
ASSESSING NON-TECHNICAL SKILLS USING THE SSA INVENTORY

INFORMATION FOR THE MINING, INDUSTRIAL, CONSTRUCTION &
TRANSPORT INDUSTRIES



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THE SITUATIONAL SAFETY AWARENESS TEST

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Delivered in an economical and convenient online format the Situational Safety Awareness Test (SSA) provides an effective tool to measure responsiveness, vigilance and attention in both cognitive and behavior dimensions of personnel.

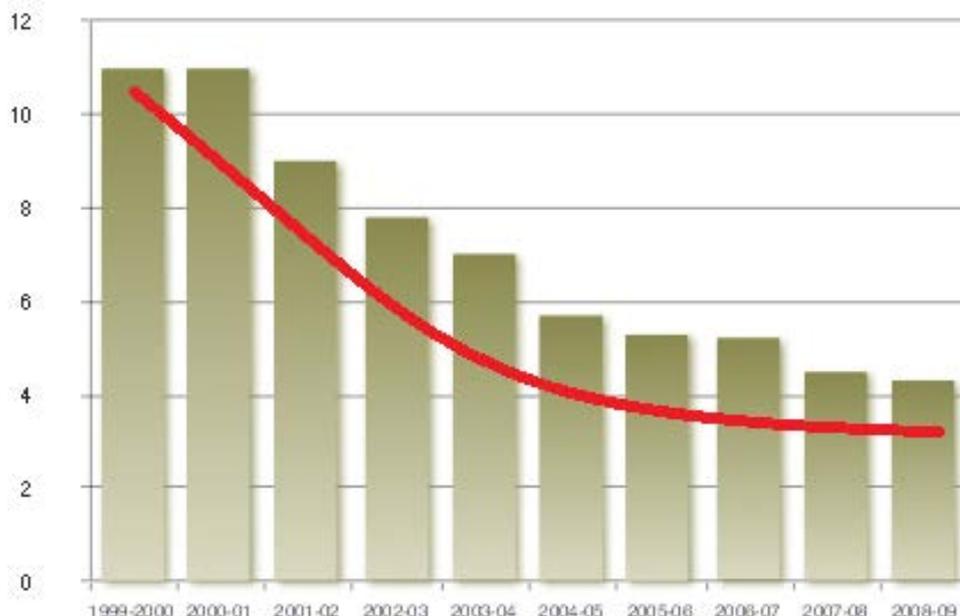
The SSA test is now widely used across the mining, heavy manufacturing, construction transport and general industrial industries and has a growing usage amongst hospitals and aviation operators. The test had become the preferred instrument of psychologists and safety professionals due to its ease of use, high validity and strong prediction capability for unsafe workers.

The test consists of a standardized safety specific behavior and competency based questionnaire founded on the most current research concerning why incidents occur in safety critical industries.

MANAGING THE HUMAN FACTOR WITH COGNITIVE SAFETY APTITUDE ASSESSMENT

The SSA addresses the safety ‘**incident plateau**’ (Donald & Canter, 1993) which has been shown to be a cross industry phenomena likely due to human factors, typically resistant to further penetration and reduction by conventional engineering and systems remedies. Safety research over 25 years has consistently shown that human factors errors account for most incidents. Dr Key Dismukes the chief scientist for human factors at NASA concluded after an extensive review of accident data, that “**Expert and conscientious people routinely make mistakes**”. Reinforcing conclusions derived from the global research on safety across all industries that the un-addressed human factor provides the most potential for loss.

