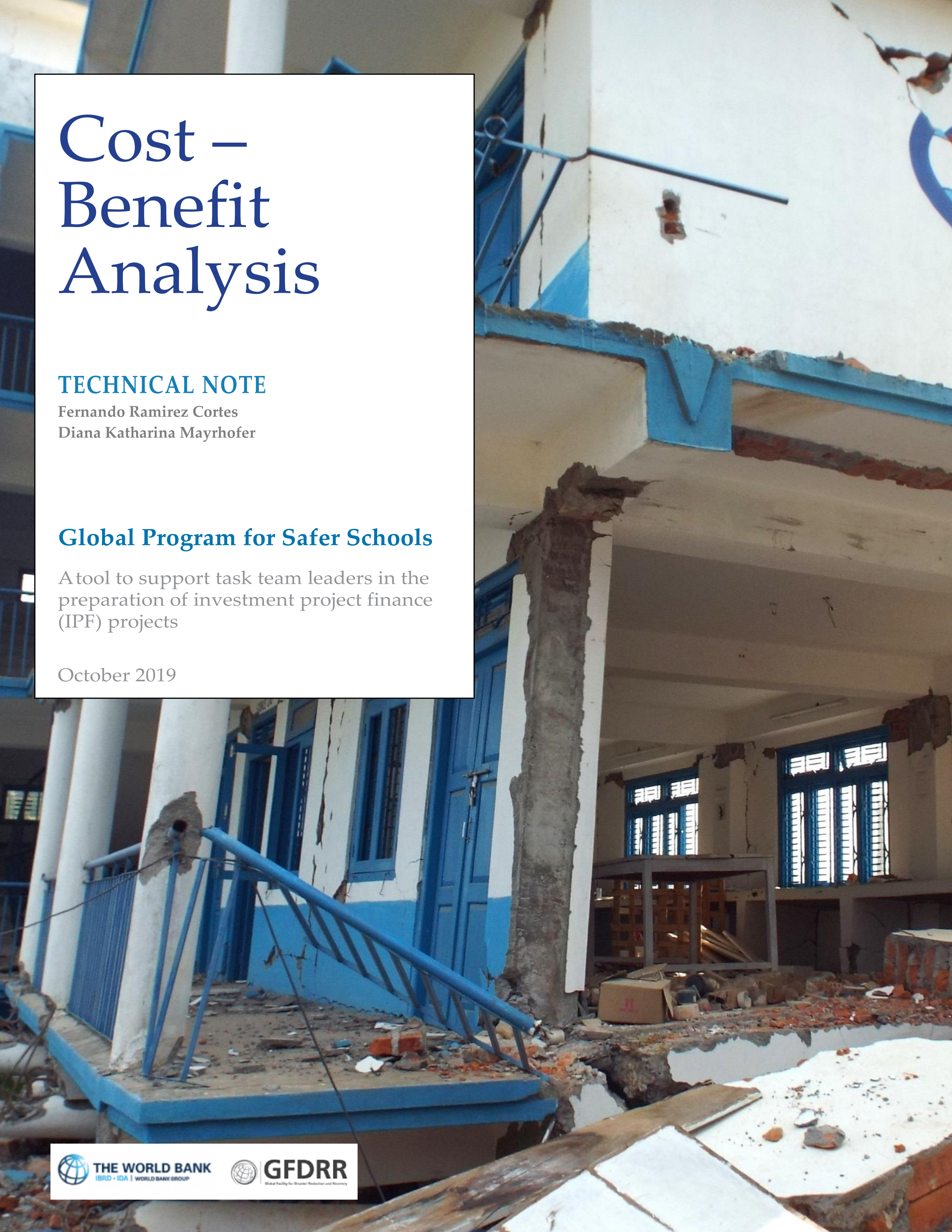

Cost – Benefit Analysis

TECHNICAL NOTE

Fernando Ramirez Cortes
Diana Katharina Mayrhofer

Global Program for Safer Schools

A tool to support task team leaders in the preparation of investment project finance (IPF) projects

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THE WORLD BANK
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Executive Summary

A cost-benefit analysis is a tool to test a safer school IPF for economic viability prior to the implementation of the project based on three indicative factors: (i) the net present value (NPV), (ii) economic rate of return (ERR) and (iii) the benefit-cost ratio. Combined they inform task teams on the economic benefits of the project and a project is viable as long as the NPV is above zero, the ERR is greater than the required rate of return and the benefit-cost ratio exceeds one. The higher the NPV and benefit-cost ratio, the higher the expected benefits from the safer school IPF. The discount rate and timeframe of the analysis should be chosen carefully. It is suggested that the chosen discount rate follows World Bank or government guidelines (often around 5 percent). The appropriate timeframe for retrofitted and replaced school buildings can be assumed to be 25 and 50 years, respectively.

