PLAN OF OPERATIONS
INDIVIDUAL PROJECT OF THE FACILITY RG-O1676
LINE OF ACTIVITY FOR INNOVATION PROTOTYPES
"TC PROTOTYPES"

DELEGATION OF AUTHORITY TO COUNTRY OFFICES[1]

HAITI
HA-T1299

I. GENERAL INFORMATION

Title	Establishing an Earthquake Early Warning (EEW) system in Haiti		
Executing Agency:	Grillo Holdings Inc.		
Focus Area:	Inclusive Cities		
Project Beneficiaries:	The Haiti-EEW is a system that will benefit all Haitians in the South of Haiti and Port-au-Prince. The alerts generated by this infrastructure can be widely broadcast through apps and SMS to reach a large number of Haiti's population (specially the most vulnerable).		
Financing:	IDB Lab Cooperation:	US$ 144,000	76%
	Counterpart:	US$ 46,000	24%
	TOTAL PROJECT BUDGET:	US$ 190,000	100%
Execution and Disbursement Period:	18 months of execution and 21 months of disbursement.		
Objective:	Mitigating loss of life and injury from earthquakes by detecting early stages of an earthquake, issuing alerts, and providing critical time for users to seek cover or exit a building before the shaking arrives.		
Environmental and Social Impact Review	This operation was screened and classified as required by the IDB's safeguard policy (OP-703) on November 5, 2021. Given the limited impacts and risks, the proposed category for the project is C.		
Project Team	Jean Emmanuel Desmornes (DIS/CHA), Adrien Dewalque (DIS/CDR), Smeldy Ramirez Rufino (DIS/CDR), Bruno Jacquet (RND/CDR), Geraud Albaret (RND/CHA), Raul Sanchez (DSP/DVF), Fermin Vivanco (MSM/LAB)		
Unit responsible for disbursements	IDB Lab Haiti		

[1] Delegation of authority for approval of TC Prototype operations up to US$150,000 is established under MIF-GN-123

II. BACKGROUND AND JUSTIFICATION

A. Problem Description

2.1. The Caribbean is a highly seismic region in which large magnitude earthquakes occur. There is a great variety in income throughout the region, however, the impact of large earthquakes disproportionately affects those in the poverty bracket as they are likely to live in substandard construction, which is more prone to collapse.

2.2. Due to the presence of a fault line between large tectonic plates, a dense population, and vulnerable residential buildings, Haiti ranks among countries with the highest seismic risk in the world. The 7.1 magnitude earthquake of 2010 that claimed an estimated 200,000+ human lives and left many homeless, was not an outlier as the country just witnessed an earthquake of 7.2 magnitude in August 2021, which is estimated to have caused damages of up to US$1.6 billion or 9.6% of the country's GDP[2], as well as 2,248 deaths and 12,200 injuries.

2.3. Aside from loss of life and its impact on the local economy, injuries are also a concern. According to Richard Allen, Seismology Professor at Berkeley, it is estimated[3] that approximately 50% of injuries were caused by falls and falling hazards, meaning that these injuries could be prevented with a few seconds of warning to take cover.

2.4. Haiti is still facing some pressing social/environmental issues that impede its development. With nearly 60% of its population living below the poverty line of US$2.42 per day and about 40% of the population lacking access to essential health and nutrition services, building resiliency, and reducing the impact of natural disasters can help the country to a path toward better living standards.

III. THE INNOVATION PROPOSAL

A. Description of the Solution being Tested

3.1. Aside from structural refitting of existing buildings to improve resiliency, Earthquake Early-Warning systems (EEWs) are the principal method for mitigating loss of life and injury from earthquakes (e.g.,[4]). EEWs provide rapid detection of earthquakes and alerting of people and infrastructure at risk. The warnings can arrive seconds to minutes before strong shaking is felt, giving people sufficient time to protect themselves. The alerts can also trigger automatic systems that stop elevators, prepare backup power, turn off gas pipes, and more. Automatic control may not be as effective in Haiti for public safety due to lack of tall buildings (no elevators) and trains (no automatic stopping).

