

# INVESTIGATING A SYSTEMS THINKING APPROACH TO COMPLEX PROJECT RISK MANAGEMENT

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## Solving a 70-year-old industry problem

**P**rojects globally continue to get larger, more expensive, more expansive, more challenging and ultimately more complex.

Unfortunately... large-scaled, capital intensive and technically intricate projects (aka complex projects) fail to meet their investor sanctioned cost, schedule and benefit objectives more than 70% of the time. A hurdle rate which has been well published and proven.

This includes: 9 of every 10 mega infrastructure projects, 5 of every 6 complex technology implementations, 4 of every 5 large dams, 3 of every 5 major road programs, 9 of every 10 major rail builds and so on. In fact, abnormally high failure rates have been observed across every major project sector, technical class and investment type with no demonstrable improvement for at least the past 70 years.

These observations are particularly concerning for the formal discipline of project risk management as this specific discipline has long been hailed by both industry and academia as being critical to a project's ability to successfully meet its objectives. Such disproportionately high complex project failure rates however suggest that the traditionally accepted

project risk management practices have been mostly ineffective in helping complex projects to succeed.

*Clearly, new thinking and methods are required.*

## The emergence of complex systems thinking as an accepted method of management control

Complex systems are those entities comprising of an advanced number of contributing components, interactions or relationships which often exist in a highly dynamic and adaptive state. Examples of complex systems include the weather, a solar system, a biological food chain, a virus, the human brain, a rain forest, an economy, the internet, a major city, a global organisation, a major project and so on.

Complex systems exist in many forms, from being as large as the universe itself to being as small as the internal electrons, protons and neutrons which make up an atom. They can be as obvious as the decision-making hierarchy of a major government to being as concealed as the manner in which trees communicate with their surrounding forest life. They may be as visually energised as a swarm of bees to as seemingly stable as a dormant volcano.

Regardless of form, mankind's dependence on complex systems is undeniable as complex systems are the fundamental building blocks of our entire existence. The food we eat, the air we breathe, the way we communicate, the way we socialise, the way we reproduce and the way we evolve are all dependent on numerous interconnected complex systems. It has thus always been of some importance that we understand how complex systems exist, interact and behave.

### The early study of complex systems

Mankind has almost certainly been studying complex systems throughout our history (the weather, seasons, stars etc.). What made these naturally occurring, complex systems so intriguing to the early scientific community was their intelligence driven behaviour and general unpredictability.

The notion of a highly connected, intelligent body which could move freely between order and disorder (and back again) with no apparent pattern, logic or rationale driving it, was found to be fascinating by a community which prided itself in defining the patterns, logic and rationale hidden within everything in the world surrounding them. Thus, the early scientific study of complex systems was fuelled by a professional curiosity to establish the systematic rules, rationale and order within seemingly disordered environments.

In this regard, most early complexity scientists (as they became known) sought to demonstrate how complex systems were characterised by clear, cause and-effect style rules however subtle or disguised. Although this premise initially offered much promise, scientists soon came to understand that most complex systems do not operate through systematically repeatable patterns, rather they play by a set of rules which are far more complex than any scientist could possibly have imagined. This was an important learning threshold for the scientific community, a Eureka Moment if you will, as it suggested that many of the conventional management methods that science had come to rely on for controlling operational systems needed to be rethought within a complex systems context.

Most natural complex systems comprise of an advanced number of highly energised contributing components which are continually interacting and adjusting in order to secure a natural equilibrium between all their individual relationships and their surrounding environment (consider a large, integrated project). Such an advanced network of transitioning interactions and relationships ensures that the total system is often so much more momentous than the individual contribution of the involved parts.

Even when some systematic patterns are replicated amongst the individual contributing parts, the total system's final output will almost certainly differ each time. Furthermore, the discovery of such complex phenomena as emergence, chaos, fractals and strange attractors rendered many of the original scientific arguments regarding hidden patterns and logic to be unfounded. The reality of many complex systems is that they hold no reasonable sense of predictability because at their core they are wildly disordered and are at all times, potentially chaotic. More to the point, it is the sheer lack of rational order which is created by an unlimited number of dynamic, internal relationships that ultimately defines a system as being "complex".

The realisation that highly complex systems are closer to chaos than to order, implied that such complex system behavioural outcomes simply could not be explained nor repeated by a systematic process. The constant transitioning of such advanced systems ensures that repeatable patterns simply cannot emerge as the relationships between cause and effect are impossible to determine.

With this realisation in hand, scientists steadily shifted their studies to rather understanding the phenomena which exist within a complex system, as opposed to attempting to establish and then reproduce systematic patterns. Complex systems are the fundamental building blocks of mankind's entire existence

Up until the late 20th century, Complex Systems Theory remained predominantly in the realm of physics, philosophy and deep mathematics, presumably due to a general lack of practical application in most of the other mainstream management sciences. Then in 1972 Edward Lorenz published a landmark conference paper which suggested that the minor beating of a butterfly's wings in one part of the world could set off a chain of events that ultimately would unleash tornadoes in other parts of the world. At the time, Lorenz was merely attempting to demonstrate, though an abstract example, the power of compounding and momentous change within a globally interconnected, meteorological system. However, what he actually achieved was to introduce a complexity concept that could be understood by a more mainstream audience without the application of deep mathematics. The premise that all things within complex systems are connected and therefore, even the most subtle, almost unnoticeable, change in one particular relationship of a complex system will create additional changes in the dynamics of all other relationships resonated with many outside of the established complexity science



community. Complex relationships are at the heart of many important contemporary problems and so Lorenz's "Butterfly Effect" became a catalyst upon which complexity theory could be transitioned into the mainstream working world.

