Safety Through Science

CSRA
CONSTRUCTION
SAFETY RESEARCH ALLIANCE

2024

Annual Review

Contents

LETTER FROM THE CHAIR

Mike Court
SVP HSEQ and Sustainability
Graham

Dear colleagues,

Firstly, a heartfelt thank you to every member of our remarkable CSRA community. We had another fantastic year of research and growth. As Chair of the Board, I have witnessed firsthand the invaluable role each of you has played in advancing our research objectives.

We launched two pioneering research projects:

- Managing Last-Minute Change
- Decluttering Safety

We concluded four projects:

- Safety Culture: Measuring the Unmeasurable
- High Energy Controls: Controlling the Uncontrollable
- Safety Return on Investment
- Mental Wellbeing

This year we created a new tier of membership that welcomes organizations that align with our mission but do not participate in research and as we celebrate our 5th anniversary, our community has grown to over one hundred members. We also have partnered with RMIT's SHINe, to accelerate innovation in safety, health, and wellbeing globally.

Annually, we select our upcoming research endeavours according to your collective input. In February 2025, we will kick off Prevention through Design, Talking Safety: Words that Work, and Energy-Based Risk Assessments.

It has been a pleasure supporting the CSRA, and I'm honoured to have been the chair of the Board for the past few years. Undoubtedly, it is the most rewarding initiative I've had in my career. We are shaping the future of HSE with defendable science and transformational research to prevent SIF events in the construction industry. The CSRA staff, CSRA board members, and research teams are passionate, resilient, collaborative, and committed to our vision, and we have a strong foundation for sustainable growth.

I am confident that we will continue to make meaningful contributions to preventing SIF events. The CSRA community's willingness to share knowledge, mentor colleagues, and engage in interdisciplinary collaboration has enriched our efforts and contributed to our collective success. Thank you for your unwavering commitment to the CSRA vision.

Mike Court

LETTER FROM THE EXECUTIVE DIRECTOR

Dr. Matthew Hallowell

Executive Director

CSRA / University of Colorado Boulder

Five years ago, we started the CSRA with the spark of an idea, a small group of visionary leaders, and a compelling vision: to eliminate Serious Injuries and Fatalities (SIFs) with transformative research and defendable science. Although we were ambitious and confident, we knew that achieving our vision would be a monumental task. Later that same year, COVID-19 hit and we weren't sure if the fledgling CSRA would survive. As a testament to your commitment, the CSRA not only survived but thrived. We quadrupled in size during one of the most challenging periods of our careers.

As we mark our fifth anniversary, I reflect on how far we have come. Our first project, the Tyranny of TRIR, was disruptive and impactful. After articulating the problem, we followed up with the hard work of devising and testing solutions such as quality-based leading indicators, more valid lagging indicators, and high-energy control assessments (HECA). Together, we have tackled some of the most challenging and stubborn topics such as predictive analytics, safety culture, and mental health. As a community we never shied away from a challenge, never compromised rigor, and we always stayed true to our mission.

I am eternally grateful to the small group of companies and their visionary leaders who seeded the CSRA, and to the hundreds of newer members who have made the CSRA the largest and most productive safety research group in the world. I am proud to serve as the Executive Director, I am proud of our academic team that includes the very best scientists in our field, and I am proud to call you all colleagues and friends. This is your community; you should be proud too.

As we look forward to our next five years, I am excited to push scientific boundaries and explore new topics. Eliminating SIFs is only something that we can achieve together, and we are now well on our way to achieving our mission. What has started in the CSRA is now changing the world. Thank you for being on this journey with me.

Matt Hallowell

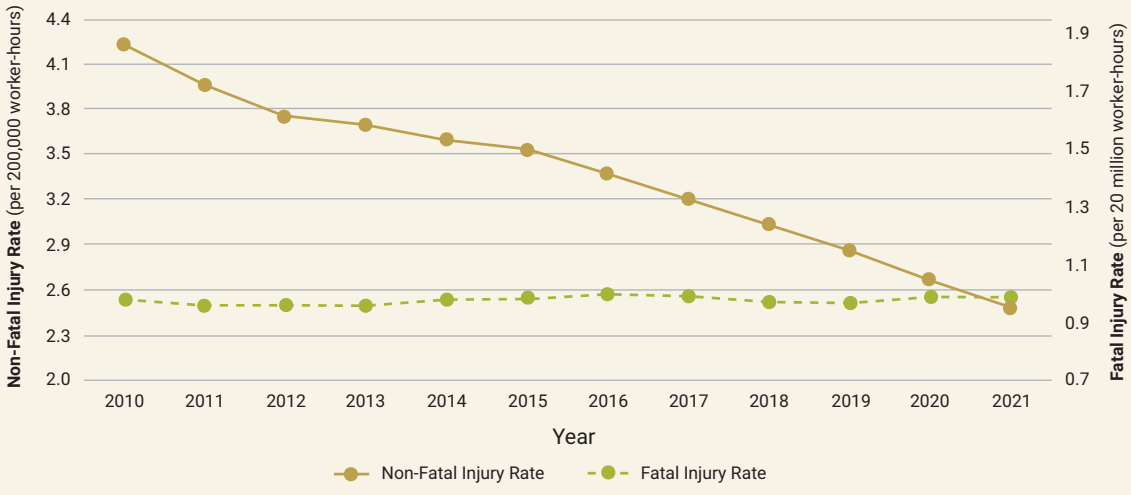
WHAT DIFFERENTIATES SIFS FROM LOW SEVERITY INJURIES?

