Impact of Winter Conditions on Construction Projects: Challenges and Mitigation Strategies

Submitted by

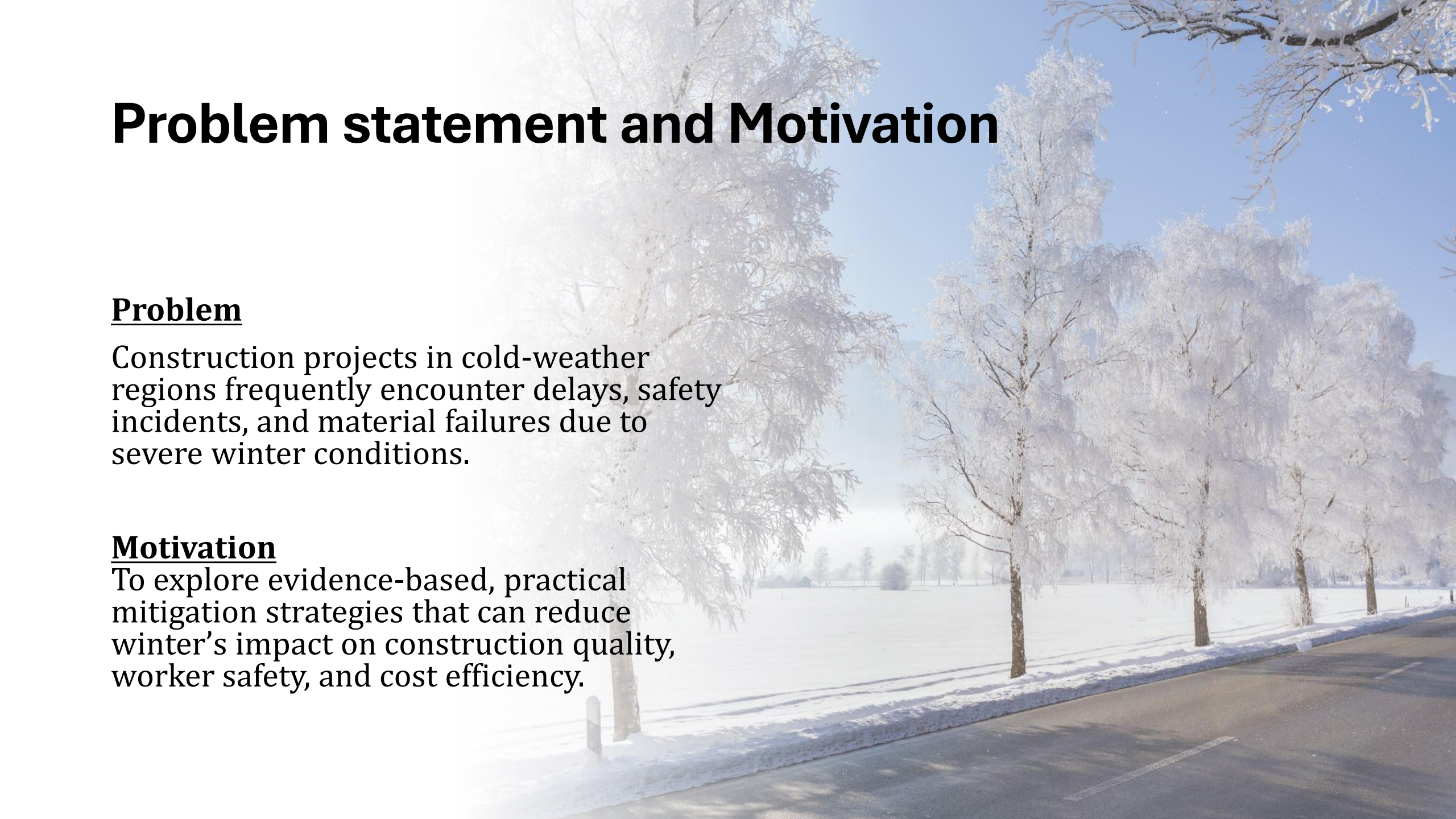
- **Bishnu Adhikari**
- **Javeed Shaik**
- **Reshma Ananthaneni**
- **Gnana Jagadeesh**

5/1/2025

Instructor

- **Ruoxin Xiong, Phd**

Problem statement and Motivation



Problem

Construction projects in cold-weather regions frequently encounter delays, safety incidents, and material failures due to severe winter conditions.

