SAFETY SERVICES ORGANISATION

HAZARD AND RISK ASSESSMENTS

RISK REDUCTION

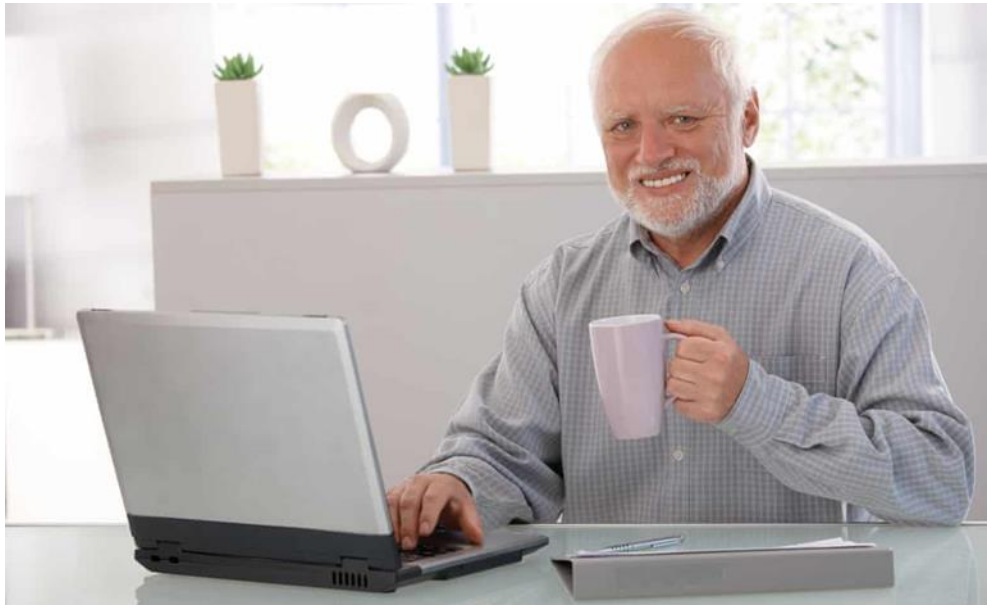
CONTENTS

- Intended Learning Outcomes (ILO)
- Relevant Definitions
- Useful Documentation and Resources
- Risk Reductions – Controls and Mitigations
- Hierarchy of Control
- Bowtie Analysis

INTENDED LEARNING OUTCOMES

To understand:

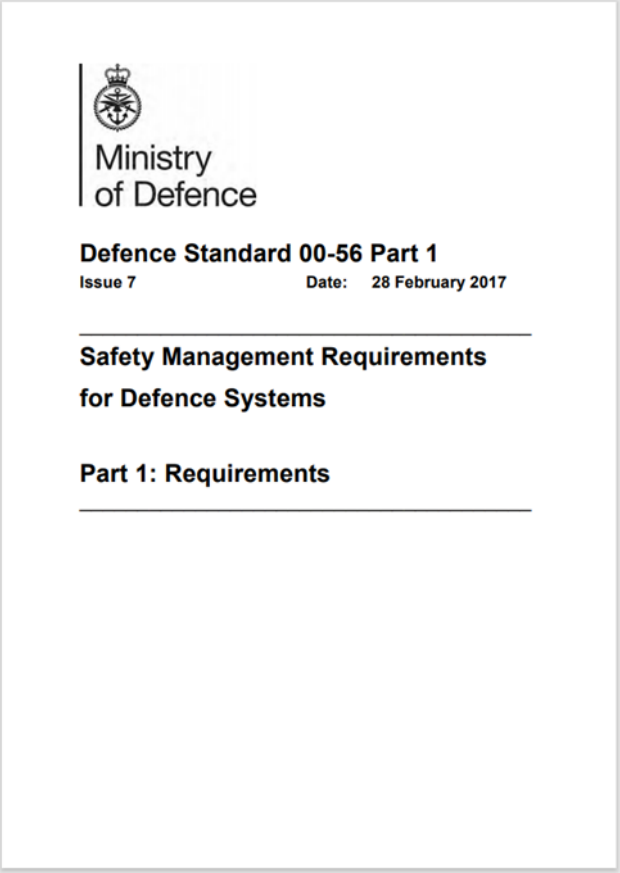
- Types of Risk Reduction
- The Hierarchy Of Controls
  - Elimination
  - Substitution
  - Isolation
  - Control (Engineering)
  - Control (Procedural)
  - PPE
- Bowtie Analysis: Principles; Advantages; Disadvantages