The two key components to consider are costs and benefits of the risk reduction intervention and functional benefits attained with the IPF. The benefits are defined by the difference between pre and post-intervention scenarios in case of an earthquake. The decision whether a deterministic or a probabilistic risk assessment approach should be utilized directly affects how costs and benefits are calculated. Both approaches are appropriate and the decisive factor may be what kind of reliable and useful information is available in the country. In order to estimate costs prior to the launch of the project, it can be assumed that the cost of intervention will be equal to the investment funds of the safer school investment of the IPF and that all cost outflows will occur at the very beginning of the project.

Regarding benefits, a safer school project is expected to offer benefits in the following three ways: (i) avoided fatalities, (ii) avoided damage to buildings and (iii) additional benefits such as upgrades of water, sanitation and hygiene (WASH) facilities and improved energy efficiency. Avoided fatalities can be estimated using a value of statistical life (VSL) approach to express the benefits of lives saved in monetary terms. The benefits of avoided damage of building can be quantified by estimating replacement and repair values based on market prices. Similarly, the benefits of energy efficiency improvements can be estimated by comparing the status quo energy consumption and its reduction after the safer school intervention based on average energy prices. It is more challenging to estimate the effects of WASH facility improvements and as their impact is often relatively small compared to the other benefits they are often disregarded in this type of cost-benefit analysis. Estimating the benefits of avoided disruption in the education sector, mental and physical injuries often poses an additional challenge. Therefore, the outcomes of the analysis can be expected to be understated and the benefits even higher.

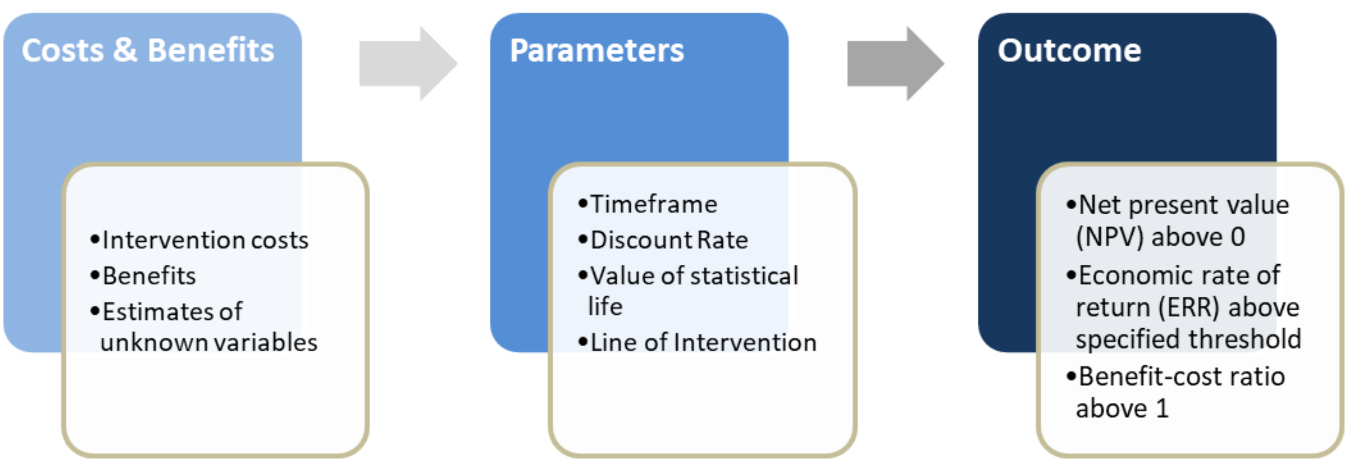
Contents

Introduction

This technical note will provide an overview of how to prepare and develop a cost-benefit analysis for a safer school investment project finance (IPF) aimed at protecting children in case of an earthquake. Even though this note centers on earthquakes, the methodology described can be adapted to other natural and climate change-related hazards. It will describe the costs and benefits associated with safer school risk reduction investments and go into depth of the three most common indicators, namely (i) the net present value (NPV), (ii) economic rate of return (ERR) and (iii) the benefit-cost ratio. It focused on an ex-ante analysis. In addition, the note will explain how to include different intervention strategies into an IPF economic analysis such as, for instance, school building replacement or retrofitting of existing buildings. Throughout the note, steps of the cost-benefit analysis will be complemented by an example of the safer school cost-benefit analysis in the Kyrgyz Republic for the IPF "Enhancing Resilience in Kyrgyzstan" (ERIK, P162635) (Annex 1). For a general overview of safer school intervention needs worldwide, please refer to the global study of investment needs developed by the Global Program for Safer Schools (GPSS). The study provides further information on the scale of the safer school challenge worldwide.[1]

Figure 1 illustrates the general flow of a cost-benefit analysis. The first step is to identify the available input data and finding proxies to estimate other important data as needed. Moreover, the hazard level should be defined within the methodology as it may not possible to predict the exact magnitude of the next earthquake nor location of its epicenter. Some of these parameters will probably have to be assumed in the model.