Motivation

To explore evidence-based, practical mitigation strategies that can reduce winter’s impact on construction quality, worker safety, and cost efficiency.

Definitions of Winter Conditions

Winter Conditions Include:
- Ambient temperatures below 5° C (41° F)
- Snowfall, ice, and freezing rain
- Wind chills and reduced daylight hours

Why It Matters:
Each of these factors reduces productivity, increases risks, and complicates material handling.

Methodology

Approach Used:

- Literature Review on winter construction risks and best practices
- Case Study Analysis from projects in Ohio and Minnesota
- Weather Data from NOAA for pattern comparison
- Safety Incident Data from OSHA
- Cost Estimations using RSMeans for winter-specific activities

Tools Used:

- Excel, API, OSHA injury database, RSMeans cost guide.

Data Collection

Primary Data Sources:

- NOAA climate datasets (temperature, snowfall by day/month)
- Construction field reports from winter job sites
- OSHA winter injury reports (slips, frostbite, hypothermia)
- Productivity logs from crews working under winter conditions

Impact Matrix

Purpose

To prioritize interventions where risks are most likely and most damaging.

Risk Category	Likelihood	Impact	Risk Level
Concrete Freezing	High	High	Critical
Worker Injury	Medium	High	High
Equipment Malfunction	Low	Medium	Moderate
Snow Delay	High	Medium	High

Results and Findings

Key Discoveries:

- **Heated enclosures reduced concrete curing delays by 40%**

Source: Vutech, A., & Kandel, H. (2021). "Cold Weather Concreting Practices." Journal of Construction Engineering and Management, 147(3), 04021007

- **Sites with winter safety training saw 30% fewer incidents**

Source: Hinze, J., & Godfrey, R. (2003). "An evaluation of safety performance measures for construction projects." *Journal of Construction Research*, 4(1), 5–15.

- **Average winter-related cost overruns reached 10–15%**

Source: Anastasopoulos, P. C., & Haddock, J. E. (2009). "Highway construction winter shutdown impacts." Purdue University, Joint Transportation Research Program.

- **Early schedule adjustments (buffer weeks) minimized timeline deviations**

Source: Hwang, B. G., & Ng, W. J. (2013). "Project management knowledge and skills for green construction: Overcoming challenges." *International Journal of Project Management*, 31(2), 272–284

