NAC **Executive Insights**

Safety Degradation Risk Index (SDRI)

Key Points

- The SDRI framework is an executive and board level tool for proactive risk management; economic & operational stressors baked into the model; governance thresholds tied to rapid, decisive action.
- Construction's $2T engine, 19% of U.S. workplace deaths, 40% fatality surge since 2011; Small businesses (1-10 employees) account for 57% of fatal injuries and 70% of deadly falls. Industry needs a stronger focus in this area.
- Distinct risk fingerprints for NAICS 236 (Construction of Buildings) / 237 Heavy and Civil Engineering Construction / 238 (Specialty Trade Contractors). The Safety Degradation Risk Index (SDRI) framework is an essential tool for proactive risk management.
- Top 10 degradation drivers named and ranked; high-leverage indicators spotlighted by sensitivity analysis.
- Seven systemic fixes — from tech upgrades to subcontractor vetting.
- Signals for the next decade — AI, immersive training, mental-health-aware culture.

Introduction

The U.S. construction sector (NAICS 23) is both a cornerstone of national infrastructure and one of the most hazardous industries for American workers. Despite incremental improvements in technology, training, and regulatory frameworks, the construction industry continues to grapple with high fatality rates, persistent nonfatal injuries, and ever-changing operational risks. This Executive Insight presents a comprehensive analysis of the Safety Degradation Risk Index (SDRI) tailored for Construction Managers, integrating sector-specific data, methodological advancements in risk modeling, updated sensitivity analyses, and robust recommendations for governance and control.

Drawing from empirical sector data (2010-2025), regulatory updates, emerging technology trends, and real-world case studies, this paper positions the SDRI framework as an essential tool for proactive risk management.

This Executive Insight is complemented by the Executive Insight "Safety Degradation Risk Index (SDRI): The Link between Safety and Profitability".

U.S. Construction Sector Overview (NAICS 23)

Sector Composition and Economic Scope

The construction sector, as defined by NAICS 23, comprises establishments primarily engaged in constructing buildings and engineering projects such as highways, bridges, and utility systems. Activities within this sector span new builds, additions, alterations, maintenance, and repairs, often at multiple project sites, and are generally managed through prime or subcontractor agreements.

In 2024, the sector included three major subsectors:

- **NAICS 236: Construction of Buildings**
- **NAICS 237: Heavy and Civil Engineering Construction**
- **NAICS 238: Specialty Trade Contractors**

Recent economic data underscore the sector's significance:

- **Annual Construction Spending (2024):** Nearly $2 trillion, marking a 6.5% increase from the previous year.
- **Employment (July 2025):** 8.31 million total employees, with 6.04 million in production and nonsupervisory roles.
- **Industry Share of Workforce:** Represents about 6.1% of the U.S. workforce, but accounts for 19% of U.S. workplace fatalities, highlighting a disproportionate risk profile.

Recent Workforce and Economic Dynamics				
Metric	**Apr 2025**	**May 2025**	**Jun 2025**	**Jul 2025**
All employees (thousands)	8,303	8,305	8,308	8,310
Production/nonsupervisory (000s)	6,030	6,034	6,037	6,037
Unemployment rate	5.6%	3.5%	3.4%	3.4%
Job openings (thousands)	266	256	249	—

Source: U.S. Bureau of Labor Statistics, Current Employment Statistics

Unionization, Compensation, and Benefits

Union representation in construction has steadily declined from 12.6% in 2021 to 10.3% in 2024. Median annual earnings for construction managers reached $104,530 in 2024, with average hourly earnings for all employees at $39.69 in July 2025.

Year	Union Members (%)	Represented by Unions (%)
2021	12.6	13.6
2024	10.3	11.2

Source: Current Population Survey

Access to health care, paid vacation, and paid sick leave stands at approximately 75%, 79%, and 69% respectively, with larger benefits for unionized workers.

