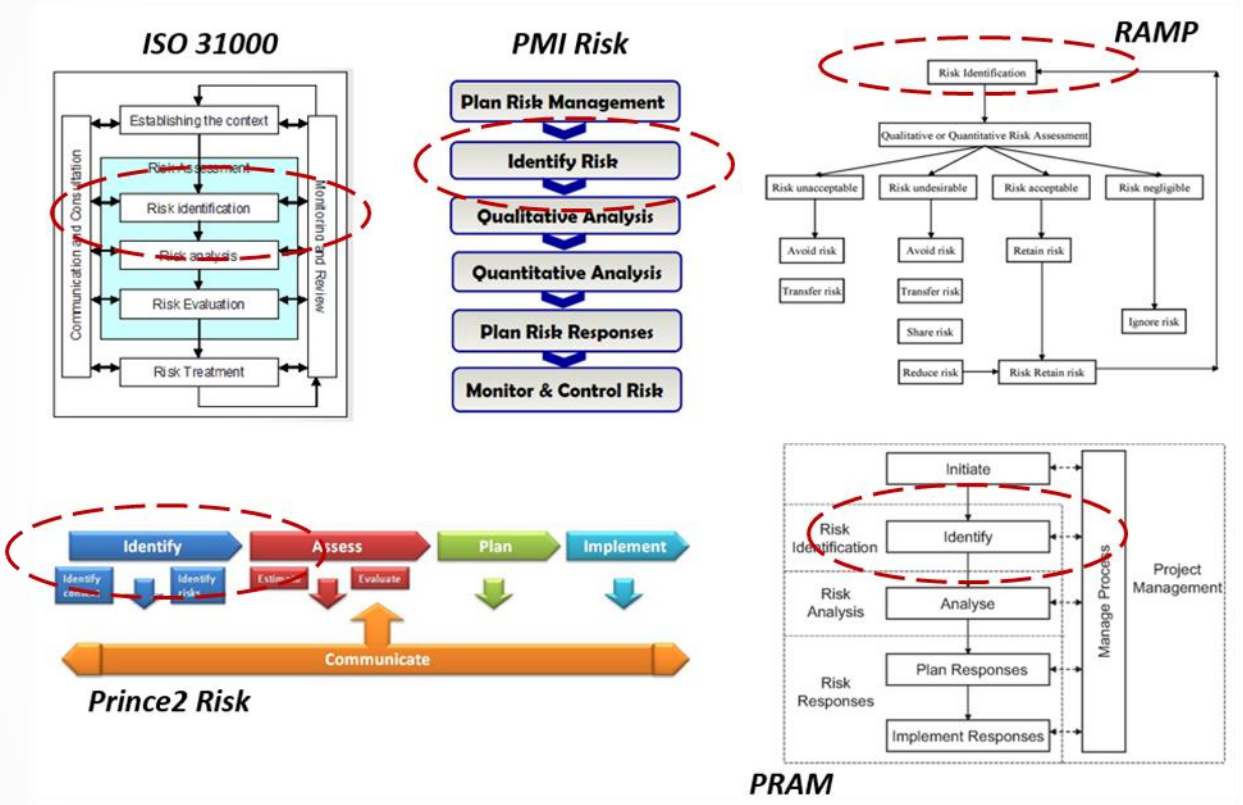
"Signals"

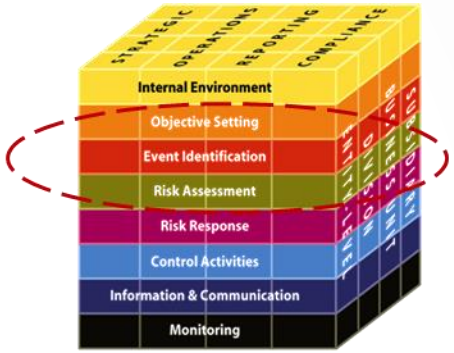
States that complex systems are highly responsive entities which are driven by signals generated from the internal contributing agents continually interacting with and adapting to both each other, and their surrounding environment

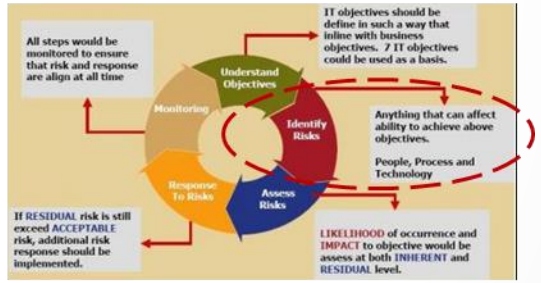


Okay, but what does this all mean for managing risk?