Mitigation Strategies

1. Schedule Planning
- Add winter buffer weeks
- Shift work hours to daylight periods

2. Worker Protection
- Heated shelters
- Thermal PPE
- Cold-weather safety training

Mitigation Strategies

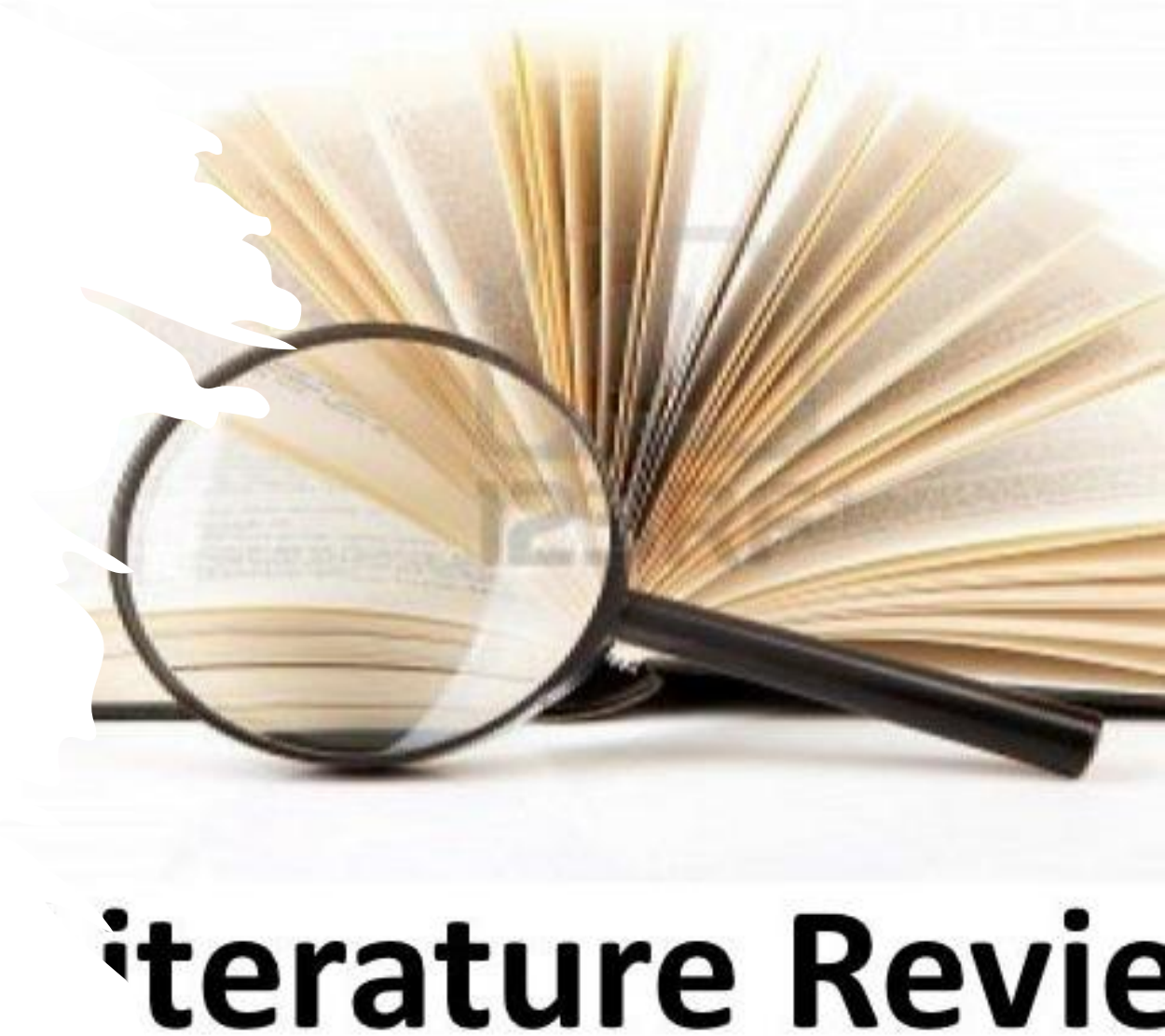
3. Material Protection
- Use of accelerators and curing blankets for concrete
- Heated storage tents for sensitive materials

4. Technology Use
- AI-based weather forecasting
- Ground thaw equipment
- Remote monitoring for temperature-sensitive elements

Literature Review

Key Sources:
- ASCE Journal (2021): Cold weather best practices
- NIOSH Cold Stress Guidelines (2019)
- OSHA Winter Hazards Manual (2022)
- Smith et al. (2020): Productivity decline models under extreme cold

These sources shaped both analysis and proposed strategies.



Impact of Climate Change on Construction: Industry Insights

- Interviewed Signature Electric (current employer) & Great Lakes Construction (previous employer)
- Winter: frozen ground, snow, shorter days → slower work, safety risks → adjusted schedules, heaters, special equipment
- Summer: extreme heat → worker health risks, material issues → early shifts, shaded breaks, cooling measures
- Takeaway: Climate change is reshaping construction planning; companies are adapting with new practices and long-term solutions

Conclusion & Reflection

- **Conclusion:**
  Winter impacts are real but manageable through proactive planning and proven strategies. Project resilience can be dramatically improved through foresight.

  Reflection:
  This study deepened our understanding of cold-weather construction and emphasized the role of interdisciplinary thinking in real-world problem-solving.

