The World Bank Group

Incorporating Climate Risk in PBC

Contracting Recommendations

Task 5 Report

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1 Executive Summary

Climate change has negative implications for infrastructure and transportation investments, especially within performance-based contracting (PBC) and Output and Performance – based Roadway Contracts (OPRC) due to their performance requirements. In order to effectively protect these important investments in World Bank client countries, it is necessary to accurately predict and value climate impacts. then integrate adaptation measures that will reduce collective risk into the contracting terms.

PBC projects face a number of pressing climate related issues based on the status quo contracting arrangements and terms which assume a static climate.

1. Climate change presents serious challenges to operations and maintenance and long-term viability of roadway assets
2. Climate risk is difficult to identify, quantify and predict since historic data does not reliably represent future climate
3. By not sufficiently accounting for climate change, the economic and social benefits of projects are not fully realized

Managing these uncertainties is key to development successful, resilient roadways through the PBC model. Further understanding these critical points allows for reallocation of risk to the stakeholder parties best suited for handling the impacts.

Key Themes

The stakeholder parties, including roadway asset owners, contractors, roadway operators, infrastructure development banks and insurance providers, present unique views on climate risk ownership but agree on key themes around risk understanding. Table 1 highlights these key themes and challenges identified as part of this study.

Risk Identification

- Why are current procurements are based on outdated data?
- How do we prepare for the uncertainty of climate?
- What time horizon should we plan for?

Risk Valuation

- What factors will drive adaptation?
- What is the Return on Investment of climate adaptation?
- What Performance Indicators measure resilience?

Risk Allocation

- How is resilience incorporated into contracts?
- Who should own climate related risk?
- What are the implications of Force Majeure terminology?

Table 1 Key Themes for Integrating Climate Change in PBCs

Understanding Climate Change Risk associated with Roadway Assets

In order to address these questions, the World Bank and its partners have considered the most relevant factors that play into risk quantification and mitigation. This includes:

1. Criticality and Vulnerability of the roadway assets, based on unique usage, design and conditions
2. Projected exposure to climate change related threats, based on location and life expectance of the asset
3. The potential fiscal value of the risks, based on if they result in increased repair costs, elevated operations activities and amplified performance deductions.
4. Mechanisms to mitigate the uncertainty of climate change risk, based on contractual language clarification, risk allocation and asset management.

The evaluation process will integrate asset specific data with publically available information to understand potential consequences of climate threat.

Recommendations

While understanding threat exposure is part of the resilience process, it will not eliminate the increasing costs related to climate change. In order to effectively reduce the investment risk associated with roadway assets, the international development industry will need to also incorporate the following measures into PBC programs:

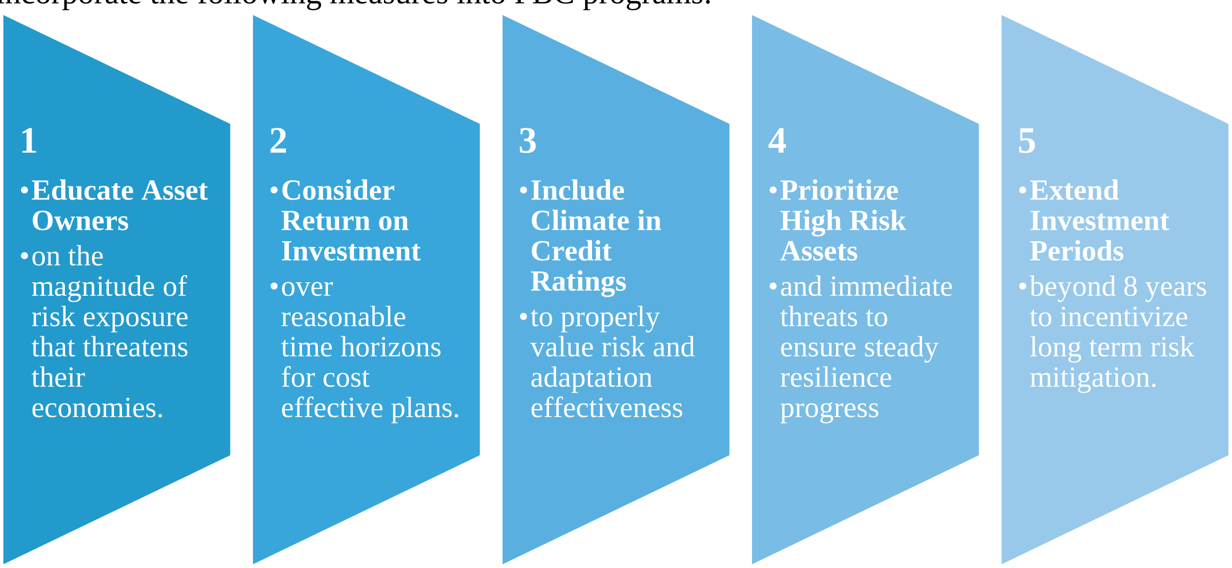


Figure 1 PBC Recommendations

2 Project Overview

Climate change and extreme weather events have increasingly significant impacts on the transport sector. Climate change threatens the ability of road networks to remain passable and connected, two functions that are highly critical in low-density areas with limited access to alternate transportation routes. However, the costs associated with maintaining operability of these roadways in the face of intensifying climate events are rising, heavily impacting the operations and maintenance (O&M) budgets of roadway operators. This is becoming increasingly unaffordable for public agencies and those private contractors who do not adequately understand the implications of climate change and therefore, do not have the appropriate mechanisms to assess the risks and properly forecast costs.

Incorporating climate change considerations into performance-based contracting (PBC) efforts is a particularly unique challenge. PBC explicitly links payment to performance of assets. For successful PBCs, all project risks should be appropriately: identified, valued, and allocated between the owner and contractor. If too much risk is shifted to the contractor, costs may increase and the performance may be compromised, which places the PBC at risk of failure. If too much risk remains with the owner, the PBC will not result in the expected savings or improved efficiencies and may, in fact, be less appropriate than other contracting models.

This analysis seeks to accomplish the stated objectives by developing a risk assessment framework that will allow the client country to properly assess the risks and impacts of climate change and assign these risks to the party best able to manage those risks, within the PBC strategy. Part of this work includes the development of performance metrics for the incorporation of climate risk considerations into PBC project design and development as well as suggested amendments to the World Bank's sample bidding documents.

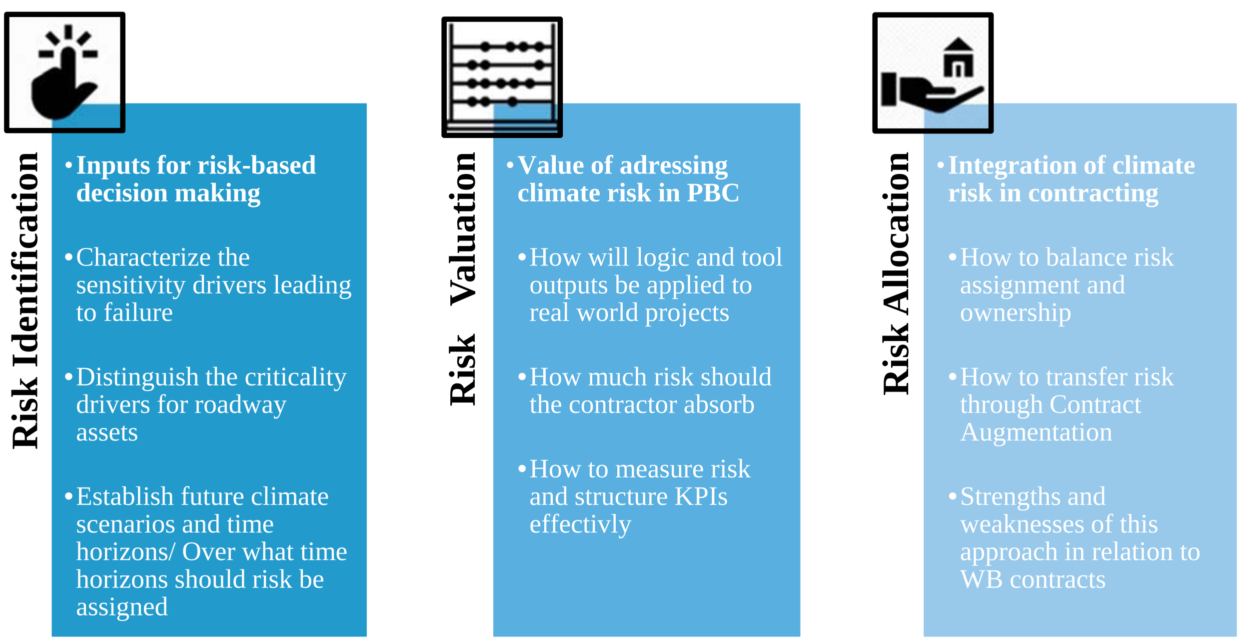


Figure 2 Project Objectives

3 State of the Industry

3.1 Published Literature

The World Bank has conducted extensive background research to understand the current state of the industry and the existing appetite for reduced climate exposure through risk mitigation and shifting the allocation of risk. The review process included evaluation of standards in both 'mature' countries who are already implementing PBCs and developing countries who are seeking mechanisms to accelerate infrastructure delivery. The project team reviewed published literature and conducted interviews with a range of industry specialists around the globe to understand the specific methodologies for addressing climate change. Specifically, the background research included the following:

- Appraisal of industry Risk Assessment Guidelines to understand current best practices for climate impact assessment
- Evaluation of global roadway Design Standards to determine current climate consideration

For detailed on the literature review, refer to Appendix A and the Task 2 report *State of the Industry Literature Review*.

