

CENG 6101 Project Management

Health, Safety, and Environment at Work

Abraham Assefa Tsehayae, PhD

January, 2017

HSE at Work



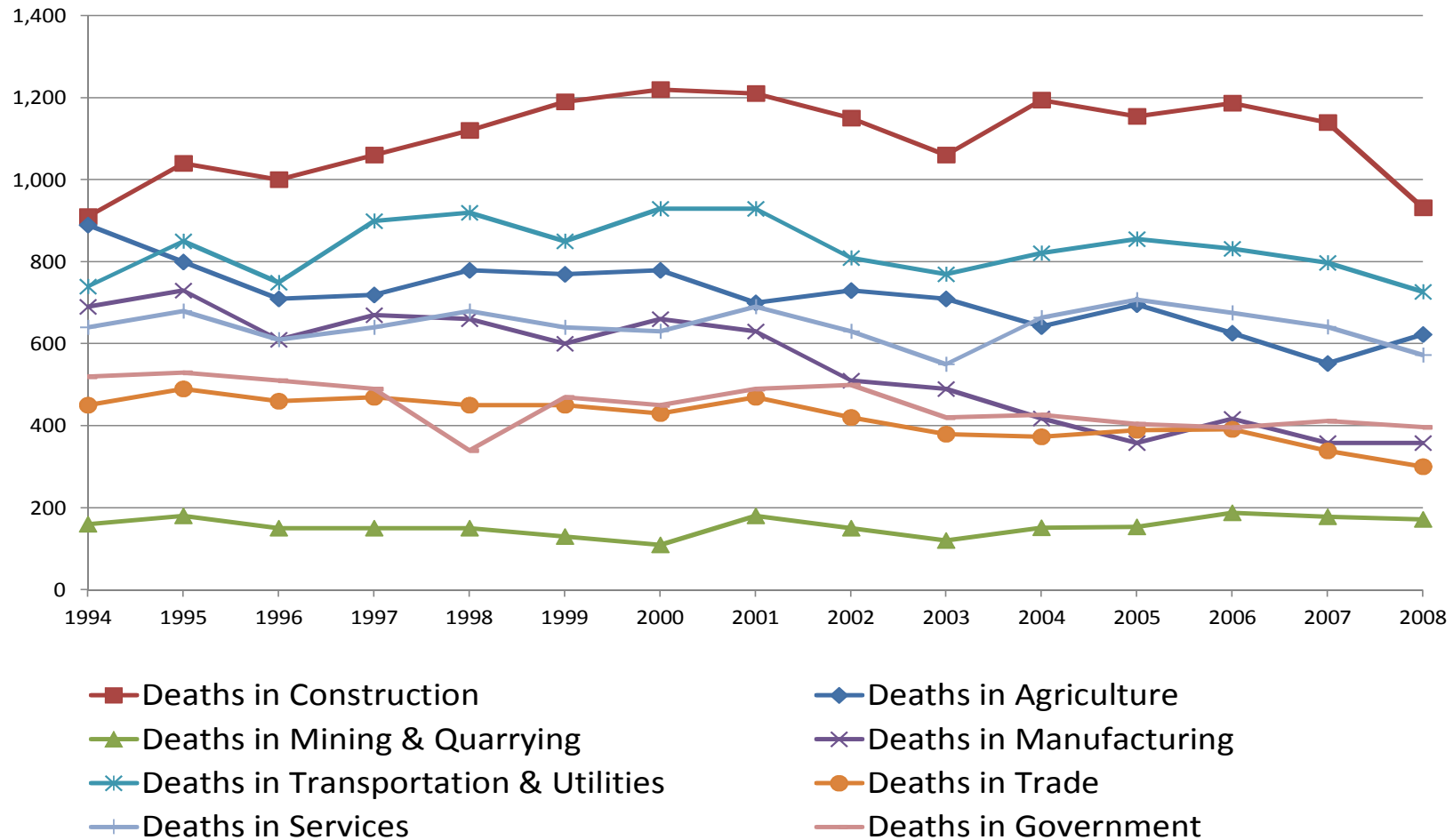
Source: Charles Ebbet, 1932

Definitions

- Safety is free from risk and danger.
- Accidents is defined as an unexpected and desirable event resulting in damage or harm.
- Hazards is an unsafe condition or activity, that if left uncontrolled can contribute to an accident.
- Risk is the assessment of 'probability of loss' and 'potential amount of loss'.

