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# Managing safety in hydropower projects in emerging markets – Experiences in developing from a reactive to a proactive approach

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ABSTRACT

International companies investing in emerging markets need to address the management of safety under varying conditions. The paper presents an evaluation of the approaches taken by an international hydropower company in two different construction projects, one in India and one in the Philippines. In the first project, the company had to intervene as a reaction to poor safety and overall performance. Based on previous experiences, the company selected a proactive approach in the second project, involving use of the contracting process to ensure adequate conditions from the start of construction and onwards. The paper accounts for the safety performance results in the two projects and interprets them in relationship to external and internal influencing factors in the respective project. It is concluded that a proactive approach has the potential of delivering satisfactory safety results at moderate costs for follow-up. A reactive approach risks exposing the company to ethical and reputation risks due to a poor safety performance before the corrective actions have taken full effect. It is also resource demanding. Results demonstrate the feasibility of turning around a project's safety performance also when preconditions are challenging.



## 1. Introduction

Electric power is vital for increased wealth in developing countries. In the two countries of current interest in this paper, India and the Philippines, there is a well-documented positive correlation between growth in electricity demand and in gross domestic product (IHS Global Insight, 2010; CEA, 1999–2009). During 1999–2009, the gross domestic product in India rose by 86% at the same time as the growth in electricity demand was 61%. The corresponding figures for the Philippines are 52% and 46% respectively.

The increased production of electricity in the two countries has largely come about through investments in thermal plants with coal as the dominating source of energy. In 2003–2004, thermal power plants accounted for 85% of the electricity generation in India (India Ministry of Power, 2010). The figure for the Philippines is 56% (Del Callar, 2006). Whereas coal fired thermal plants used to be highly pollutant, new cleaning technologies have reduced the local emissions to low and tolerable levels. Electricity generation by thermal plants is still not considered sustainable due to its effect on climate change through emissions of large quantities of carbon dioxide.

Hydropower plants have the advantage of relying on a renewable energy source. Their emissions of climate gasses depend on location and design and may be insignificant. Their contribution to electricity generation has been relatively small. In India, hydropower plants accounted for 14% of the electricity generation in 2003–2004 (India Ministry of Power, 2010). The corresponding figure for the Philippines was 19% (Del Callar, 2006). A main obstacle to the development of hydropower plants has been their effect on the environment and the local communities through river diversion, regulation of water flow, flooding and erosion and relocation of people. Plans for hydropower development often lead to protests and social unrest. Many of the negative environmental and social consequences may be prevented or compensated for through careful planning and design (IHA, 2004).

Smaller hydropower plants are generally not considered to be as intrusive to the environment and local society as large plants. Dams can be reduced in size or avoided altogether, thus avoiding many of the problems of flooding, erosions and needs of relocation of people.

One aspect often overlooked is the high risk of accidents in hydropower development projects. The construction industry is generally characterised by a high risk of accidents. According to ILO estimates, 100,000 workers are killed annually on construction sites globally, which means that the fatality rates in construction is five times the general average among employees worldwide (Murie, 2007).

Historical data show that hydropower projects in particular have been associated with many severe accidents. In Norway, for

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example, hydropower played an important role in the development of infrastructure during the last century, and high fatality rates were tacitly tolerated by society. There were 23 fatalities in the Tokke 1GW project, which was completed during the period 1956–1972 (Skjold, 2006). Improved technology that reduced the number of workers at the risk exposed sharp end, and improved safety management routines decreased this number. The Ulla-Førre 2GW project was completed between 1974 and 1984 with three fatalities. There were zero fatalities in the 182 MW Tyin project in 2001–2004.

There is no reliable statistics on fatalities in hydropower projects in India and the Philippines. Accident rates in the general construction industry are high, especially in India with the world's highest accident rate among construction workers according to ILO estimates as quoted by RICS (2009).

There are no reliable accident statistics for the Philippines. The Bureau of Labor and Employment Statistics in the Philippines reported four fatalities in construction in 2003 which is likely far too low (BLES, 2008).