3.2. The backbone of an EEW system is a network of seismic instruments continuously recording the ground motion and transmitting data to a remote server (see ANNEX VIII). When an earthquake occurs, it produces two kinds of seismic waves; the primary waves (P-waves), which travel fast and produce low-intensity shaking, and

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[2] IDB Blog - Estimating the Potential Economic Impact of Haiti's 2021 Earthquake: https://blogs.iadb.org/ideas-matter/en/estimating-the-potential-economic-impact-of-haitis-2021-earthquake/

[3] Using the 1989 Loma Prieta and 1994 Northridge earthquakes in California as examples.

[4] Allen, R. M., and D. Melgar (2019). Earthquake Early Warning: Advances, Scientific Challenges, and Societal Needs, Annu. Rev. Earth Planet. Sci. 47, no. 1, 361–388, doi: 10.1146/annurev-earth-053018-060457.

secondary waves (S-waves), which travel slower, but produce higher-intensity shaking that often causes structural damage. The EEW system detects earthquake primary waves and issues an alert for a region that is expected to experience intense shaking. As the wireless communication of the EEW system is faster than the speed of seismic waves in the geological environment, the alert may outpace the shaking.

3.3. The actionable time, that is, the time between the alert delivery and the arrival of strong earthquake shaking, depends on the user's distance from the earthquake epicenter. The alert will always arrive too late in the area close to the earthquake epicenter and does not provide users any actionable time. However, very strong earthquakes (magnitude > 7) rupture segments of faults that are often longer than 100 km. These earthquakes last more than a minute, which allows the EEW system to deliver timely alerts to regions further away from the earthquake epicenter. Thus, EEWs may be efficient especially in the event of very strong earthquakes that affect large areas.

3.4. Even though 2.7 billion people live in seismically active regions (JRC Atlas 2017), only several EEWs exist in the world. This is due to the very high cost of sensors, infrastructure, and technology development. The cost can run into 100s millions of USD (Japanese JMA EEW as an example cost more than $1B USD).

3.5. Grillo, a social enterprise with proprietary technologies developed a novel EEW solution that uses low-cost, high-performance seismic sensors and a cloud-based data platform (ANNEX IX). The Grillo's solution has been operating successfully in Mexico since 2017. The sensors are located in buildings near seismically active zones and transmit data to the cloud where algorithms determine if an earthquake is happening. The alerts are then sent to nearby populations by phone app, loudspeakers, and small internet-connected devices in homes, providing valuable seconds or minutes before shaking is felt.

3.6. In 2019, Grillo compared the previous 12 months of its alerts in Mexico with those of SASMEX, the official Mexican government EEW for Mexico City (https://bit.ly/3lp1bZl). Not only did Grillo benefit from increased coverage and reach to rural populations, but Grillo's EEW outperformed SASMEX in both number of earthquakes detected (247 to 218), and speed of detection (Grillo alerted 45% of earthquake events first to 40% for SASMEX). The raw data can be seen here: https://bit.ly/313MDFb. This is remarkable given that SASMEX took decades to build and cost over $100 million, whilst Grillo leveraged around $350,000 to build the system and deployed it within a year.

3.7. In 2021, Grillo's Mexican EEW again outperformed SASMEX in a significant earthquake originating in Acapulco. There a Grillo user recorded a video showing the Grillo alarm sounding before the SASMEX alarm.[5] The novelty of the solution is supported by evidence provided by the executing agency.

3.8. Grillo's solution went through several cost engineering iterations to arrive at a very affordable product. This was achieved by incorporating modern off-the-shelf components and leveraging new advances in internet-of-things, cloud computing, and machine learning. By arriving at a very low price for sensors, Grillo has been able to offer a higher density of sensors which reduces the time needed to issue and alert and gives people more time for action. The Grillo provides an end-to-end

[5] https://www.notion.so/grilloshake/Grillo-EEW-Performance-d95e0d69e32f4fca895044f2f9742196

system, which includes a seismic sensor, cloud infrastructure and earthquake detection algorithms.

