

Larkin Safety Illustrated

When supervisors talk about safety—accidents go down.



Make sure your supervisor has something important to say...

Larkin Safety Illustrated

world's best safety research

illustrated for supervisors' safety talks

Contents

Page	Page #
Cover	1
Contents	2
Sample #1: Introduction Page	3
Sample #1: Shift Hanover	4-5
Sample #2: Introduction Page	6
Sample #2: Corporate Memory of Accidents is Only 3 Years	7-8
Sample #3: Introduction Page	9
Sample #3: Inexperienced Employee	10-11
Sample #4: Introduction Page	12
Sample #4: Lockout/Tagout	13-14
Sample #5: Introduction Page	15
Sample #5: Why Control Room Operators Make Mistakes	16-17
Sample #6: Introduction Page	18
Sample #6: New Risks Need New Plan	19-20
Sample #7: Introduction Page	21
Sample #7: Most Fatalities Between 2:00 p.m. and 4:00 p.m.	22-23
Sample #8: Introduction Page	24
Sample #8: Accident Prone Employee	25-26
Supervisors Reduce Accidents	27
Building a Larkin Safety Illustrated	28
Research Behind the Page Design	29
What to Do Next	30
END Page	31

cover photo credit: MDE: Daily Offshore Safety/Tool Box Briefing - Borneo

Sample #1
Shift Handover

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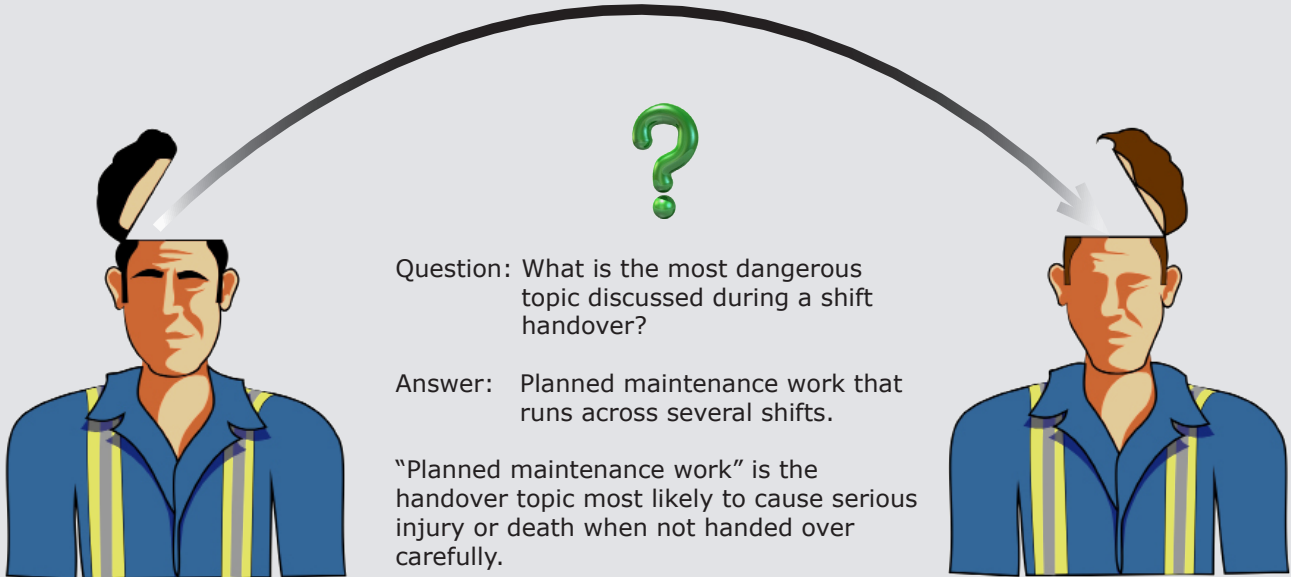
Test this sample with your supervisors

Shift Handover

50% of all operating mistakes happen in the first 30 minutes after a handover.

Why?

Because the person coming on doesn't get the handover he or she needs.



Best Shift Handovers

Best Shift Handovers Use Two Types of Communication: Log Book + Face-to-Face Conversation

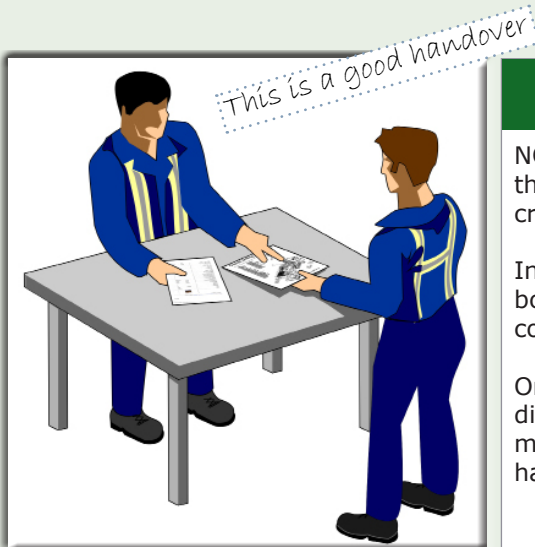
Log Book

NOT a blank book with handwritten notes.

Instead, best log books are visual.

The best use:

- areas maps
- checklists
- equipment icons
- diagrams of processes
- risks in color (highest to lowest)
- thumbnails of active work permits



Face-to-Face

NOT good enough to just leave the log book for the oncoming crew to read.

Instead, best handovers use log book together with a face-to-face conversation.

On average, face-to-face discussions clarify 3 serious misunderstandings during each handover.

Supporting Information

Talking Points - Shift Handovers

Is this true for us:

"50% of mistakes happen in the first 30 minutes of a shift"?

Should we be worried about handing over "planned maintenance"?

"Planned maintenance running across shifts is the most dangerous handover topic."

Research shows a blank handover book with only handwritten notes is not best practice.

Can we make a new handover book that is more visual:

- icons for equipment
- maps
- thumbnails for open work permits
- colors for risk levels
-with places for handwritten notes next to each visual

Do we use a handover book INSTEAD of a face-to-face conversation?

Research shows you need both (log book + face-to-face).

3 big mistakes clarified in each face-to-face handover conversation

Fifty Percent of Operating Mistakes Happen in the First 30 Minutes on the Shift

Study details:



- air traffic controllers
- 3,222 controller errors between 1988 and 1994
- FAA's Operational Error/Deviation system database
- sponsored by U.S. FAA (Federal Aviation Administration) and NASA (National Aeronautics & Space Administration)

Rocco, Pamela S.: "The Role of Shift Work and Fatigue in Air Traffic Control Operational Errors and Incidents", January 1999.

www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA360730

Best Handovers Use Log Book + Face to Face

Study details:



- study of shift handovers during the MER Mission (Mars Exploration Rover)
- MER landed two robot rovers on Mars

Parke, Bonny and Andrew Mishkin: "Best Practices in Shift Handover Communication: Mars Exploration Rover Surface Operations", October 2005.

