SAFETY RESEARCH

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WHAT IS A SERIOUS INJURY?

A Model for Defining Serious Injuries & Fatalities

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IN RECENT YEARS, the term "serious injury and fatality" (SIF) has become increasingly popular. Companies have created SIF prevention programs, institutes have launched SIF prevention initiatives and the state of California has even established regulatory requirements for reporting potential SIFs (CPUC, 2019). However, despite this momentum, there is no common definition for a serious injury that transcends organizational boundaries. As a result, it is unclear whether people mean the same thing when using the terms "SIF" or "potential SIF."

Several research organizations, regulatory bodies and institutes have attempted to define a serious injury (NSC, 2020) but, as summarized in Figure 1 (p. 24), there are considerable differences among the approaches. For example, some definitions attempt to explain the word "serious" (known as an intensional definition), while others are based on a list of injury types that are considered serious (known as an extensional definition). In the case of serious injuries, an extensional definition requires creating a comprehensive list of serious injuries that applies across all occupational settings. Extensional definitions are generally less mature and must be updated every time a new incident type is encountered. Alternatively, intensional definitions tend to be preferred because they assign meaning to a concept, phenomenon or occurrence, making them more robust and scientifically useful. As the use of the term "serious" becomes more pervasive, a precise intensional definition is needed that allows people to unambiguously determine what is a serious injury and, perhaps more importantly, what is *not* serious.

None of the definitions shown in Figure 1 (p. 24) are inherently correct or incorrect; they are just different. One can make a legitimate case that organizations should have and use definitions that best suit their specific needs. After all, customized frameworks and definitions that are aligned with the unique culture of an organization makes them easier to implement, monitor and improve. Therefore, it is not unreasonable to ask why we need a common definition of SIF. The short answer is that SIF occurrence is paradoxical, and collaboration is required to make progress toward SIF elimination. Although, fortunately, SIFs are rare in a single company, their rarity makes it challenging, if not impossible, to trend, learn and improve from their occurrence. Thus, no single company—regardless of its size—has enough information to discover how to eliminate SIFs by itself; SIF elimination requires the collaboration of the entire safety community. While the definition of a fatality is clear, "serious" remains contentious and, thus, such collaboration would be greatly enhanced and supported by the development of one definition that everyone can readily understand and use in practice.

Definitions are more useful when they are precise, concise, clear and easy to apply. Therefore, this article explains why a definition of a serious injury is needed, creates a definition of "serious injury" based on empirical evidence and consensus among experts, and builds a decision model aligned with the definition that enables consistent classification. Furthermore, it also demonstrates the practical application of this definition through an experiment to test the extent to which this new model reduces noise (i.e., variability in assessments), and thus has the potential to add value in the field to reinforce learnings able to support the future elimination of SIFs.

KEY TAKEAWAYS

- **Assessments indicate that there is no consistent understanding of the word "serious" and there is considerable noise in the classification of the same case by multiple people.**
- **An expert panel used literature from medicine, military, engineering and other disciplines to create the empirical criteria that define a serious injury—the LIFE model.**
- **A controlled experiment revealed that the LIFE model is reliable, significantly decreases noise, and serves as the foundation for professional collaboration and scientific advancement.**

Practical Needs for a Definition

To illustrate the practical need for a single definition of "serious injury," consider the following example: A construction worker lost the tip of a finger when unstable materials unexpectedly shifted in the bed of a truck. The injury involves bone damage, and the piece of finger cannot be reattached. In other words, the consequences of this injury will be permanent but there is technically no disablement because the functionality of the finger will not be affected. This example was intentionally selected because the answer is not obvious, and despite strong personal convictions or professional experiences, no one could be correct or incorrect in a classification of that incident unless a single standard definition is available for reference.

Table 1 (p. 25) compares how this case of a severed fingertip involving bone would be classified according to the definitions from Figure 1 (p. 24). Perfect agreement (i.e., zero noise) would be achieved when the different definitions are applied to reach the same conclusion for the same case. The inconsistencies in the final classifications demonstrate the need for a more precise threshold to distinguish serious from less-than-serious injuries.