Learning #1 – We need to move beyond our traditional over dependence of having to first predict a risk in order to control it

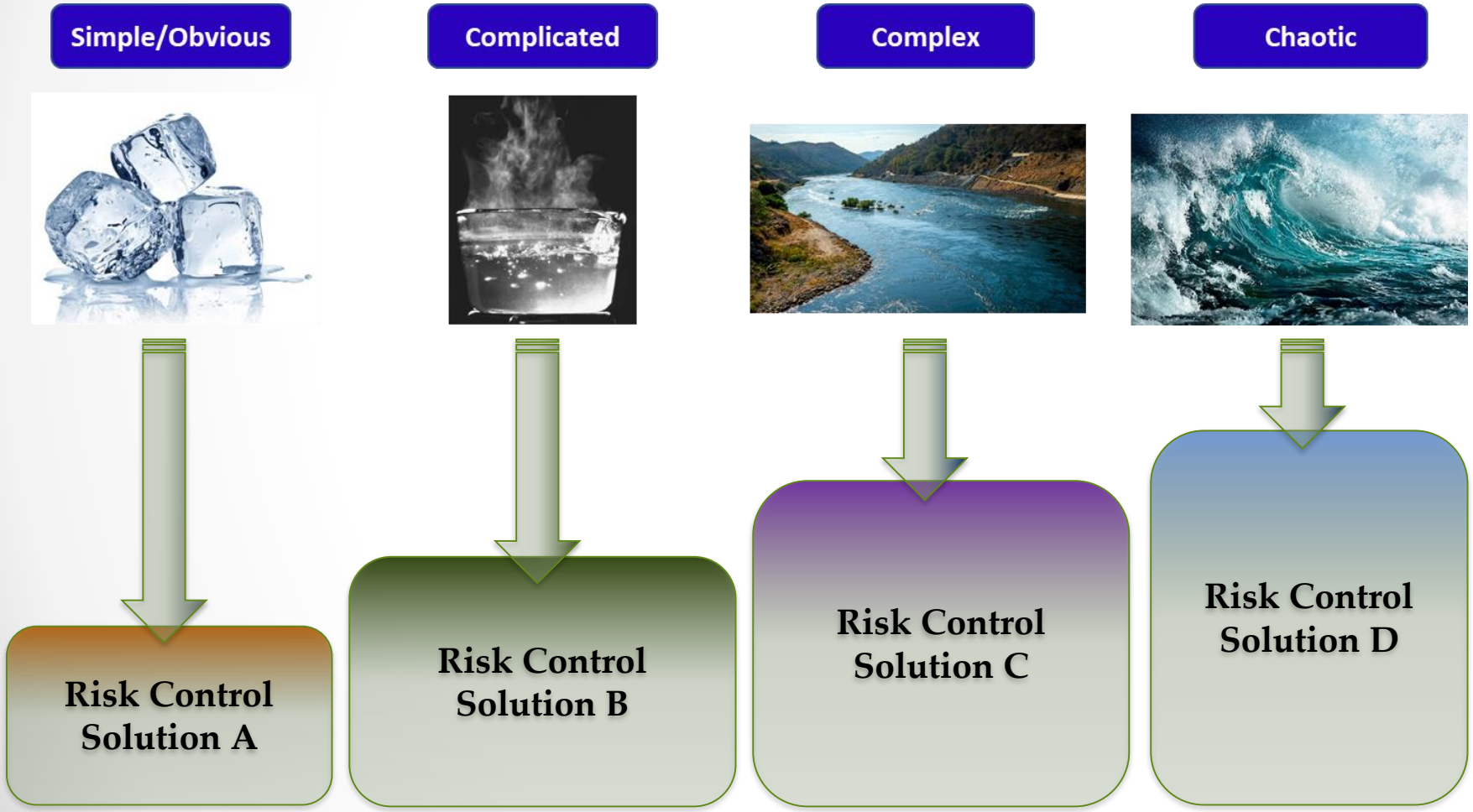






*"**The complexity literature teaches us that** one can not consistently predict the behavioural outcomes of a complex entity because as systemic complexity increases - consistency, rationality and predictability decreases. For this reason, risk