<http://www.docstoc.com/docs/50919414/BEST-PRACTICES-IN-SHIFT-HANDOVER-COMMUNICATION-MARS-EXPLORATION-ROVER>

Biggest Handover Mistake: Planned Maintenance

Study details:



- examined five serious accidents where handover problems were a contributing factor
- industries studied: offshore oil & nuclear power
- conclusion: "All incidents involved planned maintenance work."

Lardner, Ronny: "Effective Shift Handover - A Literature Review", *Offshore Technology Report - OTO 96 003*, U.K. Health & Safety Executive, Offshore Safety Division, June 1996.

<http://www.hse.gov.uk/research/otopdf/1996/oto96003.pdf>

Three Misunderstandings Corrected During Face-to-Face Conversations

Study details:



- nuclear reprocessing plant
- shift handovers by production supervisors
- handovers were tape recorded and observed
- total of 16 taped handovers with face-to-face conversations plus log books
- average of 2.66 misunderstandings clarified in each face-to-face turnover conversation

Lardner, Ronny: "Effective Shift Handover - A Literature Review", *Offshore Technology Report - OTO 96 003*, U.K. Health & Safety Executive, Offshore Safety Division, June 1996.

<http://www.hse.gov.uk/research/otopdf/1996/oto96003.pdf>

Sample #2

Corporate Memory of Accident is Only 3 Years

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Corporate Memory of Accidents is Only 3 Years



The Question

Researchers at ConocoPhillips asked themselves a question:

“Why are we repeating the same type of process safety accidents over and over?”

The Answer

ConocoPhillips found the answer:

The corporate memory for accidents lasts only 3 years.

After 3 years the accident is forgotten, so employees do it again.



What's Not Working

After 3 years, employees forget the accident even though ConocoPhillips:

- does an accident investigation
- sends a bulletin to employees
- implements recommendations
- adapts training

None of these things helped employees remember beyond the 3 years.



The Solution

ConocoPhillips is experimenting with illustrating the accident in a drawing

- illustration shows what happened
- accident details are put into call out text boxes
- CP uses the illustration in training
- CP uses the illustration when re-communicating the accident on its 3rd anniversary

Why this works:

Memory of pictures is 200% to 600% better than memory of text.

Example of an illustration similar to those used by CP is on page 2 of this *Safety Illustrated*.



Supporting Information

Talking Points - Corporate Memory of Accidents is Only 3 Years

ConocoPhillips research shows after 3 years almost no one remembers the accident.

That's why the same mistakes happen over and over.

What serious accidents (over 3 years old) do we need to talk about?

Should we ask for a list of serious accidents at our site that are more than 3 years old?

What did we learn from those accidents?

Repeating the Same Mistakes Over and Over

ConocoPhillips research team studied 84 "process safety events" in the corporate safety database.

The research team found ConocoPhillips was repeating the same type mistakes over and over.

- "process safety event" is a major accident or near miss
- causes of the process safety events were put into categories
- revealing a small number of causes behind a large number of events

Corporate Memory Lasts Only Three Years

ConocoPhillips research team tested how much detail employees remembered about past accidents and near misses.

- samples taken from the 84 "process safety events"
- interviews asked employees what they remember about each event
- team found high recall for events that were less than three years old
- team found low recall for events 3 years old and older

"At 3 years, the events seemed to be all but forgotten unless there had been a personal involvement with the event."

Illustrations are Remembered More Easily than Text

Conclusion is based on "dual coding theory" developed by Allan Paivio.

Dual coding theory says there are two pathways to learning: text and pictures.

Memory is improved by 200% when the event is communicated in an illustration rather than text only.

Paivio, Allan: "Dual Coding Theory and Education," The University of Michigan School of Education, 2006.

<http://www.umich.edu/~rdyolrn/pathwaysconference/presentations/paivio.pdf>

Other studies show using illustrations rather than text alone increases performance by 600%:

Larkin, Jill H. & Herbert A. Simon: "Why a Diagram is (Sometimes) Worth Ten Thousand Words," *Cognitive Science*, vol. 11, 1987, p. 65-99.

<http://mechanism.ucsd.edu/teaching/f12/cs200/readings/larkin.whyadiagramissometimesworth.1987.pdf>

The ConocoPhillips research is from:

Throness, Barry: "Keeping the Memory Alive, Preventing Memory Loss that Contributes to Process Safety Events," *American Institute of Chemical Engineers, Process Safety Progress*, June 2014, vol. 33, no. 2, p. 115-123.

<http://onlinelibrary.wiley.com/doi/10.1002/prs.11635/abstract>

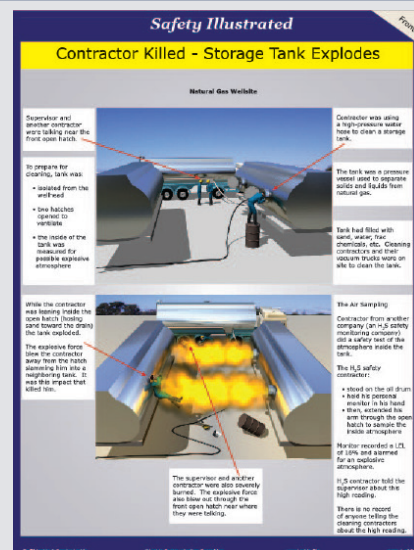
Exceptions to the 3-Year Memory Rule

ConocoPhillips researchers found three exceptions to the 3-year memory rule.

Employees did remember accidents beyond 3 years if any of these were true:

- the employee was personally involved in the accident
- the accident was so large that substantial changes were made to company policies and procedures
- a similar accident happened recently (inside ConocoPhillips or another oil & gas company) and this similar accident triggered their memory

Example: Communicating an Accident in an Illustration



To see a larger version of this *Custom Safety Illustrated*, click link below:

Larkin Safety Illustrated

Sample #3

Inexperienced Employees

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Inexperienced Employees



Inexperienced Employee Twice as Likely to be Injured

An inexperienced employee...

(less than one year experience at the company)

....is almost twice as likely to be injured as someone with one year or more experience.

In this study, employees with less than one year of experience were only 7.6% of the workforce....

BUT

....these inexperienced employees were 14% of all medical-treatment injuries.



Supervisors need to keep one eye on the inexperienced employee.



Problem is Experience Not Age

The increased risk is NOT caused by age.

Older employees were just as likely to be injured as younger employees, if the older employee had less than one year of experience.

Supporting Information

Talking Points - Inexperienced Employees

Do we have new people (less than one year experience) at our site?

- contractors or employees
- anyone at our site for the first time

Around 50% of fatalities involve employees with less than one year of experience.