Scientific Need for a Definition

Shared definitions underpin any scientific field. For example, glaciologists have a definition of "glacier," cellular biologists have a definition of "cell" and physicists have a definition of "atom." Without these strict definitions, the scientific community is effectively paralyzed by the inability to test hypotheses, replicate protocols or debate conclusions. Definitions must be created and curated; although some researchers may not like a particular definition, they must comply until they convince the research community as a whole to revise it.

The field of astronomy offers an interesting example of the maturation of a definition. The earliest definition of a planet was extensional because it was comprised of a list of observable planets in our solar system, which included Pluto. About 7 decades after the discovery of Pluto, a community of astronomers in the International Astronomical Union voted on a new intensional definition of the word "planet." The group considers an object to be a planet if it 1. orbits a star; 2. has sufficient mass to assume hydrostatic equilibrium (a nearly round shape); and 3. has "cleared the neighborhood" around its orbit. Against this new definition, Pluto was no longer considered a planet because it has not "cleared the neighborhood" and was downgraded to a dwarf planet accordingly (Brown, 2010). Although some did not like this change, the scientific community had agreed upon a new definition that is backed by a clearer understanding of the natural phenomenon.

Safety is beginning to emerge as a scientific field. However, the field must first make progress on key definitions. For example, terms such as "near miss," "leading indicator" and even the most fundamental word in this field, "safety," are still used inconsistently. This study takes an important step by creating initial alignment on the term "serious."

Methods to Define Serious Injuries for Occupational Safety

The study was performed in two phases as shown in Figure 2 (p. 26). In the first phase, an expert focus group developed a consensus-driven definition of a serious injury and created an associated classification model. In the second phase, a randomized experiment was conducted to measure the extent to which the new model increases the consistency of classification (i.e., reduces noise).

Phase 1: Creating a Definition With an Expert Focus Group

The definition of "serious injury" and associated classification model were created by an expert focus group. Focus groups are controlled face-to-face discussions among groups of people that are organized to collaboratively build toward a consensus (Barbour & Kitzinger, 1998). Focus groups were selected because they balance research rigor and practical data collection. In this study, four focus group discussions were held over the course of a year, and the process was managed by a panel of three academic researchers.

Although, experts are not required for all focus groups, it was important for this study because a wealth of experience was needed to ensure that a definition is robust and broadly useful. Per the guidance of Hallowell and Gambatese (2009), the qualifications of the focus group panel were as follows:

1. All participants had at least 5 years of experience in operations or occupational safety management (average of 14 years of experience).
2. On average, panel members had 16 years of experience in OSH.
3. Of members, 41% were actively serving or had previously served on nationally recognized committees on safety.
4. Participants held advanced degrees in civil engineering, construction engineering, OSH or other fields directly related to this study from an institution of higher learning (minimum of a B.S.).
5. Participants represented the following sectors: construction (pipeline, building, commercial, industrial), oil and gas, power generation and delivery, elevator and insurance.

The panelists were based in the U.S., Canada and the U.K. representing companies with worksites across the globe. The discussions were held in a hybrid setting due to COVID restrictions wherein some members were present in person, and some joined in through a virtual platform.

Scoping Decisions

Several key decisions were made by the expert focus groups to arrive at an achievable scope.

Philosophical focus: The focus group discussions began by critically evaluating existing definitions and severity classification methods. This review included literature from a broad array of fields ranging from athletics to military research. This review revealed several trends from current approaches, such as:

1. Limited access to medical records often results in safety professionals using their own judgment to determine whether an injury is serious.
2. Formulating a comprehensive list of all possible injuries that would be classified as serious under all conditions would be practically impossible. Additionally, a massive amount of noise appears to exist in the classification of serious injuries because individuals reach different conclusions when given the same case even when the same definition or decision model is applied.
3. Treatment-based definitions may become challenging because of the variability in medical practitioners, healthcare and medical systems, and workforces across different geographies (e.g., U.S. compared to Canada), which lead to practical and validity concerns (Mercuri & Gafni, 2011).