3.9. The Grillo sensor was designed with the primary goal of creating a reliable, high-performance, low-cost strong-motion sensor. The instrument consists of two major hardware components - the MEMS accelerometer module and the CPU module with Wifi and ethernet radios for data transmission. The instrument uses the ADXL355 triaxial, low-noise, low-power MEMS accelerometer. See ref. [6] for details on the sensor design and performance.

3.10. The Grillo cloud infrastructure utilizes AWS Cloud services to provide a low-latency, low-cost data streaming and processing. Cloud detection algorithms process the incoming sensor data, provide a near-real-time estimation of earthquake's magnitude, location and origin time, and generate earthquake alert (ANNEX X).

3.11. In 2020 Grillo's technology became an open-source solution, 'OpenEEW', supported by IBM and the Linux Foundation. OpenEEW now has a global community of developers contributing constantly to its development. The technology is well documented and is available for anyone to distribute, modify and use for any purpose. It features the information for making the seismic sensors and software for earthquake detection and alerting. It also features over 1TB of sensor data that has been published since 2017 to advance research through the AWS Open Data program[7]. By open sourcing the technology we developed over the last 5 years, Grillo's ability to scale its impact has dramatically increased. Already the OpenEEW community, with Grillo's leadership and support, is generating community-run networks in Nepal, New Zealand, and Chile. Since the official launch in August 2020 OpenEEW has attracted over 200 members to the community on Slack, and there are over 30 contributors to the technology in Github. The full schematics of the sensor and code are all published here: https://github.com/openeew.

3.12. We aim to establish and test the feasibility of a lightweight low-cost EEW system in south Haiti. Primarily, we will concentrate on evaluation of the system latency that is a crucial parameter of EEW systems as it determines the actionable time that is available for the user to take protective action.

3.13. We will evaluate the key factors that affect the alert time, including network configuration, data transmission latency, signal processing speed, and test alert delivery latency. We will adjust and improve the system throughout the experiment to minimize the alert time. Results from the Grillo pilot station deployed in Haiti show mean station-to-server data transmission latency of ~280 milliseconds and suggest that internet connection does not represent a major bottleneck of the system (ANNEX XI). Further, by depending on sensors located within the Digicel infrastructure the system will always get the most optimum latencies possible.

3.14. Grillo is concentrating primarily on alert generation and concrete implementation and the breadth of the alert delivery depends on the country/region and should be implemented in collaboration with local institutions with thorough understanding of the user needs. Extensive outreach and educational activities need to accompany the implementation of the system to make sure that users will take the right

[6] Kuna, V. M., Melgar, D., Meira, A., in prep. Evaluation of the Grillo sensor, a low-cost accelerometer for IoT-based Real-time seismology, preprint published via Earth ArXiv, doi: 10.31223/X5XS47.

[7] Data is published through AWS open data registry: https://registry.opendata.aws/grillo-openeew/

protective action. As part of this project, Grillo will be conducting workshops with local communities in collaboration with Digicel to evaluate the best alerting system and messaging.

3.15. No country in the Caribbean has a functioning EEW system that issues alerts to the public. By realizing the Grillo EEW, it should be possible to mitigate loss of life and injury in future earthquakes in Haiti through the alerts.

B. Description of the Beneficiaries

3.16. The Haiti-EEW is an infrastructure that will benefit all Haitians in the south of Haiti and Port-au-Prince. The alerts generated by this infrastructure can be widely broadcast through apps and SMS to reach a large number of Haiti's population.

3.17. In addition to Digicel customers, the budget includes 5 alarm devices with loudspeakers to be installed in schools near Les Cayes, which will protect hundreds of school children (school buildings can be more vulnerable than residences to collapse due to larger roof spans).