Being older is no protection—older employees are just as likely to be injured as young employees IF they are new to the site.

People who have worked here a long time think the safest way to do things is obvious.

It is NOT obvious.

To a new person it's not obvious at all.

Experienced employees need to watch anyone new to our site.

Metal Mining: Employees With Less Than One Year Experience are 56% of Fatalities

- study based on data from MSHA (U.S. government Mine Safety & Health Administration)
- fatalities in USA metal mining
- 56% of these fatalities were employees with less than one year of experience doing that particular task

Ross, Jamie: "Three Lessons from 2009 Mining Fatality Statistics," *Mining Man* (Blog) July 10, 2010.

<http://www.miningman.com/Blog/July-2010/Three-Lessons-from-2009-Mining-Fatality-Statistics>

Construction Workers in China: 50% of Injuries Happen in the First 10 Weeks an Employee is at the Site

Study details:

- 136 construction companies in Southern China
- 209 injuries
- 98 fatalities
- 47.5% of the combined injuries and fatalities happened to employees working at that construction site 10 weeks or less

Wang, Yousong; Yan Zhang; Sun Wah Poon; and Haiying Huang: "A Study of Construction Site Accidents," March 18, 2011.

cibworld.xs4all.nl/dl/publications/Publ274/WANG.DOC

Study Details

Study details:

- sample included 15,000 employees in USA coal mines
- sample included underground mines, open-cut mines, and coal processing plants
- injuries were those requiring medical attention
- employees with less than one year's experience at present company were 82% more likely to be injured
- Study is rare because while many other studies show increased injuries among inexperienced employees, these other studies do not show whether the higher accident rate happened because these injured employees were "inexperienced" or because they were typically "younger".
- This study had a large enough sample (15,000 employees) to include older employees who were also inexperienced.
- These older employees had the same accident rate as the younger employees if the older employees were inexperienced.
- researchers from U.S. Bureau of Mines

Butani, Shail J.: "Relative Risk Analysis of Injuries in Coal Mining by Age and Experience at Present Company," *Journal of Occupational Accidents*, vol. 10, 1988, p. 209-216

<http://www.sciencedirect.com/science/article/pii/0376634988900144>

Sample #4
Lockout/Tagout

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Lockout/Tagout

Why do people die in lockout/tagout accidents?

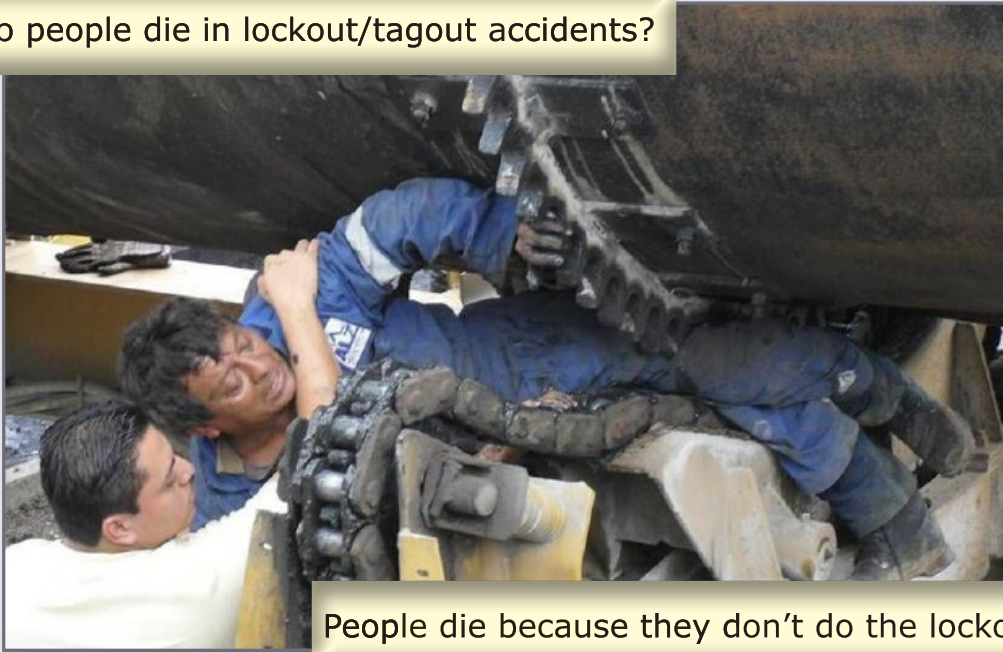
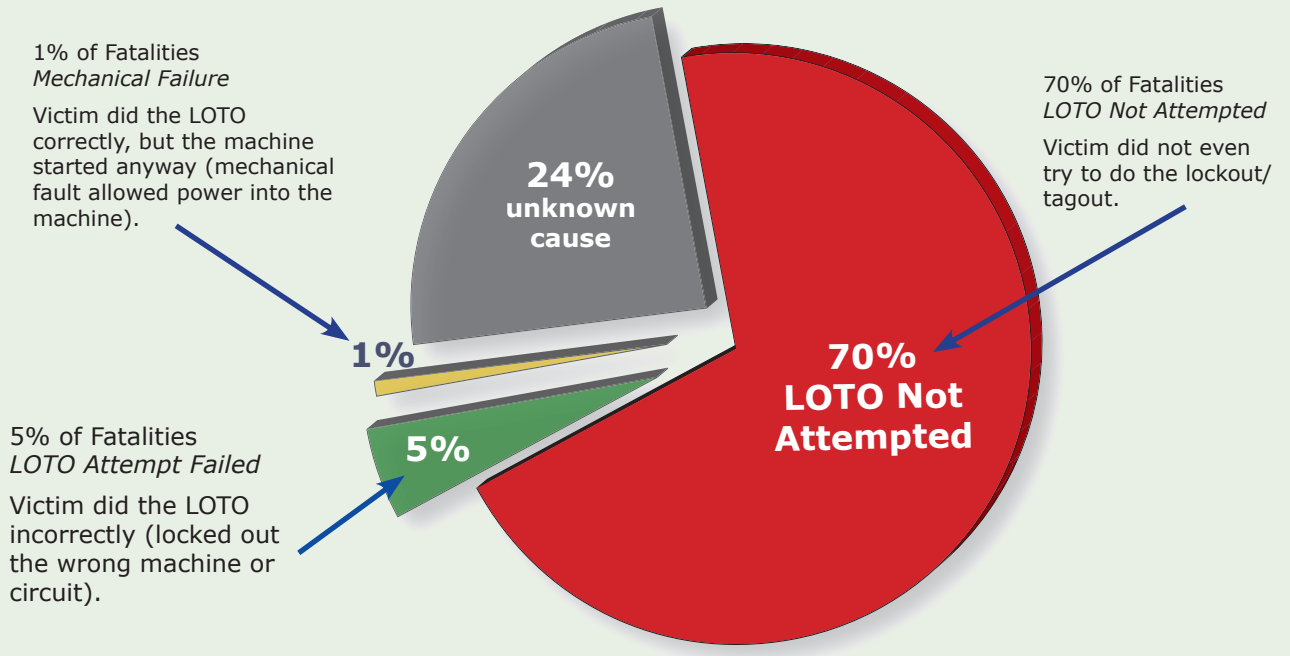


Photo credit: Jack Benton

People die because they don't do the lockout/tagout.