RELEVANT DEFINITIONS

Def Stan 00-056, Part 1, Issue 7 - Definitions:

- **Harm**: Adverse impact on people, including fatality, physical or physiological injury, or short- or long-term damage to health.
- **Hazard**: Potential to cause Harm. e.g. A physical situation or state of a system, often following from some initiating event that may lead to an Accident.
- **Accident:** An event, or sequence of events, that causes unintended Harm.
- **Risk:** Combination of likelihood of Harm and the Severity of that Harm.
- **Likelihood:** A measure of the probability that the Accident will occur.
- **Severity:** A measure of the degree of Harm.
- **Risk to Life (RtL):** Risk of Harm.



Ministry of Defence

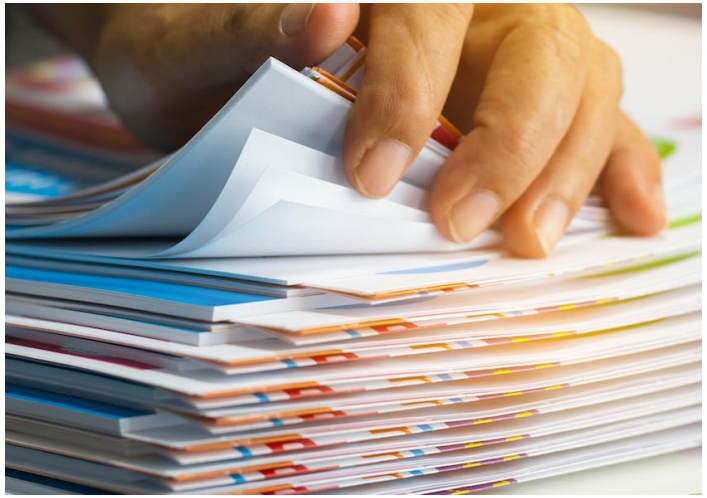
Defence Standard 00-56 Part 1

Issue 7 Date: 28 February 2017

Safety Management Requirements for Defence Systems

Part 1: Requirements

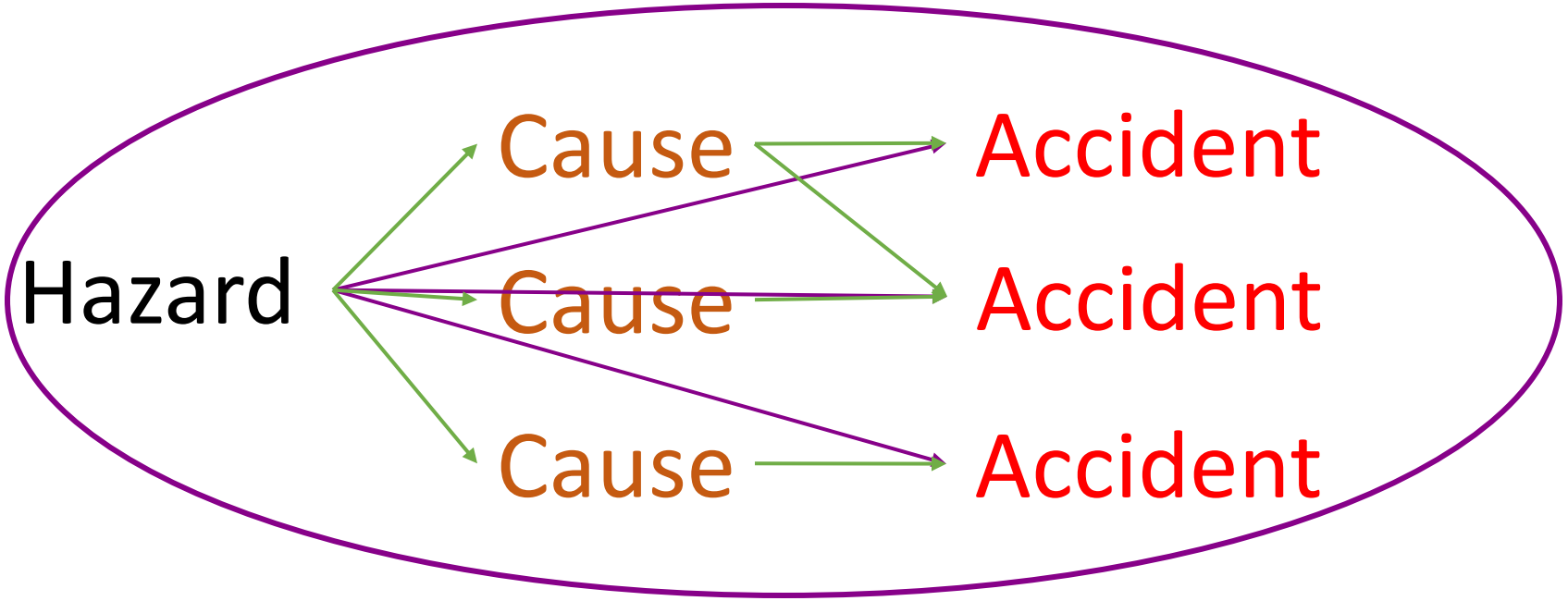
USEFUL DOCUMENTATION & RESOURCES



Useful documentation and resources:

- [1] Def Stan 00-56: The standard for "Safety Management Requirements for Defence Systems".
