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Disruptive Technology in the Context of Other Global Disruptions

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On this page: *The discussion of disruptive technology and its impacts on PPPs needs to be considered in the broader context of disruptions that have increased in recent years—and include unprecedented worldwide challenges such as climate change, natural disasters, economic disasters, and pandemics like the COVID-19 crisis.*

The discussion of disruptive technology and its impacts on PPPs needs to be considered in the broader context of disruptions that have increased in recent years—and include unprecedented worldwide challenges such as climate change, natural disasters, economic disasters, and pandemics like the COVID-19 crisis. Although the nature of disruptive events and disruptive technologies differ, there are also similarities regarding single disruptive events in terms of impacts, scope, and approaches that may be applied to respond to them.

What Are Disruptive Events?

For the purpose of this report “disruptive events” are uncertain events or conditions—economic, climate, and health-related shocks—that have the potential to cause material damage to an infrastructure asset or to disrupt its operations. These types of events are often also referred to as black swan events (extremely unlikely and unforeseen events with very large impacts). Disruptive events include natural and man-made disasters (such as conflict and war), and economic and financial crises. These unforeseeable events have the potential to disrupt economies and to have a disastrous impact on certain infrastructure sectors. In particular the pandemic has highlighted some of the vulnerabilities and risks associated with unforeseen disruptive events on long-term PPP contracts.

Selection of disruptive events, plus examples:

- **Natural hazards:** Natural hazards are naturally occurring physical phenomena. They can be:
  - Geophysical: a hazard originating from solid earth (such as earthquakes, landslides and volcanic activity)
  - Hydrological: caused by the occurrence, movement and distribution of water on earth (such as floods and avalanches)
  - Climatological: relating to the climate (such as droughts and wildfires)
  - Meteorological: relating to weather conditions (such as cyclones, tornados and storms).
- **Man-made hazards:** Events that are caused by humans and occur in or close to human settlements. They include industrial accidents, transport accidents, environmental degradation and pollution, contamination, and technological failures. Examples of man-made disasters are the Chernobyl nuclear meltdown in Ukraine, the Deepwater Horizon oil spill in the Gulf of Mexico, and the Bhopal gas tragedy in India.
- **Economic hazards:** Economic hazards are sudden and severe events that upset parts of the economy. Examples are excessive debt burdens that generate sovereign debt crises and/or liquidity crises (fiscal crisis) or the failure of major financial mechanisms or institutions, i.e., the collapse of a financial institution and/or malfunctioning of a financial system that impacts the global economy. Other economic hazards that can impact infrastructure are severe energy price increases or decreases, or unmanageable inflation.[1] An example is the financial crisis of 2008, which disrupted the global economy and significantly affected many other sectors of the economy, including manufacturing, construction, and transportation.
- **Biological hazards:** Biological hazards are a sub-group of natural hazards. They are caused by exposure to living organisms and their toxic substances or diseases they may carry (such as disease epidemics or pandemics; insect or animal plagues; parasites, bacteria and toxins). The transmission of biological hazards can cause great damage and loss of life, and can also lead to an economic crisis. A recent example is the COVID-19 pandemic that has interrupted global supply chains and caused economic and social disruption around the world.
- **Technological hazards:**[2] Technological hazards that qualify as disruptive events are large-scale cyber attacks or malware causing significant economic damage, or massive incidents of data fraud or theft. With the exponential pace of technological change, these risks have become increasingly significant for infrastructure. A breakdown of critical information infrastructure and networks (e.g., internet, satellites) causing widespread disruption would also qualify.

Comparison of disruptive events and disruptive technology

The rapidity of technological advancements in recent decades has increased the risk that disruptive changes will occur during the lifetime of a long-term PPP infrastructure project. The likeliness of both disruptive events and disruption caused by technological transformation has increased steadily in the last few decades, and both types have far-reaching consequences.

There are, however, clear differences between disruptive events and disruptive technologies in the context of infrastructure:

- The main difference is that disruptive events are usually viewed as negative events that should be avoided or mitigated (e.g., pandemics), whereas disruptive technology has the potential to transform infrastructure development and delivery, and to boost economic growth and private sector expansion. Disruptive technology is therefore generally viewed by governments and the private sector alike as

progress that is incentivized and aspired to.
- Another key difference is that unlike disruptive events, which generally come on suddenly, the effects of disruptive technologies tend to manifest themselves over time.29 Disruptive events can often be described as force majeure events, i.e., external shocks like earthquakes or wars, with drastic consequences that are beyond the control of both contractual parties and that make the performance of the contractual obligations of one party impossible.
- "Classic" disruptive events, such as floods or hurricanes, typically have regional impacts only, whereas technological disruption happens on a global scale.
- Unlike disruptive events, disruptive technology usually does not damage the physical infrastructure.
- Adequate responses to “classic” disruptive events are contingency plans and emergency strategies, whereas disruptive technology does not typically lead to an emergency situation.