management in complex environments needs to be less about "predicting" risks and more about responding intelligently to those emerging environmental phenomena which may cause risks.*

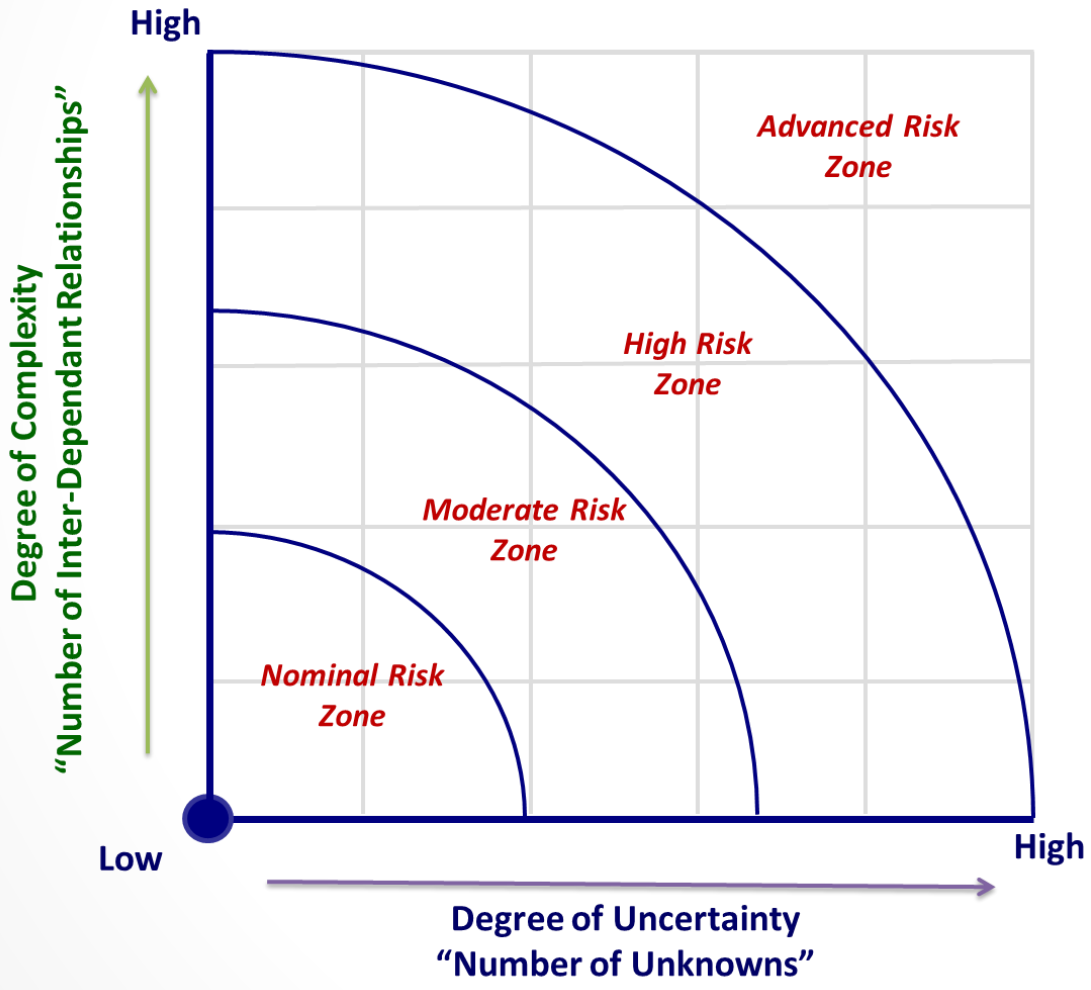
Learning #2 – We need to acknowledge that a "one size fits all" approach to risk management is impaired within an operating environment that is both contextually unique *and* continually transitioning