3.18. This project will serve as a proof of concept which can be replicated in neighboring Dominican Republic, and later other countries in the Caribbean (as well as globally).

3.19. Earthquakes do not respect geo-political boundaries, and so having a regional system that spans across countries will allow the alerts to protect more people. Alerts generated in one country can be of benefit to a neighboring country. For example, an earthquake in Haiti might generate an alert that can benefit citizens of the Dominican Republic. Grillo already has established a network of 100 sensors in Puerto Rico (with partners AWS, IBM, Puerto Rico Seismic Network, Walmart, Clinton Foundation, and others) - these alerts, for example, will be added to the overall regional system and help protect neighbors such as the Dominican Republic and Virgin Islands.

C. Key KPIs

3.20. The project's main goal is to mitigate loss of life and injury from earthquakes by detecting early stages of an earthquake, issuing alerts, and providing critical time for users to seek cover or exit a building. KPIs should be set to enable to the team to focus on measurable performance. The project will make use of the public dashboard developed by Grillo to easily visualize progress and allow monitoring of the system in real-time (status of sensors + earthquake events).

3.21. As outlined in the Results Matrix on annex I, the three main project's outcomes are as follows:

i. <u>Geographic coverage</u>: with a target of three (3) cities or towns to be covered but the system during the pilot phase.

ii. <u>Number of beneficiaries</u>: with at least 5 thousand people receiving alerts from the system.

iii. <u>Replicability/expansion</u>: where the system will be replicated or adapted in at least of another country or expanded in another region of Haiti.

IV. THE PROTOTYPE EXECUTION STAGES

A. Definition Stage:

4.1. Grillo's alerting system will need to be modified for Haiti, which requires unique earthquake detection and characterization algorithms. The new algorithms will be trained on data generated from the deployed sensors in Haiti (as well as previous deployments e.g., Mexico) and ensure that an optimal ratio is achieved between speed (how fast do users get the alerts) and accuracy (avoiding false positives and false negatives). This method for developing region-appropriate algorithms can be replicated in future deployments (e.g., Dominican Republic, Guatemala, Ecuador etc.)

4.2. When an earthquake is detected, the system will determine its magnitude and location and issue a test alert. This is done in real-time using the Amazon Web Services (AWS) cloud infrastructure.

4.3. Alerts for this project will be sent to Grillo alarm devices and phones on the Digicel network. The alarm devices (to be deployed in 5 schools), will be Internet-of-things devices with a loudspeaker and an internet connection. The phone alerts will be developed jointly by Grillo and Digicel and could comprise of a mobile app or broadcast SMS.

B. Implementation Stage:

4.4. Grillo sensors are required to continuously monitor the ground motion and transmit real-time data to the cloud server for further processing which can lead to alerts. The sensors Grillo uses are typically housed indoors with a Wi-Fi connection. For this project, the sensors will be placed inside a waterproof enclosure for outdoor installations, and ethernet connectivity for use with Digicel cell towers.

4.5. Initially 10 sensors to be installed on cell tower sites around the August 14th, 2021, earthquake epicenter in locations that are available around Petit-Trou-de-Nippes. These 10 sensors will allow quick data collection.

4.6. This will be followed by an additional 90 sensors. These sensors will add density and redundancy to the network and allow for faster and more precise alerts, as well as fewer possibilities for missed alerts.

4.7. Digicel will assist with installation of the sensors in their cell towers where available. Once the first 10 sensors are active, Grillo will begin testing the system through the real-time data. If there are no earthquakes that are detectable, then the system will be tested using historic data from USGS or other sources, which can be fed into the detection system artificially.

4.8. The data from this project will be shared as open-source data using the AWS open data program. Here Grillo already shares data from its other networks. This open data sharing allows experts around the world to learn from our work, provides transparency to the project which helps with validation, and allows our open-source community to work with the data and help improve the technology.

