

Guide to Precursor Analysis for Construction Fatalities



Implementation Resource 321-2



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Guide to Precursor Analysis for Construction Fatalities

*Research Team 321, Precursors of High-impact, Low-frequency Events,
Including Fatalities*

Implementation Resource 321-2

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Introduction

CII Research Team 321 (RT-321) produced this guide to help industry practitioners implement a newly-formed precursor analysis method to prevent high-impact, low-frequency (HILF) safety events in the construction industry. Such events, often involving high-severity injuries and fatalities, occur on an infrequent basis. However, unlike less-severe injuries, the fatality rate has remained stagnant in recent years, defying the corrective efforts of even mature organizations with strong safety cultures.

Heinrich's Pyramid Theory remains an often-cited model used in the description of injury experience. Unfortunately, this theory has led to a belief that less-severe events and fatalities are linked, which promotes expectations that improvement in the former will positively influence the latter. However, contemporary data contest this notion, and many high-performing organizations continue to experience fatal or near-fatal events. The current body of knowledge has thus far proven insufficient, and current prevention tools have proven ineffective.

The overall goal of RT-321 was to address the following essential questions: *Are there precursors to HILF events on construction projects? If so, what are they, and how can they be identified, analyzed, and used in a predictive fashion in order to prevent the occurrence of HILF events?* The team aimed to develop a predictive tool that would be used **before** work begins or **while** the work is being performed for relatively quick assessment of key work characteristics, personnel, plans, and environmental factors.

RT-321's multi-phase research project included the following activities:

1. reviewing literature, conducting root cause analyses of historic fatality cases, and undertaking research team brainstorming to generate a comprehensive list of potential factors that may be observed in a leading fashion and that contribute to HILF events
2. analyzing more than 500 past injuries to define "high energy" (i.e., the quantity of energy that can lead to a fatal incident) and provide guidance regarding when to implement the precursor analysis program
3. creating a comprehensive protocol to collect information on these factors from case scenarios via a field-implementable questionnaire
4. collecting data from fatal incidents, high-energy near misses, and successful cases of high-energy management

5. conducting an experiment with experts from RT-321, to assess the predictive validity of the precursor analysis program
6. conducting statistical analyses of the cases collected, to validate empirically the precursor analysis tool and to reduce its length to only essential factors
7. testing the precursor analysis tool by using less-experienced investigators with modest industry experience.

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Purpose and Structure of this Resource

This guide provides a detailed description of the precursor analysis tool that resulted from the RT-321 research and gives clear instructions for its implementation. This stand-alone resource can be used to conduct a precursor analysis in the field for any high-energy construction scenario. The use of this guide in low-energy scenarios (those not considered “high energy” as defined below) or the partial use of this guide (i.e., use of only certain questions) have not been validated and may not provide accurate results, but they may still provide value if used appropriately by knowledgeable construction professionals.

This resource provides the reader with event precursors, a precursor analysis questionnaire that can be used to collect data from the field, and guidance on how to interpret the responses. Introducing and defining the precursors that were discovered was of particular importance, as many are new or ill-defined in current literature.

This resource is composed of five main sections:

1. the safety management foundation that organizations must have in place before they can successfully implement this resource
2. the intended users of this resource
3. guidance on when to implement this resource
4. a full inventory of event precursors that have been demonstrated to have predictive validity
5. the full precursor analysis tool, along with an example of how to implement it.

Required Foundation for Safety Management

RT-321 recommends that organizations establish a safety performance foundation by developing an organizational culture based on the CII Zero Accidents Techniques. (See Research Summary (RS) 160-1, *Safety Plus: Making Zero Accidents A Reality*.) This starting point is consistent with the recommended foundation from recent CII safety-related projects such as RT-293, Strategies for HSE Hazard Recognition, and RT-284, Driving to Zero with Safety Leading Indicators.

The zero accidents safety program elements necessary for establishing a basic safety foundation include:

1. Demonstrated management commitment

All safety efforts must be supported by upper-level management, and that support must be demonstrated through actions as well as words. Upper-level managers must provide adequate resources—including time—for safety activities, and they should actively participate to demonstrate the importance of the company's safety efforts. Management should work collaboratively with the owner's representatives and the contractor's upper-level representatives to promote a safe project.

2. Staffing for safety

Large projects require dedicated safety personnel who are knowledgeable about effective safety practices and competent in delivering all types of safety training to groups of various sizes. Safety managers should be able to connect with workers on a personal level and provide analysis as well as encouragement during continuous improvement activities.

3. Pre-task safety meetings/Job Safety Analysis

The cornerstone for all safety management activities is pre-task planning and discussion among all involved stakeholders. A pre-task meeting that focuses on safety and includes an analysis of potential hazards should be completed in advance of the tasks to be performed during ensuing work periods. These activities are critical to ensuring that work plans take into account the associated hazards, methods for controlling these hazards, and applicable risk mitigation measures. In addition, the

team should create a back-up plan, in case the work does not go as planned and/or additional hazards arise. Pre-task planning helps to ensure that workers have thought through their work and are fully prepared to execute the work safely. The pre-task Job Safety Analysis is typically documented, and may also be known as a JSA, JHA, PTA, or an AHA.

4. Safety orientation and training

All new workers, regardless of their individual amount and level of experience, should be provided with project-specific safety training and an orientation to the jobsite. Training should also involve introducing new safety performance strategies, teaching lessons learned and best practices, and obtaining feedback from the workers. Training and orientation meetings should be interactive whenever possible. Typical safety training should include discussions of commonly identified hazards, company policies, available resources, and employee responsibilities.

5. Employee involvement in safety management

Employees are more likely to accept and integrate new safety practices when they are involved in developing the practices. Rather than being dictated by management, safety programs should be developed collaboratively and in cooperation with the workforce. Employees appreciate being involved in the development of safety practices, and are thus more likely to adopt the new practices they help develop. They also have important insights that can greatly improve the quality of all aspects of a safety program.

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Intended Users

Based upon the RT-321 research, the precursor analysis tool returned relatively reliable results across many levels of construction experience and safety training. In fact, users with five or more years of experience were consistently accurate in their assessments and far better than random in predicting event outcomes. However, when tested with inexperienced professionals (with fewer than five years of experience), the results were highly variable and less accurate. Given these findings, RT-321 recommends that this tool can be used by any member of the project team who has five or more years of safety experience, is in a position to collect candid information from workers, and is able to identify hazards in the field.

The major concern during a precursor analysis is not the experience of the investigator; rather, it is the quality of the questions asked and the quality of the responses provided during the investigation. It is critical that, if an investigator identifies that a HILF event is possible, he or she has complete authority to stop the work and take immediate corrective action. Such authority and support must come from upper management and be communicated broadly within the organization. As such, management should never penalize a crew or an investigator for stopping work; instead, such intervention should be celebrated and investigated to prevent the need for future work stoppage.