Lost time injuries per million hours worked showing incident plateau

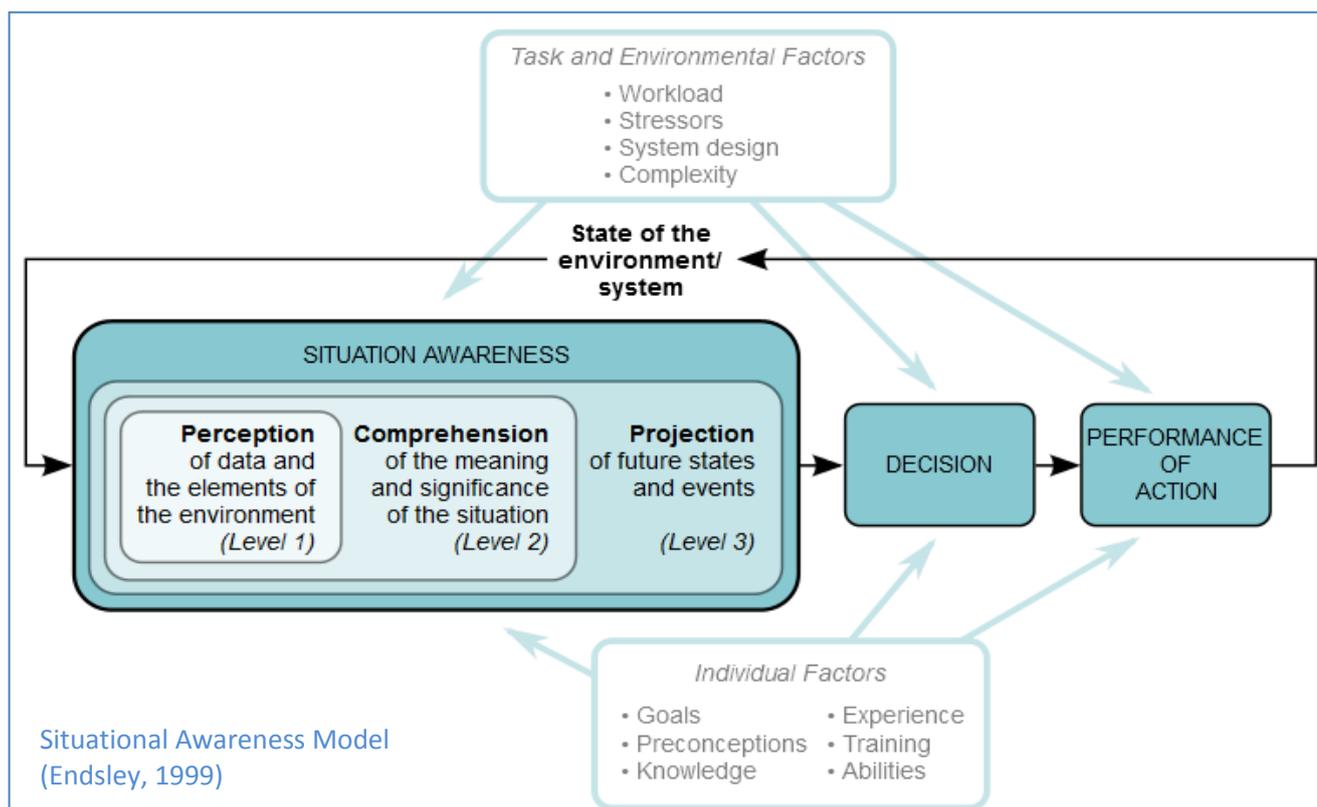


Source: Minerals Council of Australia

Situational awareness consists of three key cognitive elements; detection of elements in the current state (perception), understanding what those elements mean (comprehension) and prediction of future status (projections).

Most notably, situational awareness has been identified as a key element to success in a wide variety of operations including mining, heavy transport, construction and air traffic control. Previously, loss of situational awareness has been cited as a factor in performance failures of both miners and general industrial workers.^{1,2}

The model of situational awareness³ demonstrates how a breakdown of any element creates a bottleneck; inhibiting both decision making and action selection, and ultimately leading to greater potential for unsafe acts.



Several studies of incidents across various industries^{4,5} have identified cognitive failure as the precursor to loss of sensory and mental perception and ultimately, loss of situational awareness.

Developed after comprehensive testing for the munitions industry, the SSA can be used to effectively assess an individual's inherent ability to maintain vigilance, identify risks and to assess and respond to physical and mental stressors (i.e. fatigue, distraction etc.). In short, his or her tendency towards maintaining situational awareness.

¹ NSW Mine Safety Advisory Council; Fact sheet Number 5: Situational Awareness; Downloaded 13/05/14 from: http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0009/402579/ANTS-factsheet-No-5-Situation-Awareness.pdf

² Borys, D (2009), Exploring Risk-Awareness as a Cultural Approach to Safety: Exposing the Gap Between Work as Imagined and Work as Actually Performed, In "Safety Science Monitor" Issue 2, Volume 13, Article 3

³ Endsley, M.R (1999), Situation Awareness in Aviation Systems. In D.J Garland, J.A Wise & V.D Hopkin, (Eds). Handbook of Aviation Human Factors. Mahwah, N.J.: Erlbaum.