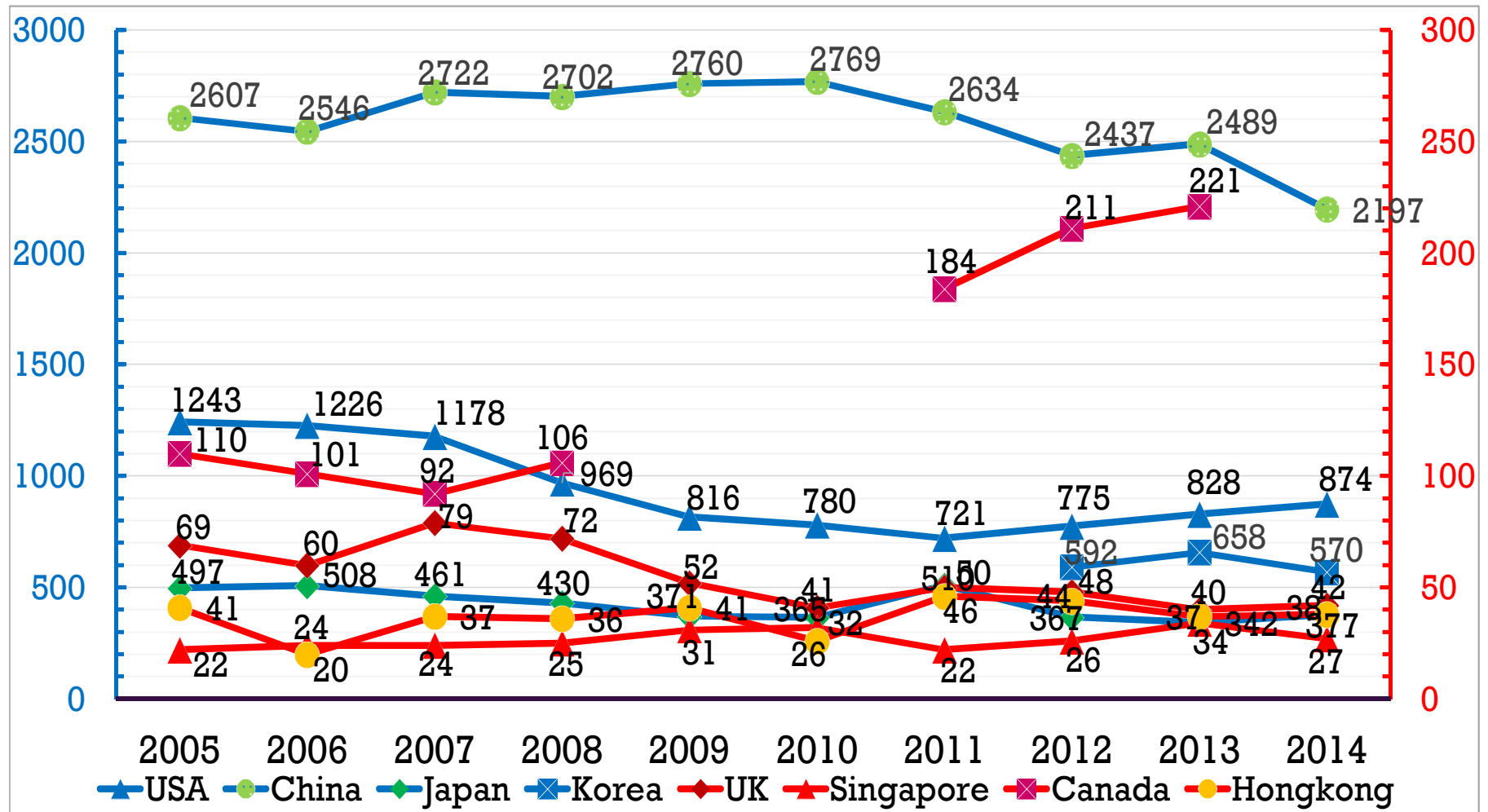
(concise Oxford Dictionary)