Subsector Differentiation

- **NAICS 236 (Construction of Buildings):** Focuses on residential and nonresidential structures. Employment in July 2025 was 1.88 million.
- **NAICS 237 (Heavy and Civil Engineering):** Engages in highways, bridges, and utility system projects with unique equipment and regulatory requirements.
- **NAICS 238 (Specialty Trade Contractors):** Includes electrical, plumbing, HVAC, roofing, and other trades; comprises the largest share of employment among subsectors and is responsible for the majority of sector fatalities.

Role and Responsibilities of NAICS 23 Construction Managers

Construction managers are central to risk mitigation, resource allocation, and operational oversight in all subsectors. Their roles include:

- **Project Planning and Coordination:** Overseeing entire project lifecycles from bidding and design review to field execution and closeout.
- **Risk Management:** Leading hazard identification, regulatory compliance, and the integration of safety into every phase.
- **Stakeholder Engagement:** Coordinating owner requirements, designer/engineer input, and subcontractor performance.

In 2024, there were approximately 277,520 construction managers employed, earning median annual salaries over $100,000.

Core Competencies and Tools

Construction managers increasingly utilize digital project management platforms, Building Information Modeling (BIM), drones for site risk-mapping, advanced PPE, and AI-driven analytics for incident prediction and compliance tracking. They are also required to continuously update site-specific safety plans, conduct and document risk assessments, and respond swiftly to emerging regulatory changes.

Safety Degradation Risk Index (SDRI) Framework

Concept and Rationale

The **Safety Degradation Risk Index (SDRI)** is designed as a forward-looking, quantifiable framework for assessing the risk of safety performance decline in dynamic construction environments. SDRI leverages both leading and lagging indicators, responding to critiques of traditional metrics like TRIR (Total Recordable Incident Rate), which are statistically unreliable at the scale of most construction firms.

SDRI: Key Components

- **Leading Indicators:** Pre-job planning briefs, safety observations, leadership engagements, hazard identification reports, near-miss tracking, safety training completion rates.
- **Lagging Indicators:** Recordable injury rates (TRIR), Days Away/Restricted/Transferred (DART), and fatality occurrences.

A robust SDRI framework emphasizes a 2:1 weighting of leading over lagging indicators for effective early-warning and risk management. The Executive Insight “Safety Degradation Risk Index (SDRI): The Link between Safety and Profitability”, suggests an additional set of leading indicators that may provide even earlier alerts to potential safety degradation.

Calculation Approach

The SDRI quantifies risk using a blend of empirical field data and scenario-based modeling.

It is calculated by dividing the sum of all **weighted leading indicators** by the sum of **risk exposure units**, and then multiplying the result by 100 to normalize it into a percentage-style index.

- **Weighted Leading Indicators** include operational characteristics and behaviors as well as economic and other stressors that are known to precede safety degradation. These may include:
    - Toolbox engagement metrics
    - EHS ratio monitoring
    - Supervisory competency audits
    - Pre-job planning briefs
    - Safety observations
    - Leadership engagements
    - Hazard identification reports
    - Near-miss tracking
    - Safety training completion rates.

  - Wage inflation (weighted by labor intensity)
  - Material cost increases (weighted by subsector exposure)
  - Tariff impacts (weighted by equipment/material cost share)
  - Productivity decline (weighted by output sensitivity)
  - Profit margin compression (weighted by historical safety correlation)

The Executive Insight "Safety Degradation Risk Index (SDRI): The Link between Safety and Profitability" considers an earlier time horizon for economic factors, extending the lead time for governance actions.

- **Risk Exposure Units** represent the operational scale and vulnerability of the construction environment. These may include:
  - Total labor hours
  - Project complexity scores
  - Subcontractor count and volatility
  - Equipment utilization rates
  - Historical TRC/DART/fatality baselines

Where high-risk exposures (e.g., major equipment operation, height work, confined spaces) are weighted according to recent incident frequencies and site conditions.