Because of these limitations, the focus groups chose to start anew rather than adopt or adapt traditional approaches. That is, instead of focusing on creating a definition from a list of treatments, the group focused its attention on the actual impact of an injury on the worker. Although it may seem that this shift would introduce more subjectivity, the expert panel agreed

FIGURE 1

DIFFERENT DEFINITIONS OF SERIOUS INJURY

Amputations, in-patient hospitalization, loss of an eye, or serious degree of permanent disfigurement (Cal/OSHA, 2020)

"Work injury that results in the injured person being disabled for a period of 2 weeks or more" (DMIRS, 2020).

"An amputation, at the time of the accident, of an arm or leg or amputation of a major part of a hand or foot" (WorkSafeBC, 2020).

Any injury matching the serious injury criteria listed below:
1. Fatalities
2. Amputations (involving bone)
3. Cerebral hemorrhages
4. Injury to internal organs
5. Bone fractures
6. Complete tendon tears
7. Herniated disks (neck or back)
8. Wounds requiring internal stitches
9. Second or third degree burns
10. Injuries resulting in loss of vision
11. Injections of foreign materials
12. Severe heat exhaustion
13. Dislocation of a major joint

Any major specified injury (e.g., loss of consciousness caused by head injury or asphyxia; amputation of an arm, hand, finger, thumb, leg, foot or toe; any burn injury including scalding, etc.; Cooper, 2019, HSE, n.d.)

"Serious injuries include death, injuries involving permanent disability, or more than 30 days of absence from work" (Farina et al., 2013, p. 612).

"A serious injury or fatality is an incident or near miss that results in or has the potential to produce fatal or life-altering injury or illness" (OSA, n.d.).

Hospital-level injuries (e.g., outcome of a hospital transport is unknown; Bryden & Andrew, 1999, p. 42)

Injuries resulting in lost work time (Hinze et al., 2006; Manuele, 2013)

TABLE 1

INJURY CLASSIFICATIONS USING DIFFERENT DEFINITIONS OF SERIOUS INJURIES

Source	Definition/Applicable criteria	Serious?
Cal/OSHA, 2020	Amputations (i.e., traumatic loss of all or part of a limb or other external body part)	Yes
Department of Mines, Industry Regulation and Safety, 2020	"Work injury that results in the injured person being disabled for a period of 2 weeks or more."	No
WorkSafeBC, 2020	"An amputation, at the time of the accident, of an arm or leg or amputation of a major part of a hand or foot."	No
Edison Electric Institute, 2020	Amputations involving bone	Yes
U.K. Health and Safety Executive, n.d.	Amputation of an arm, hand, finger, thumb, leg, foot, or toe (definition of specified injuries)	No
Onshore Safety Alliance, n.d.	"Life-altering injuries result in permanent or significant loss of a body part"	Yes
Farina et al., 2013 (p. 612)	Injuries resulting in "death, permanent disability, or more than 30 days of absence from work." [a]	No
Bryden and Andrew, 1999 (p. 42)	Hospital-level injuries [b]	No
Hinze et al., 2006; Manuele, 2013	Injuries resulting in lost work time [c]	Yes

Note. This table uses definitions from regulatory agencies and research articles related to occupational safety as shown in Figure 1.
[a] Applied in a study about construction injuries in Italy. [b] Applied in a study of highway construction projects in New York state, USA. [c] Threshold established by the authors to distinguish serious from minor or less-serious injuries.

that this philosophical approach would consider individual differences and potentially varied responses to the same injury (Hernandez & Sachs-Ericsson, 2006).

Potential versus actual: Many have extolled the value of learning from potential SIFs (e.g., Busch et al., 2021; Cooper, 2019; Martin & Black, 2015). The expert panel also agreed that the learnings from potential serious incidents are significant; however, it was deemed out of scope for this definition. Specifically, the expert panel opted to focus on actual outcomes of the incident only (i.e., attempting to determine whether an injury was *actually* serious rather than exploring whether the injury was *potentially* serious). Assessing potential severity is recommended for future work.

Chronic injuries, pain, illnesses and mental health issues: The team acknowledged that injuries in which impact is accumulated over time are undoubtedly significant and distressing to the worker. However, from a safety management perspective, it is challenging to isolate as a specific work-related incident and determine the degree to which an employee is affected at a given point in time (Carey & Pilgrim, 2010). Thus, pain, illnesses and mental health concerns were not in the scope of this study. Including these more challenging topics would be an excellent subject for future research.