C. Evaluation and Knowledge Dissemination Stage:

4.9. Evaluation of the system's performance will concentrate on these aspects of the system:

a. **Alert timeliness**: The alert time, that is, the time elapsed between the origin of an earthquake and the alert delivery to a user is a critical parameter of an EEW system. Together with the user's distance from the earthquake epicenter, the alert time determines the actionable time available for the user to take protective action. The key aspects defining the alert timeliness include the network configuration, data transmission latency, signal processing speed, and the latency in alert delivery. The system will be adjusted and improved throughout the experiment to minimize the alert time. Knowing the precise alert time will also enable us to compute theoretical actionable times for different scenarios of strong earthquake occurrence.

b. **Alert reliability**: The EEW system needs to be able to reliably recognize strong earthquakes from smaller ones and from other natural or human-made signals. We will evaluate the system's reliability in earthquake detection and magnitude and location determination.

c. **System sustainability**: The system is designed to be a long-term EEW solution for Haiti. We will establish a framework for the future continuation of the project to secure its sustainability.

d. **User feedback**: It will be important to understand how well users are prepared for future alarms emitted from this system.

4.10. The final emitting of alerts as a public tool will only be done once the Haitian government is onboard. Ideally, this project should be done in coordination with the government so that established public safety protocols are met, and alert messaging is approved. Once the testing/pilot phase has been completed, Grillo will present a public dashboard that allows monitoring of the system in real-time (status of sensors + earthquake events) to the local authorities. This dashboard will be a valuable tool and a good selling point to the Haitian authorities to support and expand this project after the duration of the prototype.

V. EXECUTION AGENCY AND ARRANGEMENTS FOR EXECUTION:

A. Executing Agency

5.1. **Grillo** offers an EEW solution that is especially suited to developing nations. The technology was developed and tested in Mexico with grants from USAID and others. The technology has been proven to be more effective than SASMEX, which has cost the Mexican government 10s of millions of USD over 2 decades. Grillo is now deploying the solution in the Caribbean, starting with Puerto Rico, and now Haiti. Even though a globally accepted certification does not exist for this type of technology, Grillo continues to follow the sector's best practices and is in compliance with environmental, social and safety requirements.

5.2. wholly owned by Grillo Holdings Inc. is a Delaware C-Corporation formed in 2015 which owns wholly Grillo Sistemas S.A.P.I., a Mexican company also formed in 2015. Grillo has delivered contracts for Harvard University, AXA insurance and others, and has received grants from USAID, IBM, Roddenberry Foundation, and others.

5.3. The CEO of Grillo, Andres Meira, had lived in Haiti from 2010 to 2013 working on reconstruction projects to alleviate the issues that arose from the 2010 earthquake. From there Andres had moved to Mexico and formed Grillo, which analyzed the Mexico City EEW (SASMEX) and developed a competitive system that could one day be applied in Haiti and other developing nations that have no EEW in place or

in development and could never afford a traditional EEW. Grillo's staff is experienced and has a proven track record of implementing similar solutions across the LAC region.

5.4. Grillo is working with various global partners for this project and others in the region to expand its solution and reach a bigger scale where its financial sustainability can be guaranteed. More details about the scalability plan are given below in section 6B.

5.5. **Other strategic partners** include:

5.6. **Digicel** is the leading telecommunications company in Haiti. They have agreed through a Memorandum of Understanding (MOU) with Grillo to locate sensors at their cell towers, assist with logistics of installations, help develop an alerting system which could include SMS broadcast to all Haitian Digicel users, and make introductions to relevant Haitian governmental authorities.

5.7. **Clinton Global Initiative** (CGI) is assisting Grillo with formation of partnerships (e.g., Digicel), seeking funding, and promotion of the project. Grillo will be announcing this project soon as a CGI Commitment to Action.

5.8. **Amazon Web Services** (AWS) has provided funds for the initial 10 sensors, and credits for its cloud servers. This will help reduce costs and maintain the project for the next 1-3 years. AWS also is providing technical guidance for this project.