Construction site



Source: U.S. Census Bureau, Labor Force, Employment & Earnings

Construction annual fatalities (2005-2014)



Source: Fang, 2017

Construction site

- Construction work is dynamic, diverse, and constantly changing in nature.
- Constantly changing job site environments and conditions
- Multiple contractors and subcontractors
- High turnover; unskilled laborers
- Constantly changing relationships with other work groups
- Diversity of work activities occurring simultaneously
- Construction workers are at risk of exposure to various hazards and risks that can result in injury, illness, permanent disability, or even death.

Types of hazards

- Chemical
- Physical
- Biological
- Ergonomic



Chemical Hazards

Chemicals can exist in the form of

- dusts, fumes, fibers (solids)
- liquids, mists
- gases, vapors



Examples of
chemical
hazards found
in construction
work:

- asbestos
- lead
- silica
- cadmium
- carbon monoxide
- welding fumes
- spray paints
- cutting oil mists
- xylene vapor
- solvents

Physical Hazards

Physical hazards are different types of energy which may be hazardous to workers.

- Noise
- Vibration
- Temperature extremes
- Radiation



Biological Hazards

Exposure may occur during demolition, renovation, sewer work, work on air handling systems, or other construction work from contact with contaminated or disease-carrying

- soil
- water
- insects (mosquitoes, ticks)
- bird, bat droppings
- animals
- structures