⁴ O'Hare, D. (2006). „Cognitive Functions and Performance Shaping Factors in Aviation Accidents and Incidents. International Journal of Aviation Psychology; 16 (2), p.145-156

⁵ Zhaoxia Liu; Lianjun Chen; Dawei Ren, "Prediction analysis of human error probability for mine hoisting systems," *Industrial Engineering and Engineering Management*, 2009. IE&EM '09. 16th International Conference on , vol., no., pp.1184,1188, 21-23 Oct. 2009

ADVANTAGES OF ASSESSING NON-TECHNICAL SKILLS WITH THE SSA

Compared with conventional measures of safety attitude, the SSA offers significant advantages in the assessment of individual non-technical skills. This is primarily due to its capability to identify individuals who are prone to breakdown in safety despite having a strong safety attitude, and those who are able to maintain the “presence of mind” required to respond in an appropriate manner under a variety of stressors. Additionally the SSA provides the following significant advantages to recruiters:

Initial detection capability: The SSA provides unrivaled capability in detecting employees who may respond well during initial safety attitude tests or interviews, but who remain prone to breakdowns in situational awareness and subsequent loss of safety.

Empirical reliability: The SSA has been empirically validated indicating that those with a score below that of an average worker can be observed to display more unsafe behaviors and a tendency to loss of situational awareness.

Improved selection certainty: Uncertainty is removed from the employee selection process due to the SSA’s empirical reliability and focus on detecting key indicators of vulnerability to loss of situational awareness.

Expedient selection capability: The SSA’s efficient and convenient online format allows selectors to critically assess individual safety awareness in contexts where tight labor markets and immediate staffing demands may result in an expedited screening process and subsequent less than optimal labor base.

Discretionary selection: Selectors are free to select a suitable cutting score for potential candidates based on organizational requirements. Commonly this cutting score is based on the average person’s ability to avoid injury while at work when unencumbered by other factors (i.e.: environment, illness, preoccupation etc.)

Ongoing workforce analysis capability: The SSA inventory’s simplicity and ease of distribution makes it the ideal assessment tool for assessing non-technical skills during and after major changes in organizational structure (i.e. merger or acquisition of new employee base) or as an assessment tool for non- technical skills training programs.

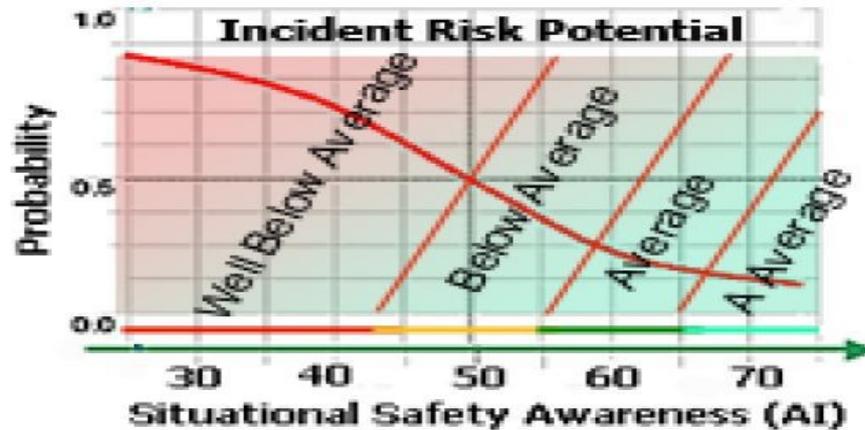
TEST PERFORMANCE RESULTS

The high validity and targeted occupational safety relevance of the SSA has led to its wide use across a diverse range of sectors including mining, medical and general industrial occupations. The high validity of the SSA is confirmed by a predictive validation sample of **808 mining and heavy industry employees and new recruits** carried out in Western Australia. Within this study:

- New recruits tested with the SSA and scoring 60 or greater were seven times less likely to have incidents than untested recruits.
- Less than 1.5% of tested recruits accounted for 9.25% of incidents whereas 10.3% of untested employees accounted for 90.7% of incidents. This indicated a better than 1:6 incident participation ratio in favor of tested recruits.