Figure 1: Cost-Benefit Analysis Flow



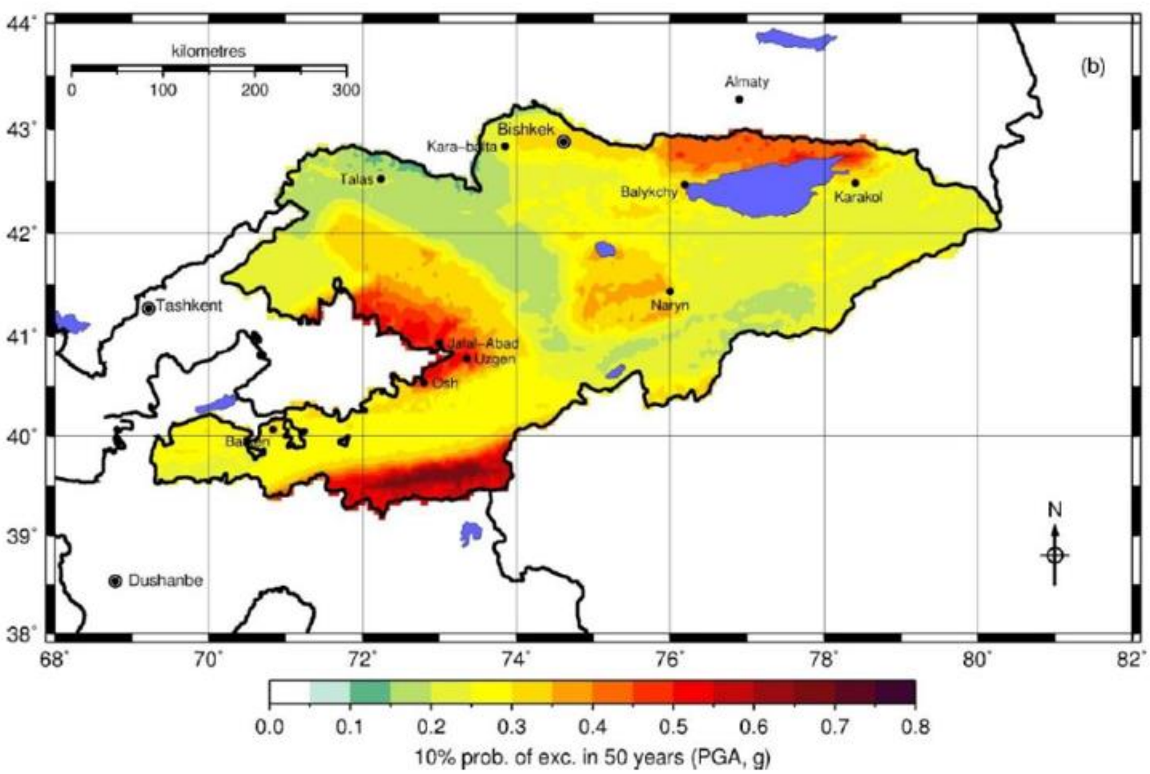
[1] Please follow this link: https://gpss.worldbank.org/en/glosi

The Mechanics of a Cost – Benefit Analysis

Prior to estimating the benefits and costs, the earthquake risk level in the country of the IPF should be determined through either a (i) deterministic approach or (ii) probabilistic approach. The **deterministic risk approach**, often referred to as scenario-based model, identifies a likely earthquake scenario and calculates the damage an earthquake of a specified magnitude (e.g. 7.5Mw) would cause. The chosen scenario earthquake often coincides with either building code design earthquakes or likely to be identified by national authorities or academia as a highly probably disaster occurring in the short to medium term. Under a **probabilistic approach** the rate of each scenario is computed and the scenarios are then pooled to determine the average annual loss (AAL) and probability of exceedance above a defined magnitude threshold (U.S. EPA, 2014). In accordance with standard disaster engineering practices, the design earthquake generally exhibits a 10 percent probability of exceedance in 50 years. For the purpose of a safer school risk reduction IPF cost-benefit analysis, both deterministic and probabilistic approaches are accepted.

This decision between deterministic and probabilistic hazard assessments will also depend on the type of information that is currently available in the country such as, for instance, national hazard maps. Figure 2 illustrates the probabilistic seismic hazard assessment done in the Kyrgyz Republic, where we can clearly identify the dark red as the zones with highest seismic hazard. Therefore, schools in these areas are the most exposed and thus, expected to be more vulnerable.

Figure 2: Probabilistic Seismic Hazard Map of the Kyrgyz Republic



Probabilistic seismic hazard map in terms of peak ground acceleration (PGA) with a 10 percent probability of being exceeded over 50 years and considering the ground conditions using the USGS shear wave velocity Vs30 (Arup, 2017).

The Three Decisive Cost – Benefit Indicators

As mentioned supra, a cost-benefit analysis is generally based on three decisive indicators: (i) the net present value (NPV), economic rate of return (ERR) and the benefit-cost ratio. Each of these three indicators assesses the viability of the project and combined they provide a realistic picture of the IPF. It would, therefore, be advisable to include all three in the cost-benefit analysis of a safer school project.