3.2 Stakeholder Engagement

To explore key trends of the published industry literature, the World Bank collected a diverse range of perspectives from representatives of governments and funding agencies as well as specialists in the fields of PBC, insurance and climate change adaptation around the globe. These perspectives help us to understand the obstacles faced by this emerging industry (See **Figure 3 Stakeholder Input**).

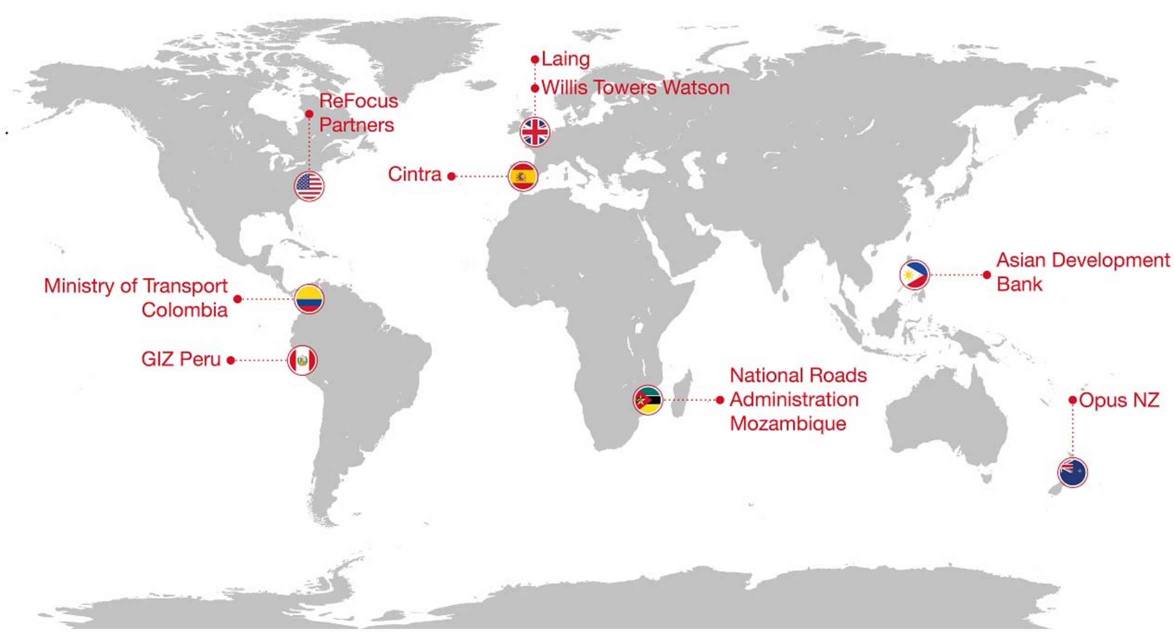


Figure 3 Stakeholder Input

Stakeholder Challenges

The World Bank aims to utilize this feedback to identify opportunities that will incentivize resilient design, construction, operation and maintenance practices within PBC, and ultimately lead to reduced investment risk for asset owners and investors.

Each of the parties involved in a PBC faces unique threats and carries a distinct ability to mitigate the risk of these threats. To this end, the project team compiled the most pressing issues identified by owners, contractors, funders, and other stakeholders during each phase of development, as detailed in Table 2.

Party	Challenges
Owners/ Client Countries	When the contingency budgets for storm repairs, increased drainage maintenance and unforeseen conditions have been exceeded, the regional governments and asset owners are hit with additional service requests
	Threats posed by offsite causes such as poor land use planning, agriculture and logging are hard to manage
	Budgeting encourages prioritization of immediate flooding and drought concerns over undetermined future threats
Contractors/ Developers	The costs associated with recovering from climate shocks and stressors will impact project profit
	Uncertainty around climate risk could dissuade contractors from bidding on PBC and/or lead to increases in price to buffer the climate risk contingency
	Competitive bid environments encourage optimistic operations and maintenance cost estimation without third party review
Funding partners /The WBG	Duration of investment terms are only 5 years which controls contract lengths and does not encourage long term planning by any party
	Contractual language should be augmented to incentivize resilience planning by contractors
	The definition of force majeure will likely need to evolve with respect to climate change
Communities	Local involvement in project development, execution and transition of ownership is vital to ensuring the ongoing feasibility of investments.
	Project evaluation should consider economic impact of roadway on local community from both the positive perspective of increased commerce and the negative perspective of business continuity downtime associated with reduced availability.
Insurers	As providers increasingly experience claims as a result of intensifying climatic events, they will need to balance these with higher premiums.
	Many countries without insurance markets lack coverage and are forced to self-insure with rainy day funds or turn to government bailout options.

Table 2 Key Stakeholder Challenges

Project Development Challenges

Through this stakeholder engagement process, the research team has also identified the primary challenges associated with each phase of the implementation process for PBCs. These are detailed in Table 3 Stakeholder Challenges

Many issues around climate risk arise after it is too late to make changes to designs or contracts so costs and performance are the only two factors that can still be adjusted. Identifying these key issues as they occur in the procurement process will assist in successfully addressing issues at the correct point in the project process.

Asset Lifecycle	Challenges	Responsible Party
Systems Planning	Lack of clear understanding of risk exposure now and in the future	Owners
Tender	Lack of connection between Climate Risk and Credit Ratings	Funding Partners
Engineering and Design	Lack of appropriate standards to encourage adaptation measures	Owners
Construction	Cost of bidding additional products and materials used to mitigate risks	Contractors
Operations and Maintenance	Inaccurate estimation of maintenance and adaptation costs	Contractors

Table 3 Project Implementation Challenges

3.3 Key Themes

Based on the knowledge gained through the stakeholder interviews and literature review, the research team has identified three key themes that appear to compound the negative impacts of climate change in t roadway contracts:

1. **Poor Risk Identification:** Climate data is out of date and future projections are variable over investment periods.
2. **Inaccurate Risk Valuation:** Vulnerability assessment of projects does not typically consider the economic and social impact of asset availability.
3. **Ineffective Risk Allocation:** Risk ownership is not aligned with responsibility and unknown exposure discourages investment.

Properly addressing these key themes should aid in better incorporating climate adaptation into PBC roadway projects going forward. The following pages provide a step by step process for holistically considering climate risk to ensure that each challenge is addressed by the stakeholders best able to effect change.

4 Risk Identification

4.1 Route Criticality

Understanding Assets

In order to develop reasonable resilience objectives for a roadway PBC, it is essential to understand what functions the roadway serves and for how long these functions can be down before, the country or community is negatively affected. Negative impacts may include human safety, economics or social wellbeing.

Roadways may connect major economic centers, provide critical trade routes or serve as daily commute pathways. They may also be primary evacuation routes, lifelines to hospitals or even the route for emergency services. In addition to their purpose of travel, many roadways carry critical infrastructure such as electricity, communications and water. Performance objectives of roadways should be linked to the functions that they serve.

1. **Vital –** Loss or damage of the roadway would have grave consequences, such as loss of life, severe injuries, loss of primary services, or major loss of core economic functions.
2. **Major –** Loss or damage of the road would have moderate to serious consequences, such as injuries or impairment of core functions and processes.
3. **Important –** Loss or damage of the roadway would have moderate consequences, such as minor injuries or minor impairment of core functions and processes.
4. **Minor –** Rural and does not connect people or critical services or infrastructure

The criticality assessment used in this work is based on the criticality scale developed as part of New Zealand's One Road Network Criteria (ONRC) review performed for the World Bank and detailed in Table 4.

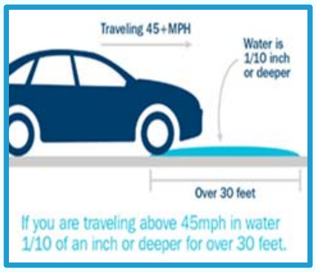
Table 4 ORNC Criticality Scale

Criticality Scale	Description
Criticality 1 (Vital)	A vital route or section of road whose failure would have a nationally significant economic or social impact, or is a nationally significant lifeline, ensuring access or continuity of supply of essential services during an unforeseen event.
Criticality 2 (Major)	A major route or section of road whose failure would have a significant economic or social impact to more than one region, or is a regionally significant lifeline, ensuring access or continuity of supply of essential services during an unforeseen event.
Criticality 3 (Important)	An important route or section of road whose failure would have a significant economic or social impact to a region, or is a significant lifeline, ensuring access or continuity of supply of essential services during an unforeseen event.
Criticality 4 (Minor)	A minorl route or section of road whose failure would have a serious local economic or social impact, or is a locally important lifeline, ensuing access or continuity of supply of essential services during an unforeseen event.