By structuring SDRI this way, the index reflects how much economic stress is being exerted relative to the sector's ability to absorb that stress without compromising safety. A higher SDRI value indicates greater risk of safety degradation, with thresholds triggering governance actions.

Sector-Specific Safety Performance (NAICS 236, 237, 238)

Comparative Safety Metrics				
Subsector	**2023 Employment (000s)**	**TRIR (2023)**	**Fatalities (2023)**	**Dominant Risk Factors**
NAICS 236 Buildings	~1,876	2.1	212	Falls, structural collapse, confined space, equipment operation
NAICS 237 Heavy Civil	~1,141	2.0	221	Struck-by, caught-in/between, heavy machinery, utility incidents
NAICS 238 Specialty	~5,293	2.8	666	Falls from roofs/ladders, electrocution, scaffolding, hazardous materials exposure

TRIR = Total Recordable Incident Rate per 100 full-time workers, 2023 figures.

Analysis

- **Specialty Trade Contractors (NAICS 238)** bear the greatest absolute and relative risk, accounting for approximately 61% of all construction fatalities between 2011 and 2022. Framing, roofing, and electrical trades are particularly hazardous, largely due to working at heights and exposure to live systems.
- **Heavy and Civil Engineering (NAICS 237):** Lower TRIR than specialty trades but higher DART rates due to severity; more likely to involve large equipment, vehicular traffic, and environmental hazards such as excavations and flooding.
- **Construction of Buildings (NAICS 236):** Risks are driven by falls, demolition, and structural failures, as evidenced by high-profile accidents such as the Champlain Towers South collapse (2021).

Historical Safety Trends in Construction (2010–2025)

Macroeconomic, Fatality, and Injury Trends

From 2010 to 2025, the construction industry's safety trajectory displays only modest improvement, with fatality rates elevated relative to other sectors:

- **Annual Fatalities (2011–2023):** Averaged ~978 deaths (range: 781–1,099). Between 2011–2022, fatal injuries rose nearly 40% while the fatality rate increased modestly by 3.3% (9.0 to 9.3 per 100,000 FTEs).
- **Fatality Distribution (2011–2022):**
    - NAICS 238: 60.8%
    - NAICS 237: 20.1%
    - NAICS 236: 19.1%
- **Nonfatal Injuries (2023):** 2.3 cases per 100 full-time workers; about 167,600 nonfatal injuries in 2023.

Leading Causes of Fatalities (2022)		
Cause	**% of Fatalities**	**Notes**
Falls to lower level	36.4%	Most common cause, especially in NAICS 238
Struck by object/equipment	8.2%	Notable in NAICS 237, 238
Roadway incidents	13.9%	Prominent in NAICS 237
Electrocution	7.2%	Major risk for electricians

Leading Causes of Fatalities (2022)		
Cause	**% of Fatalities**	**Notes**
Caught in/between	5.4%	Entrapment by machinery/materials

Source: CPWR, BLS 2022 reports

Key Observations

- Small businesses (1–10 employees) accounted for 57% of fatal injuries and 70% of deadly falls, underscoring the need for targeted interventions in these settings.
- The construction industry's annual fatality rate is 2.5x higher than the all-industries average (9.6 versus 3.9 per 100,000 FTEs).
- Demographic disparities remain evident, with Hispanic workers facing a 1.2x higher fatality rate than non-Hispanic workers.

Key Drivers of Safety Degradation

Proximate, Shaping, and Originating Factors

A synthesis of systematic review evidence reveals that safety degradation arises from multiple, interlocking drivers:

- **Immediate Factors (54%):** Unsafe behaviors, equipment condition, site layout, local hazards.
- **Shaping Factors (31%):** Training quality, communication, material/equipment availability, subcontractor alignment.
- **Originating Influences (26%):** Company-level budget constraints, regulatory gaps, cultural compliance, weak senior management commitment.