The complexity literature teaches us *that any chosen control framework must offer at least as many control solutions as the number of differing challenges being offered by the surrounding environment*

....and that all control solutions must be determined based on the specific degree of difficulty in play

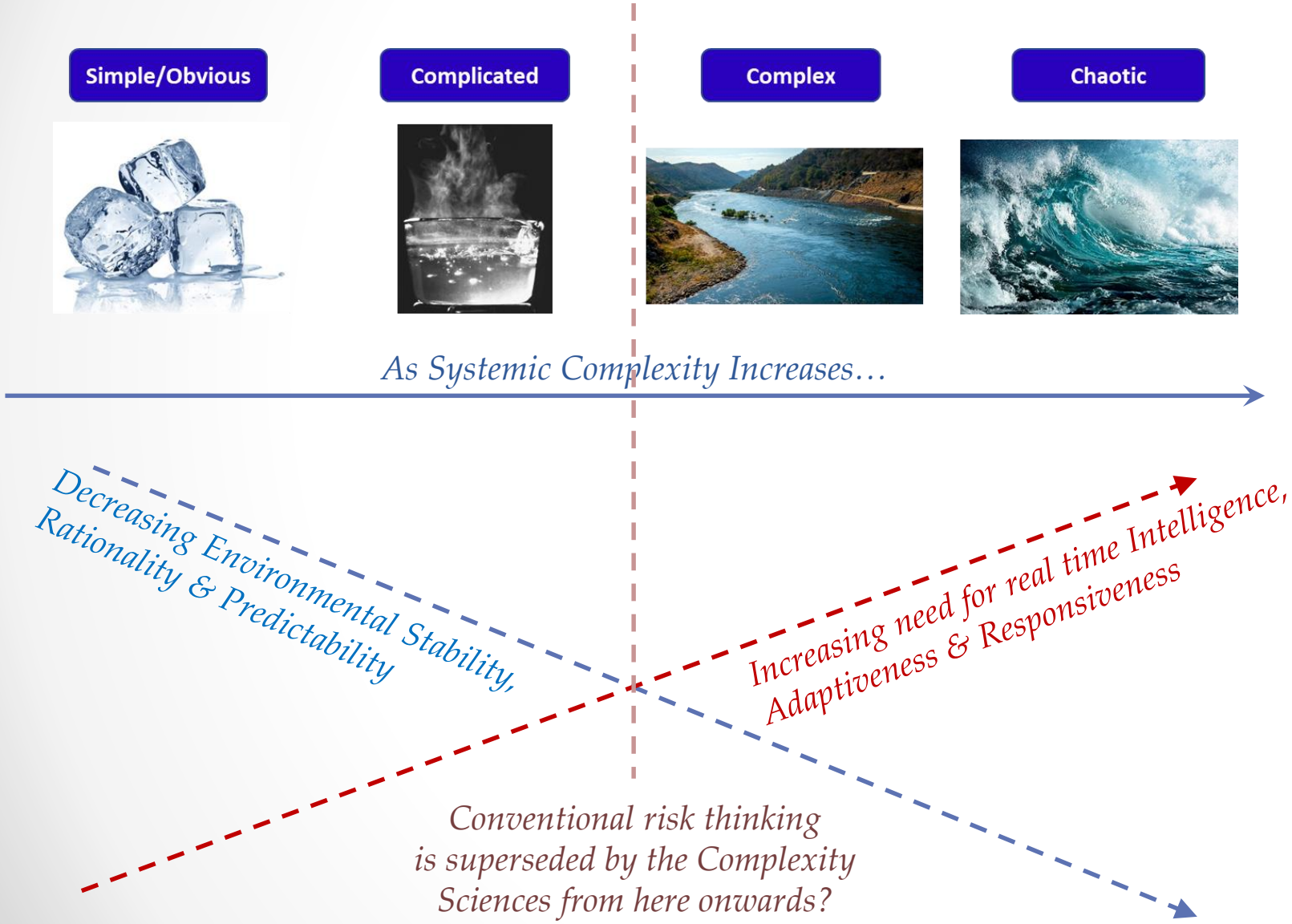
Learning #3: We need to understand that when it comes to highly complex environments, *managing the situational complexity* <u>is</u> *managing risk*