4.2 Physical Vulnerability

Design Standards

Standards traditionally set an expectation of what level of exposure is acceptable. They also specify what degree of robustness an asset should be in order to meet the objective of providing safety, up to a defined limit. The assumption has always been that the 50 and 100-year storm events were a reasonable limit to this this protection because they posed a rare threat. Unfortunately, standards reflect historic climate probability and assets designed to meet these standards will not perform as desired under a changed future condition.



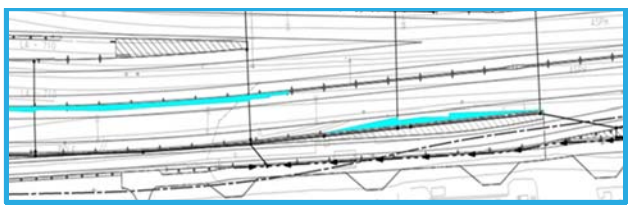
Hydroplaning occures in surface water based on vehicle speed

Surface water that is not coolected in draiange network may cross roadway

Resposible design engineering requires mitigation of this hazard

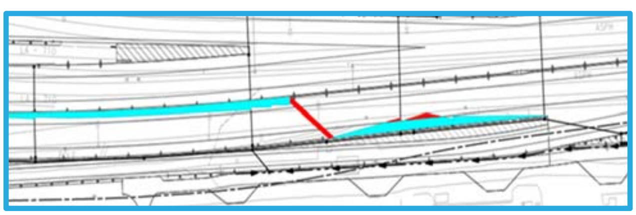
Figure 4 Hydroplaning Case Study

Existing design standards aim to prevent surface water in the travel path of a roadway that may induce hydroplaning. The case study shows how existing standards do not meet this objective.



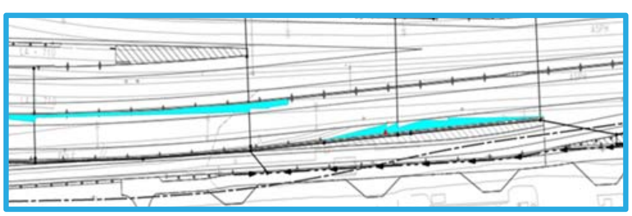
Design Standard: 50 year storm

- Overland flow pattern should meet code minimum with:
- Gutter flow remaining within the shoulder and
- No crossover flow at grade flip points



Flow Model: RCP8.5 in 2090-50th%

- 3.6-ft outer shoulder exceedance into first lane (30% of Lane 1) and
- 0.33 cfs crossover flow at grade flip (230% exceedance)



Design Adaptation: Add New Inlet

- Design Specification to include projected storms
- 50 year storm data to show higher IDF in 2090
- Performance Requirement to state no cross flow

4.3 Climate Exposure

Current climate data is based on past events and greatly underestimates the current and future risks associated with extreme weather events (shocks) and longer- term shifts in climate (stresses). To what degree, is still uncertain but we are already experiencing change. This lack of certainty introduces additional risk into PBCs, as stakeholders are faced with trying to adequately cover that cost within the longer-term maintenance and operational considerations. In addition, the contractors do not necessarily have the required expertise to make these projections and may not even have the proper resources in determining the appropriate models, emission scenarios and/or time horizons to use. Because of this, it is recommended that asset owners assign those parameters early on in the project, dependent on the overall importance of the route.

Planning Horizons

The planning horizon should be based on the lifecycle of both the roadway and the investment. Additional considerations should be made for the risk appetite of the client country and the financial institutions funding the project. This planning horizon will determine the future time period for climate data. The longer the planning horizon, the more expensive the mitigation actions are likely to be, because the climate risks are higher. Therefore, the planning horizon should also take into consideration the cost implications of the chosen time period.

Climate Modeling

All PBC projects should be required to assess the potential impacts from precipitation and temperature changes; however, considerations for winter storms and coastal flooding will also need to be evaluated based on the project location and the relevance of those potential impacts to the site. This determination can be made based on GPS location, local knowledge of the site and historic climate impacts. Both the planning horizons and the applicable climate impacts should be determined by the client country prior to releasing the bidding documents.

In addition to setting a planning horizon and RCP model based on that information, the relevant climate factors will need to be determined for each roadway location, including:

- Precipitation (rainfall, runoff, flooding, drought)
- Temperature (extreme heat, extreme cold)
- Ice / Snow (winter storms)
- Sea Level Rise and Storm Surge (coastal flooding and storms)

Figure 5 shows an example of how the intensity of a 5-year rainfall event is projected to change between the 5th, 50th, and 95th percentiles for the RCP8.5 emissions scenario in the year 2090.

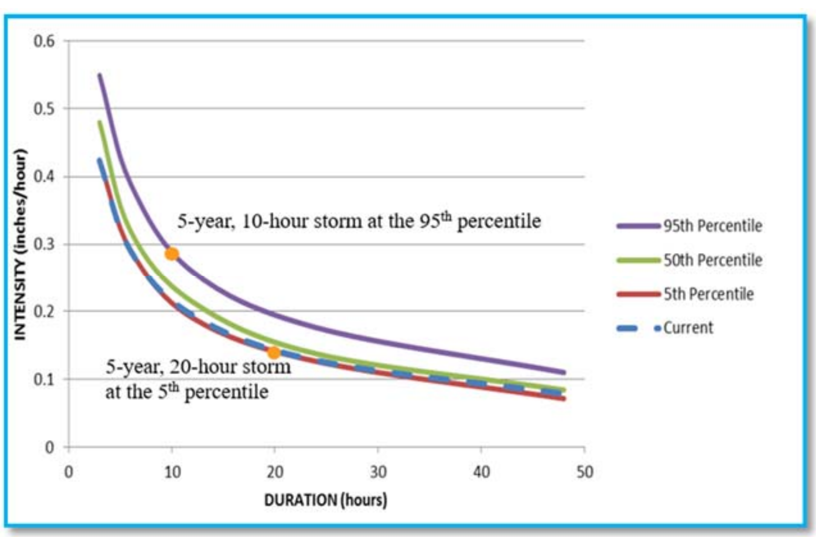


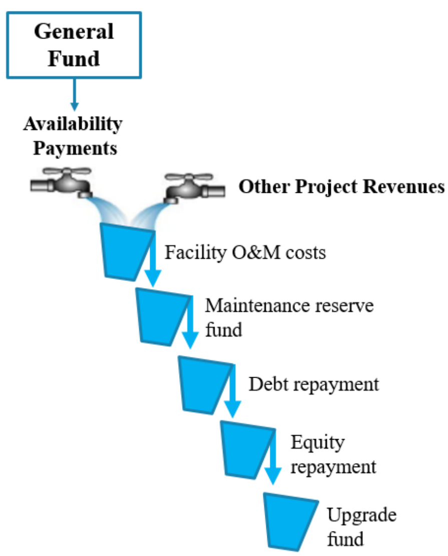
Figure 5 Adjusted IDF Curve

5 Risk Valuation

Climate change and extreme weather are only one of the many risks facing PBC contracts. These risks vary in both scale and level of control over mitigating those risks. In order to mitigate all of these project risks, asset owners typically set performance standards for each project. These performance standards dictate the expected performance objectives of the roadway. Performance standards must be distinct, measurable objectives, so the owner can determine if the roadway meets the desired performance of the contract. The performance standards are normally assessed through use of established Key Performance Indicators (KPIs) that demonstrate how effectively the roadway is meeting the designated contract objectives.

Payment Deductions and O&M Costs

If the roadway does not meet the designated contractual standards, availability payments may be subject to deductions associated with those shortfalls. As a result, increasing costs related to climate change will impact the financial viability of contracts by both increasing O&M costs associated climate impacts to the roadway and decreasing availability payments due to climate impacts inhibiting the ability of the roadway to comply with the KPIs. The structure of the availability payments is detailed in **Figure 6 Availability Payment Structure** and the financial implications of climate impacts on PBC contracts are displayed **in Figure 7 Impact of Climate Risks on PBC Cash Flow**.



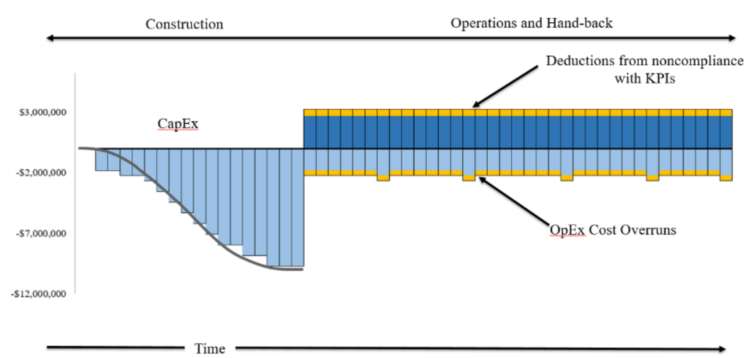


Figure 6 Availability Payment Structure   Figure 7 Impact of Climate Risks on PBC Cash Flow

Under the World Bank's Output- and Performance-based Road Contracts (OPRC) guidelines and Sample Specifications, the emphasis is placed on outcomes not inputs. The contractor is afforded significant flexibility in how those outcomes are achieved. It requires that these contractors have not only technical design expertise, but also strong management and financial experience as well. The emphasis on outputs over a set period of time means that the contractor must adequately account for potential risks, evolving circumstances and foreseeable changes.