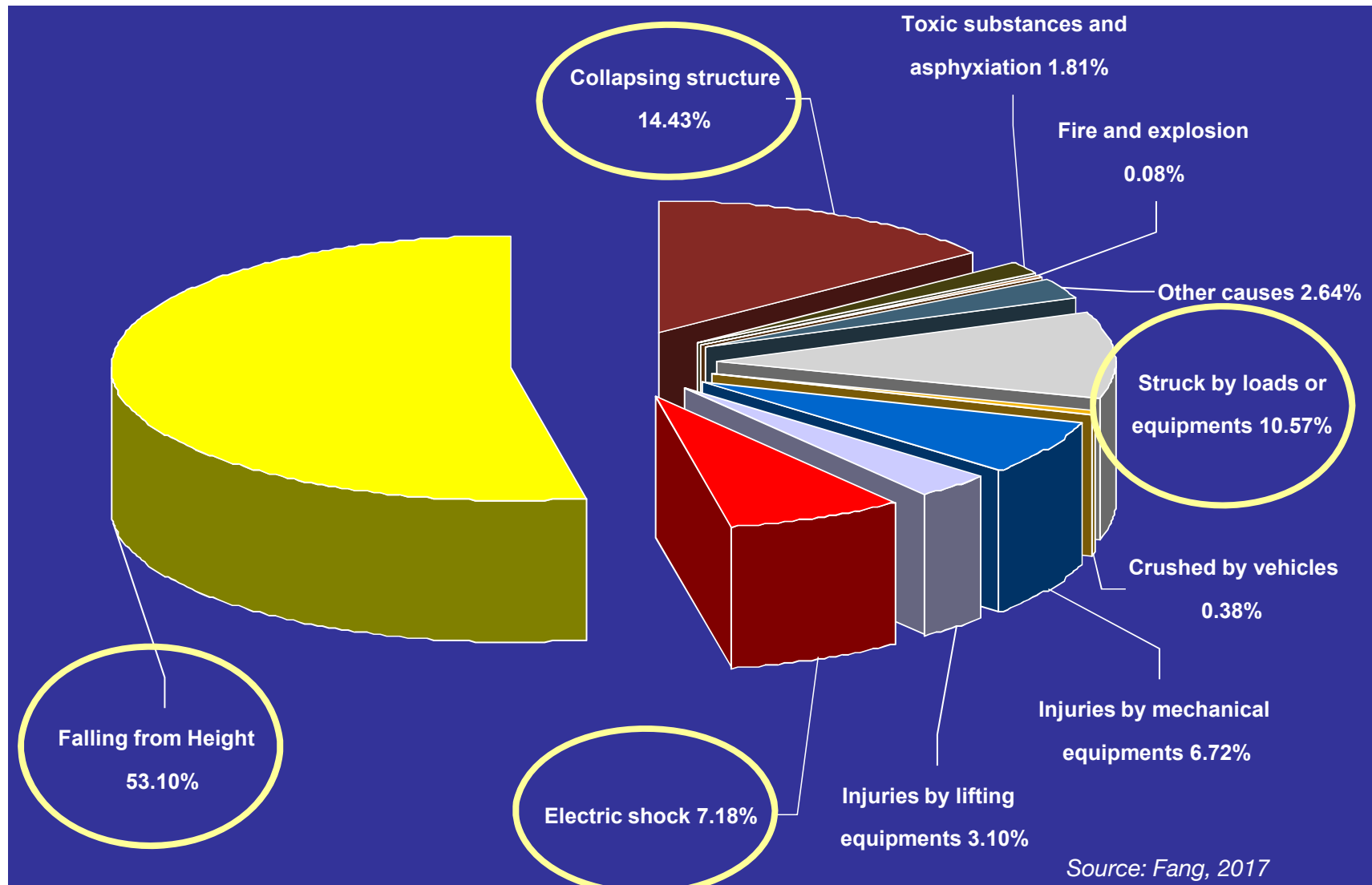
Ergonomic Hazards

Ergonomic hazards can cause painful and disabling injuries till example Musculoskeletal Disorders (MSDs) . This following situation may causes these injuries:

- heavy, frequent, or awkward lifting
- repetitive tasks
- awkward grips, postures
- using excessive force, overexertion
- using wrong tools for the job or using tools improperly
- using improperly maintained tools
- hand-intensive work



Common Causes of Fatal Accidents



Major accidents in construction

- Falls
- Electrocution
- Being struck by falling objects
- Trapped during excavation



Costs of accidents

- Direct costs and indirect costs of Safety Accidents:
- Direct costs: The direct costs are insurance (medical costs and others workers' compensation insurance benefits as well as liability and property-damage insurance).
- Indirect costs (10– 30 x Direct Cost):
 - *Transportation costs*
 - *Wages paid to injured worker for time not worked*
 - *Cost incurred because of delays which resulted from accident*
 - *Costs of overtime necessitated by accidents*
 - *Loss of efficiency of crew*
 - *Cost to break in and/or teach replacement worker*
 - *Costs for clean-up, repair or replacement and stand-by costs*
 - *Extra wage costs, slower returned worker*
 - *Costs to reschedule work*
 - *Costs of wages for supervision as a result of the accidents*
 - *Costs for safety and clerical personnel as a result of the accident*
 - *OSHA and civil fines*
 - *Cost of legal assistance*

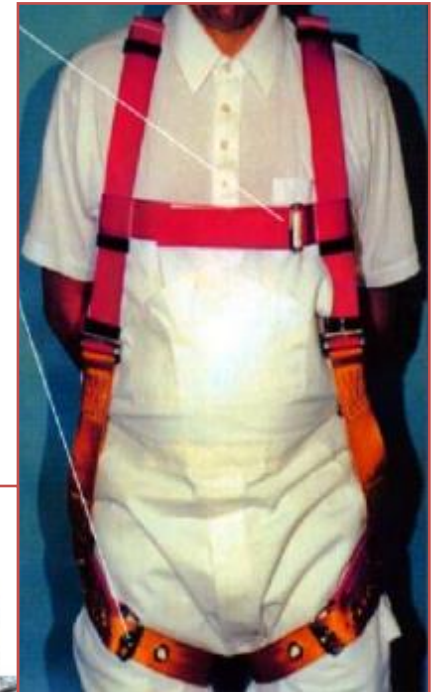


Fall Protection

- Falls are the leading cause of fatalities in the construction industry
- Conditions that required use of fall protection
- A fall from as little as 4- 6 feet
 - Can cause loss of work
 - In some cases death
- When fall protection is needed?
 - Walkways & ramps
 - Open sides & edges
 - Holes
 - Concrete forms & rebar
 - Excavations
 - Roofs
 - Wall openings
 - Bricklaying
 - Residential Construction