624 Lockout/Tagout (LOTO) Fatalities



Lockout/tagout saves lives when people do it.

Supporting Information

Talking Points - Lockout/Tagout

Where are we NOT doing LOTO and eventually someone is going to get hurt?

Can we make our lockout/tagout procedures faster and easier?

When we see someone working without LOTO, do we say something?

- On average, employees "say something" only 40% of the time they see something unsafe.
- Are we more or less than this 40%?

The main point of this research:

- 70% of the people who die in lockout/tagout accidents
- did not even try to do the LOTO

LOTO may be a hassle, but it's better than this.

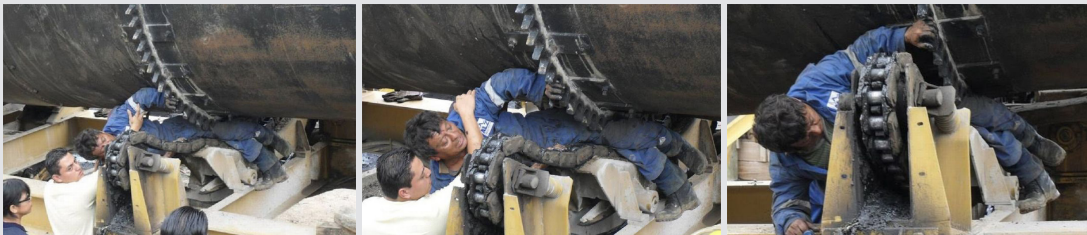


Photo Details

"Safety Photos of the Year: 'Why Lock-Out, Tag-Out is Vitally Important'"

EHS Safety News America

Jack Benton

<http://ehssafetynews.wordpress.com/?s=safety+photo&submit=Search>

Study of Lockout/Tagout (LOTO) Fatalities

Study details:

- analysis of OSHA accident investigation reports
- studied only fatalities involving lockout/tagout
- 624 total LOTO fatalities
- U.S. manufacturing companies
- 1984 to 1997

Bulzacchelli, Maria T.; Jon S. Vernick, Gary S. Sorock, Daniel W. Webster, and Peter S.J. Lees: "Circumstances of Fatal Lockout/Tagout-Related Injuries in Manufacturing," *Journal of Industrial Medicine*, vol. 51, 2008, p. 728-734.

<http://onlinelibrary.wiley.com/doi/10.1002/ajim.20630/abstract>

Why
We
Need
Supervisors'
Help....

Regulations
Are Not
Working

Regulations Are Not Working

In 1990, the U.S. Occupational Safety & Health Administration (OSHA) passed a Lockout/Tagout regulation.

Dr Bulzacchelli studied the rates of LOTO-related fatalities before the OSHA regulation was imposed and after the OSHA regulation was imposed.

The result? A very small increase in LOTO-related fatalities AFTER the OSHA regulation was imposed.

Dr Bulzacchelli concluded, "There is no evidence that the lockout/tagout standard decreased fatality rates...."

Bulzacchelli, Maria T.; Jon S. Vernick, Gary S. Sorock, Daniel W. Webster, and Peter S.J. Lees: "Effects of the Occupational Safety and Health Administration's Control of Hazardous Energy(Lockout/Tagout) Standard on Rates of Machinery-Related Fatal Occupational Injury," *Injury Prevention*, vol. 13, 2007, p. 334-338.

http://www.experts.scival.com/jhu/pubDetail.asp?t=p m&id=17916891&n=Daniel+Webster&u_id=970

Sample #5

Why Control Room Operators Make Mistakes

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Why Control Room Operators Make Mistakes

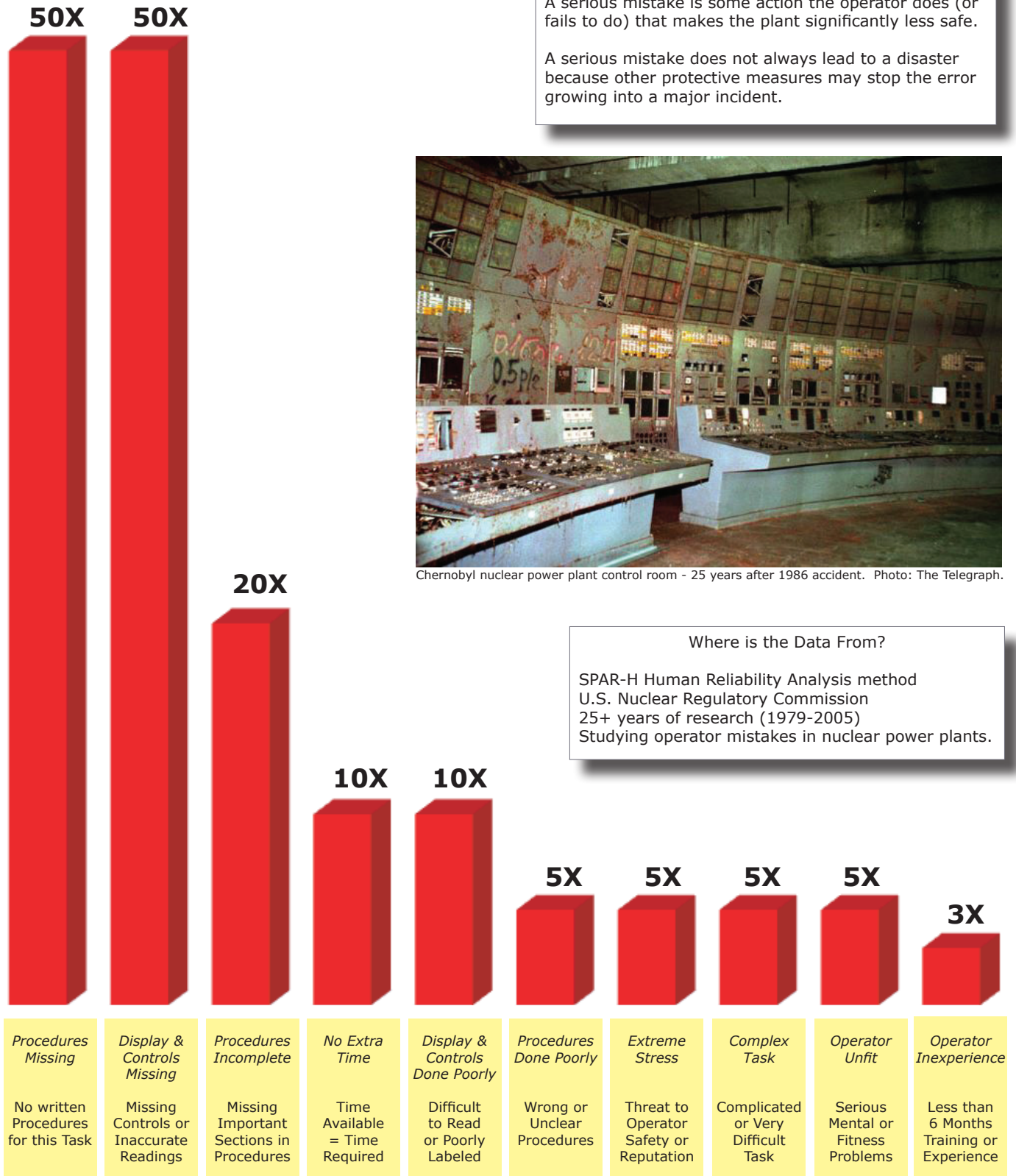
What is a serious mistake?