5.1 Key Performance Indicators

Since KPIs measure performance, no significant change should be made to either the metrics that are currently used for roadway operation or the metrics used to assess how well a particular roadway is holding up. The metrics to measure performance remain the same – what changes is the requirement that those metrics are expected to be met in the midst of climate risk. The contracting process should explicitly state that climate risk is included as part of the design considerations and the client country would indicate the projected values for precipitation, sea level rise, temperature, wind and other considerations based on the process outlined in Section 3.

If the contractor does not meet the performance standards and comply with the KPIs, relief will not be afforded through Force Majeure. This strategy should be coupled with ideas around contract augmentation presented in the following Section 6 – Risk Allocation. All of the criteria listed in Table 5 are currently used to assess roadway performance and will be directly impacted by climate change.

Physical KPIs	**Unit of Measurement**		
Flooding	Depth	**Debris Damage**	Quantity
Erosion	Volume	**Wall/tunnel damage (increased accidents)**	Length
Scour	Area	**Mechanical failure (increased pumping)**	Quantity
Pavement cracking/potholes	Area	**Salt damage (from snow treatment)**	Area
Asphalt wear	Roughness	**Snow plow damage**	Area
Drainage network damage	Blockage	**Electrical failure**	Quantity
Metal corrosion	Area	**Camera failures**	Quantity
Landscape damage	Area	**IT failures**	Quantity
Embankment failure	Length	**Street Light deterioration**	Quantity
Fire damage	Area	**Paint peeling**	Area
Railing failure	Length	**Paint melting**	Area
Operational KPIs	**Unit of Measurement**		
Accidents	Quantity	**Accessibility**	
Level of service	Rating	**Sun exposure/ Heat exhaustion**	People
Travel time	Minutes	**Capacity (change due usage type)**	Vehicles
Availability	Days	**Demand (change due to lifestyle changes)**	Vehicles
Delay Volume	Hours	**Snow removal time**	Minutes

Table 5 Standard KPIs impacted by Climate

As the program advances, there could be ways in which these metrics could be further modified to have a greater focus on climate. For example, there could be additional weightings, greater clarification about assumptions when proxies are used, better data collection and analysis techniques and standardization of practices across countries. Adherence to them would be further incentivized if the force majeure clause was modified in a way that would reduce what currently qualify as “unforeseen” events (and the associated Emergency Work reimbursements).

5.2 Maintenance Costs

More frequent and intense climatic events increase Operation and Maintenance costs over time due to more regular repairs and amplified ongoing wear and tear. Statistics show that there are also increases to operational staff hours due to the labor required to replace failed sections, repair damaged asset components and clean debris. In some cases, this may also include extra equipment that would not otherwise be required, or would be required for less days out of the year.

The cost to repeatedly repair many of these assets, exceeds the cost of building stronger, more resilient assets the first time around, but these ongoing costs are rarely calculated upfront in the bidding process. Leveraging the percent of assets expected to be damaged combined with the typical labor and material costs in the region can provide valuable insight into more realistic maintenance costs over the course of a project lifecycle.

Return on Investment

At the project-specific level, the most persuasive and broadly accepted arguments for integrating climate change considerations are based on the economics of resilience. This can include a valuation based on the return on investment (ROI) associated with decreased maintenance costs and less overall downtime or the value associated with structuring projects to make them attractive to funding and financing by third party entities (e.g., climate bonds).

As shown in Figure 8, climate impacts can result in significant increases in lifecycles costs of pavement maintenance cycles. Credit rating agencies now require OM providers to perform Realistic Outside Cost (ROC) analysis to understand possible risk exposures during the contract period. Analysis shows that 10-year pavement rehabilitation schedules are shortening to 7 years with the impact of increased climate. This is driving costs up on the order of 30-40%.

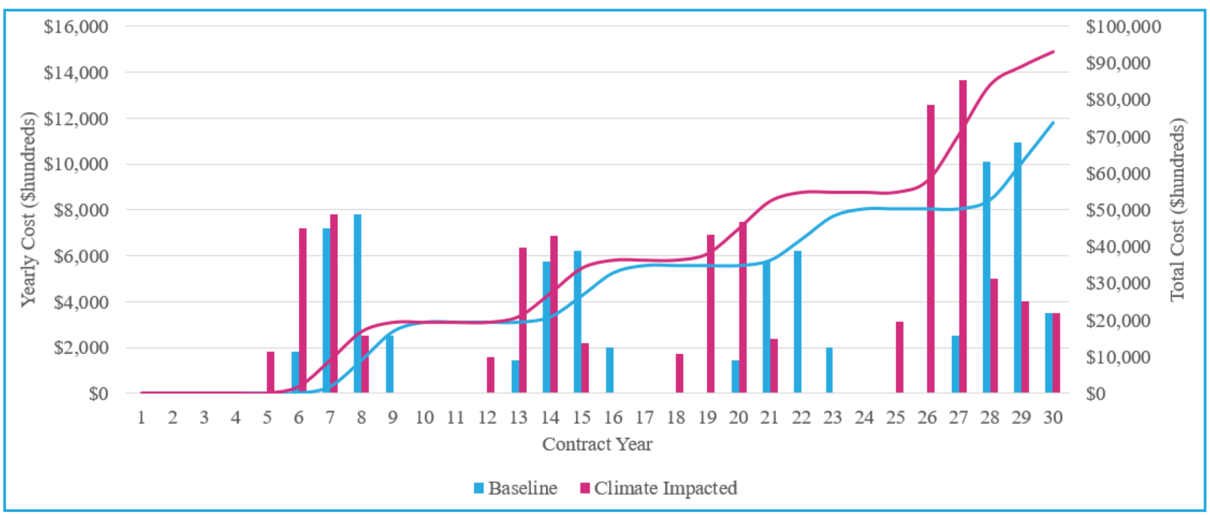


Figure 8 Climate Impacts on Costs of Pavement Maintenance

5.3 Value Capture

The infrastructure development industry consistently undervalues investment in resilience because it cannot be appreciated until an event occurs or a chronic stress persists for some time. Fortunately, there are many studies available that show investment in resilience has real value and can paid back over time, if that added value is properly captured.

For roadway contracts, value capture can be driven through availability payments that require high degrees of performance and detailed asset management planning. Tracking cost overruns should encourage both asset owners and contractors to improve resilience in the systems planning phase.

One of the fundamental challenges in the economic valuation approach is the current disconnect between the time horizons. The investment community's typical expected return on investment (3-5 years for private equity; 10-30 years for development banks) and the actual life expectancy of the transportation asset (50-75 years) means that the investment in resilience is chronically undervalued for these projects. There have been some recent attempts to solve for this disconnect through resilience bonds (although these projections still rely heavily on past events to inform overall risk) and Goldman Sachs' recent issuance of a century bond for DC Water in Washington, DC. Additional strategies for reducing climate risk and developing more effective value capture strategies for the various stakeholders is detailed in Table 6 Incorporating Risk Mitigation and Value Capture into PBC.

Stakeholder	Traditional Risk Mitigation	Expanded Risk Mitigation	Value Capture Methodology
Client Country or Asset Owner	Issue Design Standards	Offer Performance Incentives	**Set stringent Availability based payments**
Development Bank or Funding Partner	Require Loan Repayment	Reduce Interest Rates	**Offer Improved Credit Rating for Protected Assets**
Construction Contractor	Contractual Transfer	Require Business continuity management plan	
Operations Contractor	Purchase Insurance	Harden Assets	**Increase Asset Robustness**
Private Insurer	Set Liability Limitation	Offer Premium Discounts	**Risk Reduction**
Disaster Fund or National Government	Accept	Offer Hazard Mitigation incentives	**Expand Incentives for Regional Protection**
Community	Locally Funded	Invest in Maintenance	**Land Value**

Table 6 Incorporating Risk Mitigation and Value Capture into PBCs

6 Risk Allocation

Each stakeholder involved in a roadway contract is driven by a unique set of objectives that do not necessarily align. Some of the key challenges with PBC include the development of robust, agreed-upon metrics that can be standardized, easily quantified and measured. There is also a degree of predictability required to allow both the owner and contractor to accurately forecast the overall risk across a given period of time. Aspects such as climate change, which introduce uncertainty into this equation, often present a challenge for forecasting risk.

However, the issue is larger than just the uncertainty of climate risk; it also involves the overall transparency, ownership and transfer of risk (both intentional and unintentional) throughout the project's lifespan.

Transfer of Risk

It is not advisable that the client country transfer all of this risk to the contractor. Rather, the recommended approach would be for the owner to be more transparent in identifying that climate risk and defining design and maintenance considerations for its inclusion in the larger OPRC. In each following phase, the risks should be managed by party best able to address that risk.