B. Implementation Mechanism

5.9. Grillo will coordinate all activities for the project. This includes

i. Liaising with suppliers to fabricate and assemble the sensors and alarm devices.

ii. Ensuring that Haitian partners, such as Digicel can deploy and install devices. This includes agreeing locations based on analysis of historic seismicity, finding schools to install alarms in, transporting goods to locations, providing guidance on correct installation procedures, helping with maintenance.

iii. Working with Haitian partners to prepare presentations with local Haitian authorities for approval as a public utility.

iv. Working with AWS to keep the cloud systems in operation and keep data in the public domain through their open data program.

v. Keeping IDB informed of progress with reporting.

vi. Working with beneficiary communities, such as the schools that receive alarms, to educate on how to react to earthquakes, and how the system will work for them. This also will allow feedback as to how the service may need to be modified.

5.10. Monthly meetings will be planned with the key partners such as Digicel, Clinton Foundation and AWS to keep everyone informed of progress.

VI. ALIGNMENT WITH IDB GROUP, SCALABILITY, AND RISKS

A. Alignment with IDB Group

6.1. **Alignment with the IDB Lab Strategy:** The project contributes to the Inclusive Cities strategy of the IDB Lab, promoting the application of innovative technology

to reduce the risk of injuries and loss of life, and improve the livelihoods of the inhabitants of Haiti.

6.2. **Alignment with the IDBG**: the project is aligned with the IDBG Country Strategy with Haiti 2017-2021 (GN-2904), most notably the following relevant area: render key public services more accessible to enhance human development. The project will also contribute to cross-cutting themes including greater climate change resilience, protection of the environment and gender equality.

6.3. The project is complementary to the work and objectives of IDB's Rural Development (RND) and Disaster Risk Management sectors. Multiple lessons learned and best practices from IDB projects such as "National Program of Flood Early Warning (HA-L1005)" and "Program to Strengthen the National Early Warning System (EC-L1221)", have been used for the design of this project to mitigate risks and ensure a successful implementation.

6.4. These lessons learned include finding alternative solutions to Haiti's lack of infrastructure, selecting the right governance structure and a strong public local counterpart/partner, and adding as much automation as possible in the system to limit human delays and errors.

6.5. Furthermore, the project contributes to the following Sustainable Development Goals:

6.6. SDG 9 – Industry, Innovation, and Infrastructure; A) Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological, and technical support to African countries, least developed countries, landlocked developing countries and small island developing States.

6.7. SDG 11 – Sustainable Cities and Communities; 11.5) By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

B. Scalability / Replicability

6.8. Grillo's systems have been running in Mexico since 2017, and smaller networks were created in Chile and Costa Rica. Currently, a dense network of over 100 sensors is being implemented in Puerto Rico, and additional networks are being created by members of Grillo's open-source community in Nepal and other countries.

6.9. The focus of this solution has been scalability. To ensure this is achievable, a few factors were fundamental to the design of the system:

i. Low-cost hardware: The devices are made using readily available parts from China and the US. The enclosures are made from sturdy 3d printed materials.

ii. Cloud computing: the processing of data in real-time, detection of earthquakes, and monitoring of the system is all done in the cloud. This relieves the project from having to buy and maintain several servers. This also allows for fast replication in new regions. Also, traditional government EEW systems often build dedicated radio infrastructure (e.g., SASMEX) that can take decades and millions of USD to create. This is not necessary with the internet.

iii. Rapid deployment: By designing a system that only triggers when magnitude 3 or higher earthquakes occur, it is possible to install the sensors in 'noisy' locations that traditional seismic equipment would not permit. This means that telecommunications towers, schools, hotels etc. are all available. This allows for fast deployment given that civil infrastructure works are not necessary.