PREDICTIVE CUTTING SCORE

Known as the “Adjusted Assessment Index” (AAI) the cutting score lies on the probability curve indicating the candidate’s degree of vulnerability to loss of SSA compared to normal (very low incident likelihood) workers.



To take into account the combined behavioral and ability measures included in the SSA, the AAI has been set as a weighted normative score; allowing comparison of individuals against the performance of those with low risk of SSA loss.

The SSA cutting score has been further balanced by taking into account average completion time, and the weighted contributions of the included competencies to prevent distortion of the results.

Individual scales within the test are referenced (against a 2009 sample of 12,000 respondents from various industries) in such a way that proficiency is demonstrated by achievement of a benchmark based on the division between normal personnel and those who are prone to breakdown in the subject area.

AAI SCORES AND CANDIDATE ASSESSMENT

A cut-off score for the acceptance of applicants can be customized to suit the recruiter, and is frequently set at the mean of a safe (low incident rate) population. This is often around 60, where 55 represents low average performance and 65 high average performance.

In addition to the AAI score, assessors are provided with detailed client reports to aid in equitable and knowledgeable discretionary decision making. The option to set a decision score based on the lowest bounds of acceptability remains with the recruiter.

When assessing individual scales, the candidate’s immediacy to the criteria is of greater importance than the specific score achieved. In each of the scale measures, standard deviation from the mean is used to make allowances for normal individual differences; and the midpoint of the standard deviation contributes to the candidate’s final AAI score.

The normal range for AAI scores is 55-65 with increasing likelihood of unsafe behavior as scores decrease below 55 and decreasing risk as the AAI score increases above 55.

SSA SCORE DEFINITIONS

Multiple key scales (determined by job role) form the basis of the SSA and allow for a more detailed assessment of a candidate's individual characteristics. Some example scales are:

Risk Avoidance

Assesses candidate's tendency to seek or avoid risky situations such as workarounds, rule violations, or complex tasks involving considerable skill level or a lack of control. High scoring candidates in this scale would be considered to display a strong ethical tendency toward rules and procedures.

Understands Fatigue

Assesses the candidate's attentiveness to hazards related to sleep deficiency, sleep debt and generalized fatigue as well as understanding of sleep effects on performance. Also assesses candidate's understanding of the effects of stimulants, age and various other conditions on performance ability when operating equipment.

Safety Conscientiousness

Assesses the candidate's tendency to display thorough and assiduous behavior and avoid rule breaking, group pressure, negative norms or casual acceptance of other's performance to ensure safe outcomes.

Perception and Comprehension

Perception and comprehension is assessed at both visual and textual level in varying contexts including low contrast, detail perception, verbal ideation, sequencing of objects and identification with distraction. High scoring candidates are able to detect the unusual in both textual and visual formats, leading to increased ability to distinguish potential hazards in their immediate environment.

Positive Coping Skills

Addresses the constancy of the candidate's mental disposition and affects of mood on safety behavior. Impact of mood on alertness, maintenance of situational awareness, responsiveness and diligence is considered.

Defensive Safety Habits

Safety habits assessed include the capacity to monitor developments with the self and environment including weather, fatigue and personality issues. High scorers can be seen to test assumptions, verify understanding, ask pertinent questions and self monitor workload leading to greater capacity to anticipate future events.

Team and Road Safety Orientation

Assesses the inclination and capacity for the individual to demonstrate regard and consideration for other mobile equipment users as well as to display patience and encourage safety by example.

Mental Alertness

This scale measures cognitive capacity and an individual's predisposition to failure in mental functioning indicated by everyday slips in perception, physical function and memory.

Safety Self Awareness

This scale identifies the candidate's knowledge of the effects of various stressors in reducing mental capacity and ability to maintain alertness on the job.

Responsible For Safety

This scale assesses an individual's perception of their ability to direct and influence safety outcomes for themselves and others. Behavior array with regard to safety ranges from passive to proactive.

KEY SSA VERSIONS

SSA Industrial: A 115 question survey assessing mental state, preferred behavior and competencies with regard to safety. This is used to assess the probability of safe behavior of people working in operational roles. (Eg: Aircraft maintenance personnel)

SSA Precision Manufacturing

This test is a 120 question test of ability to perform at the level of a well functioning and normal adolescent or adult, relative to the performance required of an operator engaged in precision biochemical, pharmaceuticals and electronics manufacturing.