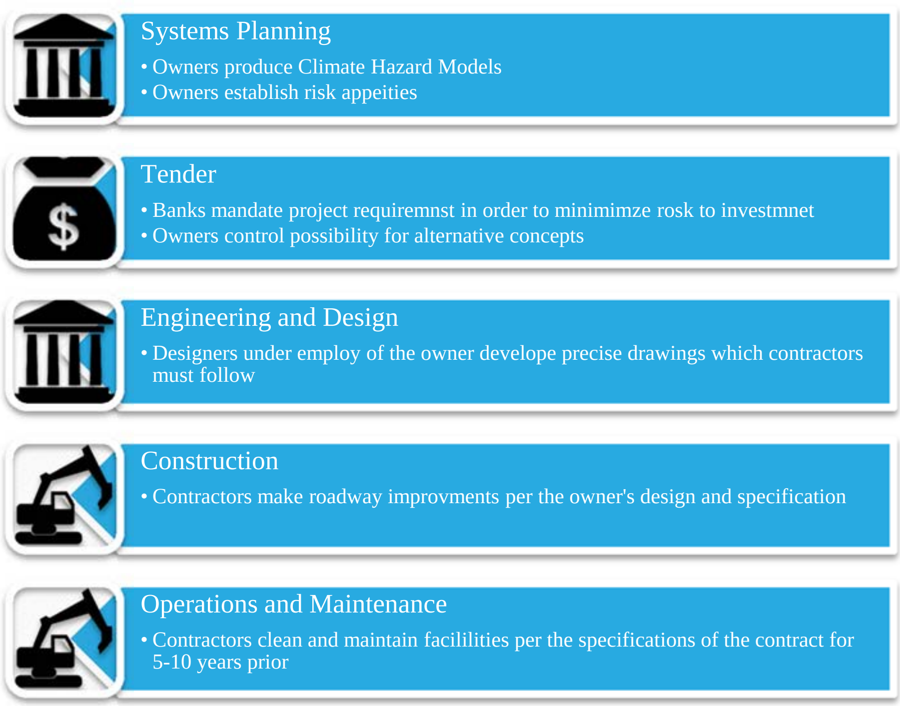


Figure 9 Risk Ownership

Adopting this approach, is an equitable sharing of risk reduction between the client country and the contractor. The client country has the responsibility for determining the overall criticality of the roadway and assigning the appropriate climate projections for design based on these inputs. This information is made available to the potential bidders in the initial Terms of Reference (TOR). That risk is then transferred to the contractors as another consideration that must be accounted for in the overall design and ultimate performance of the project.

6.1 Contractual Language

Risk allocation within operations contracts is currently toggled between contractors and client countries solely through the use of Force Majeure and Unforeseen Conditions terminology. The definition of Extreme Events and Force Majeure encompasses anything that currently disturbs the construction process and operations of an asset. As a result, there is a complete lack of accounting for weather and climate events that are likely to occur, but have uncertainty around the specifics of the frequency and intensity of the anticipated event.

Force Majeure

The Force Majeure clause, which triggers Emergency Works reimbursement, should be revisited in light of ongoing climate risk. The concept of quantifying the definition of what is actually Force Majeure may enable separation between standard climate considerations and the increasing severity of weather events.

If the World Bank revisits its definition of Force Majeure within the context of climate change and defines thresholds for types of failures, it will underwrite that link back to assumed design modifications. However, there will need to be sensitivity with redefining Force Majeure, as the redefinition will result in a transfer of risk and will likely result in decreased interest from contractors in bidding on PBC contracts if the contractor's increased risk ownership is too high. The definition of Force Majeure must strike the right balance in sharing climate risk between owners and contractors.

Ambiguous Language

Event of Force Majeure	Unforeseen Condition	Storm Event	Reasonable Expectation
Means an event beyond the control of the Authority and the Operator, which prevents a Party from complying with any of its obligations under this Contract, including but not limited to: act of God (such as, but not limited to, fires, explosions, earthquakes, drought, tidal waves and floods).	Unanticipated or unexpected circumstance or situation that affects the final price and/or completion time of a contract or project.	The occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce; Rare, unusual, weather phenomena that generate media attention, such as snow flurries in a coastal area;	Doctrine is a principle applied in insurance law which states whenever there is an ambiguity in an insurance-policy, it is resolved in favor of the insured's reasonable expectations. Usually an ambiguity arises when there are plausible, competing interpretations of a policy term.

Without explicitly stated expectations around climate risk, it is likely that neither the bidder nor the bid evaluators will adequately address that risk. It also becomes very difficult to hold the bidders accountable for criteria that are not specifically cited or linked with specific performance criteria. Currently, nearly all of the climate-related risk (and *all* of the risk associated with extreme events and future climate change) sits with the client countries. Extreme events are categorized as "unforeseen" and "imponderable" acts which will trigger the Emergency Works clause. This clause allows for the vendor to ask for additional remuneration from the Bank to cover the damages and loss of service associated with these events.

6.2 Contract Augmentation

With the advances in climate science and the documented trend towards an increase in the frequency and severity of extreme weather events, the World Bank faces the possibility of significantly eroding its investment capacity because of the increased need for disaster response and recovery efforts. Left unchecked, this could significantly impact the Bank's ability to invest in (i) routine rehabilitation needs of roadways, (ii) improvement to those roadways and (iii) development of new segments of roadways in new geographies.

A number of the open climate related risks could be reduced through amending the current bidding documents. There are three main areas where changes should be incorporated:

1. Require that key project personnel include **subject matter experts** with expertise in contingency planning, climate risk and resilience.
2. Provide **climate data as required inputs** into the design, rehabilitation and maintenance considerations and using that data to propose unit cost for rehabilitation, improvement emergency. For example, bidders would be advised to design roadways and maintenance strategies that would allow for a continuous level of service during what will become the 1 in 100 year flooding event under climate change.
3. Utilize **performance metrics** that take into account changing climate. The *Risk Management Framework* highlights specific areas within the OPRC bidding documents where the evaluation criteria, requirements and narrative could be amended to include a more explicit and proactive inclusion of climate resilience within transportation projects.

More specifically, contract amendments related to climate change exposure and risk should include language to promote the following key areas.

1

Educate Governments and Asset Owners

Lack of awareness or understanding of how risk exposure threatens investments leads to a de-prioritization of risk mitigation.

2

Consider Return on Resilience Investment

Conservative global climate models with long range time horizons result in cost prohibitive design and construction estimates for risk adaptation measures.

3

Include Climate Risk in Credit Rating

Credit and insurance ratings undervalue climate risk exposure and consequently give little consideration to the effectiveness of adaptation efforts.

4

Prioritize High Risk Assets

Urgent concerns, such as immediate threats to investments from 5-year flooding, will continue to outweigh adaptation efforts to mitigate risks that are 30 years in the future.

5

Extend Investment Periods

Contracts with shorter terms of 8 years or less do not incentivize long term risk mitigation and adaptation.

Figure 10 Contracting Recommendations

Until these issues are comprehensively addressed, OPRC contracts will likely suffer from cost overruns and declining participation.

7 Next Steps

In addition to defining performance metrics and allocating risk through contract language augmentation, there are several key considerations necessary for facilitating effective evaluation and allocation of climate-related risk exposure in PBCs. The following actions and questions should be considered.

Define Climate Risk Appetite	Coordinate across the relevant World Bank departments to agree on acceptable levels of portfolio risk based on exposure to climate impacts. Leverage this knowledge to identify potential synergies and efficiently gather hazard data across departments.	Climate risk should be identified early during the project development and programming phases to ensure widespread consideration of risk acceptance levels by the Bank. Efficiencies of scale could be acheived through collaboration and sharing of resources between projects and across disaplines.
Quantify Value of Avoided Losses	Build out the value capture model and business case for climate resilience utilizing data from past events. Collect information on costs associated with recovery and reconstruction efforts to provide a baseline of losses that would help inform the ROI analyses related to more resilient roadway systems.	Contractors should be required to fill out annual surveys to report on their losses associated with extreme weather as well as any socioeconomic co-benefits that may contribute to the overall investment value. Data analytics pertaining to retun on investmnet may incourage contractors and asset owners to invest in resilience if the break even point was within the contract term.
Leverage Risk Management Tools	PBC is one mechanism to shift upfront project costs and risks away from governments and asset owners. There are also other alternative risk management approaches and tools that could be used in conjunction with PBC to enable greater resilience to climate.	Evolving risk management tools in the insurance market, such as catastrophe bonds, resilience bonds, and reinsurance provide the needed additional contingencies. Incentivizing resilience by rewarding performance that exceeds particular baselines and results in minimal or no disruptions in service during extreme climate events.
Consider Local Communities and Stakeholders as resources	Given that the life expectancies of roadway systems typically extend beyond the investment horizon of the World Bank and the private contractors, risk planning should extend to cover the project lifecycle.	Greater community and business sector involvement may improve adaptation outcomes geared at solving for climate risk within these projects It is important to consider how the longevity of the resilience value captured and risk “owned” by the community may benefit from the investment

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Appendix A Literature Review

Climate change affects roadway performance in two ways: immediate term and long term risk. In the immediate term, extreme events are arising more frequently and with greater intensity than what has been observed in the historical record. This sees an increase in 'emergency' activities—where the risk is carried by the client—even though there could be scope in some instances to have had the risks at least partially shared with the contractor. The long term climate change impacts are more nuanced and these may, in part, potentially be subsumed by the contractor's performance standards, the definition of which forms part of this assignment. Another aspect of long-term climate change is the way it may impact the design of infrastructure, where design of improvement or new infrastructure, which is often part of the responsibilities assigned to the contractor entity under PBC. Arup reviewed a number of guideline types in order to evaluate the gloabla understanding of climate risk in the development process.