6.10. The immediate goal is to deploy the solution throughout Haiti, following the initial results of the pilot. For this to be possible, the Government of Haiti will need to validate the findings and enter a service contract with Grillo. Furthermore, Grillo has entered discussions with USAID for a potential financing to expand on the work of this pilot in Haiti. This would mean additional funding for working on messaging and ensuring behavioral change, ensuring that people react correctly to alerts, and most importantly expanding to a national system.

6.11. Using these benefits discussed above, the next phase will be to extend the solution to the neighboring Dominican Republic. This will start the creation of a regional Caribbean EEW system.

6.12. To prepare for the deployment in the Dominican Republic, which will be an important step towards a Caribbean regional EEW, Amazon has committed to donating funds for an additional 100 sensors to be deployed there. Also, Grillo has now contacted the Centro Nacional de Sismología in the DR, as getting approval from this authority will help with getting public approvals for the system, as well as Banco Popular for potential locations to install sensors.

C. Risks

6.13. Haiti has in 2021 become destabilized politically since the assassination of the president. This presents risks to the project with regards to safety as there are gangs who have control of areas where we plan to install sensors. Mobility around the country has been affected and placing sensors will now take more time than before. To mitigate this, Grillo's partnership with Digicel (MOU attached in the Annex) is key to the success of the project. Digicel has agreed to take the sensors using their people and vehicles and install them at the cell sites. Given that this is a logistical challenge they are already meeting, this will ensure that the deployment is not halted, although we do anticipate that there may be schedule disruptions in the future.

6.14. Currently there are gas shortages in Haiti. This will also affect Digicel's ability to install sensors around the country. We expect that this will be resolved soon given the political pressure around this issue. We do however anticipate in the short term that deployment schedules may be affected.

6.15. Ensuring future funding for the project is also a risk. An EEW needs to be maintained over many years as earthquakes occur infrequently and the system must be in place when needed. To mitigate this, we have kept the maintenance of the system as simple as possible by using Digicel infrastructure. The cost of replacing sensors, cloud computing and continuous development will need to be met, and we will seek funding from the Haitian government (financed via World Bank or similar) for these annual costs.

6.16. Lastly, the world is still adjusting to the reality of living in a pandemic. With the emergence of new variants, there is the risk of countries adding new restrictive traveling measures that may affect the project's operations. The partnership with Digicel is a good mitigation strategy as Digicel has strong local operations and will

be responsible for the logistical efforts of this project (including the installation of the sensors). Therefore, Grillo can ship sensors from Mexico, and maintain the system remotely. The workshop schedules may be affected but Grillo is already evaluating alternative solutions which may include working with local NGOs via video.

D. Special Conditions and Exceptions

6.17. The TC may have more than three procurements, which is an exception to the guidelines for TC Prototypes as established in MIF/AT-1565.

VII. SUMMARY BUDGET

7.1. The project has a total cost of US$190,000, of which US$144,000 (75.8%) will be provided by IDB Lab, and US$46,000 (24.2%) by the counterpart.

7.2. The instrument to be used is a non-reimbursable technical cooperation prototype to pay for the technical development, adaption, and deployment of the systems (software engineering, IOT engineering, seismology), and to cover the cost of evaluation and knowledge dissemination through workshops in Haiti.

Project Categories	**IDB Lab**	**Counterpart**	**Total**
1. Definition	$102,000	-	$ 102,000
2. Implementation	32,000	46,000	78,000
3. Evaluation & Knowledge Dissemination	10,000	-	10,000
Grand Total	**$144,000**	**$46,000**	**$190,000**
% of Financing	**75.8%**	**24.2%**	**100%**

VIII. COMPLIANCE WITH MILESTONES, FIDUCIARY AND REPORTING ARRANGEMENTS

8.1 **Disbursement by Results.** The EA will adhere to the standard IDB Lab disbursement by results as established in the "Operational Guidelines for Management of Milestones and Financial Supervision for IDB Lab and PES Technical Cooperation Projects" (updated in 2019). Monitoring will be undertaken in accordance with the performance and risk management policies (fulfilment of milestones) established in these Operational Guidelines. Project disbursements will be contingent upon verification of the achievement of milestones. These milestones will be verified using their means of verification, which will be agreed upon between the EA and the IDB Lab. Achievement of milestones does not exempt the EA from the responsibility of reaching the logical framework indicators and the project objectives.