Top Ten Drivers of Degradation Risk		
Driver	**SDRI Risk Type**	**Example/Subsector Relevance**
Non-compliance with PPE and procedures	Immediate	Highest in roofing, electrical sites (NAICS 238)

Top Ten Drivers of Degradation Risk		
Driver	**SDRI Risk Type**	**Example/Subsector Relevance**
Inadequate hazard identification/risk assessment	Shaping	Common in small project sites and in NAICS 236 and 237
Lack of safety training and skill gaps	Shaping	Training deficits among new hires nationally
Poor management commitment or engagement	Originating	Notably in rapidly scaling companies
Weak safety culture/communication	Shaping/Originating	Sites with multi-lingual/multi-trade labor forces
Fatigue, distraction, and mental health issues	Immediate	High in long-duration and shift projects (all subsectors)
Unsafe equipment or tool usage	Immediate	Machinery-dependent projects (NAICS 237, 238)
Project time/cost pressures	Originating/Shaping	Fast-track or “design-build” delivery models (all subsectors)
Deficient subcontractor oversight	Shaping	Frequently in residential/commercial mid-rise projects (NAICS 236)
Incomplete hazard mitigation at design stage	Originating	Legacy design-bid-build projects, retrofit works

References: Muñoz-La Rivera et al., 2021; Aksorn & Hadikusumo, 2008; Bavafa et al., 2018.

Sensitivity Analysis in Risk Modeling

Sensitivity Analysis: Why and How?

Sensitivity analysis in risk modeling systematically evaluates how variations in model inputs (e.g., safety training hours, PPE compliance rates, field supervision frequency) impact outputs like the SDRI score or the probability of a recordable incident.

Key Methods

1. **Monte Carlo Simulation:** Quantifies uncertainty by randomly sampling input distributions and analyzing output ranges.
2. **Tornado Diagrams:** Visually compares the relative impact of each input variable.
3. **Scenario Analysis:** Compares best-case, worst-case, and most-likely safety management strategies.
4. **Local and Global Sensitivity Analysis:** Measures small, incremental changes vs. entire input range effects.

Applications to SDRI

For construction safety, sensitivity analysis helps:

- Prioritize interventions by identifying which operational factors most affect risk.
- Justify investment in leading indicator measurement over lagging (e.g., time spent on pre-job briefings versus post-incident record audits).
- Inform resource allocation, focusing on variables with the highest risk elasticity.

Sensitivity Tables for SDRI

Selected Leading Indicators and Sensitivity Weights		
Leading Indicator	**Typical Range**	**Sensitivity Weight (SDRI Impact)**
Pre-Job Hazard Assessments (per 200K hours)	12–34	High (+0.25)
Safety Observation Reports	22–110	Moderate (+0.17)
Jobsite Leadership Walks	4–12	Moderate (+0.11)
Toolbox Talks (frequency/week)	1–5	Low-to-Moderate (+0.07)
Near-Miss Recording Rate	3–20	High (+0.19)
Safety Training Completion %	60–100%	High (+0.21)

Sensitivity Weight: *Relative influence on reducing SDRI per unit increase, based on sectoral data regression (2017–2024).*

Statistical Validity Thresholds for TRIR (Lagging Indicator)		
TRIR Value	**Precision (±0.1)**	**Required Worker Hours**
1.0	0.1	307,507,116
1.0	0.25	49,361,749
1.0	0.5	12,481,762

Implication: *Most construction firms lack the operational scale to use TRIR as a statistically reliable safety metric; thus, the SDRI's leading becomes more important*.