A serious mistake is some action the operator does (or fails to do) that makes the plant significantly less safe.

A serious mistake does not always lead to a disaster because other protective measures may stop the error growing into a major incident.



Chernobyl nuclear power plant control room - 25 years after 1986 accident. Photo: The Telegraph.



Where is the Data From?

SPAR-H Human Reliability Analysis method
 U.S. Nuclear Regulatory Commission
 25+ years of research (1979-2005)
 Studying operator mistakes in nuclear power plants.

Supporting Information

Talking Points - Why Control Room Operators Make Mistakes

- 1** Fixing "Procedures" is perhaps the best thing we can do to reduce operator errors.
 Procedures are 3 of the 10 largest causes of operator errors.

 - Procedures Missing = 50 times more likely an operator will make a mistake
 - Procedures Incomplete = 20 time more likely an operator will make a mistake
 - Procedures Poor = 5 times more likely an operator will make a mistake

- 2** Fixing "Displays and Controls" is the second best thing we could do to reduce errors.
 Instruments and gauges (including software) are 2 of the 10 largest causes of operator errors

 - Display & Controls Missing/Inaccurate = 50 times more likely an operator will make a mistake
 - Display & Controls Poor (difficult to read or poorly labelled) = 10 times more likely an operator will make a mistake

- 3** The operators' support systems (procedures & equipment) are much larger causes of errors than operators' personal problems.

 - Operator under extreme stress = 5 times more likely he/she will make a mistake
 - Operator very unfit for duty = 5 times ore likely he/she will make a mistake
 - Operator has little experience = 3 times more likely he/she will make a mistake

Where do These Estimates Come From?

The estimates of operator error probabilities used in the SPAR-H model come from:

- academic research in human information processing
- studies of serious accidents in nuclear power plants
- 70 applications of the APAR model in nuclear power plants
- confirmation through comparisons with probability estimates used in other risk analytic tools



The SPAR-H Human Reliability Analysis Method

Idaho National Laboratory

U.S. Nuclear Regulatory Commission
 Office of Nuclear Regulatory Research
 Washington, DC 20555-0001

NUREG/CR-6883
 INL/EXT-05-00509

U.S. Nuclear Regulatory Commission

Gertman, D.; H. Blackman; J. Marble; J. Byers; and C. Smith: the SPAR-H Human Reliability Analysis Method, Idaho National Laboratory, U.S. Nuclear Regulatory Commission, 2005, p. 1-230.

<http://www.nrc.gov/reading-rm/doc-collections/nurses/contract/cr6883/cr6883.pdf>

Baseline Error Rate

The SPAR-H Method uses a baseline error rate for operators' actions.

That baseline error rate is 1 error for every 1,000 times the operator attempts the action.

This baseline error rate assumes that none of the listed error causes (red bars on page 1) are affecting the operator.

For example, if you have *Missing Procedures*, the baseline error rate (1:1000) is increased by 50 times.

With *Missing Procedures*, the new error rate for this same operator action is now 50:1000 (or 1:20)

The estimate is: the operator, working with *Missing Procedures*, will make a serious error one time in every 20 times that he or she attempts this action.

Source: Boring, Ronald and Vinh Dang: "Qualification Using the SPAR-H HRA Method: A Simple Exercise," Idaho National Laboratory.

<http://www.slideserve.com/ewa/quantification-using-the-spar-h-hra-method-a-simple-exercise>

SPAR-H Worksheets

The SPAR-H document shown on the left has worksheets.

These worksheets help analysts quantify the probabilities of operators committing errors under different problems scenarios (e.g. partial loss of offsite power).

Sample #6

New Risks Need New Plan

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Test this sample with your supervisors

New Risks Need New Plan

Question: Why do military jets crash?

Answer: Pilots believe they can handle an unexpected risk without changing the flight plan.



Photo credit: South African Airforce

Your employees can handle unexpected risks. Right?
Just like this guy.

The Pattern for a Crash

1. Pilot takes off with an agreed flight plan.
2. Something unexpected happens:
 - bad weather
 - instrument failure
 - unanticipated aircraft traffic
3. Pilot decides he/she can handle this new risk without changing the original flight plan.
4. Pilot cannot adapt fast enough—plane crashes

54% of pilot decisions leading up to a crash or near-miss follow this pattern.

Lesson for Supervisors

Employees are too confident about their ability to handle unplanned risks.

In this study, most pilots:

- saw the new risk
- understood the new risk
- but....believed they could manage it without any change to the existing plan

When significant unplanned risks appear:

- stop the work
- redo the plan—controlling the new risk
- restart the work with the new plan

Supporting Information

Talking Points - New Risks Need New Plan

Fighter pilots are very confident people—that's why they crash.

- They think they can handle an unexpected risk without changing the plan.
- They can't....
- 54% of pilot decisions just before a crash come from overconfidence.

Everyone has a plan today.

But what do we do when unexpected risks pop up?

- Do we keep going—confident we can handle the new risk with the old plan.
- Or, do we stop work and make a new plan.

Don't let overconfidence get you or anyone else killed.

Stop and redo the plan.

Study of Military Aircraft Accidents/Incidents

Study details:

- military aircraft in the French Air Force (Armée de l'Air)
- analysis of 30 accident and incident investigations
- investigations published by the Bureau Enquêtes Accident Défense-air

Bourgeon, Léonore; Claude Valot; Anthony Vacher; and Claude Navarro: "Study of Perseveration Behaviors in Military Aeronautical Accidents and Incidents: Analysis of Plan Continuation Errors," *Proceedings of the Human Factors and Ergonomics Society, 55th Annual Meeting, 2011*, p. 1730-1734.