1. **Design Standards**
2. **Risk Management Guidelines**
3. **Policies**

There is currently very little consideration of climate resilience in any published design guidelines globally. The typical guidelines follow event based criteria that do not make consideration for fluctuations in climate hazard through the lifetime of an asset. Design standards have not actively addressed climate but many have increased the required design event from 50-year frequency to 100-year frequency. Even these progressive standards are static and backward thinking though using climate data from the last 100 years. In order to appropriately plan for the next 50-100 years of storms, design standards need to adopt adaptive requirements.

Tools by Scale

Many recent studies that have started to ascribe value to climate resilience. Examples of this type of work can be found:

- At the macro-economic scale (e.g., the Sterns report, the Task Force on Climate-related Financial Disclosures),
- At the country scale and regional scales (e.g., Larsen et al., 2008 – Estimating Future Costs for Alaska public infrastructure; and at
- At the system level, project and client-specific level (e.g., https://www.rssb.co.uk/research-development-and-innovation/research-and-development/research-project-catalogue/t1009)

In addition to economic and financial indicators, there has also been an effort to incorporate social and environmental values

At the project-specific level, our experience has been that the most persuasive and broadly-accepted arguments are based on the economics of resilience. This can include a valuation based on the ROI associated with decreased maintenance costs, less overall downtime or with the ability to structure projects in a certain way that would make them attractive to funding and financing by third party entities (e.g., climate bonds).

A1 Relevant Risk Assessment Tools

AWARE

The ADB requires a simple climate threat screening for all projects seeking funding using the risk management framework **AWARE for Projects**. This qualitative assessment tool is based on a three point (high/medium/low) scoring of broad data and general knowledge in 16 topic areas that have possibility to effect roadway performance. Tool development is likely to consider many of the same threats.

The qualitative assessment tool is based on a three point (high/medium/low) scoring of broad data and general knowledge in 16 topic areas that have possibility to effect roadway performance. The hazards considered are outlined below and should be considered in Risk Assessment Frameworks developed by the World Bank.

(1)	Sea Level Rise	(2)	Precipitation increase
(3)	Flood	(4)	Water availability
(5)	Drought	(6)	Landslide
(7)	Wildfire	(8)	Temperature
(9)	Solar Radiation change	(10)	Permafrost
(11)	Snow	(12)	Sea Ice
(13)	Wind increase	(14)	Wind decrease
(15)	Onshore storms	(16)	Offshore storms

Climate Screening Tool

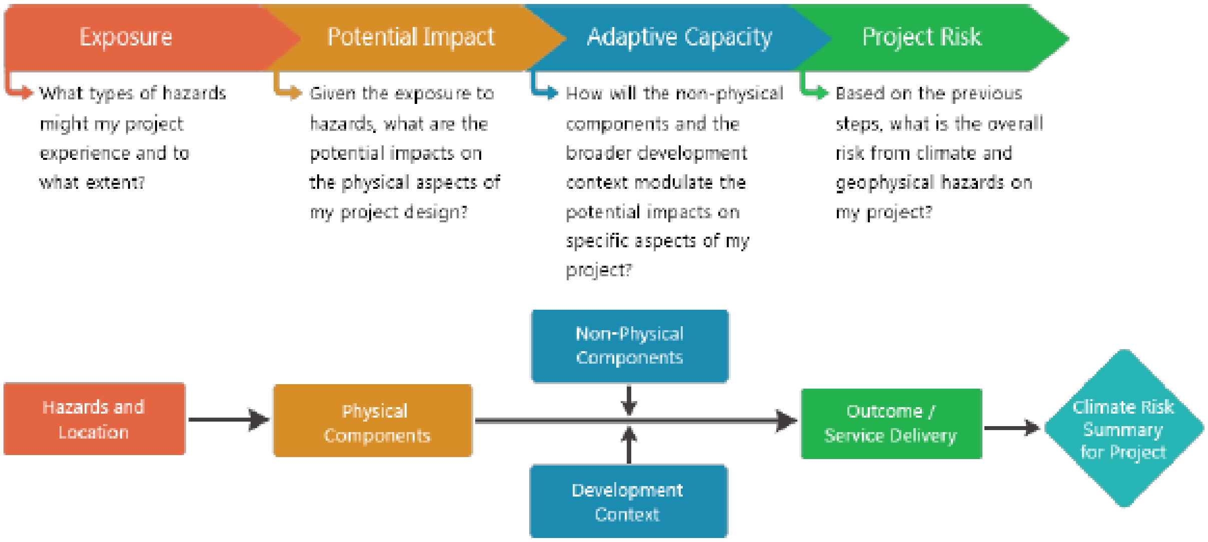
The World Bank utilizes the Climate and Disaster Risk Screening tool to compare project risk exposure to various hazards under Current and Future conditions. Such hazards include:

[1]	Extreme Temperature	[2]	Storm Surge
[3]	Extreme Precipitation and Flooding	[4]	Strong Wind
[5]	Sea Level Rise	[6]	Earthquake

This threat exposure is assessed utilizing key project information in order to determine high level risk of projects. These include:

1. Location - such as proximity to towns and water bodies
2. GPS coordinates - to pull climate data
3. Physical components – such as type of asset
4. Outcome / Service Delivery – to illustrate asset purpose

Figure A1: Project Level Climate and Disaster Risk Screening Tool: Approach for Roads Project



Determination of the potential for any of these hazards to pose an increased risk in the Future scenario allows for adaptive planning. Risk is rated on a scale of 1 to 5 and recommendations for each level are provided accordingly.

[1] Insufficient Understanding

[2] Not Exposed/No Potential Impact/No Risk

[3] Slightly Exposed/Low Potential Impact/Low Risk

[4] Moderately Exposed/Moderate Potential Impact/Moderate Risk

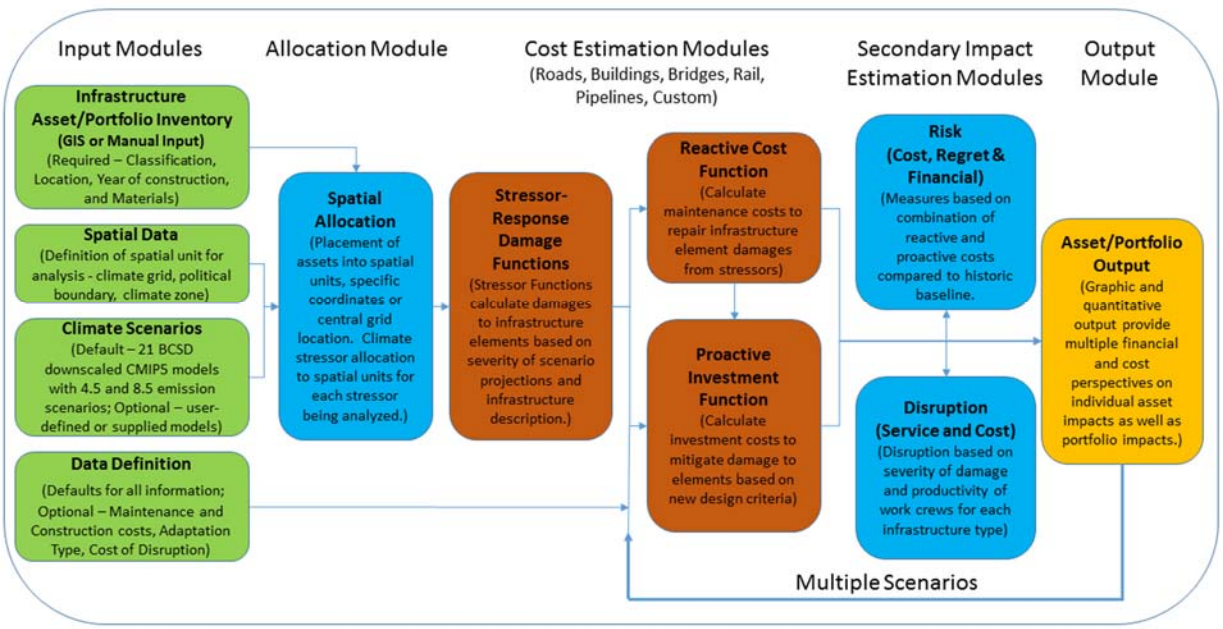
[5] Highly Exposed/High Potential Impact/High Risk

Insufficient Understanding	Gather more information to improve your understanding of climate and geophysical hazards and their relationship to your project.
No Risk	If you are confident that climate and geophysical hazards pose no risk to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented.
Low Risk	If you are confident that climate and geophysical hazards pose low risk to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented. You may also consider gathering additional information to increase your level of confidence in your rating.
Moderate Risk	For areas of Moderate Risk, you are encouraged to build on this screening through additional studies, consultation, and dialogue. This initial screening may be supplemented with a more detailed risk assessment to better understand the nature of the risk to the project.
High Risk	For areas of High Risk, you are strongly encouraged to conduct a more detailed risk assessment and to explore measures to manage or reduce those risks.

Infrastructure Planning Support System (IPSS)

The IPSS was created by researchers at the University of Colorado Boulder in 2011 and has been used by the World Bank in previous studies to understand the impact of climate change on the transport system in Africa (Cervigni, R, Losos, A., Chinowsky, P and Neumann, J, eds, 2017 - Enhancing the Climate Resilience of Africa's Infrastructure: The Roads and Bridges Sector). It is a quantitative, engineering-based analysis tool that integrates expertise from climate science, engineering, water resources, architecture, economics and other fields to produce actionable guidance in planning for climate change.