Objective measurement determination: The expert panel considered how approaches used by insurance and government for long-term care assessments should influence the authors' definition of a serious injury. These programs generally assess severity of any injury based on the impact to activities of daily living (ADL; Veteran Affairs, 2015). Essentially, ADLs are basic activities that a person performs in daily life such as bathing, feeding and continence (Shelkey & Wallace, 1999). Although the ADL framework is highly altruistic, the focus group noted that the information required to assess ADLs is not accessible by most companies because of the need to protect the privacy of the injured person. Additionally, the panel could not determine a reasonable time frame for impacts to ADLs and periods of recovery. For example, it is unclear how long a worker must be affected for the injury to be considered serious (e.g., if a worker cannot stand unassisted for 5 seconds, 5 days or 5 years). Since any recovery period would be arbitrary, it was not included in the focus group definition.

The LIFE Model

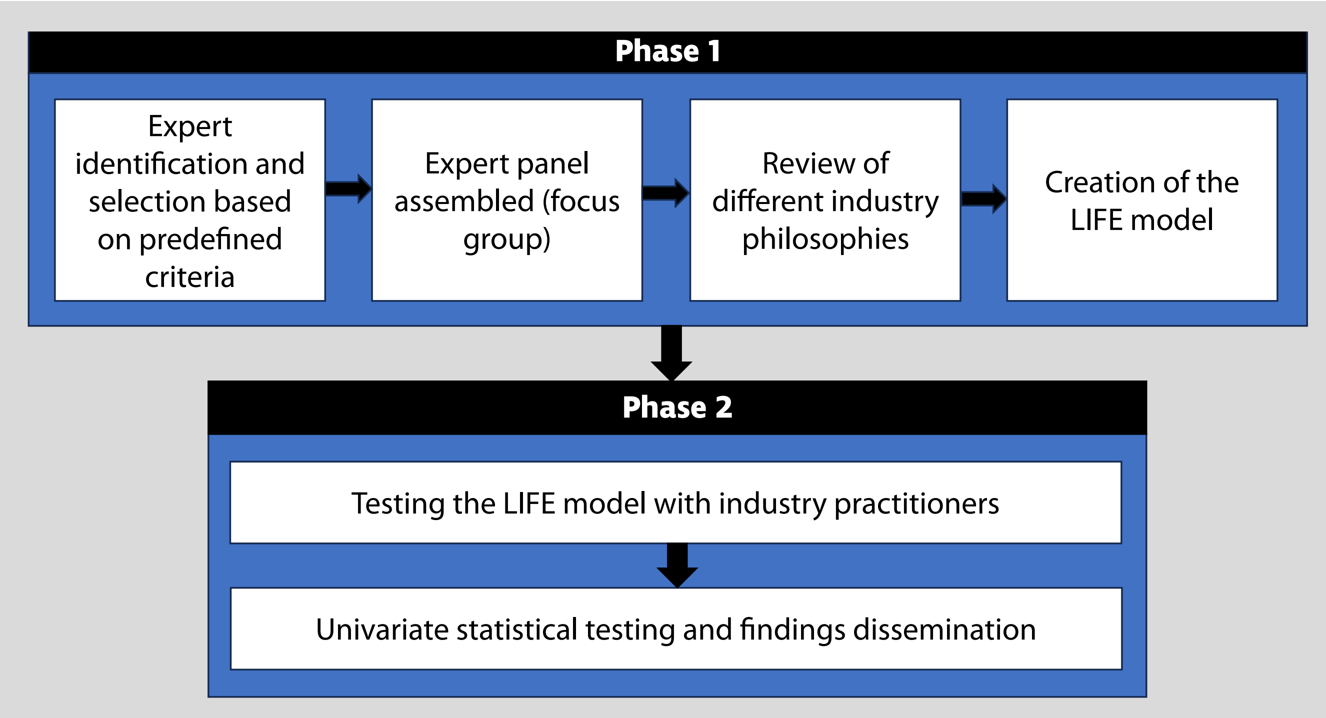
The focus groups ultimately created a definition of serious injury that follows a three-question framework called the life-centered injury and fatality evaluation (LIFE) model (Figure 3, p. 27). The definition was designed to be applicable across different contexts and with a focus on the impact to the life of the injured worker. The criteria in the LIFE model were also designed to be independent of injury types and treatments because of variability in both individual response and treatments. The general philosophy behind the LIFE model is that the incident ends, threatens or forever changes the life of the injured person.