SSA Mining

This test is a 115 question test incorporating mental state, safety competencies and preferred behaviours with respect to safety. Used for assessing the probability of lapses in mindfulness and safe behaviour in the normal functioning of people working in operational roles in mining and refining environments.

SSA Mobile Equipment operator

This test is a 105 question test of ability to perform at the level of a well-functioning and normal adolescent or adult, relative to the alert performance required of a mobile equipment operator and driver.

SSA Managers & Professionals

This test is a 140 question test of abilities and perceptions relative to the performance required of a fully functioning professional with responsibility for large scale assets. This instrument is used primarily for assessing the capacity for the management of safe behaviour at command or professional advisory level.

SSA Admin & Utilities

This test is an 85 question test of ability to maintain attention and awareness, recover from adverse events to perform at the level of a well-functioning and normal adult. Use this for assessing the capacity for safe behaviour in general utilities roles as in cooks, cleaners, admin staff

SSA Security

This test test is a 105 question test of ability to perform at the level of a well functioning and normal adult, relative to the performance required of a security professional.

SSA Apprentice

This test is a 75 question test of ability to perform safely at the level of a normal adult. This instrument is used for assessing mental functioning and basic capacity for safe behaviour in personnel with little workplace experience or safety training

SSA Graduates

This test is a 105 question test of ability to perform at the level of a well-functioning and normal adolescent or adult, relative to the growing performance required of a professional in training.

SSA(R) (Remedial)

This is a is a 44 item short test focused on present moment key functional abilities required for maintenance and recovery of attention, perception, judgment and responses to maintain situational safety awareness in the workplace. The test is used as a 'next-day' retest instrument.

DELIVERING THE SSA TEST

The multidimensional selection of scales making up each SSA version are weighted according to criteria determined by comparative tests and subject matter experts to reflect the adequacy of the measured attribute and then further compared to samples of negligible incident rate individuals.

To prevent biasing of the AAI score toward less important test items, a system of bonuses and penalties are applied to the final score to achieve an objective and logical result. Additionally, individual scale results have an acceptable margin of approximately 7-9% of the criterion score.

The acceptable cutting score (AAI) is set by the organization. However, an existing and generally accepted cutting score of 60 was found to correspond over a 14 month period to those with less than 10% of total incidents and less loss than others in the study sample.

As the majority of SSA tests are delivered unsupervised, several defensive measures have been included to guarantee accuracy of the results with repeated testing, and to prevent information sharing by test users. To inhibit the learning effect, it is advisable not to deliver repeat attempts within seven days. Successive delivery to the same individual is undertaken by delivery of an alternate form of the test with a reordered question set.

● Impression Management - Caution - Inconsistency in Responses Exceeds Normal Range
Steve seems to have experienced some difficulty in providing consistent responses to questions resulting in a degree of contradiction in 'self reported' behaviour. You may wish to explore if this is a simple matter of poor language skills, difficulty in interpretation, a lack of candidness, confused or random responding or a lack of conviction about things. Note that the respondent's desire to manage the impression they are making, may also produce this result.

Failure of Presence of Mind Steve's responses are suggestive of some tendency to a failure of 'presence of mind' or situational awareness. You should explore this further to identify if any fatigue, illness, medication, lifestyle or task and emotional overload related issues could interfere with necessary attention and due vigilance on the job.

Makes blunders Steve reports a tendency to uncoordinated, clumsy movements together with a tendency to rash emotional outbursts and inattentiveness. Check low results on the mental alertness and coping scales for verification of a need for further investigation.

In addition to the acceptable cutting score, final reports include a micro interpretation of the respondents individual scale score relative to the criteria or norm, and a graphical representation of the respondents score relative to the criteria, population mean, and the mean of a selected sample.

Additional interview guides are also provided as a secondary means of analyzing responses to key clusters of questions within the test. This is to allow comparisons of specific test proportions whose significance may be masked within an overall acceptable scale score.