<http://pro.sagepub.com/content/55/1/1730>



Most Pilots Saw and Understood the New Risk

In the study of French Air Force aircraft accidents and incidents:

- 20% of the time—pilots stayed with the original flight plan because they did not notice the new risk.
- 26% of the time—pilots noticed the new risk, but did not really understand the consequences. They saw but misunderstood the risk.
- 54% of the time—pilots noticed the new risk, understood it's consequences, but believed they were skilled enough to handle the new risk without making any changes to the flight plan.

Source same as above.



Photo Credit: Fighter Pilot Ejecting

Photo details:

- Lt Maryke Lynn
- Aeronautical Society of South Africa
- South African Air Force

<http://www.af.mil.za/news/2006/031.htm>



sa air force
Department:
Defence
REPUBLIC OF SOUTH AFRICA

Sample #7

Most Fatalities Happen Between
2:00 p.m. and 4:00 p.m.

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Test this sample with your supervisors

Most Fatalities Happen Between 2:00 p.m. & 4:00 p.m.

More fatalities happen between 2:00 pm and 4:00 pm than any other hours.

Why?

Researchers are not sure.

One likely reason:

Hurrying the work is a leading cause of accidents.

Tired employees may be rushing more between 2:00 pm and 4:00 pm.



Most dangerous hours of the day for fatalities are 2:00 pm to 4:00 pm.

Least dangerous hours of the day for fatalities are 10:00 am to noon.

An employee is twice as likely to be killed in an accident between 2:00 pm and 4:00 pm than in an accident between 10:00 am and noon.

Supporting Information

Talking Points - Most Fatalities Happen 2 pm to 4 pm

What are we doing today between 2:00 pm and 4:00 pm?

Most fatalities happen during these two hours.

Remember: rushing work is the single biggest cause of serious accidents.

Between 2 pm and 4 pm today: I want you to think about this .

Study details:

- data included 2,155,954 accidents
- 1990 to 2002
- all accidents were in the construction industry
- all accidents were in Spain
- researchers grouped together accidents that were "severe" and "fatal"
- 2:00 pm to 4:00 pm had both the greatest number of severe and fatal accidents and the highest rate of severe and fatal accidents
 - 3% of all accidents that happened between 2:00 pm and 4:00 pm were severe or fatal (the most dangerous hours)
 - approximately 1.5% of all accidents that happened between 10:00 am and noon were severe or fatal (the least dangerous hours)

López, Miguel A.; Ignacio Fontaneda; Oscar J. González Alcántara; and Dale O. Ritzel: "The Special Severity of Occupational Accidents in the Afternoon: 'The Lunch Effect,'" *Accident Analysis and Prevention*, vol. 43, 2011, p. 1104-1116.

<http://www.sciencedirect.com/science/article/pii/S0001457510003969>

"Hurrying work" is a major cause of accidents

- construction workers in this study were asked their opinions on the causes of serious and fatal accidents
- 132 workers completed the survey in 2008
- workers completed the survey in Burgos, Spain
- by far the biggest cause (mentioned by 43% of workers) was "hurrying the work"
- 2nd biggest cause (mentioned by 21% of workers) was "unsafe acts done by workers"
- 3rd biggest cause (mentioned by 20% of workers) was "drinking alcohol"

López, Miguel A.; Ignacio Fontaneda; Oscar J. González Alcántara; and Dale O. Ritzel: "The Special Severity of Occupational Accidents in the Afternoon: 'The Lunch Effect,'" *Accident Analysis and Prevention*, vol. 43, 2011, p. 1104-1116.

<http://www.sciencedirect.com/science/article/pii/S0001457510003969>

Similar Finding in Other Countries

Other researchers found similar results for severe and fatal accidents in other countries.

A disproportionately high number of severe and fatal accidents happen close to 2:00 pm to 4:00 pm in:

- Singapore
- USA
- Australia
- Sweden
- Denmark

Dumark, Jantane; Sherif Mostafa; Imriyas Kamardeen; and Raufdeen Rameezdeen: "Factors Associated with the Severity of Construction Accidents: The Case of South Australia," *Australasian Journal of Construction Economics and Building*, vol. 13, no. 4, p. 32-49

<http://epress.lib.uts.edu.au/journals/index.php/AJCEB/article/viewFile/3620/3879>

Sample #8

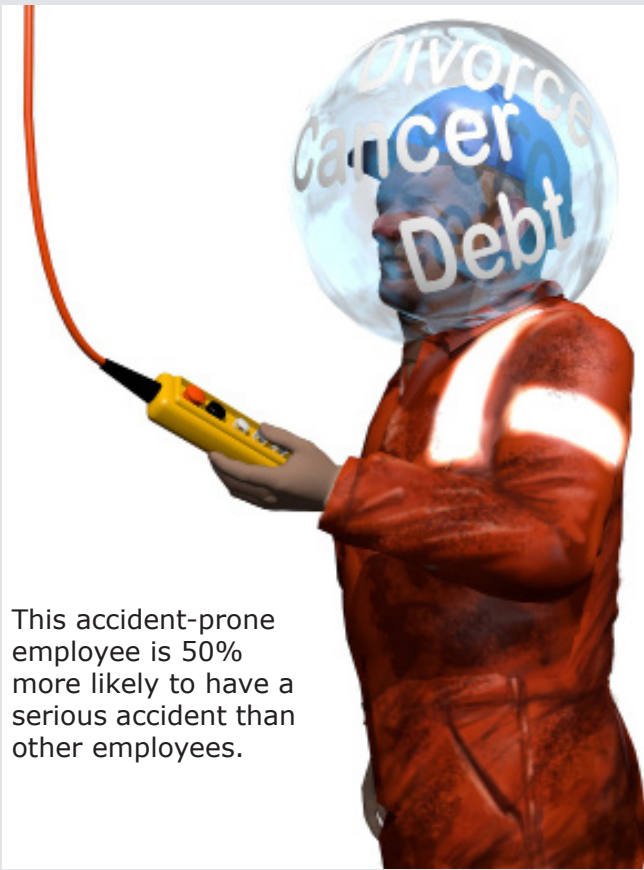
Accident Prone Employee

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Test this sample with your supervisors

Accident Prone Employee



This accident-prone employee is 50% more likely to have a serious accident than other employees.

1 in 29 employees is "accident prone".



Shell Oil Company found:
3% of employees accounted for 22% of accidents

"Accident Prone" is Not Permanent

Most people think being "accident prone" is a permanent personality trait.

The research says "No".

A tiny number of employees are permanently accident prone.

Most accident-prone employees are only accident prone for a short time (estimated at six months to one year).

Employees become accident prone when they are distracted by serious problems at home or at work.

