

COMMENTARY

The COVID-19 pandemic: Is it a “Black Swan”? Some risk management challenges in common with chemical process safety

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As we write this commentary while under stay-at-home orders (two of us in the U.S., and the other in Germany), the number of individuals infected with the SARS-CoV-2 coronavirus has surpassed 1.6 million confirmed global cases and more than 95 000 fatalities. The pandemic continues to spread exponentially in all regions of the world. The trajectory and ultimate outcome of this pandemic is still unfolding but we can already be certain that the consequences to life and livelihood throughout the world will be enormous.

We have spent much time during our careers focused on efforts to prevent catastrophic process safety events, which are typically characterized as having both very high impact and very low probability/frequency. There are strong parallels between prevention of catastrophes in chemical process safety and prevention of catastrophic pandemics, beginning with the concepts of loss of containment/loss of control of hazards.

The steps for risk analysis and risk acceptance are similar. Those analyzing risks for either a pandemic or a process safety incident must envision/describe scenarios related to a specific hazard(s). Risk is a function of the magnitude of the impact and the likelihood of occurrence of the event. If the risk is deemed to be above the risk tolerance threshold, action is required to reduce the risk. Once scenarios (cause-consequence pairs) are developed, planners must decide which scenarios are credible events and further, which scenarios carry a risk. If the risk-tolerance threshold is exceeded, risk-based decisions must be made to implement appropriate safeguards including both (a) preventive safeguards to reduce the probability of a loss of containment/control incident and (b) mitigative safeguards to reduce the consequences should loss of containment/control occur.

The modern concept of Black Swan events was developed by Nassim Taleb in his 2007 book entitled *The Black Swan, The Impact of the Highly Improbable*¹. According to Taleb, a Black Swan event has

three attributes: “First, it is an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility. Second, it carries an extreme impact (unlike the bird). Third, despite its outlier status, human nature makes us concoct explanations after the fact, making it explainable and predictable.”

Application of the Black Swan concept to process safety was advanced in a 2012 article in *Process Safety Progress* entitled “Beware of the Black Swan: The Limitations of Risk Analysis for Predicting the Extreme Impact of Rare Process Safety Incidents”.² While there have been true Black Swan events in process safety in the history of the chemical process industries (CPI), there have also been many severe but rare events which were either foreseen or were predictable based on known science and experience. These identified/predictable events do not satisfy the first of Taleb's three qualifying criteria for a Black Swan—that nothing in the past can convincingly point to its possibility.

Since the publication of Taleb's popular book, the term Black Swan has come into much more common usage by risk management professionals and others—perhaps to the point of being misapplied and overused. In an award-winning Actuarial Society presentation, Werther acknowledged that when using current risk assessment and forecasting methods in the financial and insurance industries, there are true Black Swan events. However, he also asserts that some events widely perceived as Black Swans are being “wrongly labeled”. They were in his view predictable.³

Based on our experience in dealing with low-frequency (rare) high-impact scenarios in chemical process safety, we were asked our opinion as to whether the current COVID-19 pandemic should be classified as a Black Swan event.

Although the timing of its appearance and exact nature of this specific SARS-CoV-2 coronavirus had not been predicted, experts in infectious disease/public health protection have been warning us for

decades that a global pandemic involving a highly infectious respiratory disease virus was a plausible scenario.

In 1918, near the end of World War I, an influenza pandemic struck which claimed the lives of nearly 50 million people worldwide.⁴ The virus was highly infectious, and global transmission was facilitated by movement of large numbers of people between continents and regions (characteristics noted as similar to the current pandemic). A global study (conducted under the auspices of the U.S. National Academy of Medicine) was completed shortly before the 100-year commemoration of the 1918 pandemic.⁵ The study concluded that although there are enormous uncertainties in modeling the risks of infectious disease crises, the case for more action is compelling no matter how the risks are calculated. Since 2015, the business thought leader and philanthropist Bill Gates has also repeatedly made the argument for “a clear road map for a comprehensive pandemic preparedness and response system, because lives, in numbers too great to comprehend, depend on it.”⁶⁻⁸

Outbreaks of SARS (2002-2003) the “bird flu” H5NI virus (2003-2007), the “swine flu” H1N1 virus (2009), MERS (2012+), and Ebola (2013-2016) resulted in numerous studies which identified the need for improved global risk management systems/procedures and have recommended specific measures to rapidly detect, communicate, and control the threat of a pandemic. Modeling studies of global economic impact have also been done using virus pandemic scenarios with different degrees of virulence (disease severity) and infectiousness (ease of transmission).⁹ The models show significant economic impacts, driven by factors such as reduction in global tourism, workers staying at home to avoid infection, and supply chain interruptions as different regions are affected at different timings.

With multiple warnings from experts in epidemiology and related public health fields that a major pandemic is not a question of if, but only of when—the current pandemic cannot be viewed as a Black Swan. It does not meet Taleb's first criteria of “lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility”. The caveat is that the pandemic is still evolving and could take a surprise turn before it is finished. But if nothing appears which would satisfy Taleb's first criteria, then our conclusion would remain unchanged.

The obvious next question is that if it is not a Black Swan, why was not the world better prepared with more effective safeguards to rapidly detect/communicate and then rapidly respond to prevent widespread loss of containment/control?

Many studies will undoubtedly be done in coming years by both national governments and global organizations (eg, the World Health Organization¹⁰ under the United Nations) to try to answer these questions.

We believe that common findings of these future postmortems will be that:

- Experts in epidemiology/health risk analysis and economic impact analysis presented credible risk assessments, recommended proven safeguards to implement, described appropriate global, and regional preparedness planning/coordination approaches, and identified critical research needs to further improve preventive and mitigative safeguards.

- Experts were unable to convince final decision makers to establish the necessary public policy and/or to allocate adequate resources to global agencies and governments/to implement the above recommended actions and/or to sustain/maintain them.

Government leaders around the world with the power to authorize funds and to implement strong safeguards were not convinced that the risk of another pandemic like the Influenza pandemic of 1918 was sufficiently high to divert the required resources away from more immediate issues those governments faced in order to address prevention and mitigation of a pandemic, or were not convinced that the public would accept the cost of such safeguards.

This is also a familiar dilemma in the process safety world. Convincing final decision-makers on the importance/urgency to address risk scenarios which have very high impact, but which are perceived to be very low probability (infrequent events measured in once in a lifetime⁴) is never easy. It requires building strong technical and economic arguments, effectively communicating the basis for the assessment and the accuracy of the predictions, and building the technical competence and trust in the target audience required to process the information. This requires a great amount of preparation/effort in order to get commitment for the necessary capital and personnel.

This effort must be made. Key decision-makers must ensure that the voices of experts are heard. As we have repeatedly learned in our process safety world (and appear to be on course to similarly, and painfully, learn in the global public health world), the cost of preventive and mitigative safeguards to address in advance a predictable high impact event can be dwarfed by the ultimate impacts should such measures not be taken.

Perhaps it is fitting to close with the following quote, which can be applied at both a government level and at a corporate level.

We learn nothing from history except that we learn nothing from history.

Marcus Tullius Cicero, 106-43 BC

We wish all of you a safe transition through this pandemic.

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