The safety pyramid is not valid. There is no stronger evidence than the trends from the past 20 years. While the rate of non-fatal injuries have declined, the fatality rate remains unchanged. This suggests that SIFs happen for different reasons than low-severity incidents. That is, what has helped us prevent lower severity injuries are not having an impact of SIF prevention. Therefore we set out to identify the unique causes of SIFs, which we hoped would help us add more focus on high-impact events in our safety activities.

In collaboration with 17 safety experts across the industry, a Delphi study identified seven potential SIF differentiators: unfamiliarity with task, risk normalization, poor hazard recognition, absent or not followed work plan, absent direct controls, poor response to change, and unavailable resources. Data from 38 past incidents (13 SIFs, 13 LSIs, and 12 pSIFs) was analyzed using a retrospective investigative tool. Experts assessed whether each differentiator was present, and logistic regression revealed two key differentiators: absent or not followed work plan and absent direct controls.

The analysis also indicated that human factors may not be exclusive to SIFs, meaning general safety practices focusing on human behavior may not effectively address SIFs. Additionally, SIFs and pSIFs share the same causes, implying organizations can enhance SIF prevention by analyzing pSIF incidents, which occur more frequently. You can read more in our recent publication *"The Things That Hurt People Are Not the Same as the Things That Kill People: Key Differences in the Proximal Causes of Low-and High-Severity Construction Injuries"* which was published in the Journal of Construction Engineering and Management.

Fatal and Non-Fatal Injury Rates for the U.S. Construction Industry
(Rolling 3-year average)



DELIVERING HIGH-QUALITY TRAINING

Safety training is challenging because of limited training resources, logistical constraints, and variability in the quality of instruction. Trainers often lack formal knowledge in educational theory, making it difficult to engage adult learners, especially given the diverse educational backgrounds, experience levels, and motivations of workers. This project sought to address these challenges by exploring the optimal approach for delivering safety training to construction workers.

To do so, a longitudinal field-based experiment was conducted, where all workers received the same training content but through different delivery styles. The experiment tested five methods: video-only, traditional lecture, interactive lecture, interactive lecture with hands-on activities, and a hybrid of video, interactive lecture, and hands-on activities. Data was collected from 591 workers across 17 organizations spanning key industry sectors. Multivariate statistical analysis revealed the following results:

Key Takeaways

1

Overall, just training folks on *"what is a hazard"* can result in a meaningful improvements in their hazard recognition performance.

2

Video-only and Interactive Lecture with Hands-On Activity were **EQUALLY** effective in improving hazard recognition performance of workers.

3

Video-only and Interactive Lecture with Hands-on Activity **OUTPERFORMED** all other delivery methods in improving hazard recognition performance of workers.

4

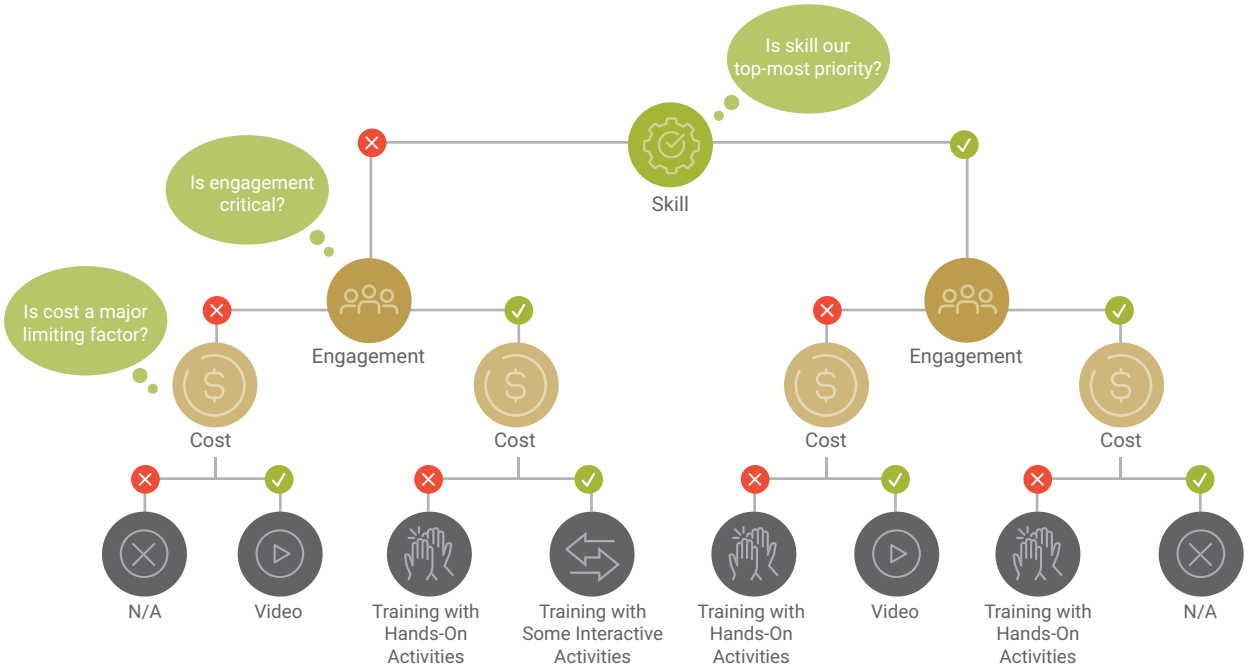
Video-only and Traditional Lecture did **NOT** generate positive engagement or enthusiasm to learn.

5

Interactive lecture was an engaging learning experience for workers, however it did **NOT** improve their hazard recognition performance.

These findings indicate that lectures where learners get to interact with each other and participate in hands-on activity are the most versatile delivery method. Although resource-intensive for organizations, they can improve learners' performance and their desire to learn.