The LIFE model classifies an injury as SIF if it results in the following outcomes:

1. Life-ending: A case that results in the death of the injured person. As the name suggests, this question is simply for classification of a fatality.

2. Life-threatening: A case that requires immediate medical intervention or lifesaving support (e.g., CPR, defibrillation) to save the injured person's life. Any incident where a lifesaving intervention or medical care without which death would have been imminent is considered life-threatening. This definition is commonly used in trauma centers to triage patients and prioritize medical resources (Tanabe et al., 2007).

FIGURE 2
RESEARCH PROCESS



3. Life-altering: A case in which the injured worker will not fully recover and will most likely suffer permanent impairment from the loss of the use a major internal organ (e.g., brain, heart, lungs, liver, kidneys), body function or body part. The expert panel recommended considering the loss of any body part as serious for two main reasons: 1. doing so maintains the simplicity in the model and 2. this type of injury is irreversible. This categorization is consistent with the OSHA (2020) definition of serious physical harm and with the model of disablement developed by the World Health Organization (Rondinelli et al., 2021). According to the LIFE model, a body function is a psychological or physiological function of the body system such as vision, range of motion or spatial orientation. Similarly, body parts are anatomical parts of the body (e.g., organs, limbs and their components) that support body functions. Examples include eyes or the urinary tract.

Any case that does not meet one or more of the three criteria would be classified as non-SIF from the organizational point of view. This is not to imply that the event is not serious for the injured person, but simply from an organizational perspective, its classification would not be SIF.

To demonstrate the LIFE model, four example cases taken from the OSHA repository are provided in Table 2.

Phase 2: Experimental Testing

The second phase of this study focused on experimentally testing the LIFE model with real cases. An A + B longitudinal study was designed (i.e., repeated measures were taken to isolate changes, per Schaie & Hertzog, 1983). This experimental protocol allowed the authors to measure the extent to which the LIFE model reduces noise and improves consistency of classifying serious injuries. The experiment involved three key steps: 1. pre-LIFE model (baseline) survey in which participants use their existing methods of classification; 2. introduction of the LIFE model to the participants; and 3. post-LIFE model survey in which the participants were requested to use the LIFE model in their classifications.

Both surveys (pre- and post-LIFE model) required participants to evaluate actual injury cases and determine whether the injury was an SIF or not. In the pre-LIFE model survey (i.e., baseline survey), participants were asked to use and describe their existing methods of classification to arrive at their conclusions. In the second survey, the participants were instructed to use the LIFE model to make the classifications. In both surveys, they answered the following questions using a Likert scale (1 = strongly disagree; 5 = strongly agree) to indicate the extent to which they agreed with each statement:

1. My conclusions for these cases align with my company's philosophy on what makes an injury serious.
2. It was easy to determine the conclusions for these cases.
3. I feel confident in my conclusions.

The case narratives were taken from the OSHA database on severe injuries (2015 to 2021; OSHA, n.d.). From the cases selected, the academic researchers removed extraneous information to avoid confounding effects. All other information was retained. Fatality cases were not included for two reasons: 1. the conclusion of life-ending is not open to interpretation; and 2. the case examples could not be modified in a way that would not reveal the conclusion. Thus, this experiment tested only the "serious" component of SIF.

A total of 18 cases were selected and embedded within a survey. The survey included a stratified sample of nine SIF and nine non-SIF cases with each group having three levels of difficulty (easy, medium and difficult). This was intentionally done to test consistency in classifications. The order of the cases was randomized by using a counterbalanced survey design. Specifically, the 18 cases were randomly subdivided into two surveys, A and B, each with nine cases. Additionally, half the participants were randomly selected to receive survey A first (presurvey) and the others were randomly selected to survey B first (Figure 4, p. 28). Therefore, every participant received both surveys A and B during the experiment. This approach controls for ordering effects that can be a source of cognitive biases among participants (Perreault, 1975).