### **Complexity science goes mainstream...**

Complexity theory now began to appeal to many mainstream organisations who for the longest time had found themselves dealing with a broad range of complex and often chaotic challenges, within such conventional pursuits as strategy, leadership, management operations, production efficiency, logistics and of course, project management.

The principles of Complexity Science now provided a welcome explanation to understanding complex problems within many mainstream environments.

Soon the principles of Complex Systems Theory were being studied and applied across a much broader range of management pursuits as they offered a new way of seeing order where formerly only the random, erratic and unpredictable had been observed.

By the late-1980's a number of academic institutes had been established with the express purpose of advancing the study of complex systems in order to realise its more practical applications. Perhaps the most

famous of these is the Sante Fe Institute which came to specialise in studying those complex systems which were known to adapt to their environmental circumstances through a self-controlled sense of intelligence.

Specifically, complex "adaptive" systems are capable of sending and receiving signals between their internal agents and their surrounding environment and in turn can alter their behaviour (self-correct), so as to achieve a particular goal. More distinctly, Complex Adaptive Systems (CAS) alter their behaviour based on environmental feedback and retained memory.

The intelligence driven and self-correcting nature of a CAS has become an area of particular interest to both the scientific and mainstream management science communities as such systems offer a new lens to look at the world's most complex challenges such as war, famine, poverty, disease, wealth disparity and social unrest. Many of these challenges are believed to be behavioural outcomes of such macro global complex adaptive systems as politics, economics, trade and social behaviour. Complexity Science in the modern era now has farther reach and appeal than at any other time before.

Complexity Science now encompasses a broad range of disciplines which may include the study of; complex patterns (e.g. fractals), complex behaviours (e.g. non-linear dynamics), complex interactions (e.g. networks), complex states of existence (e.g. chaos) and of course; complex systems (e.g. major projects).

In this regard, Complex Systems Theory is not a single theory, but rather a collection of theories (and associated tools) from a broad range of complexity disciplines which may assist to address a specifically complex challenge inherent within a particular complex system - for example, how to control risks which might emerge from within a highly complex, project delivery environment.

Complex Systems Theory is no longer considered to be a purely theoretical pursuit, but rather a new generation management science for controlling the complex challenges which can arise from within complex environments.

More relevant however is how complex systems thinking potentially offers new insight into how to improve the control methods and associated decision making of complex project risk management.

### The Future of Project Risk Management?

Systems thinking is not a new discipline, especially not in Engineering circles, but it is one that has gained significantly more street credibility and traction within the project risk management discipline in recent years.

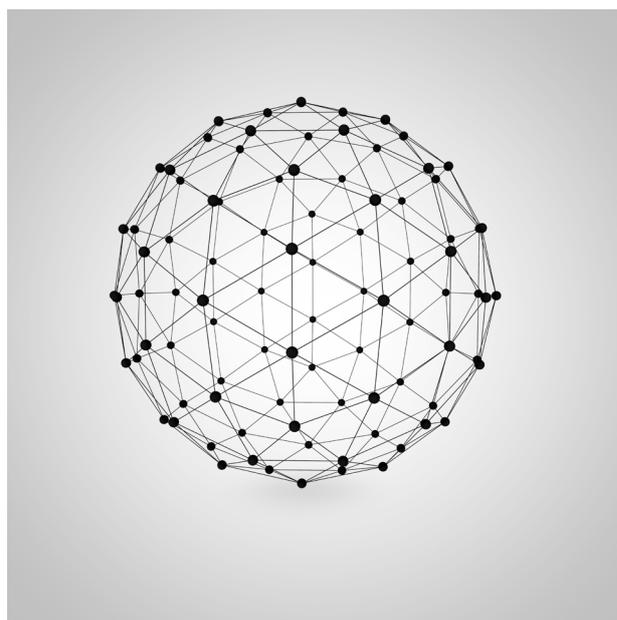
Such seminal project risk academics as Bent Flyvbjerg (Oxford), John Hollman (AACE) and Edward Merrow (IPA) have published numerous case studies and thought pieces demonstrating the power and value of approaching project risk management with a systems thinking mindset.

Viewing major projects as a complex ecosystem of co-dependant and continually shifting stakeholders, tasks and relationships; has significantly more merit when attempting to

understand complex-adaptive risk phenomena, than merely following the linear step-by-step methods endorsed by the conventional *brand name* risk management methodologies.

In conclusion, systems thinking offers the global project risk management discipline a new lens upon which to look at some of their most complex risk challenges.

This in turn opens up numerous exciting possibilities which may in turn elicit genuine, positive change within the complex project management universe.



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### About the Writer

Warren is an Engineer, Risk Professional and Complex Systems' Specialist, who has particular interest in understanding how the complexity sciences may offer a better means to controlling disruptive phenomena within complex organisations.

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 also currently engaged in a higher degree in research (PhD) program at the Queensland University of Technology, whereby he is Investigating a Systems Thinking Approach To Controlling Risks within Complex Projects.