The video-only training seminar was highly effective in improving performance, but workers did not find it to be engaging. Therefore, our results show that the best method to train workers depends on balancing resource constraints with desired goals. Based on our findings, a decision tree was developed to assist with the selection of the appropriate training delivery method.



Related Research

The CSRA recently completed an experiment evaluating the use of Virtual Reality (VR) as a platform for workers to practice safety skills. While the field experiment showed that VR effectively increased worker engagement, it did not improve learning outcomes, such as hazard recognition performance. This reinforces the earlier findings that each training delivery method comes with trade-offs that organizations must consider.

Guidance on how to deliver high-quality in-person training was published in 2023 and developed by analyzing qualitative data collected from 143 workers and 190 trainers. The CSRA will continue to function as a test-bed that designs and examines new instructional techniques, innovative technologies, and classroom management methods that can be applied within the industry to improve the effectiveness of any training we deliver.

SAFETY ROI:

Is the juice worth the squeeze?

In 2022, the Safety ROI team set out to answer a critical question: where should the next safety dollar be invested? With limited resources and a growing array of safety policies, it's essential to prioritize interventions that deliver the greatest return on investment. Many safety programs run simultaneously, making it difficult to determine which interventions truly enhance safety and which have little to no effect. To address this, the team developed a four-step process to objectively measure the impact of safety investments:

1
Create a template to estimate the direct and indirect costs of key safety interventions.

2
Conduct field experiments to measure immediate improvements in safety performance.

3
Link short-term safety measures with long-term lagging safety indicators.

4
Develop a protocol to quantify business returns from safety interventions.

Two training interventions were selected for case studies: (1) training on improving pre-job safety briefs, and (2) training on identifying and controlling high-energy hazards. These were tested using Multiple Baseline Testing (MBT), which isolates cause-effect relationships. The results showed significant, consistent improvements across different organizations and sectors:

"Energy-based safety" training reduced exposure to high-energy hazards by **11%**

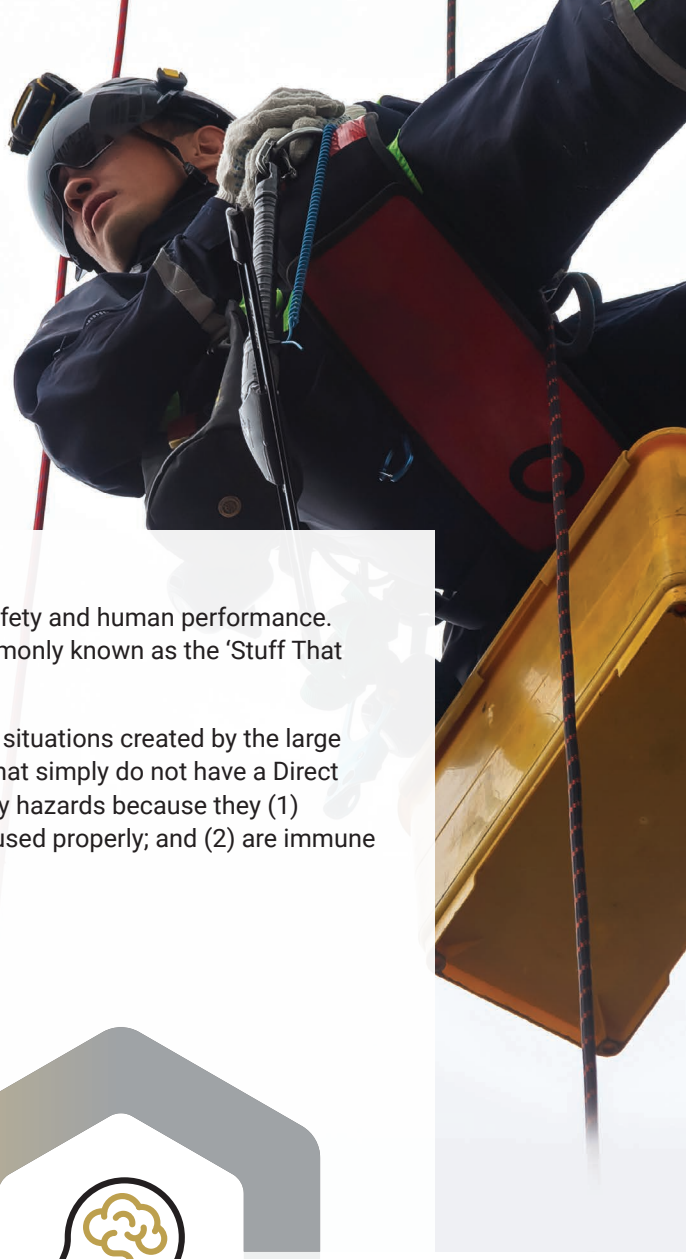
"Excellent pre-job safety meetings" training improved the quality of daily briefings by **43%**

Next, the team will examine whether these short-term improvements translate into long-term safety outcomes (lagging indicators), using data from 29 companies. This analysis will help determine whether metrics like pre-job briefs and HECA scores can serve as proxies for long-term safety performance.

Finally, to evaluate the broader impact of safety interventions on firm value, the CSRA team identified both tangible and intangible impacts, publishing a network analysis of their interrelationships. Data from 68 companies was analyzed to see how different types of injuries (first aid, medical treatment, death) affect firm value. This approach challenges traditional beliefs and asks: "Is good safety good business?" The answer is a clear yes, and the framework developed will help rank-order safety interventions to ensure the effort invested is truly worthwhile.

HIGH ENERGY:

Controlling the Uncontrollable



The CSRA's work is grounded in the theories of energy-based safety and human performance. This results in a focus on the control of high-energy hazards, more commonly known as the 'Stuff That Kills You' or STKY.

