APPLICATION OF A LOSS CAUSATION MODEL TO THE WESTRAY MINE EXPLOSION

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Lacking the simplest protective gear, miners struggle through toxic fumes to carry hundred-plus-pound loads of sulfur out of an active volcano in Java (Indonesia). Greedy for economic growth, the now defunct 32-year Suharto regime *paid scant attention to worker safety.*  

*National Geographic, March 2001*
This could never happen in Canada – or could it? (i.e. paying scant attention to worker safety)
OUTLINE

• Scope & Objectives
• Introduction
  – Westray
  – Loss Causation Model
• Model Components
• Lessons Learned
• Concluding Remarks
SCOPE & OBJECTIVES

• **Scope**
  - Case study developed using public domain resources (particularly Report of the Westray Mine Public Inquiry)

• **Objectives**
  - Systematically analyze accident causes
  - Identify lessons to be learned
  - Ultimately, prevent similar accidents in future
• Coal mining has been an integral part of Pictou County (Nova Scotia) history since the first commercial mine opened in Stellarton in 1807, to the closing of the Drummond mine in Westville in 1974. On September 11, 1991 Westray opened a new mine in Plymouth.

• At 5:20 am on May 9, 1992 after only eight months of operation, an explosion ripped through the mine killing 26 men who were underground at the time.
Pictou County – Northeastern Nova Scotia
Westray – Plymouth, NS
INTRODUCTION

Loss Causation Model

- Tool used in accident investigation to determine root causes
- Many variations of such models
- Domino model used here
- Structured method of identifying and categorizing multiple causes
- Management issues (inspectorsate and other government officials outside scope)
MODEL COMPONENTS

- Lack of Management Control
  - Inadequate: Program
  - Standards
  - Compliance

- Basic Causes
  - Personal Factors
  - Job Factors

- Immediate Causes
  - Substandard Practices
  - Substandard Conditions

- Incident
  - Event

- Loss
  - Unintended Harm or Damage
LOSS
Property
• Curragh Resources bankrupt
• Loan defaults (provincial and federal governments)
• Severance, worker’s compensation, pension plan, and UI payments
• Cost of criminal investigation and trial
• NS Power loss of coal
• Future wages/income/personal losses
Mine Layout

Legend
- Support
- Boom Truck
- Continuous Miner
- Dumper
- Fan
- Person
- Scoop Tran
- Stacker
- Shuttle Car
- Tractor
- Vent Tube
- Burnt Vent Tube
- Roof Bolter
- Rock Fall
- Fire
- Water

Source: Exhibit 74

Westray Mine
Post-Explosion

Scale: 1:5000
Information: Interviews
Date: May 1995
Prep. By: Andrew Harris
Coal Dust Explosibility

![Graphs showing the relationship between coal dust concentration and peak pressure (P_max) and peak rate of pressure rise (dP/dt)max.](image)
IMMEDIATE CAUSES
Substandard Practices

- Improper use of ventilation
- Poor housekeeping with respect to coal dust
- Continuation of mining in spite of inoperable methanometers
- Storage of fuel and re-fueling of vehicles underground
- Inadequate rock dusting
IMMEDIATE CAUSES

Substandard Conditions

- Inadequate ventilation system design and capability
- Poor state of mine roof
  - Frequent roof-falls
- Thick layers of coal dust
  - Unacceptably high level of combustible matter
- Inadequate system to warn of high methane levels
BASIC CAUSES

Personal Factors

- Lack of mining experience of personnel working in mine
- Lack of knowledge of safe underground work practices
- Physiological stress
  - Methane overexposure
  - Fatigue due to 12-hour shifts
- Psychological stress - fear of reprisal
- Improper motivation
  - Production at expense of safety
BASIC CAUSES
Job Factors

- Lack of proper orientation and training
- Inadequate follow-through from inspections
- Poor communication of standards (e.g. JOSH Co.)
- Inadequate purchasing of rock dust
- Inadequate leadership in terms of assignment of responsibility
- Lack of safe work practices and procedures
- Inadequate engineering during mine design and planning
LACK OF MANAGEMENT CONTROL
Inadequate Program Elements

- Management commitment and accountability to safety matters
- Management of change procedures
- Incident investigation
- Training
- Task definition and safe work practices and procedures
- Workplace inspections and hazard ID
- Program evaluation and audit
LACK OF MANAGEMENT CONTROL
Inadequate Program Standards

- Concern expressed by management toward safety matters
- Follow-through on inspections for substandard practices and conditions
- Action on hazard reports submitted by employees
- Job instructions for employees
- Equipment maintenance
- Scheduling of management/employee meetings to discuss safety concerns
LACK OF MANAGEMENT
CONTROL
Inadequate Compliance Factors

- Poor correlation between management actions and official company policy concerning relationship between safety and production
- Compliance to industry practice and legislated standards
  - Methane concentrations, rock dusting, control of ignition sources underground, etc.
**LESSONS LEARNED**

- *Don’t do things the Westray way!*
Pre-Contact Control

- **SYSTEM**
  - Loss Management System: PSM

- **ATTITUDE**
  - Internal Responsibility System: IRS
  - Everyone responsible for health and safety to extent of authority and ability
CONCLUDING REMARKS

- Loss causation model is a useful tool for identification of root causes of accidents
- Accident prevention requires leadership by management on safety issues
- Pre-contact stages afford greatest opportunities for loss prevention
- Loss management system and attitude towards safety go hand-in-hand