IPSS can be run at either the portfolio level or an individual asset management level. One of the most relevant aspects of this model is that it allows the user to project the economic impacts of climate change on transport. These impacts are expressed in a number of ways including direct physical impacts and cost of disruptions, as well as lost investment opportunities. While this is a powerful tool across the portfolio level with potential application at the asset level as well, it was determined that its proprietary aspects would preclude adoption across the Bank's larger transport portfolio.



PDNA Guidelines

The UN Post Disaster Needs Assessment Guidelines looks at costs of infrastructure repair.

The Guideline outlines the World Bank's procedure to assess the effects of a disaster on the Transport Sector, following the traditional methodology originally developed by the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC). The *Handbook for estimating the socio-economic and environmental impact of disasters*,4 volumes, United Nations, 2003), further developed by the World Bank´s Global Facility for Disaster Recovery and Reduction (GFDRR) (*Guidance Notes for Damage, Loss and Needs Assessment*, 3 volumes, The WorldBank, Washington, D.C., 2010), and now expanded and adopted by the PDNA. Application of the methodology enables the assessment of disasters' economic and social impact on the Transport Sector, and the estimation of post-disaster needs for recovery and reconstruction.

Type of work	Range in Cost
Rehabilitation	
Dirt road, flat terrain	4,000 – 5,000
Dirt road, undulating terrain	5,000 – 6,000
Dirt road, mountainous terrain	6,000 – 8,000+
Gravel road, flat terrain	12,000 – 14,000
Gravel road, undulating terrain	15,000 – 18,000
Gravel road, mountainous terrain	18,000 – 21,000+
Paved road, flat terrain	22,000 – 25,000
Paved road, undulating terrain	25,000 – 28,000
Paved road, mountainous terrain	28,000 – 32,000+
Reconstruction	
Dirt road, flat terrain	8,000 – 10,000
Dirt road, undulating terrain	10,000 – 18,000
Dirt road, mountainous terrain	18,000 – 25,000+
Gravel road, flat terrain	45,000 – 50,000
Gravel road, undulating terrain	50,000 – 65,000
Gravel road, mountainous terrain	65,000 – 80,000+
Paved road, flat terrain	100,000 – 150,000
Paved road, undulating terrain	150,000 – 180,000
Paved road, mountainous terrain	180,000 – 250,000+

Source: UN-ECLAC

In the post-disaster setting the most urgent task is to promptly assess humanitarian needs and respond to those affected. After this it requires an assessment of the damages and losses caused by the disaster, then development of a recovery plan that will lead back to a stable economy. To meet such challenges a country affected by a disaster often requires the support of a wide range of national and international actors. In the past this process was characterized by a multiplicity of parallel needs assessments and planning exercises conducted by respective individual groups, agencies, and donors. Typically such assessments varied in scope and rigor and would be undertaken at different stages during the phases of response, and recovery.

A2 Applicable Industry Standards

While, international engineering standards as a whole have not yet adopted official language around climate change adaptation planning, many leading organizations are in the process of conducting research and publishing position papers on the topic. The selected documents have been reviewed to understand potential for integration of climate consideration into a PBC model where extreme weather impacts held corresponding performance indexing. The chosen Standards and Guidelines aim to include diverse global perspectives focused around the following subjects:

Design Requirements

There is currently very little consideration of climate resilience in any published design guidelines globally. The typical guidelines follow event based criteria that do not make consideration for fluctuations in climate hazard through the lifetime of an asset. Design standards have not actively addressed climate but many have increased the required design event from 50-year frequency to 100-year frequency. Even these progressive standards are static and backward thinking though using climate data from the last 100 years. In order to appropriately plan for the next 50-100 years of storms, design standards need to adopt adaptive requirements.

Performance-Based Contracting

Performance-based contracting has been developed around a robust set of engineering- and construction-based industry standards that have been developed over decades of project-based work and academic studies. Climate change itself is still an emerging field with one of the primary challenges being that it cannot be derived from past events or data. At best, past data provide a benchmark; however, they do not provide a reliable proxy for future events. The uncertainty of climate change is also constantly evolving in the midst of increased global warming and its concomitant changes in the environment (e.g., rapid ice loss, increased severity of droughts).

The implementation of a Performance Metric approach allows for attention to changing asset exposure and variable usability conditions due to climate impacts but still do not connect these to cost of inaction. There are currently no published PBC guidelines that include provisions for climate related deterioration of assets. The mechanisms in PBC guidelines however, lend well to consideration of climatic events as they determine roadway performance based on daily usability and availability. This in turn requires contractors to consider reasonable risk exposure over the term of the contract

Risk assessment and allocation

Arup reviewed a number of documents considering climate impact to roadways prepared for the World Bank and for other agencies working in the infrastructure development sector. The majority of risk related documents follow ISO risk guidelines for quantification of reasonable and unreasonable risk. The documents did not cover risk allocation.

Appendix B Stakeholder Engagement

B1 Stakeholder Interviews

This collection of individual knowledge aids in the development of user-friendly methodologies to improve the efficiently and accurately assessing future climate vulnerability of World Bank financed roadway projects globally. This is essential in order to determine the possibility for economic loss due to climate over the investment period. Each party Interviewed provided unique feedback to understand these potential economic losses as well as mechanisms to reduce exposure.

Figure 11 Stakeholder Interviews

Industry Stakeholders	Contributor	Role	Region
Asian Development Bank	David Ling	Bank	Asia
Ministry of Transport	Cristian Chaparro	Owner	Colombia
National Roads Administration	Irene Simoes	Owner	Mozambique
Opus	Rowan Kyle	Contractor	New Zealand
Cintra	Confidential	Contractor	Spain
Laing	Mark Westbrook	Contractor	UK
ReFocus	Shalani Vajjhala	Investment Strategist	US
Willis Towers Watson –	Rhys Newland	Insurance	UK
Resilient Analytics	Paul Chinowsky	Advisor	US
German Development Agency	Jeanine Corvetto	Bank	Peru

B1.1 Interview Questions

Name / Date	
Organization / Name of department within your organization	
	What role does your organization fit into? (Government agency/grantor/owner; Contractor; Investor; Financier; Advisor; Other….)
2	What more specific contributions does the organization make in the roadway infrastructure life cycle / value chain (research, policy, design, construction admin/ supervision, operations, maintenance, concessionaire…)
	From your viewpoint, what are the main threats related to climate (flooding/intense precipitation events, increase in drought conditions, rising sea levels, increase in hurricane intensity, higher heat, etc.) that effect operation of transportation infrastructure, especially roadways? How might these change in future?
4	Which of these climate related hazards are most likely to require retrofits or alterations in roadway design, construction, operation or maintenance over time?
	What mitigation measures are being implemented in your organization and others to deal with these threats today? How is the approach adapting for future requirements?
6	How are climate projections or future climate scenarios developed within your organization? What industry standards do you follow? How has your organization defined and planned for extreme weather events and longer-term stressors like sea level rise in the past?
	How does your organization (or others), currently allocate or manage risks related to climate change from a contractual standpoint? E.g. do you manage them in-house, are they passed down to other organizations, or passed upwards to government?
8	From your perspective, how could project risks, such as climate related impacts, be allocated most effectively through the life cycle of roadway projects?
	Which parties are currently best suited to manage the different risks associated with climate change for any particular project? For example, do you think that the risks are well-known enough to be able to be priced efficiently by contractors?
10	Is there sufficient information available in early stages of the project development process to understand what the risks related to climate change may be for all of the stakeholders involved? What additional information might be needed to better define those risks, appropriately allocate ownership and estimate the cost of mitigation measures?
	Force Majeure wording associated with contractual compensation events often results in Owner responsibility for climate risk if effects can be distinguished from normal wear and tear. Are there currently any practices in place to separate consequences (damage or downtime) resulting from climate change versus typical weather? This can be applicable to the owner or the operator.
12	In your experience, what contractual performance metrics, if any, have incentivized better allocation of climate related risk exposure?
	Do roadway performance metrics enable builders and operators to properly understand, plan for and budget climate resilience measures?
14	What flexibility do PBC mechanisms contain that allows for improved mitigation of climate related roadway hazards? Are there changes that would improve this flexibility? i.e. must maintain minimum number of open lanes at all times
	How could compensation events within the contracts be better defined in order to create equitable sharing of climate risk while still encouraging high performance?
16	Do you know of any contract mechanisms or variations processes that would secure continuous improvement in climate resilience? i.e. a mechanism to deliver improved resilience as more is known about the impacts of climate change over time?

B1.2 Industry Perspective Takeaways

Contractors, Developers and Private Partners

One view is that current contractors working in emerging markets are not adequately accounting for severe weather and harmful events that can occur, due in part to perceived unpredictability of these events. In the same vein, the definition of extreme events and force majeure that is defined as an Act of God which in essence translates to an unpredictable event. The concept of quantifying the definition of what is actually force majeure may enable separation of standard climate and the increasing severity of weather events. Contractors are unmotivated to bid on projects with high levels of uncertainty and will be further discouraged by increased risk ownership experienced if the safety net of government bailouts are eliminated. The solution in this case will require careful review of the current definition of "predictability" in relation to climate change and potential evolving insurance practices.