The Controlling the Uncontrollable Project set out to deal with the STKY situations created by the large proportion (around 33%) of construction industry high-energy hazards that simply do not have a Direct Control for safety. Direct Controls are able to protect against high-energy hazards because they (1) effectively mitigate a high-energy hazard; (2) are installed, verified, and used properly; and (2) are immune to unintentional human error.

The Definition of a Direct Control

Specifically targeted to the high-energy source

Effectively mitigates exposure to high energy when installed, verified, and used properly

Effective even when someone makes a mistake

But in STKY situations, where there is no Direct Control available, there is not yet any agreement as to what the acceptable alternative level of control is. What is 'good enough'? Or more specifically, what is 'good enough' until we develop and innovate our way to the ideal of a Direct Control for each high-energy hazard found on the jobsite. At the moment, site teams often just have to make do with what they have, but that itself isn't really good enough.

This project therefore aimed to provide more robust and structured guidance as to what actions were appropriate when no Direct Control is available. The team unpacked various STKY situations to determine what is an acceptable Alternative level of control, whilst also examining the potential to develop direct controls or alternative work practices. The research process involved focus groups, role playing and noise experiments, working together to develop a set of rules for Alternative Controls, examining the different layers of protection.

The project has resulted in a new foundational definition of a Control (something we didn't have before), a set of rules for Alternative Controls, and a revision to the Hierarchy of Control grounded in the principles of energy-based safety. Publications, and the supporting academic journal articles, detailing all of these outputs will soon be available on the CSRA website.

During the project it quickly became clear that two STKY situations were highly problematic – so much so that they had to be scoped out. These situations were Work Zone Management and Heavy Mobile Equipment with Workers on Foot. In order to unpick these two challenging situations to the depth required, the CSRA launched two STKY Challenges. Two industry-level learning teams were established, with invitations extended to those with direct field experience of the problems to help delve into the details of why and how the work as currently undertaken meant no Direct Controls, or even Alternative Controls, are available. The initial workshops held in April developed enhanced understandings of the situations and a no-limits brainstorming of potential solutions. A second learning team workshop was held in August and invited in those with the ability to help develop practical and meaningful solutions that can keep workers safe in the field. The CSRA STKY Challenge is an ongoing mission to stimulate the development and innovation of potential solutions or new ways of undertaking construction tasks that keep workers safe when undertaking work in these two very STKY situations.

Team members participating in the research process

MEASURING THE QUALITY OF MENTAL WELLNESS INTERVENTIONS

In 2023, the CSRA produced mental health guidance based on validated medical literature, behavioral psychology, and a survey of 1,197 employees within the industry. This project continued in 2024, building on the initial work. The survey had identified financial uncertainty, excessive job demands, and external factors (i.e., outside of work) as the top stressors, with job satisfaction, financial security, and belonging as the most desired wellness outcomes. These patterns were consistent across various demographics, including frontline workers, office staff, and different age and ethnic groups.

To understand why these issues matter most, CSRA held jobsite focus groups. Focus groups allowed participants to share their views freely, revealing areas of agreement and complexity in workers' experiences. The findings from these discussions provided actionable, evidence-based pathways for improving employee mental wellness.

Additionally, the 2023 Mental Health Guide aimed to help practitioners meaningfully interrogate any proposed interactions that claim to improve the mental wellness of individuals. Building on that, CSRA designed and validated a tool to measure perceptions of workers towards mental health resources and interventions. Unlike traditional medical tools, this tool isolates the impact of workplace interventions, allowing organizations to prioritize investments that have a positive effect on mental wellness. As non-medical professionals, this tool would allow us to prioritize our limited resources towards interventions that truly makes a positive impact.

CSRA designed and validated a tool to measure perceptions of workers towards mental health resources and interventions.

SAFETY CULTURE:

Measuring the Unmeasurable

Team 'Spaghetti and Meatballs' bravely set out to make safety culture useful for those working in the field. The first research meeting also became something of a group therapy session, which clearly justified the CSRA taking on this problematic concept! Colleagues were able to share their frustrations and problems with safety culture as a safety management 'tool' in its current form. Three key things quickly arose:

- There is a need to **define** safety culture in a useful way – or to dispel it entirely.
- There is a need for science-backed tools able to **measure and monitor** what safety professionals can simply feel on a jobsite.
- There is a need to know how we can **practically** use safety culture: For example: What is best practice? Can we train safety culture? What are the roles for workers, management, and leadership?

The first meeting also revealed that safety culture is actually so problematic that some firms have stopped using it as a concept altogether.

Early on, the team explored safety culture through its extensional definition – evaluating the various elements or components that literature has referenced as influential in practice through Q Methodology. This early empirical work revealed that what were considered to be the most important safety activities for a positive safety culture were also the most difficult to identify and measure, such as commitment and accountability.

The team then looked to innovative ways of how we could measure such things, considering how we could best mobilize existing tools or develop novel proxies to evaluate them. For example, safety climate surveys (accepting that they are a worker opinion survey, and nothing more) have been validated as correlating to safety performance in the field – so there was no need to reinvent that particular wheel. Instead, the team focused in on 'deeds not words' and distilled out a number of novel organizational business factors that linked to C-suite, organizational and management commitment and for which we could easily obtain empirical quantitative data. The collected data are being analyzed for their correlations to safety performance in the field. This research will enable safety professionals to evidence how business factors influence safety, and what changes an organization should make to optimize their safety performance.

→

Ralphies help the team work towards consensus

The team have also unpacked in depth Corrie Pitzer's concept of the 'hidable near miss' which can give insights into safety culture through levels of worker engagement and psychological safety. The theory goes that if you have a lot of near miss reports for incidents that could otherwise easily be hidden, you have a good safety culture. Workers are engaged with safety and so report, and also trust leadership to take positive action as a result. This is the first empirical test of this theory to determine if firms with more hidable near misses have better safety performance overall.