The **NPV** is the present value discounted to present times minus the costs of the investment (Formula 1). Defining a discount rate (here: r) and timeframe (here: n) is critical when expressing future benefits in monetary terms. The further into the future benefits lie, the higher the effect of the discount rate expression will be. Appropriate discount rates could be determined by following standards published by the World Bank on IPF discount rates.[2] Alternatively, an analysis can also be based on the recommendations of the Central Bank of the country. The timeframe is similarly important, and it is be suggested to use a time horizon of 25 years for retrofitted and 50 years for replaced school buildings. In order for a safer school IPF to be viable, the NPV should be positive and the higher, the better.

Formula 1: Net Present Value

$$Net\ Present\ Value\ (NPV) = \sum_{t=0}^{n} \frac{\text{Benefits} - \text{Costs}}{(1+r)^n}$$

The **ERR** is the rate at which the NPV is equal to zero. In other words, the ERR is the minimum discount rate at which a safer school IPF would be viable. The ERR can be determined by setting the NPV zero and solving for the ERR (Formula 2). Similarly, to the NPV, the higher the ERR, the more desirable a safer school IPF will be as it signifies high return on the IPF.

Formula 2: Economic Rate of Return

$$NPV = 0 = \sum_{t=0}^{n} \frac{\text{Benefits} - \text{Costs}}{(1+\boldsymbol{ERR})^n}$$

The **benefit-cost ratio** is the NPV of benefits divided by the NPV of costs (Formula 3). This allows a for a direct comparison between benefits and costs at the beginning of the project (time zero). The higher the benefit-cost ratio the better and at the minimum it should be above 1.0. Any ratio below 1.0 indicates that the IPF costs outweigh the risk reduction and functional benefits of the IPF.

Formula 3: Benefit – Cost Ratio

$$Benefit - Cost\ Ratio = \frac{NPV\ of\ benefits}{NPV\ of\ costs}$$

In addition to the three indicators, a **sensitivity analysis** is a valuable tool to inform on the robustness of the outcomes of the analysis and determine the driving factors of the IPF's viability. In fact, a sensitivity analysis highlights critical input variables and how their changes affect the overall project outcomes within the analysis framework. In safer school IPFs the most common indicators for a sensitivity analysis are (i) the value of statistical life (VSL), (ii) the discount rate, (iii) split between retrofitting and replacement (if applicable) and (iv) number of avoided fatalities.

[2] For instance, the World Bank publication "Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects" suggested a discount rate of 5 percent (2015a).

The Losses, Benefits and Impact Analysis

Definition of Safer School Intervention Options

Formula 4: Threshold Formula for Retrofitting

$$\textit{Cost Efficiency Ratio} = \frac{\text{Intervention Cost (IC)}}{\text{Replacement Value (RV)}}$$

The decision on the line of intervention will be based on engineering analysis. At the time of analysis, the task teams may only have an estimate of the split between different intervention options such as retrofitting and replacement. The actual one will be confirmed once the analysis has been conducted. This is partially due to the fact that prior to a detailed analysis the actual cost efficiency for the retrofitting and replacement of the selected group of schools can only be estimated. Gathering reliable unitary cost data (US$/m²) is instrumental for the analysis so that the task teams can compute the cost efficiency ratio per school. Retrofitting is considered not economically viable when the total cost of the intervention works in a school building (including retrofitting and improvement of functional conditions) is above a given percentage of the replacement value (Formula 4). The replacement value could be estimated based on market value or official cost estimates by the national government. This means that the costs for retrofitting a school should be between 45 to 60 percent of what it would cost to rebuild the same school, following. The exact threshold depends on government policies.

The timeframe in the cost-benefit analysis should be chosen for each intervention strategy as their life cycles may differ. For instance, retrofitted school buildings can be expected to have a shorter life span than replaced ones and therefore, it is advisable to separate them into two different categories in the calculations. If there are additional intervention strategies that may affect the lifespan of a school building such as transitional retrofitting approaches (Box 1), they should also be taken into consideration. The framework of the cost benefit analysis under ERIK assigned a timeframe of 25 years to retrofitted and 50 years to replaced school buildings.

Box 1: Transitional Retrofitting

Transitional retrofitting is an intervention strategy used to guarantee the safety of children in the short to medium term. The intent is to apply some retrofitting solutions to the school building that are not as comprehensive as traditional retrofitting methods, but will still ensure temporary life safety of students for a time of up to 10 years. After this initial time, the building will likely need to undergo a traditional retrofitting intervention or even replacement. Ideally, some of the material used during the transitional retrofitting could also be used in the retrofitting or replacement of this school facility.

Calculating Costs

In many cases the cost of intervention will be equal to the investment funds of the safer school investment of the IPF. Ideally the costs would be based on the exact intervention costs based on the selected schools. However, as this is generally not possible in an ex-ante cost benefit analysis, the costs can be considered the investment amount (Box 2). If available, unitary cost data (US$/m²) is often used as a proxy, especially in larger national school portfolios. In the cost estimation, it would be possible to make assumptions about which point in time the funds will be disbursed over the timeframe of the project. For instance, it may be assumed that 50 percent will be spent in the first year, 25 percent in the second and the remaining 25 percent in the third year of the IPF. This assumption would be important in the calculation of the project's net present value and economic rate of return. In case of uncertainty, it may be advisable to assume that all funds will be spent in the first year, which would produce a more conservative estimate.