  - Access (Free): https://www.dstan.mod.uk/StanMIS/
- [2] The MOD's Acquisition Safety and Environmental Management System (ASEMS) Online:
  - Access (Free): http://www. https://www.asems.mod.uk/
- [3] Health and Safety at Work Act 1974
  - Access (Free): https://www.legislation.gov.uk/ukpga/1974/37/contents
- [4] The Management of Health and Safety at Work regulation 1999:
  - Access (Free): https://www.legislation.gov.uk/uksi/1999/3242/contents/made
- [5] HSE Risk Assessment - A Brief Guide to Controlling Risks in the Workplace
  - Access (Free): https://www.hse.gov.uk/research/rrhtm/rr151.htm
- [6] HSE Reducing Risks, Protecting People
  - Access (Free): https://www.hse.gov.uk/managing/theory/r2p2.pdf
- [15] Explosives Industry Group – Protective Measures - A guide on measures other than personal protective equipment to protect people in explosives working areas, 2003
  - Access (Free): http://www.eig2.org.uk/wp-content/uploads/PROTECTIVE_MEASURES.pdf

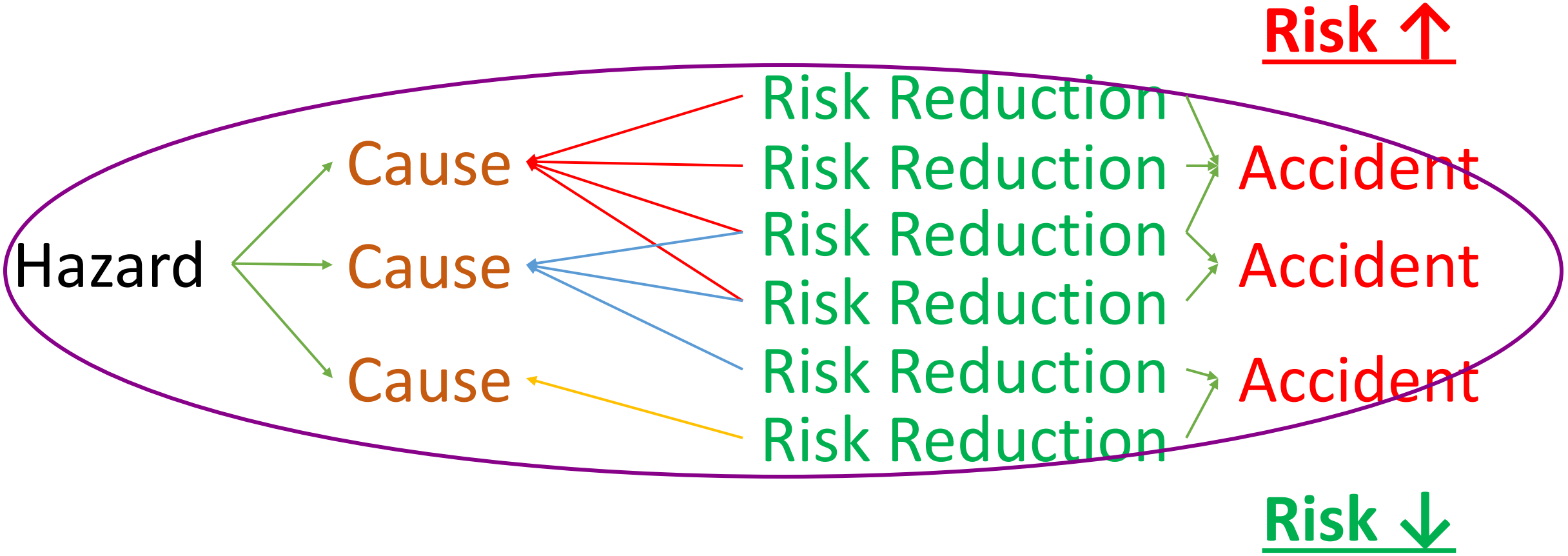
RISK REDUCTION – CONTROLS AND MITIGATIONS



Risk?