As ever, definitions are critical for scientific research, and the first challenge in the list above – to define or dispel safety culture – ultimately resulted in the latter. A robust theoretical argument, supplemented by qualitative data provided by the team, has been developed and will be published in the journal *Safety Science* to make the case that we should simply put safety culture as a practical and scientific concept right in the trash!

The spaghetti and meatballs analogy remains a great tool for explaining the complexities involved with safety culture. Some aspects of culture are immediately observable (meatballs), some may be untangled through strategic analysis (spaghetti), and others are nebulous yet essential to the recipe (the sauce). But we can't scientifically measure the sauce using a meatball-measuring tool! We should be measuring these distinct aspects using the best validated tools for the job and monitoring them individually to ensure improvements in performance. A safety climate survey is a great example of such a validated tool, but it just doesn't tell you your safety culture. We can't grab 'safety culture' as a whole with just one tool or add a number of measures of different elements together and call it safety culture – that's unscientific and a fallacy of logic. What we should be doing as safety professionals is measuring and monitoring each aspect distinctly and in the most effective and methodologically appropriate way – now that's just good science, and good safety.

ON-GOING RESEARCH PROJECTS

Decluttering Safety

The decluttering safety project kicked off in February 2024, with Jack Suehiro of PGE and Sharon Feeney of Otis as our Chair and Vice-Chair respectively. The research team started out looking at safety clutter in different ways, exploring where it comes from and how it endures, and whether clutter is actually a thing or an adjective – as one person's safety clutter can be another person's safety gold. Early findings revealed that *how* we do safety can make a big difference in how cluttery something becomes, with administrative, management and leadership decisions having influence. The team aims to develop ways to identify safety clutter within current operations and provide supporting evidence that it's OK to remove it or change how we do things. A way of assessing new initiatives and processes *before* we implement them is also planned, so we can check they won't simply become safety clutter once deployed. Ultimately, the hope is to equip safety professionals with science-backed tools to help reduce their safety clutter and ensure optimal safety operations out in the field.

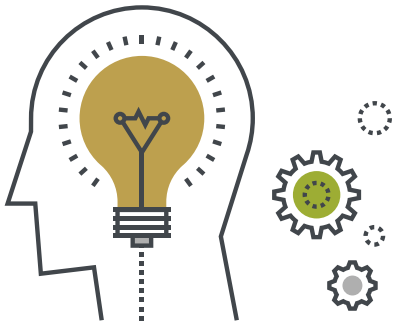
Managing Last-Minute Change

Research suggests that over half of all SIFs involve last-minute changes to the work process or environment, yet managing these changes is difficult. We often assume workers should be able to spot safety-critical changes, but studies in Applied Psychology show that humans struggle to detect changes when multitasking. If workers can't detect changes during work, expecting them to make safe decisions in time becomes unrealistic.

The CSRA research team has taken steps to address this by defining what constitutes a "last-minute change" and categorizing various types of changes, with examples directly linked to SIFs. This foundation ensures the focus remains on changes that are safety-critical. Concurrently, the team is designing a controlled laboratory experiment to investigate two key questions: (1) what types of last-minute changes workers fail to detect during work, and (2) what factors enhance or hinder their ability to identify these changes. The experiment will introduce different human factors and work conditions to ensure the results are broadly applicable. Ultimately, the findings will guide the development of tools to help workers better anticipate, recognize, and respond to safety-critical changes in the field.

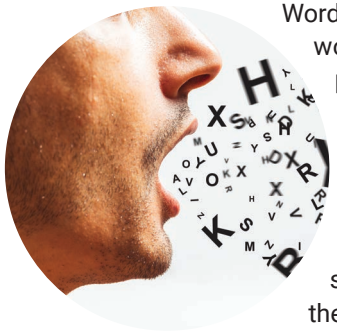
RESEARCH ON THE HORIZON

Prevention through Design (PtD) of Safe Work Operations: Phase I



The influence that the design of our built infrastructure has on daily human life, including on those who construct the designs, places considerable importance on creating designs that are safe and enable healthy and prosperous lives. That is, for design to be beneficial, it demands attention. Conducted with care, design can be extremely beneficial; without critical thought and ethical guidance, design may unintentionally cause harm. The prevention through design (PtD) concept recognizes the importance of good design to the safety and health of those who interact with the design. Previous PtD research studies to date have predominantly explored how the design of the "product," i.e., the physical shape, location, and quality of the infrastructure being constructed, influences safety during its construction. Designing the construction work operations, project phasing, and logistics to minimize safety risk is just as important to worker safety and health as designing the permanent features of the facility. However, less well-known and researched is how the PtD concept and practices can be used to positively affect the design of the "process" used for construction of the infrastructure. In this scoping study (Phase I), we aim to identify opportunities and focus areas for applying PtD when designing the work process for a project. Phase II of the study will then involve detailed verification and understanding of targeted practices for development and implementation in practice. Consistent with the CSRA mission, the research focuses on minimizing the risk of serious injuries and fatalities (SIFs) on construction projects. Current PtD-related practices, such as high-energy control assessments, design risk assessments, and the use of design principles and guidewords, are hypothesized as prospective practices that help realize the benefits of PtD in creating safer work plans to eliminate SIFs.

Talking Safety: Words that Work



Words matter. And in the complex world of safety and SIF prevention, not all words are created or used equally. This project will explore the elements that make safety communications really work, unpacking how content, style, and format influence the way messages are shared and received across different demographics, such as age, company position, and more. We'll investigate the discourses that emerge when we're talking safety, and unpack how the communication of safety knowledge can transform conversations, strategies, and decisions. Our goal is to better support the implementation of SIF prevention research in practice, ensuring that safety communication not only resonates but also drives the actions that save lives.