Box 2: Cost Estimates under ERIK and Their Effect on the Applied Intervention Strategies

In the ERIK cost-benefit analysis, it was assumed that the costs equal the allocated safer school funds of the IPF (US$ 12 million) all of which were spent in the first year of the project. Finding accurate data on cost estimates in the Kyrgyz Republic was challenging due to a lack of data on school construction costs nor was possible to identify reliable cost multipliers dependent on the location of the schools (rural, urban or remote). This challenge was amplified as the selected number of schools, their exact location and the intervention strategy (retrofitting or replacement) remained unknown. Nevertheless, based on as much market research as possible and considering cost data from other World Bank projects in the Kyrgyz Republic led to a conservative estimate of 12 school facilities to be intervened. It was assumed that 30 percent will be replaced and the remaining 70 percent retrofitted. These estimates were then used as the basis for the cost-benefit analysis.

Estimating Benefits

A safer school project is expected to offer benefits in the following ways: (i) avoided fatalities, (ii) avoided damage to buildings, (iii) functional such as upgrades of water, sanitation and hygiene (WASH) facilities and improved energy efficiency and (iv) additional benefits. The avoided disruptions caused by a disaster in the education sector would be an additional benefit. Benefits are calculated based on the difference of damages and fatalities with intervention in comparison to status quo (

Formula **5**). This method applies to both a scenario-based and probabilistic approach. As a cost-benefit analysis is often conducted ex-ante and may require highly specific information (e.g. the number of schools to be intervened), it is often necessary to estimate the input data as accurately as possible.

Formula 5: Benefit Calculation

$$Benefits = \sum Damage\ due\ to\ earthquake\ without\ intervention - damage\ with\ intervention$$

Avoided Fatalities

To estimate avoided fatalities the following factors are key: (i) location and magnitude of earthquake risk, (ii) number of schools to be intervened, (iii) school occupancy[3] rates and (iv) crowding[4] rates of schools. As the group of selected schools is likely to be unknown at the time of the cost-benefit analysis, these may need to be estimated by taking the best-known average for school occupancy and crowding rates. Another way of tackling this challenge is by using estimates of how many lives US$1 invested can save under a pre-determined risk model (either probabilistic or deterministic) and scale it to the IPF's investment budget.

[3] Occupancy refers to the time students spend in school. For instance, boarding schools have an occupancy rate of 100 percent, while single shift schools have a much lower occupancy rate.

[4] Crowding rates refer to the number of students per school.

This would naturally consider occupancy and crowding rates in combination with damage ratios. Often these estimates are available or can be approximated. If there are pre-defined selection criteria for eligible schools to be included or intervention strategies to be followed in the Project Appraisal Document (PAD, World Bank 2019), this should be taken into consideration for these estimates.

One key step in the cost-benefit analysis involves establishing a monetary value for avoided fatalities. There a number of different approaches utilized to identify the value of statistical life (VSL). Firstly, an in-country survey could be conducted of the IPF to ascertain the willingness to pay to prevent the loss of life, reflecting the intrinsic value of life. This is usually a good representation of the perceived VSL and reflects income levels. Secondly, national governments often produce official VSL statistics, for instance in the U.S. Environmental Protection Agency (EPA) proposes US$9.7 million as VSL in the United States (EPA 2013). In some cases, even the international community collects and publishes data on the VSL Thirdly, if no information is available an approximating can be estimated by scaling a different country's VSL to the country to be intervened through GDP ratios. This can be done by estimating the VSL in any given country (Box 3). As the highest benefits usually stem from lives saved, it is important to discuss the use of VSL with government counterparts as quantifying the value of life can be a sensitive topic in some countries.

Box 3: Value of Statistical Life (VSL) Calculation in the Kyrgyz Republic

A VSL of approximately US$ 180,00 was established for the Kyrgyz Republic. This has been determined by adjusting the US VSL of US$9.7 million to the ratio of the GDP per capita rate (Y) of the United States and the Kyrgyz Republic following the formula:

$$VSL_{KG} = VSL_{USA} * (Y_{KG}/Y_{USA})$$

For the United States the GDP per capita in 2016 was US$ 57,608 and in the Kyrgyz Republic US$ 1,073 (IMF 2016). Dividing the GDP per capita gives a ratio of approximately 0.01862. Taking the 2016 EPA recommendation of US$ 9.7 million and multiplying it by the GDP per capita ratio estimates the VSL for the Kyrgyz Republic at approximately US$ 180,000.