<p>Responsible for Safety Steve reports an average level of belief in his ability to control or influence what happens to him and others suggesting a general tendency to be proactive with regards to own or others safety.</p>	<table style="width: 100%; border-collapse: collapse;"><tr><td style="padding: 2px;">Score</td><td style="padding: 2px;"><div style="width: 69%; height: 10px; background-color: orange; border: 1px solid black;"></div></td><td style="padding: 2px; text-align: right;">69%</td></tr><tr><td style="padding: 2px;">Norm / Benchmark</td><td style="padding: 2px;"><div style="width: 74%; height: 10px; background-color: green; border: 1px solid black;"></div></td><td style="padding: 2px; text-align: right;">74%</td></tr><tr><td style="padding: 2px;">Population mean</td><td style="padding: 2px;"><div style="width: 69%; height: 10px; background-color: blue; border: 1px solid black;"></div></td><td style="padding: 2px; text-align: right;">69%</td></tr><tr><td style="padding: 2px;">Sample mean</td><td style="padding: 2px;"><div style="width: 69%; height: 10px; background-color: pink; border: 1px solid black;"></div></td><td style="padding: 2px; text-align: right;">69%</td></tr></table>	Score	<div style="width: 69%; height: 10px; background-color: orange; border: 1px solid black;"></div>	69%	Norm / Benchmark	<div style="width: 74%; height: 10px; background-color: green; border: 1px solid black;"></div>	74%	Population mean	<div style="width: 69%; height: 10px; background-color: blue; border: 1px solid black;"></div>	69%	Sample mean	<div style="width: 69%; height: 10px; background-color: pink; border: 1px solid black;"></div>	69%
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EXAMPLE FULL REPORT

Client: PROGRESSIVE AVIATION SOLUTIONS

Results for survey 10321 SSA (INDUSTRIAL) v5.0 [BCAST] completed 04 / 06 / 13 01:35:05 AM

Respondent name: Respondent 04-06-2013 00-53

Date of Birth:

Telephone:

Email:

Address:

Age Range:

Education:

Ethnicity:

First language:

Job Type:

Location:

Position:

Summary Results

Assessment Index (Overall Score) calculated as: 52 **Adjusted Assessment Index: 48**
Time taken to complete this survey: 31 minutes **Expected Time: 30 minutes** **Time adjust: +1 minutes**

Survey comprehension level:

Respondent's preliminary results indicate that her comprehension of the text was adequate to successfully complete the survey.

RESULTS SUMMARY:

The SSA INV (INDUSTRIAL) v5.0 test is a 109 question test of ability to perform at the level of a well functioning and normal adolescent or adult, relative to the alert performance required of an industrial worker and equipment operator. This instrument is used primarily for assessing operators of more complex equipment and processes. The SSA test addresses the person's non technical safety skills through their ability to see and understand external risks, maintain attention of surrounding events, function with coordinated and reasoned action and to generally remain vigilant of any degrade in own performance due to various human factors.



Respondent's results indicate a below average capacity with respect to the benchmark for safety minded persons, to maintain her situational awareness and master or cope with the safety needs of the role.

Respondent reports a greater competency in

- Managing the self to avoid cumulative or compounding effects of unrelieved stress
- Anticipating the hazardous effect of distractions, fatigue and variable diligence in self and others
- Ability to think ahead and project, detect errors, avoid pitfalls and infer developing hazards in the situation

Respondent's results indicate that caution should be exercised with respect to tasks requiring competent skills in

- Capacity to maintain and recover a balanced emotional state with increased stress or exposure to adverse circumstances
- The capacity for mental and visual sharpness to detect the unusual or occasional event in common contexts Identifying and avoiding risky situations that may seem to be within own capability in favour of caution. Display respect and care for the safety of others in the team

The respondent's risk of loss of situational awareness (SA) can be determined by transferring the Ai score to the 'risk probability curve' on the graph. An Ai score of less than 50 would suggest a greater or growing risk of loss of SA with stress, fatigue and other disruptive factors. An Ai score greater than 55 provides for increasing certainty of safe behaviour.

INTERVIEW GUIDE & ALERTS

Makes blunders Respondent reports some tendency to uncoordinated, clumsy movements, a tendency to rash emotional outbursts and inattentiveness. Check results on the mental alertness and coping scales for verification of a need for further investigation.