Energy-Based Risk Assessments

The risk of serious injuries and fatalities is more than a number, it is a complex combination of energy, controls, exposure duration, and a multitude of human, organizational, and managerial factors. This project is designed to uncover the layers of risk, helping us understand what we need to change, how much to change it, and what outcomes we can expect in the future. We'll explore the practical ways to measure the risk of serious injuries and fatalities, the connection between that risk and long-term safety outcomes, and the role of tools like climate diagnostics and human factors. By unraveling these relationships, we can improve planning and make informed decisions that reduce risk of serious incidents.

CSRA RESEARCH JOURNEY

Our research journey has been one of continuous learning, collaboration, and innovation. From our beginnings with The Tyranny of TRIR to the successful completion of a record-breaking four research projects in 2024, our trajectory continues to inspire the future of our work.

Driven by impactful findings, collective efforts, and an unwavering commitment to advancing knowledge, our research remains highly relevant. Each project originates from the needs of our industry members and is carefully selected by our board of advisors, ensuring that our work directly addresses the challenges and priorities of the field.

CSRA COLLABORATORS

The collaboration of researchers from multiple universities and areas of specialization brings together a wealth of diverse knowledge and resources. By merging unique strengths and perspectives from different institutions and areas of expertise, these partnerships foster innovation and facilitate access to a broader pool of knowledge. Such collaborations often result in high-impact research with global significance.

Dr. John Gambatese
Oregon State University
Prevention through Design

John Gambatese is a Professor in the School of Civil and Construction Engineering at Oregon State University. Dr. Gambatese's educational background includes Bachelor and Master of Science degrees in Civil Engineering from the University of California at Berkeley, and a PhD in Civil Engineering from the University of Washington. He has industry experience as a structural engineer and as an engineer for a construction management firm. Dr. Gambatese's research interests are in the broad area of construction engineering and management with specific focus on safety, prevention through design, work zone safety, risk and reward, and temporary structures. He is a Fellow in the American Society of Civil Engineers (ASCE), a member of the American Society of Safety Professionals (ASSP), and a member of the National Academy of Construction (NAC). He is a licensed Professional Civil Engineer in California.

Dr. Ziyu Jin
Colorado State University
Prevention through Design

Ziyu Jin is an Assistant Professor in the Department of Construction Management at Colorado State University. Dr. Jin holds a B.S. degree in Construction Management from Suzhou University of Science and Technology, an M.S. degree in Engineering Management from Syracuse University, and a Ph.D. in Civil Engineering from Oregon State University. Before joining CSU, she was a lecturer in the Gerald May Department of Civil, Construction, and Environmental Engineering at the University of New Mexico. She has taught various courses including Civil Engineering Design, Engineering Statics, Building Information Modeling, Structures for Construction, Project Delivery Systems, and Safety Management. She is passionate about promoting occupational worker safety and health in construction, especially with the help of advanced technologies. She is an affiliate member of the American Society of Civil Engineers (ASCE) and a member of the American Society of Safety Professionals (ASSP).

Dr. Helen Lingard
RMIT / SHINe

Decluttering Safety

Dr. Helen Lingard is a Distinguished Professor at RMIT University, Melbourne, Australia. She leads the Construction Work Health and Safety Research and is the Executive Director of RMIT Safety and Health Innovation Network (SHINe). Helen has worked in industry in large scale civil engineering infrastructure projects and with clients in mining, telecommunications and construction sectors to develop, implement and evaluate initiatives to improve workers' safety, health and wellbeing. In 2009 Helen was a recipient of an Australian Research Council Future Fellowship and her book, '*Work Health and Wellbeing in the Construction Industry,*' was published in 2023. Since 2018, Helen is academic lead and member of the Culture in Construction Taskforce, comprising the Australian Constructors Association and the Governments of New South Wales and Victoria. The Taskforce addresses three key issues in the construction industry: gender diversity; health and wellbeing; and time for life.

Matt Morris
University of Colorado

Managing Last-Minute Change

Matt Morris is a registered professional engineer and holds BS and MS degrees in Civil Engineering from the University of Colorado, Boulder. In his previous roles as a civil engineering officer in the U.S. Air Force and a project manager for a major commercial general contractor, he led over 160 projects. Matt is currently a Teaching Professor at the University of Colorado and taught previously at the United States Military Academy, West Point, and Colorado School of Mines.

Dr. Nathalie Moyen
University of Colorado

Safety Return on Investment

Dr. Nathalie Moyen is a Professor of Finance and the W.W. Reynolds Capital Markets Program Chair at the Leeds School of the University of Colorado Boulder. Nathalie teaches primarily in the Leeds MBA programs, and throughout the years she has also taught at the Business School of the University of New South Wales, the Sauder School of the University of British Columbia, and the Wharton School of the University of Pennsylvania. Nathalie's research focuses on the financial decisions that corporations make and how these financial decisions can influence economic decisions such as capital investments.

Dr. Leaf Van Boven
University of Colorado

Managing Last-Minute Change

Leaf Van Boven, a Professor and Chair of the Department of Psychology and Neuroscience at the University of Colorado Boulder, directs the Environment, Decision, Judgment, and Identity lab and is Co-Director of the Center for Creative Climate Communication and Behavior Change. He earned a B.S. in Psychology from the University of Washington and a Ph.D. in Psychology from Cornell University. He is a distinguished fellow of the Society for Experimental Social Psychology, the Association for Psychological Science, and the Society for Personality and Social Psychology. Professor Van Boven was Associate Editor at the Journal for Personality and Social Psychology and the Psychological Science. Van Boven's research integrates social, environmental, and political psychology. He integrates social, environmental, and political psychology to investigate the processes influencing people's everyday lives, using laboratory experiments, national surveys, and field studies. Professor Van Boven has published more than 100 papers and has been continuously funded by the National Science Foundation.