Despite these differences there are, however, characteristics disruptive technologies share with specific disruptive events:

- In parallel to the challenges brought about by COVID-19, climate change, and economic disruptions, large-scale technological transitions create winners and losers. Technological change is at once a constant threat for one sector or project type, e.g., fossil fuel projects, and an opportunity for another, e.g., the renewable energy sector. Similarly, digitalization spurred by COVID-19 measures led to rapid growth in digital platform-based infrastructure services, such as online education or online health care services, while the demand for public transport was declining.
- Similar to some disruptive events, risks associated with disruptive technologies fall into two categories: On the one hand, they can trigger acute shocks that are difficult to foresee (e.g., black swan events like cyber attacks or natural disasters caused by extreme weather events). On the other hand, some causes of disruptive events, such as climate change or a deteriorating global economic environment that leads to a financial crisis, can build up gradually and cause “chronic stresses” that lead to long-term changes that are to some extent predictable.
- More and more disruptions—whether they are caused by external shocks and stresses or through technological advances—have not only a regional but also a global impact.
- Several typical consequences of disruptive events can also be viewed with regard to disruptive technologies. Though disruptive technologies do not usually cause physical damage to infrastructure assets, disruptive events and disruptive technologies alike can have severe long-term consequences that can be similar, including social unrest and disruptions in supply chains, demand, and economic activity.
- Actions that need to be taken to mitigate, prepare for, or prevent disruptive events go beyond emergency measures and contingency plans and include, for example, long-term climate change mitigation and adaptation measures, which may then themselves have the ability to transform infrastructure sectors over time.
- It is difficult to predict the occurrence as well as the impacts caused by disruptive events and disruptive technologies. Due to these uncertainties, risks associated with both types of disruptions cannot be fully assessed and allocated to the parties in a PPP contract. These risks are therefore typically not sufficiently reflected in the PPP contractual terms.
- Disruptive events and disruptive technology alike can change the contractual equilibrium during the term of a PPP infrastructure contract up to the point where an asset becomes useless (stranded asset).

Can lessons regarding disruptive events be applied to disruptive technology?

The growing number and intensity of disruptions caused by black swan events and their far-reaching consequences have started an ongoing discussion on how PPP frameworks can be strengthened to ensure that the causes for disastrous events are mitigated, and future projects are made more resilient to these shocks and stresses. Consequently, during the past decade case studies, in-depth analyses, and tools that deal with uncertainty in the framework of PPPs have been developed. In addition, consideration has gone into how to

address these challenges through proper risk allocation, contractual predictability and flexibility.[3]

Though the nature of disruptive events and disruptive technologies differs, useful guidance can be drawn from the global experience of the impact of disruptive events on PPPs; analysis of underlying issues, occurrence and impacts of risks and ways to address them; and tools that have been developed to deal with the growing number of disruptive events in the context of PPPs. The lessons learned and approaches discussed or taken with regard to specific disruptive events can therefore provide a useful basis for the development of guidelines aiming to enhance the resilience of PPP contracts and contract management in the context of the exponential pace of technology change. This report is therefore embedded in the broader discussion of disruptive events.

Footnote 1: Marsh & McLennan. 2020. 2020 Global Risks for Infrastructure: Appendix.

Footnote 2: These risks are also discussed as a sub-group of man-made hazards.

Footnote 3: See, for example The Climate Toolkits for Infrastructure PPPs (World Bank 2022). Links to other relevant resources related to PPPs, climate change and natural disasters are accessible through Climate-Smart PPPs: Further Reading and Resources on the Public-Private Partnership Resource Center. For detailed resources related to pandemics and epidemics and PPPs, see Covid- 19 & PPPs on the Public-Private Partnership Resource Center. Regarding financial crisis and PPPs, see The Effects of the Financial Crisis on Public- Private Partnerships (P. Burger, J. Tyson, I. Karpowicz, and M. Delgado Coelho, IMF 2009).

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