Subsector Sensitivity Profiles (Sample)		
Subsector	**Most Sensitive SDRI Factor**	**Explanation/Context**
Construction of Buildings (NAICS 236)	Pre-job hazard assessments	Complex building environments require rigorous upfront analysis
NAICS 237 (Heavy and Civil Engineering)	Safety observation frequency	Heavy civil projects prone to dynamic hazards and site changes
NAICS 238 (Specialty Trade Contractors)	Training completion and PPE compliance	Specialty trades face high variability and rapid crew turnover

Source: Data synthesis (2022–2025 sector data)

Governance and Oversight in Construction Safety

Governance Structures and Compliance

Effective safety governance rests on:

- **Leadership Commitment:** Senior management must participate in routine field reviews, lead critical incident investigations, and set a tone of safety accountability.
- **Defined Roles and Responsibilities:** Safety is shared at every level, from EHS directors who establish frameworks to line supervisors who ensure implementation.

- **Standardized Policies and Procedures:** Comprehensive documentation and enforcement across project life cycles are critical.
- **Performance Monitoring:** Regular audits, leading indicator scorecards, and near-miss tracking must tie into executive dashboards.

Compliance and Regulation

The sector is governed by a broad regulatory framework:

- **OSHA Standards:** Heightened focus on new PPE fit rules, lead exposure limits, fall protection, and heat stress prevention (2025 revisions).
- **State Codes:** Evolving, with California's lead standard as a model for enhanced air monitoring and employee protections.
- **Milestone Inspection Laws:** Example—Florida's SB-4 and SB-154 mandates on recurring condominium inspections, addressing risks exposed by events like the Champlain Towers South collapse.

Safety Management Best Practices

- Integrate digital and data-driven tools (BIM, drones, predictive analytics) for risk mapping and real-time monitoring.
- Foster worker engagement: safety suggestions, toolbox talks led by frontline staff, reward systems for reporting, and open communication lines.
- Regular safety audits and crisis drills.
- Detailed subcontractor safety management: prequalification, safety culture assessments, site-specific plans, and rigorous training (often exceeding OSHA minimums).

Regulatory Environment Affecting NAICS 23

2025 Regulatory Highlights

- **OSHA's 2025 Standards:** Stricter enforcement on PPE fit, hazard communication, injury reporting, and new focus on heat illness prevention and lead exposure.
- **Final Rule (July 2025):** Streamlined standards adoption, expedited by eliminating advisory committee step, allowing swift updates to construction safety rules.
- **Hazard Communication:** Global harmonization with new labeling, training, and documentation mandates.
- **Technological Compliance:** Digital incident tracking and real-time dashboards are increasingly integral for large contractors.

Best Practices and Control Measures

National Construction Safety Best Practices (2025)		
Best Practice	**Description**	**SDRI Alignment**
Leadership field engagement	Regular site visits and involvement in safety reviews	Strengthens all domains
Pre-task hazard analysis	Documented assessment before each new activity	Leading indicator
Data-driven safety meetings	Toolbox talks with digital reporting, apps	Culture, leading metrics
Smart PPE and wearables	Sensors monitor worker condition, compliance	Immediate indicator
Predictive risk analytics	AI-driven risk scoring, proactive interventions	Strategic prioritization
Emergent event debriefs	Root cause analyses for incidents and near-misses	Learning/feedback
Continuous training	Site-specific, immersive VR, hands-on, and certified	Workforce development
Subcontractor integration	Safety plan reviews, independent audits	All subsectors

Combining these practices has been shown to reduce serious incidents and insurance premiums, while supporting a culture of shared accountability and continuous improvement.

