Scientific Data: A Tool to Counter Misinformation in the Ituango Hydroelectric Project

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ABSTRACT

Large infrastructure projects are often evaluated in terms of technical, environmental, and financial risks. However, the experience of the Hidroituango Hydroelectric Project in Colombia demonstrated that uncertainty and misinformation can become critical risk factors in their own right, particularly during emergency and recovery phases.

Following the 2018 contingency, the project faced not only a complex engineering challenge but also widespread public concern, media pressure, misinformation, and growing distrust among stakeholders. In response, the project strengthened its technical monitoring capabilities through the creation of an integrated Technical Monitoring Center (CMT), combining real-time instrumentation, geotechnical monitoring, remote sensing technologies, and multidisciplinary technical analysis. Equally important, the project implemented a strategy focused on transparency and proactive communication, making scientific information accessible to communities, authorities, and oversight institutions.

This paper describes how the integration of scientific monitoring, data traceability, and transparent communication contributed to reducing uncertainty, supporting evidence-based decision-making, and rebuilding trust during the recovery of one of Colombia's most important infrastructure projects. The experience highlights the role of scientific data not only as a technical management tool but also as a key element in countering misinformation and strengthening stakeholder confidence in complex infrastructure developments.

1. INTRODUCTION

The Hidroituango Hydroelectric Project is the largest hydropower development in Colombia and one of the most significant infrastructure projects ever undertaken in the country. Located on the Cauca River, the project includes a 235-meter-high dam and a planned installed capacity of 2,400 MW, making it a strategic asset for Colombia's energy security.

In 2018, the project experienced a major contingency following the blockage of an ancillary diversion gallery. The resulting situation created a complex emergency scenario at a critical stage of construction, when neither the dam nor the spillway had yet been fully completed. The event generated significant concern regarding the safety of downstream communities and required extraordinary engineering and risk management decisions.

While considerable attention has been given to the technical aspects of the contingency and subsequent recovery, the experience also revealed another challenge: the rapid spread of uncertainty and misinformation. During both the emergency and recovery phases, technical information often struggled to keep pace with rumors, speculation, and public narratives that amplified fear and distrust.

This paper examines how scientific monitoring, integrated data management, and transparent communication were used to address this challenge and support the recovery of the project.

2. FROM TECHNICAL EMERGENCY TO INTEGRATED RISK MANAGEMENT

The immediate priority during the contingency was the protection of human life and the environment. Decisions were guided by three fundamental principles: protecting people, safeguarding environmental conditions, and subsequently recovering the project. Consistent with these principles, a precautionary evacuation of downstream communities was implemented as a risk management measure during the emergency.

However, the emergency quickly evolved into more than a technical challenge. The event occurred under conditions of genuine technical uncertainty, as engineers and authorities were required to make critical decisions in an unprecedented situation. At the same time, media reports, public speculation, and misinformation circulated widely, often presenting extreme scenarios regarding potential dam failure, uncontrolled infiltrations, or catastrophic downstream consequences.

Public concern was therefore understandable. Communities were facing a situation for which there were few precedents, while technical assessments were evolving as new information became available. This combination of real uncertainty, constant questioning, and growing distrust demonstrated how risk perception can be shaped not only by technical conditions but also by the information environment surrounding an event.

During the emergency, calls to dismantle the project emerged from different stakeholders, including politicians and other public actors. However, technical evaluations indicated that abandoning the project would have created even greater risks than its controlled recovery. This experience highlighted the importance of integrated risk management, combining scientific assessment, continuous monitoring, early warning systems, preparedness, and emergency response.

As the recovery progressed, scientific understanding of the project's behavior steadily improved through extensive technical assessments and continuous monitoring. Nevertheless, misinformation continued to generate concern among stakeholders. In some cases, community protests and roadblocks affected stabilization activities. False alerts regarding potential rock mass instability before the commissioning of the generating units also contributed to unnecessary evacuations and heightened public anxiety.

These experiences demonstrated that technical solutions alone were not enough to rebuild public confidence. Scientific evidence also needed to be understandable, accessible, and verifiable by those affected by the project.

3. RECOVERY SUPPORTED BY SCIENTIFIC EVIDENCE

Based on this integrated risk management approach, the recovery of the Hidroituango Project focused on safely restoring the project, as its recovery and subsequent operation represented the most effective strategy for reducing the risks created by the emergency.