CSRA 2024 GRADUATES

The CSRA PhD students are invaluable to our research, bringing fresh perspectives and innovative approaches to complex problems. Their journey is characterized by deep intellectual curiosity, resilience, and a commitment to contributing new knowledge to their field. By fostering a collaborative environment, our PhD students help push the boundaries of our field, ensuring that our organization remains at the forefront of scientific discovery and innovation. Their dedication and expertise not only enhance our research capabilities but also help mentor and inspire the next generation of researchers and safety professionals.

DR. JAZMIN LOPEZ

Jazmin earned her MS in Civil Engineering from the University of Colorado Boulder and completed her PhD with the CSRA in Spring 2024. Her dissertation evaluated the value proposition of adopting virtual reality (VR) for construction safety training. She led training sessions for over 250 front-line workers across seven states, incorporating Energy-Based Hazard Recognition training and situated learning in VR. The sessions enabled participants to witness virtual, yet realistic and relatable, construction accidents within a controlled environment. This approach allowed Jazmin to evaluate whether the implementation of VR technology impacted participants' situational awareness skills and increased their situational interest in construction safety training. Currently, Jazmin is a Project Manager at Artaic Group, overseeing construction projects for the City of Golden and the City of Lone Tree.

DR. SREEJA THALLAPUREDDY

Dr. Sreeja Thallapureddy graduated in May 2024 and currently serves as a Safety Specialist at Kiewit. Her expertise lies in incident investigation and learning, where she served as the grad-uate lead on the Incident Investigation and Learning project during her time with the CSRA. In her current role, Sreeja plays a pivotal part in enhancing safety protocols on jobsites, leveraging her comprehensive understanding of incident management to drive improvements. With a commitment to advancing her skills in safety management, Sreeja aims to contribute to the development and implementation of safety best practices. Her work at Kiewit underscores her proactive approach to ensuring occupational safety and fostering a culture of continuous im-provement in workplace safety standards.

CSRA PEER-REVIEWED PUBLICATIONS

These publications form the **defendable science** from our CSRA Vision and underpin all our work. The abstracts are summarized here, with full papers available with free full access through our Knowledge Center for you to read at your leisure.

Hallowell, M.R. and Oguz Erkal, E.D. (2024) Severity-Based Lagging Indicator: An Alternative Measure of Safety Performance, *Professional Safety*, 69(04) 20-27

Severity-Based Lagging Indicator (SBLI) is introduced as an alternative lagging safety metric that addresses some of the key problems of traditional metrics (such as TRIR) whilst keeping some strengths. SBLI is an adjusted injury rate that weights injuries by their relative severity and aggregates them into one rate. Compared to traditional lagging indicators, SBLI produces more meaningful and statistically stable trends that can be used for benchmarking and progress monitoring. Although not entirely without problems – SBLI is still retrospective and is based on the view of safety as the absence of incidents – it is a step towards a more meaningful safety metric for business decisions.

Oguz Erkal, E. D., Hallowell, M. R., Ghriss, A. and Bhandari, S. (2024). Predicting Serious Injury and Fatality Exposure Using Machine Learning in Construction Projects. *Journal of Construction Engineering and Management*, 150(3), 04023169.

Most safety prediction models employ information associated with past incidents to predict the likelihood of future injury or fatality on site, but this focuses only on failure and neglects conditions associated with safety success. Empirical data about business-, project-, and crew-related factors were collected to predict serious injury and fatality (SIF) exposure conditions. A variety of modeling techniques were tested in a machine learning pipeline and found that the multilayer perceptron (MLP) approach best distinguished SIF exposure conditions from safety success conditions using nonlinear decision boundaries. The most influential factors in the models included the crew experience working together, supervisor experience with the crew, total number of workers under the supervisor's purview, and the maturity of leadership development programs for frontline supervisors.

Bayona, A., Hallowell, M.R. and Bhandari, S. (2024) Things That Hurt People Are Not the Same as Things That Kill People: Key Differences in the Proximal Causes of Low- and High-Severity Construction Injuries, *Journal of Construction and Engineering Management*, DOI: 10.1061/JCEMD4.COENG-14545.

The Safety Pyramid suggests that there is a fixed ratio of low- to high-severity injuries and the notion that injuries of all severity levels share the same general causes. This study asked 'what, if anything, is different about the causes of SIFs?' Details of serious injuries and fatalities (SIF, n=13), potential serious injuries and fatalities (PSIF, n=12), and low-severity injuries (LSI, n=13) were collected and analyzed for the presence or absence of potential differentiators. No differences between SIF and PSIF cases were found, but two factors differentiated LSI and PSIF/SIF: (1) absent direct controls; and (2) absent or not followed work plan. Control of high-energy hazards through effective work planning, discipline, and execution is vital for targeting SIFs

Thallapureddy, S., Sherratt, F., Hallowell, M. and Bhandari, S. (2023) Effective information collection in incident investigations: A systematic review and narrative synthesis, *Safety Science*, https://doi.org/10.1016/j.ssci.2023.106404.

Conducting effective incident investigations is a critical aspect of any safety management system. Learning from any incident is heavily dependent on the quality of the information initially collected, yet this first stage in the process is often neglected when compared to the analytical and learning stages. To identify factors that can influence high quality information collection within investigations, a systematic review was carried out, comparing and contrasting studies focused on investigation information collection across all safety–critical domains. A lack of empirical studies able to support the optimization of this vital first phase of the investigation process was identified. This review enhances our understanding of the major factors involved in eliciting high quality information from incident investigation interviews.

