Challenges of Disruptive Technology

On this page: *Alongside the benefits, the rapid change enabled by disruptive technologies is also bringing new uncertainties. Read below on the key challenges of disruptive technology for PPP infrastructure projects.*

Alongside the benefits, the rapid change enabled by disruptive technologies is also bringing new uncertainties. New technology that makes decentralized distribution more attractive can lead to changes in demand on centralized energy projects; toll roads may require new traffic management technologies that lead to major efficiency gains but require high upfront costs; public transport schemes may become obsolete because of changes in technology that lead to advanced ride-sharing options. In addition, the exponential increase in data generated through new technologies such as AI and big data poses societal and technical challenges, including heightened cybersecurity risks and issues related to data privacy, protection, and confidentiality.[1]

Some of the key challenges of disruptive technology include:

(a) Technological Obsolescence:

One major risk that comes with disruptive technology is that infrastructure that is designed or built today—or is already operational—will become outdated or inadequate for the purpose of the service, or will not fulfill technological standards set by the contracting authority or other government agencies in the future. Due to the rise of disruptive technologies, there is considerable uncertainty about which technologies and business models have the potential to become dominant and which sectors they will impact the most. For long-term PPP projects, this means that there is an increasingly high risk that key assumptions will have to be readjusted over the lifetime of a project. Although disruptive technology provides opportunities for investors, new technology standards or “green” requirements that are set off by fast-paced technological development put long-term investors under constant pressure to innovate and upgrade infrastructure or risk a sharp decline in demand.

A sharp decline in demand resulting from changes in key assumptions can result in either increased costs or lower revenues for the private partner or the contracting authorities, respectively. User-fee concessions (including roads, airports, ports, ferries, parking garages, etc.) could be facing stress due to reduced demand, whereas availability fee-based projects may come under pressure as the public sector faces fiscal limitations.

Eventually the PPP project could even become economically unviable—or so unattractive that it could be considered a stranded asset. For example, the displacement of landlines by mobile technology may make the operation of landlines economically unviable; in light of the climate targets from the Paris Agreement and falling prices for renewable energy projects, infrastructure projects that use fossil fuels, such as coal, have already become less attractive and may become stranded assets in the future.[2]

Examples:

- Price drops in the renewable energy market in recent years have made existing long-term power purchase agreements (PPAs) (even those with renewable energy) seem overly expensive and

unattractive (see Box 1).
- Mobile technology displaces landlines, leaving investors of landlines stuck with obsolete infrastructure.
- Advances in battery storage technology lower demand for transmission networks.
- Increased digitalization reduces the need for commuting or business travel.
- Autonomous vehicles affect the way roads, refueling stations, and parking garages are used and supplant conventional vehicles, disrupting established infrastructure assets and supply chains.

Box 1: The Rise of Renewables

PPPs in the energy sector are commonly structured as an arrangement with a single-purpose independent power producer (IPP) to design, own, operate, and maintain a power plant, and then sell the power generated by the plant to an offtaker, typically a government agency or government-owned utility, in accordance with a power purchase agreement (PPA). The PPA is typically for a period of 15 to 25 years and can provide a fixed feed-in tariff for the duration of the term.

With rapid advances in renewable energy technology, such as solar photovoltaic (PV) modules, prices for renewable energy power are falling, and existing long-term PPAs that are based on fixed tariffs are becoming increasingly unattractive. In addition, new procurement mechanisms—such as auctions—have proven effective in using competitive forces to bring down procurement prices, and market players that can give consumers economically attractive choices will likely disrupt centralized electricity production going forward. In such circumstances, many countries prefer to end existing, fixed-tariff contracts that were signed when solar and wind project development costs were higher.

Examples globally abound. A task force in Kenya, formed to address concerns about the high cost of electricity, recently presented its report and recommendations to Kenya's president. One of the recommendations is the review and renegotiation of existing power purchase agreements. Several states in India are trying to renegotiate renewable energy PPAs. In France a finance law enacted at the end of 2020 provides for the renegotiation of the feed-in tariffs of approximately 800 solar PPAs concluded between 2006 and 2010. Other examples can be found in the case studies here.