Achieving this objective required highly complex engineering activities, including underwater works on intake structures, tunnel plugging operations using innovative methods, treatment of underground cavities, and the complete reconstruction of the powerhouse.

Given the scale and complexity of these interventions, every major engineering decision relied on scientific evidence, continuous monitoring, and multidisciplinary technical analysis. Rather than following predetermined assumptions, recovery activities were continuously adapted according to observed conditions, instrument readings, and ongoing technical assessments.

This evidence-based approach became a cornerstone of the recovery strategy. Continuous scientific monitoring not only supported safe engineering decisions but also generated the reliable information needed to demonstrate project stability and support transparent communication throughout the recovery process.

4. THE TECHNICAL MONITORING CENTER (CMT)

A key component of this strategy was the establishment and consolidation of the Technical Monitoring Center (Centro de Monitoreo Técnico, CMT).

The CMT integrates a multidisciplinary team that operates 24 hours a day, 7 days a week, continuously assessing project conditions through a network of more than 3,600 instruments installed across both surface and underground structures. These instruments monitor a wide range of variables, including deformations, displacements, pressures, seepage conditions, and other geotechnical parameters.

To complement conventional instrumentation, the CMT integrates several monitoring technologies operating at different spatial scales:

- Interferometric radar systems for real-time deformation monitoring of the dam and surrounding rock mass.
- Satellite-based observations to assess large-scale slope behavior around the reservoir and downstream areas.
- Seismic monitoring networks to evaluate ground motion and structural response.
- Hydrometric stations that provide flow monitoring and flood forecasting capabilities.

The integration of these data sources enables a comprehensive understanding of project behavior in real time and supports informed operational and risk management decisions.

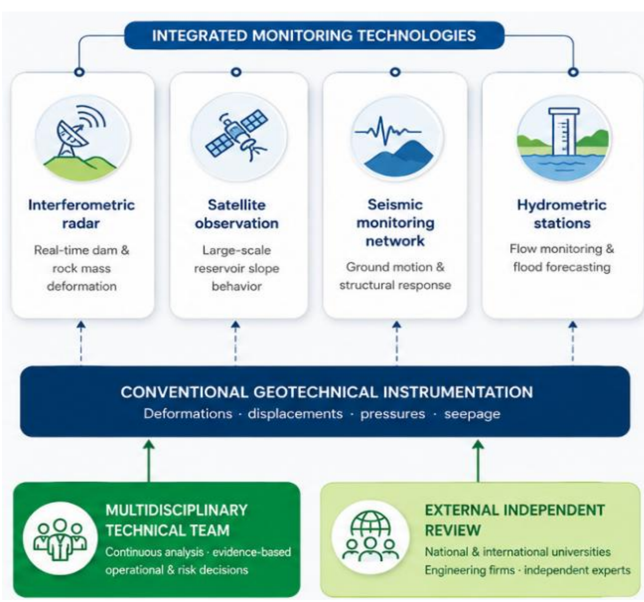

Figure 1. Technical Monitoring Center (CMT), EPM

Importantly, technical analyses and monitoring results have also been reviewed by national and international universities, engineering firms, and independent experts. This external review process helped strengthen confidence in the information generated by the monitoring program, reduce potential biases, and provide additional verification of the technical assessments.

The experience demonstrated that generating data was not enough. For scientific information to support decision-making and build trust, it also needed to be understandable, accessible, and verifiable by different stakeholders.

5. COMMUNICATION AS A RISK MANAGEMENT STRATEGY

One of the principal lessons learned during the recovery process was that technical monitoring alone is insufficient in contexts characterized by high uncertainty.

Reliable information only contributes to informed decision-making when it is accessible, understandable, and trusted by stakeholders. For this reason, the project adopted a communication strategy aimed at increasing transparency and facilitating public access to scientific information.

Monitoring results and technical assessments have been shared through multiple channels, including technical reports, public information displays, visits to the Technical Monitoring Center, project tours, community meetings, radio broadcasts, and digital communication platforms. Beyond keeping stakeholders informed, this strategy enabled them to better understand the complex engineering works required for the project's recovery, directly verify the stability conditions of the infrastructure through scientific evidence, and contrast technical explanations with monitoring data. Transparency therefore became an essential complement to technical monitoring, helping bridge the gap between scientific evidence and public perception.

