

1.3 The systemic nature of complex problems

A complex situation, just like anything that is complex, is one where there are a number of interconnected and interdependent parts such as people, objects or feelings. Of course, we can't see the parts interacting. The system is invisible until we draw it. Instead, we tend to see the result of parts interacting in the form of individual events.

Events get our attention. We tend to react to them, treating each event as a separate incident. While our reactions are understandable, they generally aren't that effective. Obvious remedies may in fact make things worse. To better understand complex situations, we must see the event as the visible part of the problem just like the tip of an iceberg. The event is what gets you interested, intrigued or worried but the really dangerous part is what lies below the surface.

But what does lie below the surface? Well, when you explore the history of an event, you might find that there have been similar or related events in the past. By compiling data and tracing the trends of variables over time, patterns in behavior tend to emerge. When one variable rises, another may fall and a third may rise with a short time lag. To see these trends we need to step back from an event and look for patterns of behavior over time. Trends or patterns of variables over time lie just below the waterline.

While patterns of behavior reveal trends, we need to look more deeply towards the bottom of the iceberg to understand the root causes of the problem. Behind any pattern of behavior is what we call a "systemic structure". A systemic structure is a system of interconnected factors that have created this pattern of events. Describing and modeling the systemic structure helps understand complex behavior.

Let's illustrate with an example. Back in 1984, a type of seaweed by the name of "caulerpa taxifolia" was accidentally introduced into the Mediterranean Sea. The algae proliferated and began colonizing the seabed. Called "killer algae", caulerpa reproduces more rapidly than native seaweeds, and its long stems deprive local varieties of oxygen and sunlight. The phenomenon went relatively unnoticed until 1989 when it was first seen by scuba divers and reported by Professor Meinesz and his colleagues from the University of Nice. This is the event. By 1989 the seaweed had colonized 1 hectare along the coasts of France and Monaco. The algae had spread to Italy by 1994, Spain by 1995 and Tunisia by 2000. Pleasure and fishing boats were suspected to have transported the algae on anchors and in nets to other parts of the Mediterranean. Within 16 years, 13000 hectares of the Mediterranean were colonized by caulerpa taxifolia and native seaweeds and ecosystems died out in areas where the seaweed took over. We can plot these trends over time to see a pattern of behavior.

After a little investigation, three variables appear to be interconnected and responsible for spread of caulerpa taxifolia: the "birth of new caulerpa taxifolia seaweed", the "death of other seaweed species" and the "contamination of boats".

I have hypothesized the following systemic structure that I believe is creating these patterns. As the killer seaweed population increased, other indigenous algae died out as its long strands block out the sunlight and its poisonous leaves repulse the fish required by local species for reproduction. New caulerpa taxifolia then colonized the sea floor where old seaweeds used to be. As the population increased, so too did the risk that boats pull up caulerpa and drop it elsewhere on the sea floor. The contamination of boats can explain the spread of the seaweed from Monaco to other parts of the Mediterranean.

The finished result is a representation of the systemic structure that lies at the bottom of the iceberg, generates patterns of behavior over time including the events that catch our attention. It is called a “connection circle”. In our next unit we will practice drawing complexity.