Hallowell, M., Oguz Erkal, E.D., Sherratt, F., Court, M., MacLean, B. and Davis, M. (2024) Safety Performance Measurement in Environmental, Social & Governance Frameworks, *Professional Safety*, July Edition 0724 23-25.

Environment, Social, and Governance (ESG) standards, frameworks, and ratings recommend that organizations communicate material threats and opportunities to investors and other stakeholders. Safety is often included within the social component of ESG, which include organizational values, practices, and metrics related to organizational occupational safety management. At present, ESG disclosures relating to occupational safety typically reference injury rates as a meaningful indicator of safety performance which is antithetical to modern safety science and philosophy. Analysis of a sample of ESG Reports revealed a misalignment in ESG reports between safety values and safety metrics (i.e., what companies say they value is not what they measure). ESG standards and reporting can be improved by adding valid and reliable measures of safety that are better aligned with practices and organizational values.

COMMUNITIES OF PRACTICE

2024 was an outstanding year for the CSRA Community of Practice. Each month, the CSRA invited safety professionals from different corners of our industry to share their experiences and insights with the community at large. It takes a village to effect change, and this forum serves as that central hub, open to both CSRA members and non-members alike. This year, we took a deep dive into several critical themes: future of safety metrics, high energy controls assessment (HECA), learning from incidents, quality of safety activities, and mental wellness. The CSRA CoP will continue to remain an open forum for everyone to share stories, generate ideas, debate point of views, and develop shared learnings in our quest to eliminate SIFs.

We will continue to keep these calls fresh with new topics and engagement strategies with a focus on practical efforts being taken to eliminate SIFs. In 2025, we will tackle the following topics:

1. **Lessons from HECA Implementation**
2. **What are Alternative Controls?**
3. **Safety Culture**
4. **Unique Precursors of SIFs**
5. **Measuring the Quality of Wellness Interventions**

2024 Speakers

Dr. Elif Erkal
Associate Director for Research and Strategy
CSRA / University of Colorado Boulder

Arnaldo Bayona
Research Assistant
CSRA / University of Colorado Boulder

Doug Rosenthal
Director Health, Safety & Environment
Orion Marine Group

Robert Waterhouse
Program Manager
Energy Safety Canada

LaRhonda Julien
Inspection Performance Specialist
Georgia Transmission Corporation

Dr. Steven Ayer
Associate Professor
University of Colorado Boulder

Dr. Matthew Hallowell
Executive Director
CSRA / University of Colorado Boulder

Dr. Fred Sherratt
Associate Director of Research
CSRA / University of Colorado Boulder

Dr. Sid Bhandari
Associate Director of Research
CSRA / University of Colorado Boulder

To sign up for these calls, please visit our website and subscribe to receive the invites: https://www.csra.colorado.edu/csracop. Recordings of our calls are archived on the website.

CSRA BOARD OF ADVISORS

Our Board of Advisors is a distinguished group of experts whose talent and dedication drive our mission forward. Comprising leaders from diverse industries, they bring a wealth of knowledge and experience to our organization. Their commitment to excellence ensures we remain at the forefront of innovation and best practices. Each advisor's unique insights and strategic guidance are invaluable assets, propelling us toward achieving our goals with integrity and vision. We are grateful for their unwavering support and the exceptional contributions they make to our ongoing success.

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Al Payton
Vice President, Safety and Technical Training
CenterPoint Energy

LETTER FROM THE VICE CHAIR

Mike Quashne
Senior Manager, Health Safety Security & Environmental
Luminace

Another year brings new innovation, new discoveries, and renewed dedication from our CSRA members and supporters! It's important for us to pause from time to time and reflect on the things we've accomplished with the knowledge and incredible engagement from the CSRA community.

Our team members, Community of Practice participants, and the wonderful supporters of our organization all across the world are the heartbeat of our work. As we test radical new ideas and re-test some traditional ones, the energy of our membership is the key ingredient to our recipe of success. Every quarter, more than 100 operational and safety leaders descend on Boulder, Colorado with spirit and vigor to make new progress toward the CSRA's vision of eliminating serious injuries and fatalities within the construction sector. Those consummate professionals come to us to engage in a behavior that is often rare and elusive: to give of themselves with the willingness to have their mind changed and to boost the ideas of others. During each visit, I'm newly inspired by that engagement, openness, and joy that our team members offer, and after each visit I'm freshly dedicated to our cause.

As we wrap up some of our most ambitious projects and commit to intrepid new endeavors, the leadership of our members will continue to be the best indicator of our success and impact. It certainly isn't easy to take time from our busy schedules to give of ourselves for the good of the community, but each year we see the visible impact of our work with the success of our members, and with the excitement of the safety community who is often hungry for the work we provide. Our projects and our organization are powered by the foremost construction safety researchers in the academic world, and the top safety and operational leaders in the construction world. By themselves, the impact of each can only reach so far. Our unique combination of the two continues to lead us to paradigm-shattering conclusions and products.

In the next year, as always, we'll embark on a journey with new and unique projects to explore things we hadn't even begun to dream of in the past. Whenever it seems like we might run out of ideas, our members and their contacts come to the table with dozens of new and creative concepts for us to test and develop. The projects we take on next year and the year after will be on topics that come from our members that we can't conceive of today. That is the thrill of the research and work we do.

I'm incredibly proud to be a part of the CSRA and to work with our fantastic member companies both inside and outside of our research. I'm humbled and excited to serve our community as CSRA's newest Vice Chair, and I'm determined to continue to boost the impact we have, both inside and outside of our organization.

Thank you all for your continued support, engagement, ideas, knowledge, and dedication. Let's move forward with another strong year!

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