### 1.1. This paper

This paper reviews the experiences of an international hydropower company (IHC), owned by the Norwegian government, and involved in developing and operating hydropower facilities in emerging markets primarily in joint ventures with indigenous partners. The company primarily invests in smaller, run-of-river plants. The company's policy is to invest on commercial terms and ensure an adequate health, safety and environmental standard in the construction and operation of hydropower plants. This is accomplished through the promotion of internationally-recognised power industry standards, and transfer of competence gained through the development of hydropower projects in Norway.

In the start-up phase from 2002, the IHC took the role as financial investor and had limited resources for technical and managerial follow-up of investment projects. Experiences with cost overruns, delays and poor safety performance in the company's construction projects resulted in decisions to build up technical expertise and management systems for a closer follow-up of the investment projects. This build-up of resources took off in 2007.

The paper accounts for the experiences with two of IHC's projects from the start of construction until June 2010:

- A 196 MW Greenfield project in Himachal Pradesh in India, where construction started in 2005.
- A 75 MW Refurbishment project in Luzon in the Philippines with start of construction in 2008.

In the first project, IHC had to intervene as a reaction to poor safety and overall project performance when the project was three years into the construction phase. The second project illustrates a proactive position, where a new company policy on HSE management of construction projects was implemented in contract work and site follow-up. The paper addresses the following questions:

1. What has been the development in the overall safety performance in the two projects and to what extent can this be explained by IHC's reactive and proactive interventions respectively?
2. Have there been any specific weaknesses in the safety management during construction in the two projects indicating shortcomings in IHC's different approaches?
3. To what extent can the differences be explained by influencing factors beyond IHC control?
4. What resources have been marshalled by the IHC in the two cases, and what implications does this have on the efficiency of the two approaches?
5. Have there been any synergetic effects between safety and overall project performance and to what extent can this be explained by IHC interventions?

## 2. Materials and method

### 2.1. Overall analysis model

The analysis model underlying the study is shown in Fig. 1. It is assumed that the safety performance of each site is determined by the site specific construction process, which also includes the prevailing safety practice. This study focuses on the resources marshalled by the IHC and the actual interventions to improve safety at the sites and their effects on safety practices and performance. The results are interpreted in relationship to the moderating effects of project internal and external influencing factors.

### 2.2. Key data about the studied projects

The two projects were selected for this paper because they represent two distinct different approaches in the IHC's portfolio of construction projects when it comes to the company's follow-up of safety and overall performance.

Table 1 summarises some key facts about the projects.

The influence of the different characteristics of the projects on safety performance will be further elaborated in Section 3.2.

### 2.3. Points for intervention

#### 2.3.1. Reactive approach

In the Indian project, design as well as contract structure were decided before the IHC took on ownership. Before the intervention, the Indian project was followed up by the IHC through its representation on the JV Board and in the management committee and through periodic progress reports. At the start, there was no systematic safety performance reporting.

A technical expert was allocated to the project and visited the site regularly. The IHC had also recruited an international expert on tunnelling for secondment in the project.

It became evident in 2006–2007 to the IHC management that the safety and overall performance of the Indian project were not acceptable. This was one of the reasons why the company in 2007 decided to increase its resources for project follow-up in general. Technical staff was strengthened including the recruitment of a HSE manager at the end of 2007. Three fatalities in January 2008 (one involving transportation and two off-duty fatalities due to an avalanche) further underlined the severity of the situation. An internal report by the HSE manager early in 2008 documented the lack of

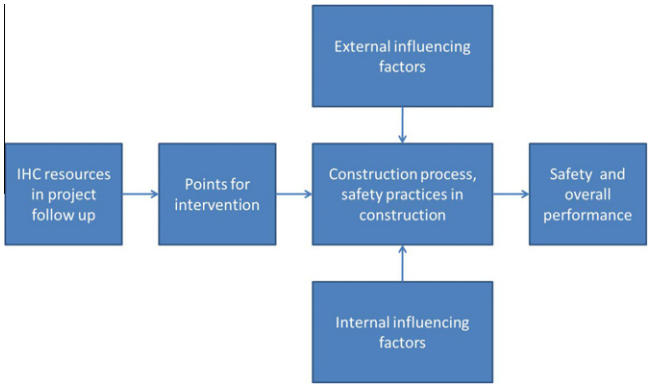


**Fig. 1.** Overall analysis framework.