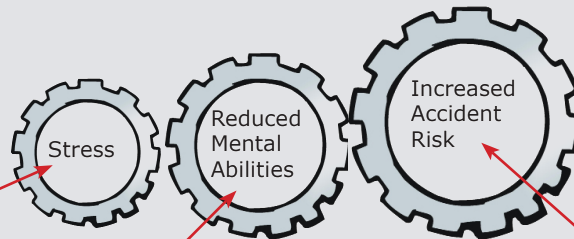
When the problems are gone—they are no longer accident prone.

Psychological Stress Makes Employees Accident Prone

When the stress is gone, the accident proneness goes away.

Stress:

- financial problems
- family problems
- health problems



Stress-released chemicals in the brain reduce:

- memory
- concentration
- coordination

Accident-prone employees are not really at work.

They are not "in the moment".

Their minds are somewhere else.

Reduced alertness increases chance of accident

Advice for Supervisors

Accidents happen when:

An "accident prone" **employee** is working in an "accident prone" **situation**.

If there is nothing you can do to reduce the stress of an "accident prone" employee—then try to keep him or her away from "accident prone" situations.

Example: Trucking Company Reduces Accidents by 78%

This trucking company ranked all its routes from highest risk to lowest risk.

After an accident, the driver was automatically moved to a lower-risk route.

Over 7 years, accidents decreased by 78%.

Background Information

Talking Points - Accident Prone Employee

Everyone has problems at some time:

- divorce
- bankruptcy
- cancer or other health problems

People with problems are 50% more likely to have a serious accident than people without problems.

People with problems are not "in the moment". Their minds are somewhere else. So they are more likely to have an accident.

The good news: being accident prone is NOT permanent. When the emotions calm down—being accident prone goes away.

If someone is having a difficult time, we need to keep our eyes on his or her safety.

Psychological Stress Makes Employees Accident Prone



Study details:

- 153 people all in the UK Royal Navy
- researchers measured their psychological stress on a questionnaire and their number of accidents over a three-year period
- "accident" was an injury where the person missed three days or more of work
- stress was found to be mostly work related:
 - disagreements over job requirements
 - feelings of not being rewarded for their efforts
 - dissatisfied with their working conditions
 - family problems caused by excessive work
- results shows that those people with high levels of stress had significantly more accidents
- people with numerous accidents also reported problems with:
 - concentrating
 - remembering instructions
 - physical coordination

Day, Andrea; Date Brasher, and Robert S. Bridger: "Accident Proneness Revisited: The Role of Psychological Stress and Cognitive Failure," *Accident Analysis and Prevention*, vol. 49, 2012, p. 532-535.

<http://www.sciencedirect.com/science/article/pii/S0010457512001170>

One in 29 Employees is Accident Prone

Study details:

- review of 79 studies on "accident proneness"
- samples include 147,105 people in 18 countries
- "accidents" required medical treatment
- if accidents were random, then the number of people with more than one accident would be 3,695 people
- the actual number of people with more than one accident was 5,080 people - much more than would be expected if accidents were random

Visser, Ellen; Ysbrand J. Pijl; Ronald P. Stolk; Jan Neeleman; and Judith G.M. Rosmalen: "Accident Proneness, Does it Exist? A Review and Meta-Analysis," *Accident Analysis & Prevention*, vol. 39, 2007, p. 556-564.

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CE40fjAB&url=http%3A%2F%2Fwww.researchgate.net%2Fpublication%2F6702281_Accident_proneness_does_it_exist_A_review_and_meta-analysis%2Ffile%2Fd912f50b8797daa5e3.pdf&ei=FmXDUq4kyc7JAfzIgdg&usq=AFQjCNHgfCuuP32R0Y-W6PDBUmQGoDQvAA&sig2=v9jUAWeq3GXQEQ4sLzARow&bvm=bv.58187178,d.aWc

Trucking Company Reduced Accidents by 78%

Study details:

- trucking company
- studied accident records to locate their "accident prone" drivers
- moved these accident prone drivers to routes with "low accident potential"
- after seven years:
 - 13% of their drivers had been labelled "accident prone" and moved
 - total number of accidents decreased by 78% while total miles driven increased

Study quoted in: Fleming, James: "Accident Proneness and Accident Law," *Harvard Law Review*, vol. 63, 1950, p. 769-795.

http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=4135&context=fss_papers

Accident Prone is Not Permanent

Study details:

- literature review of 88 studies on "accident proneness"
- authors agree that some people are accident prone
- authors disagree however that being "accident prone" is a permanent personality trait
- authors looked at long-term studies of accident proneness (studies of accidents over several years)
- these long-term studies showed that employees who were involved in a large number of accidents in one year were not involved in many accidents in year #2, year #3, or year #4
- these long-term studies investigated accidents among:
 - Royal Air Force apprentices
 - Shipwrights apprentices
 - Helsinki bus drivers
 - Royal Dockyard apprentices
 - London bus drivers
 - Ulster bus drivers
- authors conclude that being "accident prone" is a temporary psychological condition declining after the first year

Froggatt, Peter and James A. Smiley: "The Concept of Accident Proneness: A Review," *British Journal of Industrial Medicine*, vol. 21, no. 1, 1964, p. 1-12.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1038287/>

Three Percent of Employees Account for 22% of Accidents



Study details:

- research at Shell Oil Company's manufacturing complex in Deer Park, Texas
- studied five years of accident records (1981-1986)
- included 7,131 accidents
 - 392 of these accidents were "major" (OSHA recordables)
 - 6,382 of these accidents were "minor" (Involved some injury)
 - remaining accidents involved no injury
- to make the possibility of an accident more equal, researchers looked at accidents within "job families":
 - Operations (operator, lab tester)
 - Electrical (electrician, instrument mechanic)
 - Process (pipefitter, machinist)
 - Maintenance (boilermaker, welder)
 - Miscellaneous (carpenter, insulator, painter, garage mechanic)
- result: 3.4% of employees accounted for 21.5% of accidents
- number of employees having multiple accidents was much higher than what you would expect if accidents were random
 - for example: the number of employees who should have 10 accidents during the five years is less than one (if accidents were random); the number of employees who actually did have 10 or more accidents during the five years was 27

Mayer, David L.; Scott F. Jones; and Kenneth R. Laughery, Sr.: "Accident Proneness in the Industrial Setting," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, vol. 31, 1987, p. 196-199.

<http://pro.sagepub.com/content/31/2/196.abstract>

Supervisors Reduce Accidents

When supervisors talk about safety—accidents go down.



$$r = -0.65$$

The correlation between supervisors' informal conversations about safety and serious accidents in eight Dutch chemical plants.

Sico van As: "Communication and Industrial Accidents," SOM Research Report, University of Groningen, The Netherlands.

<http://irs.ub.rug.nl/ppn/228120691>.