A variation of this risk is that disruptive technology leads to a situation where certain equipment becomes inadequate for the purpose of the service or is required by new policies, legislation or standards. The implementation and subsequent changes in operation may require some up-front cost and make the project more expensive than expected. If these new design elements were not foreseen when the PPP contract was closed, their implementation may also require amendments to the performance indicators or other PPP contractual provisions.

Examples:

- Technology may become available for fiber optic projects that do not fit exactly with project specifications but are more efficient.
- New technologies become common practice for high speed trains, requiring the operators of the high speed rail network to upgrade the entire system.
- Because autonomous vehicles rely to a large degree on sensing technology, existing roads, tunnels and bridges may need to be upgraded as more autonomous passenger vehicles and trucks enter the market.

(b) Decentralization:

One general effect is that disruptive technology has a tendency to allow for more decentralization of infrastructure services. This decentralization makes it possible to get around large- scale infrastructure

providers and networks and buy the services directly, thus decreasing demand for centralized infrastructure.

Examples:

- Availability of autonomous vehicles and ride sharing can decrease the demand for urban transport services.
- Decentralization in the energy sector. For example, rooftop solar systems with net meters not only allow consumers to generate their own electricity instead of buying it from the utility but actually enable the excess power to be fed back into the grid, thus decreasing demand for electricity produced by centralized power utilities and impacting their revenues and financial sustainability.

(c) Cyber Attacks:

Digitalization and data availability also increase the risk of cyber crimes. As infrastructure increasingly interconnects through the internet of things (IoT)—which enables services related to smart buildings, autonomous vehicles, and smart transit systems—cybersecurity risks become more of a threat for infrastructure than in the past. Large scale cyber attacks or the breakdown of critical information networks or systems can: impact the delivery or operation of infrastructure assets; interrupt relevant supply chains; and prevent potential infrastructure users from gaining access. Such attacks and breakdowns can thus lead to construction or infrastructure service delays or changes in demand.

(d) Data Theft:

With increased data exchange that is accessible for several parties, there is also a growing risk of massive data fraud or theft of private or official data. Personal or official data may be sold to third parties. Infrastructure can become a target for sophisticated organized crime organizations looking to extract sensitive information. Apart from the financial implications, projects may need to implement new legislation, policies, and regulations related data privacy during the course of the PPP project.

(e) Economic and Social Disruption:

Some technologies also create broader economic and social risks as whole sectors are disrupted. Disruptive innovation could, for instance, lead to massive changes in the job market if human skills and talents are increasingly replaced with technology, or if new technologies replace old ones, requiring different skillsets or labor forces. Government policy or decisions to implement social standards to prevent adverse social effects of new technology (e.g., education and training for workers whose jobs could be made redundant) may also have cost implications for PPP projects in the long term. At the same time, it will be critical for industry to plan ahead by investing in education and training for these workers.[3]

Box 2: Coal Project Decommissioning and the Just Transition for All Framework

The World Bank has developed a Just Transition for All methodology that ensures that coal workers and communities are not lost within an energy transition and irreparably burdened with social and environmental legacy issues. This methodology, as narrowly applied to coal within the energy sector, (i) strengthens policies, regulations, institutional governance, and inclusive growth processes; (ii) ensures that workers and communities in coal regions are not left behind; (iii) properly closes coal mines and thermal power units to mitigate contributing further to public and climate risks; (iv) ensures adequate environmental remediation for repurposing of lands and infrastructure assets; and (v) strategically leverages public sector investments to attract private investors to sustain regional transformation.

Source: World Bank. "Just Transition for All: The World Bank Group's Support to Countries Transitioning Away from Coal."

Footnote 1: G20 Infrastructure Working Group. 2020. "G20 Riyadh InfraTech Agenda, Background." Risks and challenges of InfraTech are also described in more detail in Infratech Value Drivers (World Bank Group 2020).

Footnote 2: According to the International Energy Agency's (IEA) Renewable Energy Market Update " Challenges and opportunities beyond 2021" (last visited September 13, 2022), the cost of electricity from onshore wind and solar PV is increasingly cheaper than from new and some existing fossil fuel plants.

Footnote 3: Pellen, Adrian. 2017. "Disruptive Technology Brings Risk and Opportunity to Infrastructure Projects." Marsh McLennan BRINK, August 14, 2017.

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