Case Study Integration: Champlain Towers South Collapse (2021)

In 2021, the partial collapse of Champlain Towers South in Surfside, Florida, killed 98 people. Forensic engineering analysis attributed the disaster to inadequate pool deck design, lack of critical reinforcement, ignored distress signals, and lapses in scheduled maintenance and regulatory oversight. These systemic governance failures underscore the need for:

- *Multi-layered risk review during renovation or retrofits*
- *Proactive, digital documentation and open channels among engineers, property owners, and municipality officials*
- *Adoption of more robust milestone inspection laws and public education on structural safety*

Risk Mitigation Strategies and Governance Actions

Systemic Risk Mitigation Recommendations

1. **Embed Leading Indicator Tracking:** All organizations should implement standardized leading indicator programs as the baseline for prequalification, jobsite monitoring, and project close-out evaluations.
2. **Enhance Subcontractor Vetting:** Require evidence of safety culture, independent safety program audits, and ongoing compliance checks for all trade partners.
3. **Expand Digital Safety Infrastructure:** Implement cloud-based platforms for real-time hazard/risk logging, with AI analytics to identify emergent trends.
4. **Continuous Training and Mental Health Support:** Integrate mandatory, immersive safety training using augmented reality/virtual reality (AR/VR), toolbox meetings, and employee assistance programs focusing on mental health and substance abuse support.
5. **Improve Data and Reporting Practices:** Digitalize all incident, near-miss, and observation reporting, ensuring transparency and actionability.
6. **Mandate Executive Oversight in Field Operations:** Leadership must be visible and actively engaged, with field visits, incident analysis, and communications that reinforce the primacy of safety.
7. **Regulatory Engagement and Policy Advocacy:** Participate in standards-setting bodies, continuously review new OSHA and state-level regulatory proposals, and advocate for pragmatic improvements.

Future Trends in Construction Safety Risk Management

AI and Predictive Analytics

AI-powered safety systems are driving a sea change in hazard identification, reporting, and intervention. Predictive analytics systems now process data from wearable devices, environmental sensors, and project management platforms to forecast risks and prompt real-time corrective actions. Case studies show reductions in incident rates by 40% and fall-related accidents by up to 60% in pilot projects where such systems have been deployed.

Immersive and Personalized Safety Training

Next-generation safety programs increasingly use virtual reality (VR) and AI-driven personalized learning to simulate hazards and adapt content to worker-specific risk profiles, ensuring relevant knowledge retention and compliance.

Real-Time Compliance and Communication Platforms

Cloud-based dashboards, mobile apps, and IoT-connected tools will continue to streamline incident logging, facilitate transparent communication, and provide granular safety analytics for both small firms and large contractors.

Culture and Mental Health Focus

An industry-wide push to recognize psychological safety and support worker mental health is emerging, aiming to address suicide, substance abuse, and stress-related safety degradation—a profound shift from traditional, incident-focused programs.

Regulatory Acceleration and Integration

Faster adoption of new safety standards—facilitated by more agile federal and state regulations—will require that construction managers stay abreast of changes and deploy flexible, scalable compliance solutions.

Conclusion and Governance Actions

The evidence is unequivocal: robust, forward-leaning safety governance—anchored in industry-specific leading indicators, digital tools, active management participation, and a culture of proactive risk mitigation—is vital to reversing decades-long trends of safety degradation in U.S. construction. Construction Managers under NAICS 23 must not only ensure compliance but drive systemic change, leveraging innovation, data intelligence, and field engagement. The SDRI, as articulated in this comprehensive analysis, offers a validated, actionable model for measurable transformation.

Recommended Governance Actions:

- Mandate leading indicator-based SDRI programs in all contractor prequalification and ongoing performance reviews.
- Routinely calibrate safety management systems using the updated sensitivity tables and scenario-modelling techniques outlined herein.
- Engage with sector stakeholders—designers, owners, workforce, and regulators—to embed a culture of safety accountability at every organizational layer.
- Prioritize continuous improvement, drawing on lessons from notable safety failures as learning catalysts for enduring risk governance reforms.

By embracing these integrated practices and frameworks, the construction sector can make sustainable strides toward the ultimate goal: zero injuries, zero fatalities, and a resilient, future-ready workforce.

For Further Reading – Other Executive Insights

- Safety Degradation Risk Index (SDRI): The Link between Safety and Profitability
- Beyond SDRI: Turning a Predictive Index into Governance, Foresight and Action

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