Participant Recruitment

Research participants who were not involved in the creation of the LIFE model were recruited to avoid confirmatory bias (i.e., tendency to look for information that favors one's prior beliefs or hypotheses; Klayman, 1995). Uncompensated and voluntary participation was sought from safety professionals who represented a diverse set of employers and geographical regions. The presurvey was completed by 49 participants and the post-survey was completed by 39 participants (i.e., an attrition of 10 participants).

On average, the survey participants had 19 years of safety and health experience and represented the following industry sectors:
- infrastructure construction (27%)
- oil and gas (21%)
- electrical power generation and delivery (14%)
- commercial building construction (4%)
- other industries (e.g., elevator, consulting, petrochemical, mission critical data center, insurance; 24%)

After the presurveys, participants received prerecorded video training on the LIFE model. The prerecorded video was used to deliver consistent training on LIFE model to boost the internal validity of the process and avoid any confounding effects due to different interpretations. The video included a summary of the philosophical approach and the process that led to the creation of the model, a description of the model, and a step-by-step guide with the specific rules associated with the definition of SIF. In short, it summarized how the LIFE model was created, what are life-ending, life-threatening and life-altering events, and finally how it should be used (see Table 2).

Results & Discussion

The baseline survey provided the information needed to empirically measure the noise associated with current definitions

FIGURE 3
LIFE MODEL

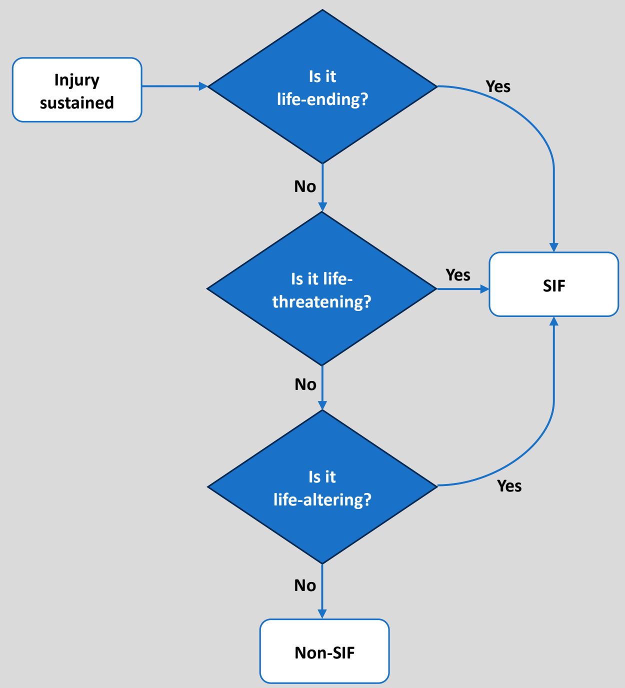


TABLE 2
LIFE MODEL APPLIED TO REAL CASE EXAMPLES

Case example	Conclusion	Explanation
An employee was walking on a ceiling grid and fell approximately 60 ft through a draft opening, striking another employee on a lower level. The employee on the lower level was hospitalized for fractures and other injuries. The employee who fell suffered injuries that resulted in a fatality.	SIF	Life-ending injury: Resulted in a fatality
During a steam-assisted gravity drainage, a worker was burned by steam that came out of a filter pot. The worker sustained full thickness (third-degree) burns to the face and torso and remained in the intensive care unit for 3 weeks to receive treatment.	SIF	Life-threatening injury: The injured worker would not have survived without the life-saving support received at the intensive care unit.
An employee was struck in the left hand by a pump jack. An X-ray at a clinic revealed two broken fingers. Due to nerve damage related to the broken bones, the employee permanently lost motor function in both fingers.	SIF	Life-altering injury: There is a permanent loss of a body function (lost motor function).
An employee was cutting a piece of wood with a table saw when the blade lacerated his right index finger. He received six external stitches at a clinic. The worker returned to work on modified duty after 3 days and to normal duties after 1 week.	Not SIF	There is no evidence of fatality, near-death nor permanent impairment. Restricted duty does not meet criteria to be an SIF.