8.2 **Project Supervision.** The Project will be associated with the Line of Activity RG-O1676 in Bank systems. It will be supervised by the IDB Lab Specialist based in the Haiti IDB Country Office and executed in coordination with the Project Team for RG-O1676.

8.3 **Procurement**. The Executing Agency shall have a procurement policy in place to ensure that Project-related procurement is done at competitive market prices. It shall also prepare a procurement plan (the "Procurement Plan") acceptable to the

Bank, that describes the contracts for goods and services required to carry out the Project, including the estimated cost of each contract, and the proposed methods for acquisition of its goods and services, including consultants' services. The Bank may request annual reports on execution of the Procurement Plan by the Executing Agency. Implementation of the procurement policies, terms of reference, and contracts for the acquisition of goods and services, as well as the Procurement Plan and fulfillment thereof may be subject to ex ante review or ex post supervision by the Bank, at its discretion.

8.4 **Financial Management:** Disbursements will be made in accordance with the Financial Management Guidelines for IDB-Financed Projects (OP-273-12) July 2, 2019 or future updates. The Executing Agency shall maintain *financial data and internal accounting and administrative control systems acceptable to the Bank* to provide the necessary documentation to permit verification by the Bank of the procurement and expenditures for the Project and facilitate the timely preparation of financial statements, budgets, and reports. The Bank reserves the right to audit all financial statements, internal controls, procurement, or other aspects of the Project.

8.5 **Financial Statements.** The Executing Agency shall prepare and make available for the Bank its annual financial statements, which must be certified by an external auditor acceptable to the Bank and include a note on the use of the Contribution and Counterpart Resources for the Project. The financial statements must be submitted to the Bank within 90 calendar days of the close of each fiscal year. Together with its annual financial statements, the Executing Agency must submit to the Bank a certification of integrity, transparency, and use of funds in the format to be outlined in the Technical Cooperation Agreement.

8.6 **Bank Executed Projects:** In cases where the EA is the Bank, the TC will be implemented in accordance with Bank-Executed Operational Work of the IDB (GN-2765).

8.7 **Project Status Reports:** The Executing Agency is responsible for presenting a PSR to the IDB Lab within 30 days following the end of each semester or more frequently if required by IDB Lab. The PSR must include information on the implementation of the project, results obtained and contribution to reaching the project objective as presented in the Result Matrix (Annex I) and other planning instruments. Additionally, the document must include information on challenges encountered during the implementation period and possible paths to address these challenges. Within 90 days of finishing the execution period, the Executing Agency will present to IDB Lab a Final PSR giving priory to reporting on key results achieved, a sustainability plan, scaling up strategy and lessons learned.

8.8 **Project Coordinator:** The Executing Agency will appoint a Project Coordinator either from its existing staff or at its own cost. Expenses relating to project coordination and/or administration costs are not eligible under the IDB Lab contribution, rather such expenses must be financed by the counterpart contribution. The Project Coordinator shall have overall responsibility for the management of the project, including submission of PSRs, tracking milestones and results and coordination with IDB Lab.

APPROVAL

This Technical Cooperation Prototype is recommended and approved for funding under IDB Lab's Line of Activity for Innovation Prototypes MIF/GN-123 (project number RG-O1676, document number MIF/AT-1565, and resolution number MIF/DE-8/19).

Recommended by: Jean Emmanuel Desmornes and Adrien Dewalque (IDB Lab Co-Team leaders)

Approved by: ______________________ **Date:** 11 fevrier 2022

Yvon Mellinger, IDB Country Representative in Haiti