Avoided Economic Damage

In general, avoided economic damage centers on (i) avoided direct damage to buildings, (ii) loss in asset value of infrastructure and (iii) disturbances of future economic activities. The increase in asset value (including school equipment) is defined as the difference of asset values expressed in terms of pre-intervention values and post-intervention building valuation. There are different methods on estimating the avoided direct damage to school buildings and the asset value. For instance, both can be based on replacement value based on market prices, civil works to conduct the necessary repairs or estimates based on government procurement prices (both civil works and

Box 4: Economic Damage Estimates of School Buildings for ERIK

For ERIK, the benefits of the avoided economic damage were derived by taking the average of the benefit-cost ratios for the selected 12 raions from the World Bank study on seismic risk in the Kyrgyz Republic conducted by Arup (2017). In the analysis, the benefit-cost ratio is assumed to be 0.57 for retrofitted buildings and replaced school buildings. This ratio was then scaled to the total amount of the safer school component of the IPF to determine the actual benefit of avoided damage.

replacement value). Regarding schools, estimating avoided direct damage should be done by comparing direct damage to school buildings prior and post-projects. Potential disturbances of future economic activities may not necessarily be applicable to schools as they are generally not considered centers of economic activity. If data on benefit-cost ratios is available, the information could be used to determine the estimated benefits from the safer school IPF intervention (Box 4).

Functional Improvements

Benefits of functional improvements such as, for instance, energy efficiency and WASH upgrades can also be considered in the cost-benefit analysis. Energy efficiency is based on the estimated reduction of energy usage in school facilities expressed in monetary terms, based on average energy prices. This reduction can be estimating using country-specific literature from a number of sources (e.g. academia, government, international organizations) and are dependent on the type of intervention (Box 5). However, a common argument is that some underheated schools may not actually decrease spending on energy sources as energy efficiency increases, but instead the average temperature in schools will increase. This is a possibility that is often disregarded in the actual computations as benefit improvements in temperature within school facilities are difficult to quantify.

Box 5: Functional Improvement Estimates under ERIK

> The reduction in energy usage was based on calculations on a World Bank energy assessment in the Kyrgyz Republic, which lead to an estimate of 14 percent and 20 percent reduction of energy usage for retrofitted and replaced buildings, respectively. The average heated area per school was assumed to be 11,000 cubic meters and the average energy usage was 33 kilowatts per year with an average price energy of US$0.04 per kilowatt for coal (World Bank, 2015b). Neither improvements of WASH facilities nor upgrades of learning environments have not been reflected in the cost-benefit analysis due to difficulties to accurately quantify them.

With regards to benefits in WASH facility improvements, the increase in health and welfare benefits remains difficult to quantify. A study conducted by UNICEF (2011) lists water and sanitation facilities as key ingredients for the public health of students and links the spread of diseases to inadequate WASH facilities. Benefits due to improvements of WASH facilities are expected to be based on health improvements as the spread of diseases is curbed, e.g. diarrhea (Garn et al., 2016). In addition, the construction of new WASH facilities or the improvement of old ones can lead to a reduction in days of schools missed by girls due to menstruation. However, as these benefits are difficult to quantify and it may not be possible to include them in the cost-benefit analysis. Similarly, benefits of learning environment improvements (e.g. better lighting and study spaces) are often omitted from a cost-benefit analysis (Box 5). In these cases, it can be assumed that the benefit-cost ratio will be understated due to unobservable welfare benefits.

Additional Benefits

There are added benefits of safer school interventions that are often difficult to quantify. These included (i) avoided disruption in the education sector and (ii) avoided emotional harm as well as physical injuries. The benefits of avoided disruption in the education sector due to disasters such as earthquakes is challenging to quantify. A lengthy disruption can lead to increased drop-out rates as children do not return to continue their education even after schools have been reopened. This can derail them in not only their academic career, but also in fulfilling their human capital.[5] Even when children return to school, they will need to catch up on the time missed due to the disaster and it may permanently affect their education. Every year in education missed can impact long-term earning potential, life expectance and even directly impact the education of future generations. Safer schools can, therefore, allow students to avoid significant disruption to their education and enable them to pursue their individual potential both in academia and beyond. The Global Program for Safer Schools (GPSS) has currently planned studies to investigate how to best quantify the avoided disruption in the education sector.

Avoided emotional harm and physical fatalities are also key benefits of safer schools. Long-term disabilities, both minor and significant ones such as amputations, can have a detrimental effect on the development of children and their lives as adults. This is particularly harmful in low-capacity countries that miss crucial infrastructure to integrate these children not only in schools, but the community at large. This may also force them to give up their education and limit their chances of a positive career in the future. Similarly, mental stress such as post-traumatic stress disorder can have the same effects even if not quite so visible. The tendency to drift into depression, addiction and other mental issues is heightened with children who have suffered during disasters. Safer schools can provide a safe space for children, both physically and mentally. In-depth studies would be needed to quantify the benefits gained by avoiding emotional and physical injuries.

[5] Please refer to the World Bank's "Human Capital Index".