The experience demonstrated that scientific information creates value only when it is visible, understandable, accessible, and verifiable. Otherwise, alternative narratives, often lacking technical foundation, may dominate public discourse.

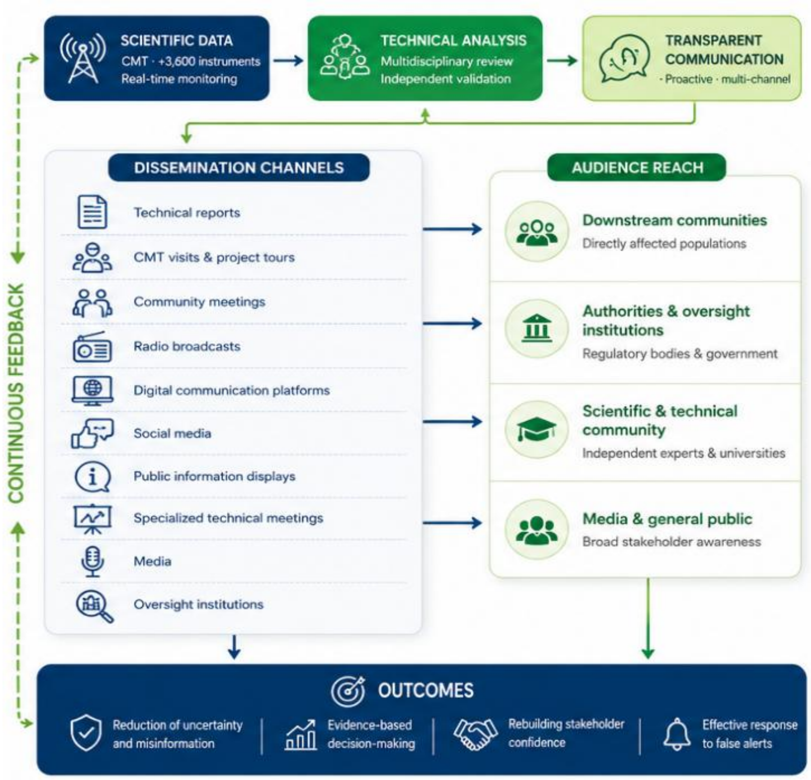

Figure 2. Communication and dissemination framework, EPM

6. OUTCOMES AND LESSONS LEARNED

The integrated approach combining scientific monitoring, technical analysis, and transparent communication contributed significantly to the recovery and operation of the project.

Today, four generating units are in operation, contributing approximately 1200 MW of clean energy to Colombia's electricity system while the project continues progressing toward its full installed capacity.

Beyond technical and operational achievements, the recovery process has also contributed to rebuilding confidence among downstream communities. The continuous sharing of monitoring results and project information has helped stakeholders better understand project conditions and the measures implemented to manage risks.

Many people from surrounding communities are directly involved in the project through employment opportunities and have benefited from social investment programs, environmental initiatives, infrastructure improvements, and financial transfers that support local development.

Several key lessons emerged from this experience:

- Technical monitoring is necessary but not sufficient for managing uncertainty.
- Scientific data must be transparent, understandable, and verifiable.
- Communication should be proactive rather than reactive.
- Integrated monitoring systems strengthen both decision-making and stakeholder confidence.
- Trust is built not only through technical performance but also through transparency and engagement.

7. CONCLUSIONS

The Hidroituango experience demonstrated that scientific data can play a role far beyond traditional engineering applications. During the recovery of a complex infrastructure project, scientific evidence became not only the basis for technical decision-making but also an essential component of effective risk management.

One of the main lessons from this experience is that reducing risk did not depend solely on engineering interventions. It required safely recovering and operating the project through scientific monitoring, rigorous technical analysis, independent review, and transparent communication.

For infrastructure projects operating under heightened public scrutiny, scientific information creates value only when it is understandable, accessible, verifiable, and openly communicated. Under these conditions, it becomes a powerful tool for reducing uncertainty, countering misinformation, and strengthening stakeholder confidence.

Ultimately, the Hidroituango experience suggests that transparency is not simply a communication principle, it is a fundamental component of effective risk management. Reliable scientific information must not only be generated; it must also be communicated before misinformation fills the gap.