Fall protection and prevention options

- Safety Nets
- Hand Rails
- Safety Harness (PFAS)
- Equipment guards
- *Fall protection systems must be in place before work start*



Personal Fall Arrest System, PFAS

- Must be properly trained
- Key requirements
 - No free fall more than 6 feet
 - Must be inspected prior to use
 - Safety line must be able to support 5000 lbs



Guardrails

- Top rail between 39 to 45 inches tall
- Toeboards at least 3 inches tall
 - Top rail
 - Mid Rail
 - Toe board



Falling Objects

- Hardhats are required
- Use of canopies is authorized
- Barricade the area to prevent unauthorized entry

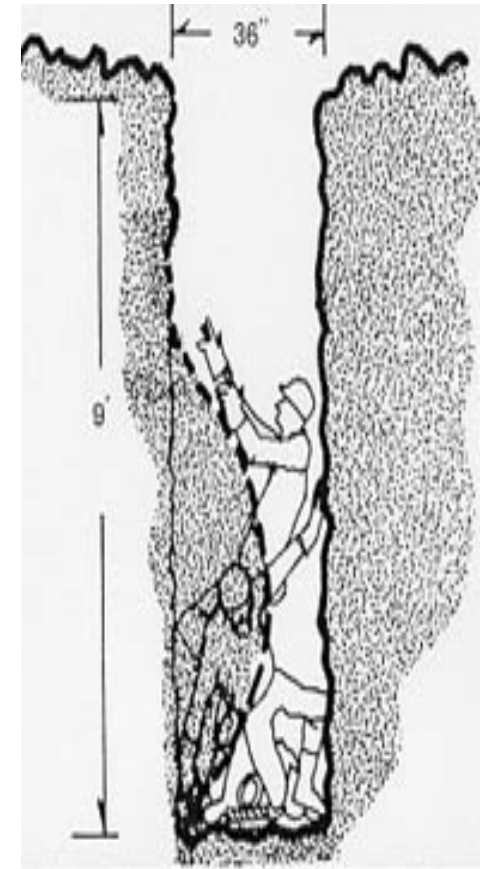


Electrical Accidents

- Contact with Power Lines
- Lack of Ground Fault Protector
- Missing Ground on electric cords
- Improper use of equipment
- Improper use of electric cords

Excavation Hazards

- Highly hazardous construction operation
- Cave-ins are the greatest risk
- Most accidents occurred in 5-15 ft deep



How to improve health and safety on construction sites?