Outcomes of the Cost-Benefit Analysis of ERIK

Overall, the safer school component under ERIK has an estimated NPV of US$ 17.9 million: 59 percent from avoided loss of lives, 38 percent from avoided economic damage, and 2 percent from the expected reduction in energy consumption. The benefit-cost is 1.5 and the ERR stands at 9.6 percent. All three indicators highlight ERIK's economic viability (Table 1).

Table 1: Summary of Input Variables and the Cost-Benefit Outcome under ERIK

Input Variables	
Timeframe – Retrofitting	25 years
Timeframe – Replacement	50 years
Discount rate	5 percent
Split Retrofitting – Replacement	70 – 30
Value of Statistical Life	US$180,000
Lives Saved Per Million Invested (Adjusted)	0.32 lives saved/year
Benefit-Cost Ratio Economic Damage	0.57
Energy Efficiency Savings - Retrofitting	14 percent
Energy Efficiency Savings - Replacement	20 percent
Viability Outcomes under ERIK	
Total NPV	US$ 17.9 m
Avoided Loss of Lives NPV	US$ 10.6 m
Avoided Economic Damage NPV	US$ 6.8 m
Energy Efficiency NPV	US$ 431,516
ERR	9.6 percent
Benefit-Cost Ratio	1.50

The outcomes of the analysis can be considered adequate as conservative assumptions have been made due to some uncertainties in the input data and the limited information available. The avoided loss of lives estimates under ERIK were based on the World Bank study (Arup 2017), where an investment of US$ 60 million is estimated to save 535 lives in the education sector over a period of 50 years. Adjusting the ratio for the ERIK project intervention of US$ 12 million acknowledging the higher than average safety benefits of the intervention, the analysis estimated an average of almost 4 lives to be saved annually. The higher than average benefits stem form the selection criteria, where only schools located in the raions with the highest seismic risk in the country are eligible. Utilizing the estimated VSL of US$ 180,000 and number of lives saved per year, and net present value of US$ 10.67 million had been determined. The calculations of additional benefits (i.e. from functional improvements) are likely to remain understated as upgrades in WASH facilities and improvements in learning environments remain outside the scope of this cost-benefit analysis under ERIK.

Looking Ahead

The upmost priority of the cost-benefit analysis is to path the way towards safer schools and do the most good for the most children. This should also be reflected in government policies and the analytical method used. The analytics feature varying standards of intervention options (e.g. life safety vs. fully operational building performance levels), so that options can be compared and benefits maximized. This includes not only performance levels of buildings, but also functional improvements such as energy efficiency and WASH facilities. As in many safer school interventions, the highest number of benefits will likely stem from saving the lives of children, it is crucial to ensure a comprehensive and sound methodology on how to estimate the value of statistical life.

The overall cost-benefit analysis described above is a high-level tool to estimate the economic viability of a project. Once this analysis has been concluded, a similar process with more detailed input data can be useful in guiding the intervention strategy for individual schools to be intervened under the IPF. At this point there should be a final list of eligible schools, further information on the costs for intervention and basic overview of the conditions, occupancy rate, area and location of the eligible schools. This detailed cost-benefit analysis can then prioritize the final list of schools to be intervened based on technical and objective criteria, namely a cost-efficiency and safety index. The individual school benefit-cost ratio can be determined through identifying the following:

- Detailed status quo construction drawings, structural and building service plans (such as site plans and external works, architectural plans and elevations of buildings, parts of buildings and components), and retrofitting or replacement designs (including their cost estimates) by building type. These should be compliant with relevant codes and design standards.
- Threshold between replacement and retrofitting will also influence the benefit-cost ratio of each individual school. As replacement options will be more expensive than retrofitting, the costs will increase, but simultaneously health, welfare and learning environments will achieve higher overall benefits in replacement interventions than in retrofitting. Therefore, a potential decrease in benefit-cost ratio may be deceptive as many of the mentioned benefits are difficult to quantify and thus, cannot be accurately reflected in the cost-benefit analysis.

This will also inform on the decision between retrofitting and replacement. the costs for the retrofitting or replacement of the group of selected schools should be analyzed in detail with regards to engineering solutions, costs and intervention strategies to maximize benefits for each individual school of the first bundle of the group of selected schools on which will be intervened. In fact, knowing the retrofitting – replacement split in the intervention strategy and the individual school benefit-cost ratios can be utilized to directly inform the future cost plan, schedule of works and the milestones for future intervention on structural and non-structural building components for the group of selected schools. In a forthcoming Volume 2 of technical notes on safer school cost-benefit analysis, this will be discussed in greater detail.

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Annex I: Overview of ERIK

The IPF 'Enhancing Resilience in Kyrgyzstan" (ERIK) is comprised of 5 components: (i) strengthening disaster preparedness and response systems (US$ 4 million), (ii) improving safety and functionality of school infrastructure (US$ 12 million), (iii) enhancing financial protection (US$ 3 million), (iv) project management and monitoring & evaluation (US$ 1 million) and (v) contingent emergency response. Component 2 refers to the safer school component.