ATTENTION AND RECOVERY			
Mental Alertness	Score	73%	
Respondent reports an average present capacity to maintain full and alert functioning, with a the ability to avoid every day slips in perception, memory and lack of physical coordination. Respondent may occasionally forget things or experience clumsy behaviour which could lead to errors of omission and safety violations, when overwhelmed or severely distracted.	Norm / Benchmark	76%	
	Organisation mean	77%	
	Sample mean	73%	
Personal Resilience	Score	63%	
Respondent's coping skills appear to be very marginal at a slightly below average level suggesting a tendency to some emotional instability and possibly signs of anxiety or even depression when under stress. Typical behaviour of individuals with lesser coping skills is a loss of a sense of humour, sensitivity and tendency to project their dissatisfaction by being critical of others and to complain about the things that prevent them from full performance. A difficulty in relaxing and possibly slower recovery when under load would likely show up as growing fatigue affecting both vigilance and responsiveness.	Norm / Benchmark	78%	
	Organisation mean	65%	
	Sample mean	63%	
FUNCTIONAL ABILITIES			
Executive Functioning	Score	70%	
Respondent indicates an above average ability to plan, organise, project outcomes and discern a logical sequence in both practical and abstract tasks. Contributing significantly to Respondent's safety mindfulness and capacity to avoid risk.	Norm / Benchmark	55%	
	Organisation mean	72%	
	Sample mean	70%	
Perceptual Acuity	Score	24%	
Respondent's results on the basic test of perceptual and cognitive acuity was at the very low or critical level suggesting extreme difficulty in distinguishing unusual differences or objects in the environment that may represent a hazard or in noticing the unusual.	Norm / Benchmark	66%	
	Organisation mean	54%	
	Sample mean	24%	

EXAMPLE QUESTIONS

Typical questions within the SSA consist of accuracy and speed performance items, memory items, multiple choice questions, unprompted hotspots and drag and drop items. Some example questions are shown below.

Instructions: How many images can you remember and match?

33				
		B		
		B		
				33

Lapsed time in seconds: 53

Identify and click on the greatest hazard in the picture



Next Question

Lately, I have noticed everything is just going my way, it all seems so effortless.

- Very untrue
- Mostly untrue
- Slightly true
- Mostly true
- Very true

Next Question

Exit Survey

How quickly can YOU target the SMILING face?

CLICK START AND BEGIN INSTANTLY OR CLICK TO RESET



TARGETS = 0 | TOTAL TIME = 0 sec

Can you make a story here?

INSTRUCTIONS: Complete the exercise by dragging the pictures into the boxes below to make a logical story, by using your mouse.

EMPIRICAL RATIONALE

Extensive research in the area of human performance and safety form the basis of the SSA's validation. Overall the basic SSA instrument demonstrates a mean test reliability of the scales at an alpha of 0.86 for 743 respondents.

Each of the competency scales were assessed against measures of relevance, importance and frequency in the perception and hazard identification scales. Only items meeting the criteria of moderate difficulty and high discrimination were engaged. Scales for perception and comprehension were included to fulfill the need for combined visual and cognitive activity measures with diagnostic capability.

Reliability for the scales was calculated using Chronbach's alpha and a sample size of 743 adults. Scale item correlations and reliabilities were established against other well regarded instruments to reinforce the validity measuring certain attributes indicating the reliability of the scales psychometric properties⁶.

SSA Scale Reliabilities	
Safety Competency	Reliabilities
(Ability)	Alpha
Hazard Awareness	0.92
Perception and Comprehension	0.89
Safety Habits	0.90
Understanding Fatigue	0.94
Safety Perspectives (Attitudes)	
Team Safety Orientation	0.73
Responsible for safety	0.86
Safety Conscientiousness	0.78
Risk Avoidance	0.80
Personal Status (Mental State)	
Coping Skill	0.86
Mental Alertness	0.89
<u>Rosenweg (2011)</u>	

Some improvement was shown during test-retest analysis due to the learning effect experienced on scale items over a 2 week period. In 2005-2006 reliabilities were re-calculated due to changes to some items and the inclusion of additional scales.

Cross scale correlations and reliabilities to measure the accuracy and repeatability of the questionnaire items in obtaining reliable responses to the personal status and attitude scales were conducted by Rosenweg,⁷ and Goldberg.⁷

⁶ Rosenweg, P. (2011), Assessing Situational Safety Awareness; Engineering Safety Resilience with the SSA Inventory. Melbourne, Australia: Psyfactors.

⁷ Goldberg, L.R. (2001) IPIP. A Scientific Collaboratory for the Development of Advanced Measures of Personality Traits and Other Individual Differences. <http://ipip.ori.org/>



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