So how do we deal with this?

RISK REDUCTION – CONTROLS AND MITIGATIONS



Introduce Risk Reduction measures to address each of the Credible Causes and determine how they might affect the potential outcomes of the Hazard.

RISK REDUCTION – CONTROLS AND MITIGATIONS

Risk = Likelihood x Severity

Designed to reduce the Likelihood of the event occurring (i.e. Controls).
Designed to reduce or lessen the effects of the consequential outcome (i.e. Mitigations).
Designed to tackle both aspects of Risk.

Example Hazard:
Exposure to Hazardous Material (HAZMAT) During Handling of Munition

Controls: PPE shall be worn during handling activities. Prior to handling the munition shall be inspected for potential sources of exposed HAZMAT etc.
Mitigation: First Aid Protocols.
Control (Both): No HAZMAT present within the design of the munition.

HIERARCHY OF CONTROL

The Hierarchy of Control (Most Effective to Least Preferred):

1) Eliminate;
2) Substitute;
3) Isolate;
4) Control (Engineering);
5) Control (Procedure) of SSW;
6) Personal Protective Equipment (PPE).

Reduction

Example Hazard: Inadvertent Detonation of Munition Warhead

1) No Personnel Involved / Inert Munition; 2) More Insensitive Energetic Compositions; 3) Remote Work; 4) Safe and Arming / Electrically Isolated; 5) Procedures: Anti-Static, Handling, Storage, Manufacturing, Contraband….; 6) Bomb Suit

There are some cases where trying to achieve the more preferred means of Control are neither possible nor considered to be Reasonably Practicable.

[11, 15, 16]

BOWTIE ANALYSIS – INTRODUCTION

Aim: To aid cause and consequence analysis for identified hazards. To determine where Control and Mitigations need to be made to reduce the risk associated with the identified Hazard.

Principle: Bowtie Analysis requires the identification of Hazards or Events, Threats (Causes) and the Consequences (Accidents) and the estimated loss.

It enables a more in-depth analysis of identified Hazards, determination of Causal Routes, and aspects of the risk that needs to be remediated/controlled in order to avoid experiencing the final Consequences of the Hazard i.e. Controls and Barriers.

BOWTIE ANALYSIS – KEY COMPONENTS

Key Components (Simple):

- **Hazard / Hazardous Event**
- **Threats** - Direct Causes that will potentially lead to realisation of the Hazard /Event.
- **Consequences** – The consequential outcomes of the Hazard / Event (i.e. the Accidents).
- **Preventative Control/Action/Barrier** – Measures implemented to reduce the likelihood of the Hazard / Event.
- **Recovery Control/Action/Barrier** – Measures implemented to reduce the severity, or, lessen the level of propagation of the Hazard / Event.

Key Components (Complex):

- **Escalation Factors** – Likelihood of Failure of the Controls.
- **Escalation Factor Controls** – Controls to address the identified Escalation Factors.

