

TerranearPMC Safety Share

Week of March 11, 2013 – Swiss Cheese and the Perfect Storm

In 2000, the movie, *The Perfect Storm* (starring George Clooney) hit the silver screen and became an instant blockbuster. While the love affairs and incidental conversations and working relationships were strictly Hollywood, the actual story was, indeed, true. The story was first brought to the attention of the entire nation in the 1997 novel (written by Sebastian Junger) by the same name.

The story is about the *Andrea Gail*, a commercial fishing vessel that was lost at sea with all its crew. The vessel and her six-man crew had been fishing the North Atlantic Ocean out of Gloucester, Massachusetts. Her last reported position was 180 mi (290 km) northeast of Sable Island on October 28, 1991.

The *Andrea Gail* began her final voyage departing from Gloucester Harbor, Massachusetts, on September 20, 1991, bound for the Grand Banks off the coast of Newfoundland, Canada. After poor fishing, the captain headed east to the Flemish Cap where he believed they would have better luck. Despite weather reports warning of dangerous conditions, the captain set course for home on October 26, 1991. It is known that the ship's ice machine was malfunctioning and unable to maintain the catch for much longer. This is suggested as a key factor in the decision to head home on October 26.

This now infamous *Perfect Storm* was a nor'easter that absorbed Hurricane Grace and ultimately evolved back into a small unnamed hurricane late in its life cycle. The initial area of low pressure developed off Atlantic Canada. Forced southward by a ridge to its north, it reached its peak intensity as a large and powerful cyclone. The storm lashed the East Coast of the United States with high waves and coastal flooding before turning to the southwest and weakening. Moving over warmer waters, the system transitioned into a subtropical cyclone before becoming a tropical storm. It executed a loop off the Mid-Atlantic US and turned toward the northeast. The system then evolved into a full-fledged hurricane with peak winds of 75 miles per hour (120 km/h), although the National Hurricane Center left it unnamed to avoid confusion amid media interest in the predecessor extratropical storm. It later received the name "the Perfect Storm" after a conversation between Boston National Weather Service forecaster Robert Case and author Sebastian Junger. The system was the fourth hurricane and final tropical cyclone in the 1991 Atlantic hurricane season.

The storm is now referred to as "perfect" as it involved three weather systems that came together with deadly results. The first was called "a little, innocuous" low-pressure system that formed over the Great Lakes, then followed the usual path of North American weather: west to east, from Chicago to Maine, and on past Nova Scotia. En route, it met the second piece of energy: An icy cold high-pressure system drafting down from Canada. The two systems combined into a storm in the North Atlantic, off Nova Scotia's coast. The third piece of energy was what made the "perfect" storm so perfectly terrible: a late-season hurricane, Grace, blowing from the south. By itself, a hurricane has colossal force. "A mature hurricane is by far the most powerful event

on Earth," wrote Sebastian Junger in his book "The Perfect Storm." "The combined nuclear arsenals of the United States and the former Soviet Union don't contain enough energy to keep a hurricane going for one day."

A year before the Perfect Storm, James T. Reason and fellow professor, Dante Orlandella, at the University of Manchester, developed the *Swiss Cheese model* of accident causation. Originally, this was a method used to describe risk analysis and risk management with regards to human behavior in the aviation, engineering, and healthcare industries. It likens human systems to multiple slices of Swiss cheese, stacked together, side by side. It is sometimes called the *cumulative act effect*.

Reason hypothesizes that most accidents can be traced to one or more of four levels of failure: Organizational influences, unsafe supervision, preconditions for unsafe acts, and the unsafe acts themselves. In the Swiss cheese model, an organization's defenses against failure are modeled as a series of barriers, represented as slices of Swiss cheese. The holes in the cheese slices represent individual weaknesses in individual parts of the system, and are continually varying in size and position in all slices. The system as a whole produces failures when all of the holes in each of the slices momentarily align, permitting (in Reason's words) "a trajectory of accident opportunity", so that a hazard passes through all of the holes in all of the defenses, leading to a failure. Therefore, unwanted occurrences, such as the tragedy of the Andrea Gail can be explained by viewing the various weaknesses or failures within a chain of events as holes in different layers of Swiss cheese where they all line up and result in the ship capsizing and sinking, followed by the death of its crew.

In the beginning, the perfect storm itself can be seen as a string of events that line up to cause the devastating storm; that is, a low pressure system, followed by an icy cold-high pressure system and then combining with a late-season hurricane. While each one of these weather events by themselves is a typical occurrence, happening in the order, time and place in relationship to each so that together, they form a devastating weather pattern, is extremely rare.

By looking at the other events that affected the Andrea Gail, we can see that each incident separately would not cause tragedy. The fact that the captain decided to go out for another fishing expedition and goes to a remote location to catch fish and the refrigerator breaks down, causing the captain to decide that they need to return to Gloucester Harbor at that particular time (when the triple weather system combines into a single Perfect Storm), can be seen as numerous events lining up to cause "a trajectory of accident opportunity" (as James Reason describes).

The Swiss cheese model and the unfortunate Perfect Storm incident, together, offer us an example of how we can examine our own work tasks — whether at home or at work — and to determine if individual events can be related to a slice of Swiss cheese. The incident by itself may not appear to be hazardous, but when lined up with other events, a catastrophe could be around the corner. By correcting such an event, we are filling in a hole in a slice of Swiss cheese; thereby being proactive to prevent an accident.

Only a mediocre person is always at his best.

W. Somerset Maugham (British Playwright and Novelist)