and classification schemes. Noise was measured as the variability (i.e., standard deviation) in the responses to the same cases (Table 3, p. 28). Therefore, a larger standard deviation would indicate higher levels of noise. Results show that before the LIFE model was introduced the noise across different cases was very high, indicating disagreement among professionals on the classification of the same cases. From the open-ended responses, the authors learned that the source of variation was the wide range of interpretations of the word "serious" and the lack of available decision models. More than half the participants (55%) used their personal judgment to classify the injuries and nearly a quarter of participants reported that it was challenging to classify even with their current resources. These baseline results reinforce the merit of this study by quantifying the degree and source of the noise.

After the LIFE model training, the level of variation among participants decreased significantly (23% overall reduction from a standard deviation of 1.41 to 1.08). The residual variability may be explained, in part, because only a brief introductory video was used to introduce the LIFE model and there was no opportunity to practice with feedback. As with any decision scheme or definition, users would benefit from practice.

To compare the experimental groups statistically, the authors used the Kuder-Richardson test (KR-20) to measure the consistency of case assessments with varying degrees of difficulty. The KR-20 statistic is a suitable tool for assessing internal consistency in surveys that have binary responses (e.g., SIF or non-SIF; Tan, 2009). Table 4 summarizes the results. Note that a negative KR-20 coefficient indicates that the consistency is worse than chance; zero indicates that the consistency is equal to chance; and positive indicates the extent to which the consistency is better than chance. A KR-20 coefficient of 1.0 indicates perfect consistency in responses. The findings show an increase in consistency in survey A, where baseline values went from moderate consistency before the LIFE model was introduced (KR-20 = 0.23) to strong consistency levels (KR-20 = 0.53) after. Similarly, there was a noticeable increase in consistency in survey B, where baseline results performed worse than chance (KR-20 = -0.44) but reached moderate consistency levels once the LIFE model was introduced (KR-20 = 0.21).

FIGURE 4
SURVEY DESIGN

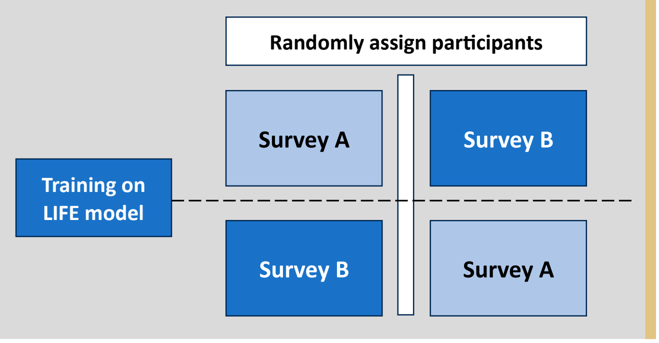


TABLE 3
SURVEY FINDINGS

Survey	Pre-LIFE model			Post-LIFE model		
Case	***SIF (%)***	***Non-SIF (%)***	***SD (Noise)***	***SIF (%)***	***Non-SIF (%)***	***SD (Noise)***
1	32	68	0.49	5	95	0.22
2	32	68	0.48	0	100	0.00
3	41	59	0.50	0	100	0.00
4	95	5	0.21	10	90	0.22
5	18	82	0.39	10	90	0.30
6	77	23	0.43	86	14	0.40
7	82	18	0.39	100	0	0.00
8	100	0	0.00	90	10	0.30
9	95	5	0.00	100	0	0.00
10	11	89	0.32	0	100	0.00
11	0	100	0.00	0	100	0.00
12	0	100	0.00	0	100	0.00
13	48	52	0.51	83	17	0.38
14	70	30	0.47	39	61	0.50
15	89	11	0.32	94	6	0.24
16	100	0	0.00	100	0	0.00
17	96	4	0.19	78	22	0.43
18	100	0	0.00	89	11	0.32
Total SD	--	--	**1.41**	--	--	**1.08**