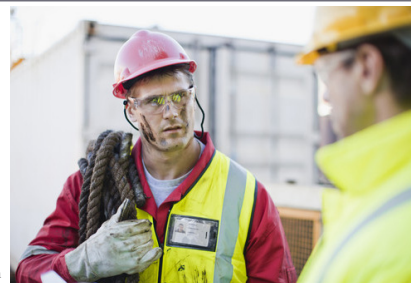
Only 2% of employees will change their behavior based on anything they read.

70% of employees who change their behavior do so after a face-to-face conversation with their supervisor.

Rogers, E. M.: *Diffusion of Innovations*, New York, The Free Press, 1962.

Clampitt, Phillip G.: "Employee Perception of the Relationship Between Communication and Productivity: A Field Study," *The Journal of Business Communication*, vol. 30, no. 1, 1993, p. 5-27.

<http://postgradicm.wikispaces.com/file/view/Clampitt+P+&+Downs+C+%281003%29+%27Employee+perceptions+of+the+relationship+between+communication+and+productivity%27.pdf>



Compliance with written safety standards (PPE) climbed from 47% to 74% when supervisors personally asked for the compliance.

Wogalter, Michael S.; Vincent C. Conzola; Tonya L. Smith-Jackson: "Research-Based Guidelines for Warning Design and Evaluation," *Applied Ergonomics*, vol. 33, 2002, p. 219-230.

<http://www.who.int/ctc/guidelines/ArtElevenWogalterNine.pdf>



When supervisors talk about safety, unsafe acts go down.

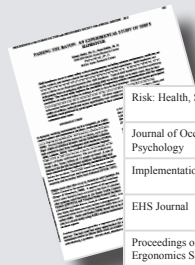
supervisors informal conversations about safety	unsafe material handling	$r = -0.75$
	unsafe electrical work	$r = -0.81$
	failing to use PPE	$r = -0.86$

Zohar, Dov and Gil Luria: "The Use of Supervisory Practices as Leverage to Improve Safety Behavior: A Cross-level Intervention Model," March 2003

<http://www.sciencedirect.com/science/article/pii/S0022437503000781>

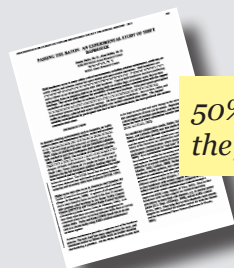
Building a *Larkin Safety Illustrated*

1. We Study Safety Research—Looking for Results Relevant for Supervisors



Risk: Health, Safety & Environment	Accident Analysis and Prevention	Human Factors	Journal of Safety Research	Risk Analysis: An International Journal
Journal of Occupational Health Psychology	Journal of Health Communication	International Journal of Environment and Health	Health, Risk & Society	Journal of Accident Investigation
Implementation Science	Fire Safety Journal	Annals of Occupational Hygiene	International Journal of Workplace Health Management	New Solutions
EHS Journal	Reviews of Human Factors and Ergonomics	Risk Management	Work and Stress	African Newsletter on Occupational Health and Safety
Proceedings of the Human Factors & Ergonomics Society Annual Meeting	Indian Journal of Occupational and Environmental Medicine	Scandinavian Journal of Work, Environment, and Health	Journal of Health, Safety and Environment	Risk, Decision and Policy

2. Condense Results Into One Useful Conclusion



50% of all operational errors happen in the first 30 minutes after a handover

3. Illustrate the Conclusion In a Easy-to-Talk-About Design

4. Supporting Information and Talking Points on a Second Page

Research Behind the Design

Larkin Safety Illustrated

Shift Handover

Point Size
large enough to read if
projected onto a screen

Complexity
writing is grade level 5 to 7
(60% of adults read at this
level)

50% of all operating mistakes happen in
the first 30 minutes after a handover.

Why?

Because the person coming on doesn't
get the handover he or she needs.



Verdana Font
designed for reading
online

Drawing
increases attention,
comprehension, and recall
(improvement over text
alone is between 100% and
600%)

Color
increases time spent
on page by 21%



Question: What is the most dangerous
topic discussed during a shift
handover?

Answer: Planned maintenance work that
runs across several shifts.

"Planned maintenance work" is the
handover topic most likely to cause serious
injury or death when not handed over
carefully.



Dot Points
2.5 times more people
will read dot-point text
compared with a solid
paragraph

Best Shift Handovers

Handovers Use Two Types of Communication: Log Book + Face-to-Face Conv

Line Length
3½ inch (9
centimeters) best
length for reading
ease and accuracy

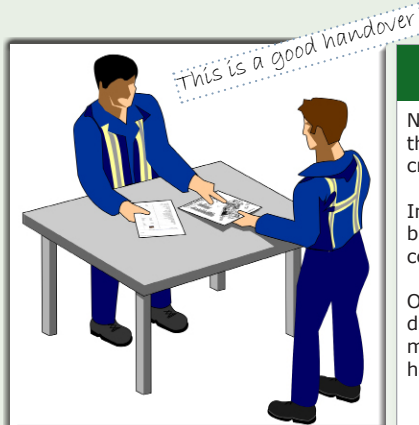
Log Book

NOT a blank book with
handwritten notes.

Instead, best log books are visual.

The best use:

- areas maps
- checklists
- equipment icons
- diagrams of processes
- risks in color (highest to lowest)
- thumbnails of active work permits



Face-to-Face

NOT good enough to just leave
the log book for the oncoming
crew to read.

Instead, best handovers use log
book together with a face-to-face
conversation.

On average, face-to-face
discussions clarify 3 serious
misunderstandings during each
handover.

No Large Text Blocks

maximum number of lines in any single paragraph is
6 or 7 lines

if the eyes can scan a text block in one fixation—the
reader assumes the text is thematically linked

a single fixation = 6 or 7 lines of type

The Larkins

Email or Call Us



We would be happy to speak with you about Larkin Safety Illustration or any of your safety communication needs.

You may schedule a telephone call or conference call for no charge.

Phone: 1-212-860-2939; Email: Larkin@Larkin.Biz

Other Services



Presentation

- 1 to 3 hours
- shows examples and research supporting communication best practice

Workshop

- 6 hours
- more hands on with a small group

Implementation Contract

- 2 weeks
- TJ moves inhouse, joins a project team, and works on a major communication project

Who We Are



Dr TJ Larkin



Sandar Larkin

Since 1985, we have been helping large companies improve communication with employees.

Book	<i>Communicating Change</i> , McGraw-Hill, New York
Most Read Paper	"Reaching and Changing Frontline Employees," <i>Harvard Business Review</i>
Newest Papers	Download our newest papers on communicating safety from our website: www.Larkin.Biz (no charge)
TJ's Background	Ph.D. in Communication (Michigan State University) M.A. in Sociology (University of Oxford)
Sandar's Background	Sandar is originally from Burma and worked with the Long Term Credit Bank of Japan before starting Larkin Communication Consulting with TJ.

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END