Asset Owners, Client Countries, Government Agencies and Public Partners

When the contingency budgets for storm repairs, increased drainage maintenance and unforeseen conditions have been exceeded, the regional government and asset owners are hit with additional service requests. While the goal of PBC is to transfer the risks associated with asset operation to developers, many threats are clearly outside of the control of the developers responsible for the assets. One of the major issues raised has been related to risk ownership for threats posed by offsite causes such as poor land use planning. This includes problems such as increased runoff from unplanned urbanization to debris flows resulting from irresponsible agricultural practices and natural resource management. Mitigation of these threats by the private developer is near impossible, resulting in necessary involvement of government entities.

Development Banks, Investors and Funding Partners

Consideration and planning for the impacts of climate may necessitate the reevaluation of each business case for new roadways. Increased operational costs resulting from escalating climate impacts and declining usage could both lead to reduced project profitability and additional project failures. Projects subject to changing criticality and increased maintenance run the risk of becoming non-viable or failing, resulting in borrower default. Funding partners see increasing exposure to the risk of losing their investment in assets that are heavily damaged or underutilized to the point of no longer being profitable or worth maintaining.

Local Communities and Regional Governments

Roadway assets are intended to have a longer life span than the length of the operations contracts which facilitate them. That leaves the community or regional government as the sole beneficiary and responsible party for that roadway after departure of the developers. This implies that the community and regional government should have a vested interest in efforts that reduce the long-term risks associated with these projects.

Insurance Providers and Disaster Funds

Climate projections indicate increasing volume and intensity of storms which means that insurance providers will be forced to increase insurance premiums or decline coverage to high risk assets if they hope to stay profitable. Alternatively, insurance providers may also pursue additional opportunities to engage with clients to help analyze, assess, and manage risks in order to keep projects viable and keep premiums affordable.

B2 Stakeholder Workshops

B2.1 The Asian Development Bank

August 16th 2017 - Manila, Philippines

The Arup team coordinated with the ADB Transport group to conduct an area specific learning event around the effect of climate change on ADB and WB contracts in the Asia Pacific region. The 5-hour workshop focused on three key topics relating to future climate risks surrounding roadway operation and performance – based contracts (PBC):

1. Risk Identification and Quantification
2. Risk Allocation
3. Contract Augmentation

The attitudes and opinions related to climate change awareness in PBC will be considered in Arup's research findings around global trends in roadway operation contracting.

Risk Identification

The existing ADB roadway procurement process does not include climate change sensitive language outside of the necessity for screening using AWARE. The decision to consider planning for changes in climate related risk (from a design or budget perspective) over the life of the project are at the discretion of the contractor performing the works.

Those projects with an average AWARE score of medium to high risk are recommended for more detailed analysis through a Climate Risk and Vulnerability Assessment during the Project Preparation stage. Risks and recommendations are included in the 'Recommendation for the President' (RFP) but after that there is no formal mechanism that ensures the risk mitigations and recommendations are incorporated in the detailed design of the project.

1. Currently, there is a 10% contingency set aside for lump sum contracts to cover extreme weather events such as those listed above. However, operators are experiencing such high intensities and volumes of extreme events on a regular basis that this contingency is insufficient. One storm often completely depletes these small contingencies and every other event following is an unrecoverable financial loss to the operator.
2. Representative examples of those losses include typhoon-induced damage, flooding from precipitation events, obstructions from large trees and landslides (sometimes involving whole upstream watersheds), and growing sinkholes, as well as an increase in "nuisance" flooding which often means a foot of water – making vehicular passage impossible.
3. There has been ongoing discussion about climate impacts being made worse by land issues (poor land-use management) outside the project boundaries. There is still uncertainty around how these issues should be addressed and by whom.
4. There is necessity to understand how varied risk levels are addressed over the length of roadways with dissimilar exposure and vulnerability.

Presently, output based contracts utilize metrics or KPIs similar to those used in WB and other private international bank contracts, though it varies dramatically between assignments. The indicators being used are routinely in the category of maintenance quality and not asset availability. Recent contracts have been lump sum with payment deductions based on the performance.

Table 7: Metrics

Maintenance	Performance
Surface Cleanliness	Daily Flow Rate
Pavement Roughness	Available Lanes
Vegetation Control	Revenue Generation

Risk Allocation

ADB projects are usually administered by in-country staff through local contracts on behalf of the national government. The workshop participants were under the impression that PBCs do not exist in the ADB yet, but there was some indication of adapting WB contracts for PBC use by the ADB in Pakistan. Also, while operation contracts have been linked with improvement contracts, the concept of special purpose vehicles (SPV) which commercially tie the upfront construction with the maintenance of an asset does not exist at the moment. There was doubt that there was an appetite for this in most geographies due to the risks involved with long term contracting.

1. The ADB operations contracts are only 5- 7 years in length so there is not the same level of “ownership” with respect to longer-term climate impacts although there are still significant financial impacts in the short-term (see above).
2. The ADB is already facing diminishing interest in O&M contracts given the uncertainty in returns due to a variety of disruptors – unforeseen conditions and climate change are key among those.
3. An issue for the current contracting in the region was a complete lack of accounting for weather and events that are likely to occur although unpredictable. In other words, the definition of extreme events and force majeure encompasses anything that currently disturbs the construction and running of an asset. The concept of adjusting the definition of what is actually force majeure seemed very unattractive due to the already dwindling interest in operations contracting.
4. This should be discussed in relation the perspective that developing countries should not be paying for the impacts that are being realized by climate change. The feeling is that developed countries such as the US, Europe and China are the instigators so should be the ones to provide resources to solve for it.

Contract Augmentation

The existing ADB roadway procurement process does not include climate change sensitive language outside of the necessity for screening using AWARE. The decision to consider planning for changes in climate related risk (from a design or budget perspective) over the life of the project are at the discretion of the contractor performing the works.

1. Risk allocation within operations contracts is toggled from contractors to government parties solely through Force Majeure and Unforeseen Conditions terminology that defines these events using generic language unspecific to event scale.
2. It was recognized that the ADB procurement process does not easily provide a vehicle for climate change adaption requirements. There is no link between procurement and the loan requirements through incentives or other means. There is also currently no pre-qualification process for a loan which could be used as a gateway.
3. ADB felt that the opportunity for influencing the contracts was in the 'bidding documents,' primarily because the actual contract documents are commercially sensitive and between the national government and contractors. Neither bidding documents, nor contract documents were publicly available.
4. Workshop participants felt that consultation during project preparation stages could have profound effects on understanding the true risks to a project.

Further review of how to modify contractual language to encourage climate change adaptation planning will be carried out in later stages of the project. Preliminary findings will be included as a basis for discussion at the workshop to be held at the WB in Washington DC on September 18th and will be expanded through background research.

B2.2 The World Bank

September 18th 2017 - Washington, DC

A second workshop was hosted by the World Bank in Washington, DC to gather additional input into the Assessment Framework. The discussions were similar in theme to those in Manila with some additional nuances. Additional concerns focused on the following:

1. The World Bank contracts also follow a 5-7-year window as with ADB contracts. There are similar concerns as to longer-term ownership for climate risks given this horizon. There were initial discussions about greater community involvement and ownership of the longer-term risks although it was recognized that this would involve a larger effort than what was scope for this project.
2. There are various climate tools that have been or are currently in development for the World Bank. A standardized climate "look-up" table will be required for World Bank staff to assign specific project criteria to be used in transport projects (see Task 4 Performance Metrics memo for methodology). The IMF is currently in the process of finalizing such a product that could be readily shared with the Bank. There was general agreement with the workshop attendees on this approach.
3. There was recognition that the Force Majeure clause, which triggers Emergency Works reimbursement, may need to be revisited in light of ongoing climate risk. There was discussion as to whether or not extreme events should truly be considered as unpredictable or if they should be better accounted for in the models. This was one area where the participants agreed that further, more formalized discussions may be warranted.

4. Some areas of the Bank are exploring how climate resilience can be incorporated into existing design criteria. One example was with respect to stormwater. There was interest in Texas DOT's approach of using highways as areas of storage during extreme events. There are similar gray-green efforts being explored in Bank projects.
5. There was a quick discussion as to whether or not there needed to be stronger metrics to measure the economic impact of extreme events (climate-induced) at a programmatic scale. In general, the participants felt that there was an overall recognition of the issue at the Bank and while some figures might exist within the Disaster Risk and Reduction program, they are likely not collected in a way that they could be easily leveraged for this work.

B2.3 Workshop Exercise Questions

Exercise #1: Assessment Tool Input
• What sensitivity drivers lead to asset failure?
• What criticality drivers set the importance of roadway assets?
• What future climate scenarios and time horizons should be used in assessment?
Exercise #2: Risk Allocation
• Who is best positioned to manage climate risks?
• How much risk should the contractor absorb?
• How to measure risk and structure KPIs?
• Over what time horizons should risk be assigned?
Exercise #3: Contract Augmentation
• What will be the barriers to implementation of Contract Augmentation?
• What are possible alignment points or other synergies with ongoing WB programs?
• Who will be the key stakeholders to engage in terms of new policies and implementation?