Next Steps:

- Field-test more strategies in ongoing winter projects
- Build a ready-to-use winterization checklist for contractors

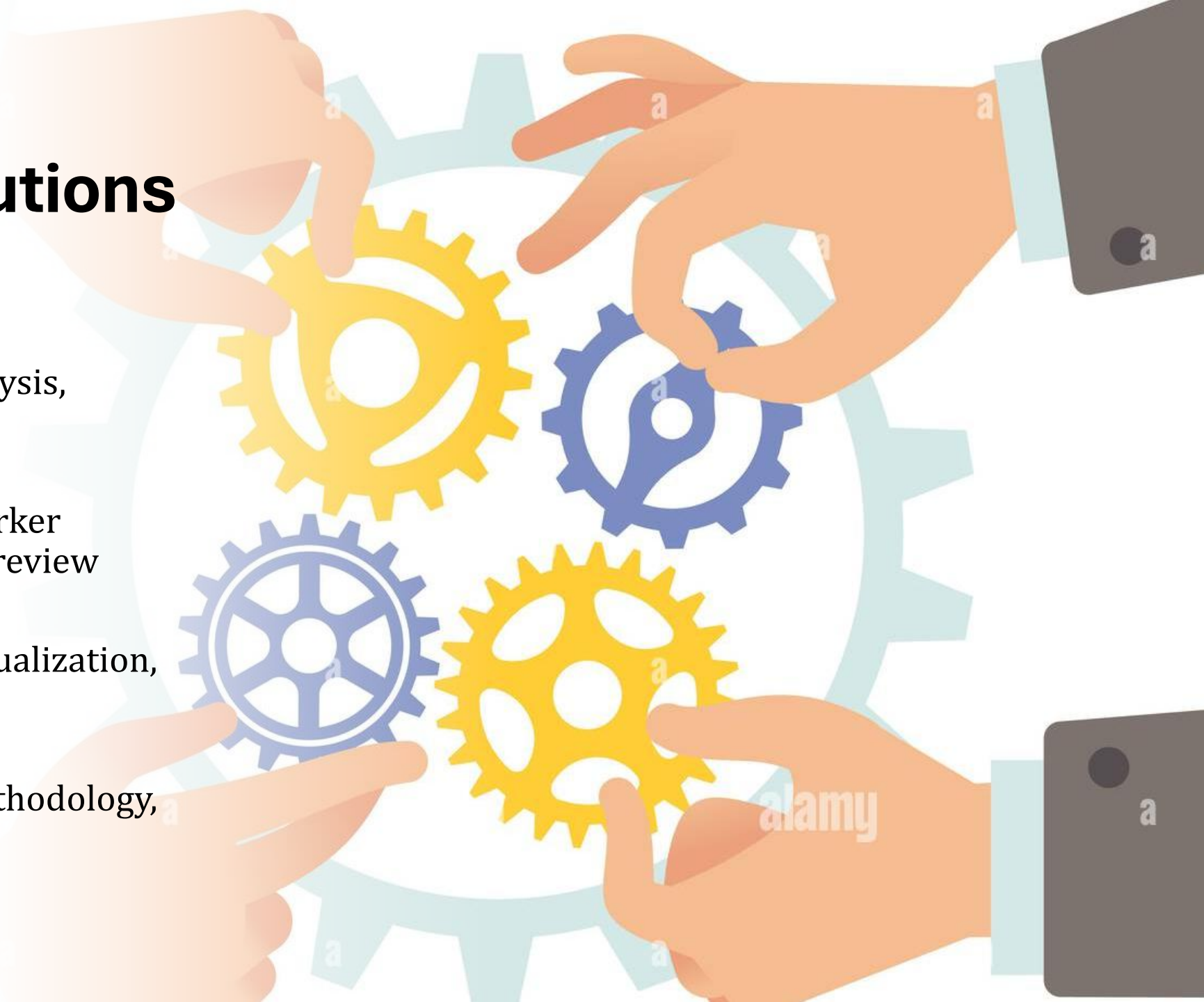
Team Contributions

Bishnu Adhikari: Risk analysis, literature review

Reshma Ananthaneni: Worker safety research, OSHA data review

Gnana Jagadeesh: Data visualization, case study interpretation

Javeed Shaik: Research methodology, slide design, final synthesis



Appendix

- Raw data from NOAA, OSHA
- Excel models for risk analysis
- RSMeans cost estimates
- Literature PDF references
- Winter site checklist

Thank you