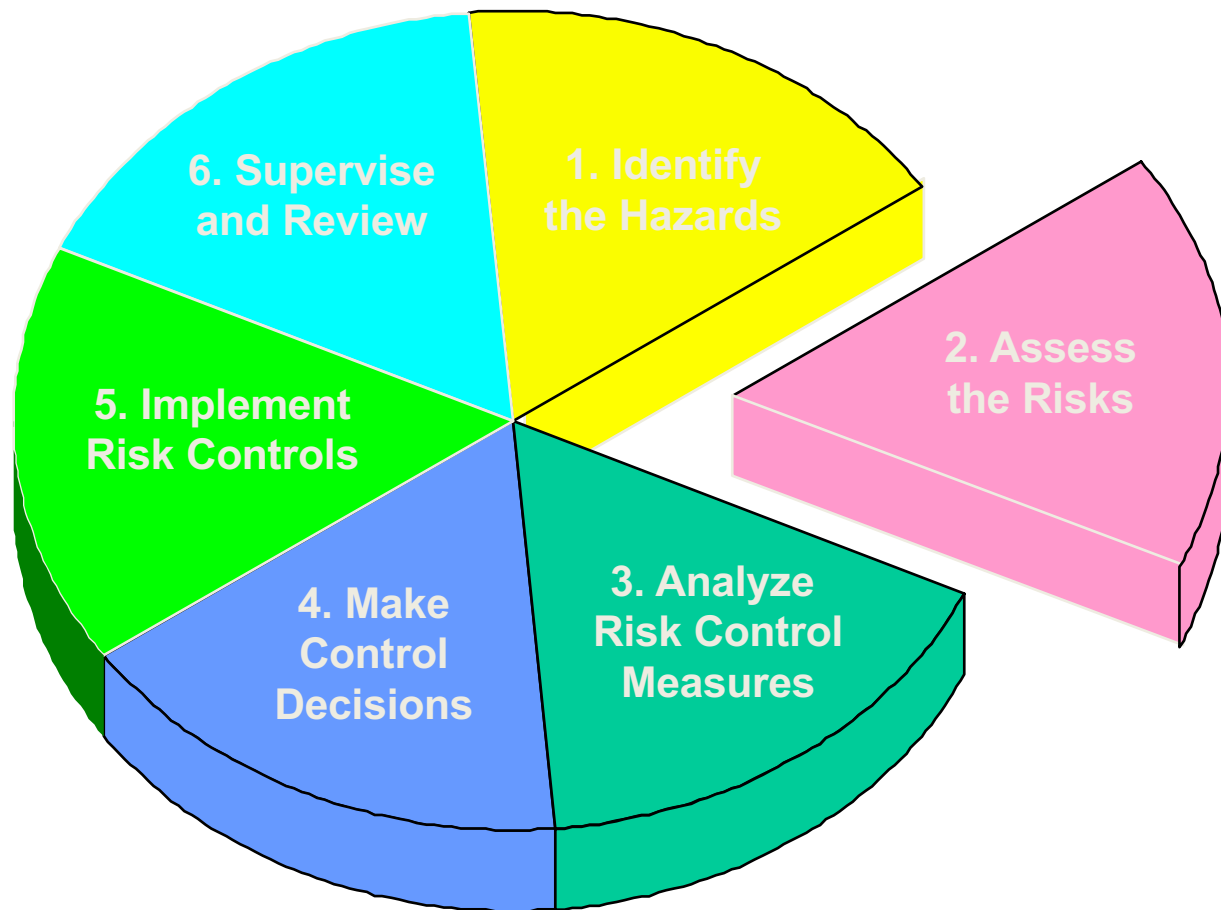
- Reactive measures
 - Accident recording & reporting
 - Accident investigations
- Proactive measures
 - HSE safety policy
 - HSE safety programme/plan
 - HSE safety induction/training
 - Tool-box talk
 - Others

Systemic Analysis of Safety



Systemic Analysis of Safety

- Safety Risk Assessment: An evaluation of threats in terms of severity and probability