The objective of Component 2 under the ERIK project is to improve the safety and functionality of existing state school infrastructure by supporting the Government in the implementation of the State Program on Safer Schools. At least 6,000 students in schools with safer infrastructure and improved learning environment, and in the long term 1 million students and teachers will benefit from the operationalization of the State Program on Safer Schools under Component 2. Specifically, Component 2 aims to:

- Maximize the number of school children protected from earthquakes by implementing cost-effective interventions which are primarily intended to protect life safety[6];
- Reduce economic losses and minimize disruptions in the normal operation of schools and the education service caused by earthquakes;
- Improve functional conditions and learning environment of schools, including water and sanitation and energy efficiency; and
- Develop capacity in the education sector to take implementation of the State Program on Safer Schools to scale.

ERIK will finance civil works to improve safety and functionality of existing priority school facilities. This activity will include: (i) feasibility studies and detailed design of interventions including on-site inspection of facilities; (ii) building works and construction supervision; and (iii) construction of temporary classrooms to avoid disruptions in the normal operation of schools during building works, among other complementary activities. Two main lines of intervention will be implemented (Table 2): (i) replacement of existing buildings by new safer buildings; and (ii) seismic retrofitting of existing buildings. Seismic retrofitting will be accompanied by functional rehabilitation of the school buildings, while both replacement and seismic retrofitting might include construction of additional classrooms to cover current or future needs.

Table 2: Lines of intervention to be financed under Component 2

Lines of intervention	Objectives	Application	Complementary interventions
1. Replacement of existing buildings and systems	Reduce seismic vulnerability (improve seismic	If seismic retrofitting is not viable from a safety	Construction of new classrooms

[6] In a building that complies with a life safety performance objective, injuries may occur during large intensity earthquakes; however, the overall risk of life-threatening injury as a result of structural damage is expected to be very low. In this sense, this performance objective aims to protect occupants' life (children, teachers). This performance objective does not ensure that economic losses and disruptions to the education service will be minimal as a consequence of earthquakes.

	performance up to a minimum of life safety), and improve functional conditions and quality of learning environment	and/or economic viewpoint	
2. Seismic retrofitting of existing buildings		If current seismic performance of existing school building does not meet life safety	Functional rehabilitation: Water and sanitation Energy efficiency (e.g. insulation of building envelop, replacement of windows/doors) Capital repairs Construction of new classrooms

ERIK will also finance capacity building in the education sector to take implementation of the State Program on Safer Schools to scale. This activity will support the preparation of a long-term national intervention and investment plan, which will enhance the capacity of the Government to implement the State Program. This plan will include: (i) an intervention strategy to improve the safety and functionality of school infrastructure countrywide; (ii) an investment strategy to finance the implementation of the plan; and (iii) explicit prioritization criteria to maximize the benefits of the investment with clear short to long term goals. This activity will also contribute to creating the enabling environment needed to implement the State Program by designing and delivering a capacity building program for key stakeholders in the country.

Priority schools to be financed under Component 2 will be selected through a transparent risk-informed decision-making process jointly established by the Client in close consultation with relevant stakeholders and with support from a World Bank Technical Assistance. To ensure objectives are met, and to ensure transparency, a risk-informed decision-making process will be applied in the school selection. This process involves the following three main steps: (i) from the national portfolio, a group of “candidate” schools which are located in raions and cities with highest seismic risk are identified; (ii) “selection criteria” (Table 2) are applied to short-list a sub-group of “eligible” schools; and (iii) a ranking of “eligible” schools is established through a “prioritization" process in which schools with high priority levels are selected for intervention under Component 2 based on available funds. The “selection” and “prioritization” processes aim to maximize the benefits of the interventions financed under Component 2 in terms of protection of life, reduction of physical damages and reduction of economic losses while ensuring social inclusion of different ethnic and income groups. Moreover, these processes will also ensure that results of this Project are nation-wide scalable by covering a representative group of different typologies of school buildings that require different types of interventions.

Component 2 design and implementation methodology will contribute to establishing a framework for scaling up interventions nationwide. Interventions designed and implemented under Component 2 are intended to address the needs of different vulnerable school building types in a way that can be replicated nationwide. Instead of the traditional “case by case” approach in which solutions are designed for a specific school facility, the project will build on analytical results from an ongoing World Bank technical assistance supported by GFDRR which analyses existing information about the entire school portfolio. By using advanced seismic and cost-efficiency analyses, retrofitting interventions can be optimized in order to identify cost-efficient solutions for different school building types to be implemented at scale. From previous experiences, the affordability of the interventions and efficiency of the investments will increase as a result of this approach. For instance, an intervention cost reduction of over 50% was achieved in a similar safer school program in Peru (P152216) using similar analyses. In addition, through the GFDRR grant the World Bank is supporting activities to build capacity of key stakeholders in the country on seismic performance-based assessment, seismic retrofitting and cost/efficiency analysis. Overall, the outcomes of the project will assist the government with a stronger and more transparent technical and operational platform to convene IFIs and donors to leverage further investments.