BOWTIE ANALYSIS – PROS AND CONS

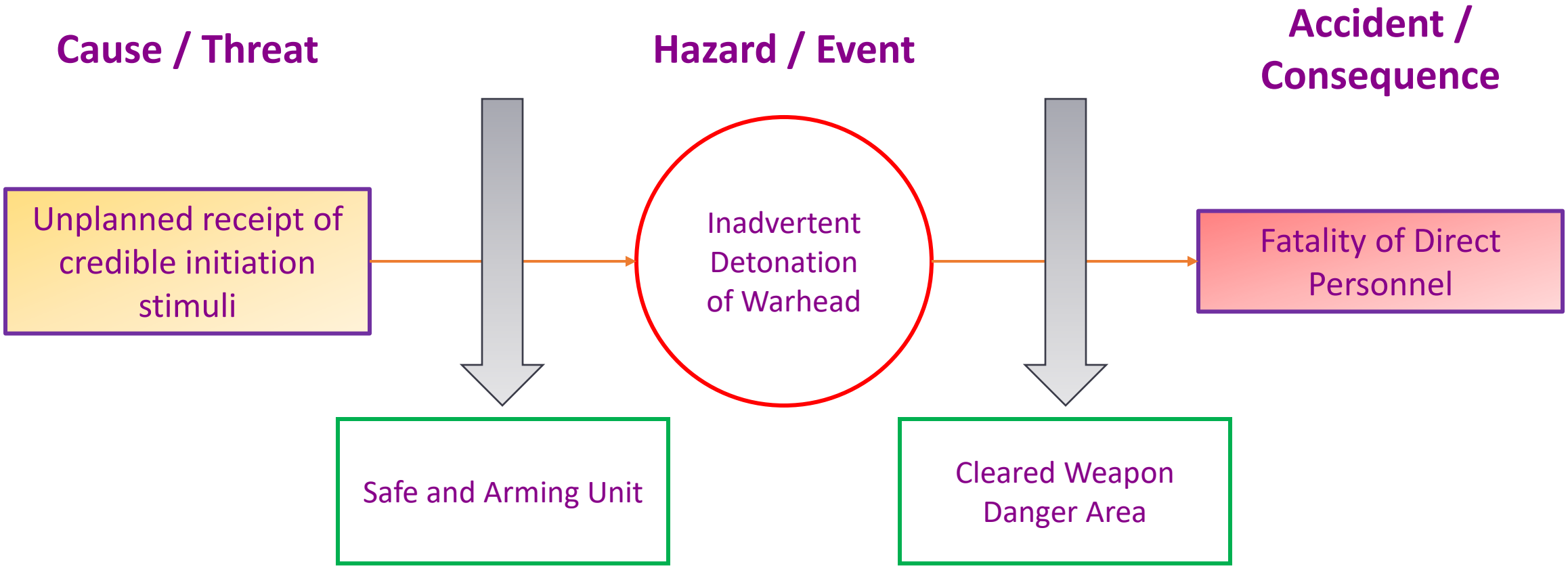
Pros:

- **Clear Definitions** – Hazard, Threats, Accidents, Controls and Mitigations.
- **Ease of Understanding** - Relationships between all components.
- **LHS of Bowtie** – Identified Causes vs Controls Measures and Intervening Safeguards designed to reduce the likelihood of the Hazard / Event.
- **RHS of Bowtie** – Hazard / Event vs Mitigation Measures designed to the reduce the effect of the potential Accidents.

Cons:

- **No quantitative information provided** (unless linked to Causal Analyses like Event Trees and Fault Tree Analyses).
- **Does not link with defined Risk Estimations or Classifications**.
- **Requires detailed knowledge** of the safety-related aspects of the System under assessment.
- **No standardised methods for developing Bowties**.
- **No way to measure the effectiveness of the Controls or Mitigations**.

BOWTIE ANALYSIS – EXAMPLES



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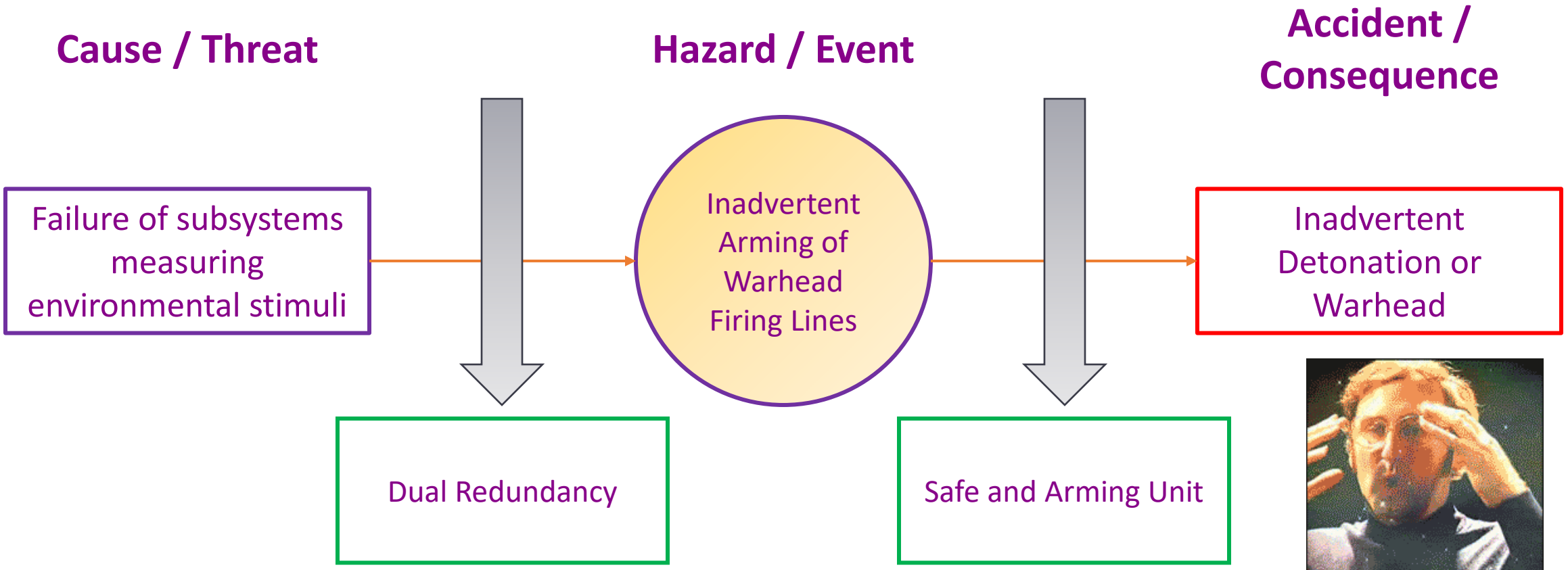