The complexity literature teaches us *that any uncontrolled increases in an environment's complexity will equate to greater exposure to risk, primarily in the form of the increased emergence of unwanted behavioural phenomena.*

It is thus imperative that if risks are to be effectively controlled within a complex context, then the situational complexity also needs to be effectively controlled.

Learning #4: We need to better understand where conventional risk thinking becomes impaired and is in turn superseded by Complexity Theory



The complexity literature teaches us *that everything has a natural limit – conventional risk management methods are no exception to this rule.*

The Complexity Sciences were borne from the need to better control the behavioural outcomes of highly integrated and dynamic relationships (systems), whereas risk management was borne from the need to better control the impacts of uncertainty.

Although the two disciplines share enough commonality there is much contradiction in their method. Modern risk managers need to understand the differences if they are to succeed in a working world that is only getting more and more complex.

Summary

Key Learnings…

- Complex entities do not behave the same way as rational ordered (simple) entities, they are subject to very unique constraints and associated phenomena.
- For each degree rise (or fall) in complexity, new systemic behaviours/phenomena will come into play
- For this reason, appointed risk officers all ***have a duty*** to assess whether their proposed risk control solutions are contextually appropriate for the degree & nature of complexity in play

Reminder of more in the series…

ENGINEERS AUSTRALIA | RISK ENGINEERING SOCIETY | Risk Engineering Body of Knowledge

- **Session 1** Webinar Tuesday 30 April - An Introduction to Complexity and how it influences risk, will cover a broad range of complexity themes and concepts relevant to modern day management of risk

- **Session 2** Webinar Tuesday 7 May - Will dive deeper into specific complexity concepts and associated risk controls based on the feedback generated in the first session. We are looking towards the first session's attendees to tell us what they would like to learn more about in the 2nd session

- **Session 3** EA Risk & Project Controls Conference Sydney May 17th - a 30 minute presentation on our PHD research and findings to date on "Investigating a complex systems view of risk management within complex project delivery environments"

RISK ENGINEERING & PROJECT CONTROLS CONFERENCE 2019

ICC | SYDNEY | AUSTRALIA | 15 – 17 MAY 2019

Questions?

Warren Black - Biography

Warren is an Engineer, Risk Professional and Complex Systems' Advisor who has particular interest in understanding how the complexity sciences may offer a better means to controlling emergent risks within highly complex, operating systems.

Warren consults to industry on how to improve Governance, Risk & Assurance practices so that they may reflect not only the degree of investment at risk, but also the specific complexities in play.

Warren is currently engaged in a higher degree in research (PHD) program, whereby he is *Investigating a Complex Systems Approach To Controlling Risk within Complex Organisations*, at the Queensland University of Technology.

www.complexus.com.au

Geoff Hurst - Biography

Geoff is a well qualified OHS and Risk Engineering professional with expertise in the development of safety and risk management frameworks, embedding & developing effective Health & Safety Management Systems, workplace wellness programs, and implementing workplace cultural change in a variety of settings.

Geoff leads the ENGENEOHS Alliance to deliver on safety and risk related projects specific to client needs in the key areas of Engineering, Enterprise, Environment, Or Health & Safety. He is the President - Risk Engineering Society.

Geoff delivers the Risk & Due diligence module at Swinburne University and Risk and Hazard Management topics at Federation University (VIOSH) and has a special interest area in dealing with Complex Socio Technical systems.