TABLE 4
CONSISTENCY TEST RESULTS

Survey	Pre-LIFE model coefficient (KR-20)	Post-LIFE model coefficient (KR-20)	Delta (improvement)
A	0.23 (***N*** = 22)	0.53 (***N*** = 18)	$\Delta_{KR\text{-}20} = 0.30$
B	-0.44 (***N*** = 27)	0.21 (***N*** = 21)	$\Delta_{KR\text{-}20} = 0.64$

TABLE 5
COMPARATIVE ANALYSIS

Parameter	Statistical test	Pre-survey mean score [/5] (a)	Post-survey mean score [/5] (b)	Difference (b-a)	*p*-value	95% confidence interval	
						Lower	Upper
Alignment	Paired *t*-test (*N* = 39)	3.73	3.26	-0.47	$p = .006$	-0.94	-0.18
Ease of use		3.63	3.87	0.24	$p = .194$	-0.15	0.76
Confidence		4.02	4.15	0.13	$p = .618$	-0.30	0.50

Note: The confidence interval reported here corresponds to the difference in the means of the pre- and post-survey scores for evaluating alignment, ease of use and confidence.

Lastly, when testing the LIFE model, the authors also inquired about the ease of use, confidence in their classification, and alignment with company philosophy before and after the LIFE model training. A paired *t*-test was performed to compare the difference in means of the same group of participants at two points in time (i.e., before and after LIFE model scores; Kim, 2015). The results showed that, on average, practitioners found that the model was easier to use than their previous approach and they were more confident in their classifications, but these changes were not statistically significant. The participants did feel that the LIFE model was not aligned with their previous approach, which is not surprising given the variability in approaches documented. The implication is that alignment to a new model will require that practitioners compromise by departing from their current methods toward one common approach. This may be easier said than done. Table 5 summarizes the previous findings.

Conclusions

There will never be one perfect definition, framework or model for serious injuries. This is simply because serious injury classification will always be driven to some degree by perceptions, which are inherently subjective. Also, a level of uncertainty is involved in the assessment of injury cases that cannot be reconciled because safety professionals are not medical professionals, information is often missing or undeterminable for various reasons (legal and otherwise), and a component of individuality is involved where each person's body recovery (or suffering) is different. The LIFE model addresses some of these concerns and provides advantages to the safety community at large.

The LIFE model is a more mature intensional definition that expresses the meaning behind the word "serious." An intensional definition of serious injuries tends to be more scientifically mature because it captures the philosophical meaning behind the word, which allows the definition to remain more stable as new injury types are encountered. In contrast, extensional definitions of serious injuries require the safety community to agree upon and maintain a full list of serious injury types. As history shows, extensional definitions yield conflict and discomfort, especially in the case of serious injuries for which contexts, personal suffering and medical diagnoses can vary greatly.

The LIFE model describes when an injury is serious and when an injury is not serious. The model also helps one to understand what makes an injury serious and why we ascribe that term and deploy resources accordingly. This LIFE model definition takes inspiration from other industries and is grounded in empirical evidence that may be practically and objectively verified.

The LIFE model reduces noise in injury classifications but does not align with company philosophies. Research indicates that current approaches produce wildly inconsistent classifications of serious injuries (in many cases, worse than a flip of a coin). The LIFE model vastly decreases noise by increasing the consistency in the way that multiple professionals classify the same case. Although one could argue that any single model would improve consistency, the results suggest that the professionals generally prefer the LIFE model to their current approaches because it is easier to use and increases confidence. However, the results also suggest that the LIFE model does not necessarily align with existing company approaches, which means that practitioners will have to consider the trade-off between advancement of safety as a science and community-based learning or individual preference and company distinction.

By focusing on the impact to an injured person's life and maintaining a high bar for what constitutes a serious injury, the LIFE model is aimed at helping organizations to better prioritize learning opportunities and balance individual and organizational perspectives. Because SIF incidents are relatively rare in a single company, collaboration is required across organizational boundaries to enable shared learning and scientific advancement. Eventually, organizations and indeed the industry as a whole could use the LIFE model to focus resources on learning from and preventing incidents that may result in death, near-death or permanent injury. In summary, the LIFE model advances safety as a scientific discipline and is an important step toward the common goal of eliminating SIFs. PSJ

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