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ILO RECAP

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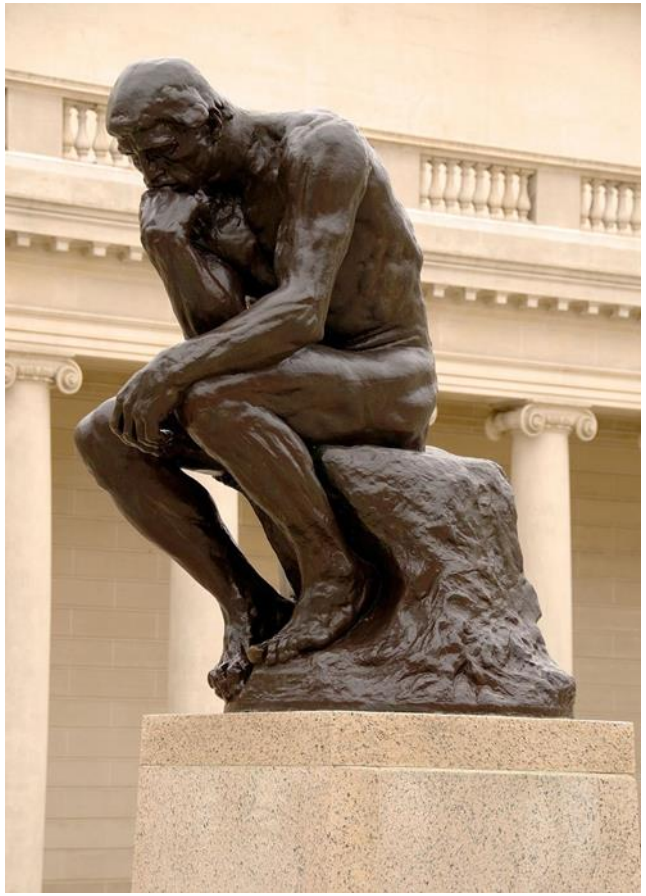

THANK YOU FOR LISTENING

ANY QUESTIONS?

REFERENCES

[1] Def Stan 00-56: The standard for “Safety Management Requirements for Defence Systems”.

[2] The MoD’s Acquisition Safety and Environmental Management System (ASEMS) Online:

[3] Health and Safety at Work Act 1974

[4] The Management of Health and Safety at Work regulation 1999:

[5] HSE Risk Assessment - A Brief Guide to Controlling Risks in the Workplace

[6] HSE Reducing Risks, Protecting People

[7] Defence Safety Authority, DSA01.2 Implementation of Defence Policy for Health, Safety and Environmental Protection, Chapter 3, Duty Holding, Issue 1.1

[8] Image - https://bbs.binus.ac.id/international-business/2017/11/writing-course-intended-learning-outcomes-cilo/

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[11] Image - https://i.kym-cdn.com/photos/images/original/000/363/584/f56.gif

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[14] Civil Aviation Authority – Bowtie Analysis - https://www.caa.co.uk/Safety-initiatives-and-resources/Working-with-industry/Bowtie/

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