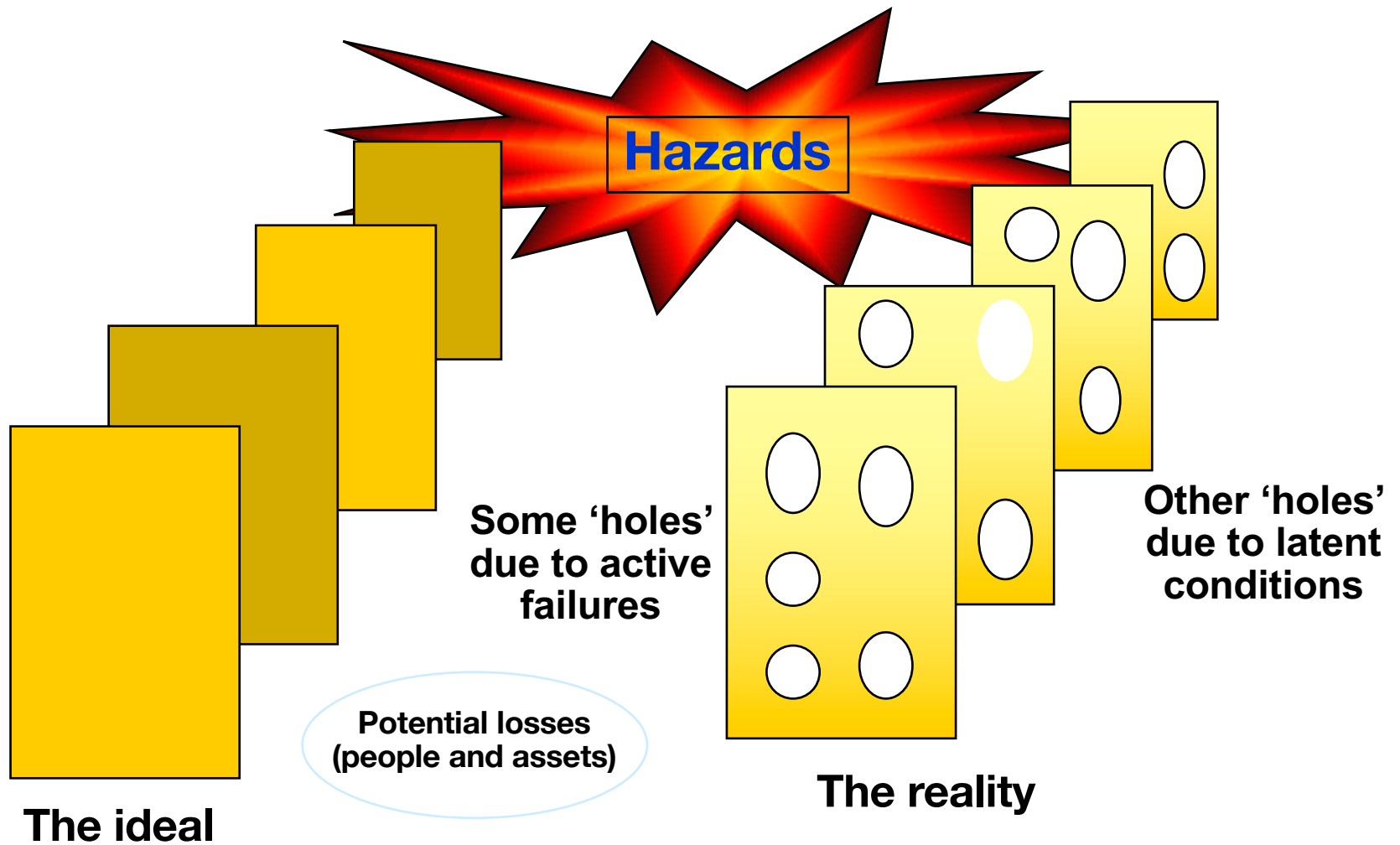


THE “ENHANCED” RISK ASSESSMENT MATRIX

- Numeric Code is used to prioritize hazards and determine their acceptability using a quantitative methodology

		Probability					
		Frequent	Likely	Occasional	Seldom	Unlikely	
		A	B	C	D	E	
S E V E R I T Y	Catastrophic	I	1	2	6	8	12
	Critical	II	3	4	7	11	15
	Moderate	III	5	9	10	14	16
	Negligible	IV	13	17	18	19	20
		Risk Levels					

“Swiss Cheese” Model of Defenses



Source: James Reason: “Managing the Risks of Organizational Accidents”

Types of incident/accident measurements

ID		Scale of Measure
	Safety Incidents	Frequency of incidents (Sum of incidents/Total sum of incidents)
1	Near Miss (Unsafe working conditions)	Integer (Number of reported near miss per month)
2	First Aid (minor personal injury)	Integer (Number of reported first aid per month)
3	Medical Aid (major personal injury)	Integer (Number of reported medical aid per month)
4	Modified Work Incidents	Integer (Number of reported modified work incident per month)
5	Number of Modified Work Days	Integer (Number of reported modified work days per month)
6	Lost Time Incident	Integer (Number of reported lost time incident per month)
7	Number of Lost time Workdays	Integer (Number of lost day reported due to lost time incident per month)
8	Fatality Incident	Integer (Number of reported personnel fatality per month)
9	Equipment/Property Damage	Integer (Number of reported equipment/property damage incident per month)
	Safety Incident investigation	Total number of hours for investigation
10	Personnel involved in investigation	Real number (Number of personnel involved in investigation)
11	Process time	Real number (Average duration of investigation in hours)

Benefits of Safety Program

- Reduced workers' compensation claims
- Reduced expenses related to injuries and illnesses
- Reduced absenteeism
- Lower employee complaints
- Improved employee morale and satisfaction
- Increased productivity
- Reduction of hidden cost
- Reduced insurance cost

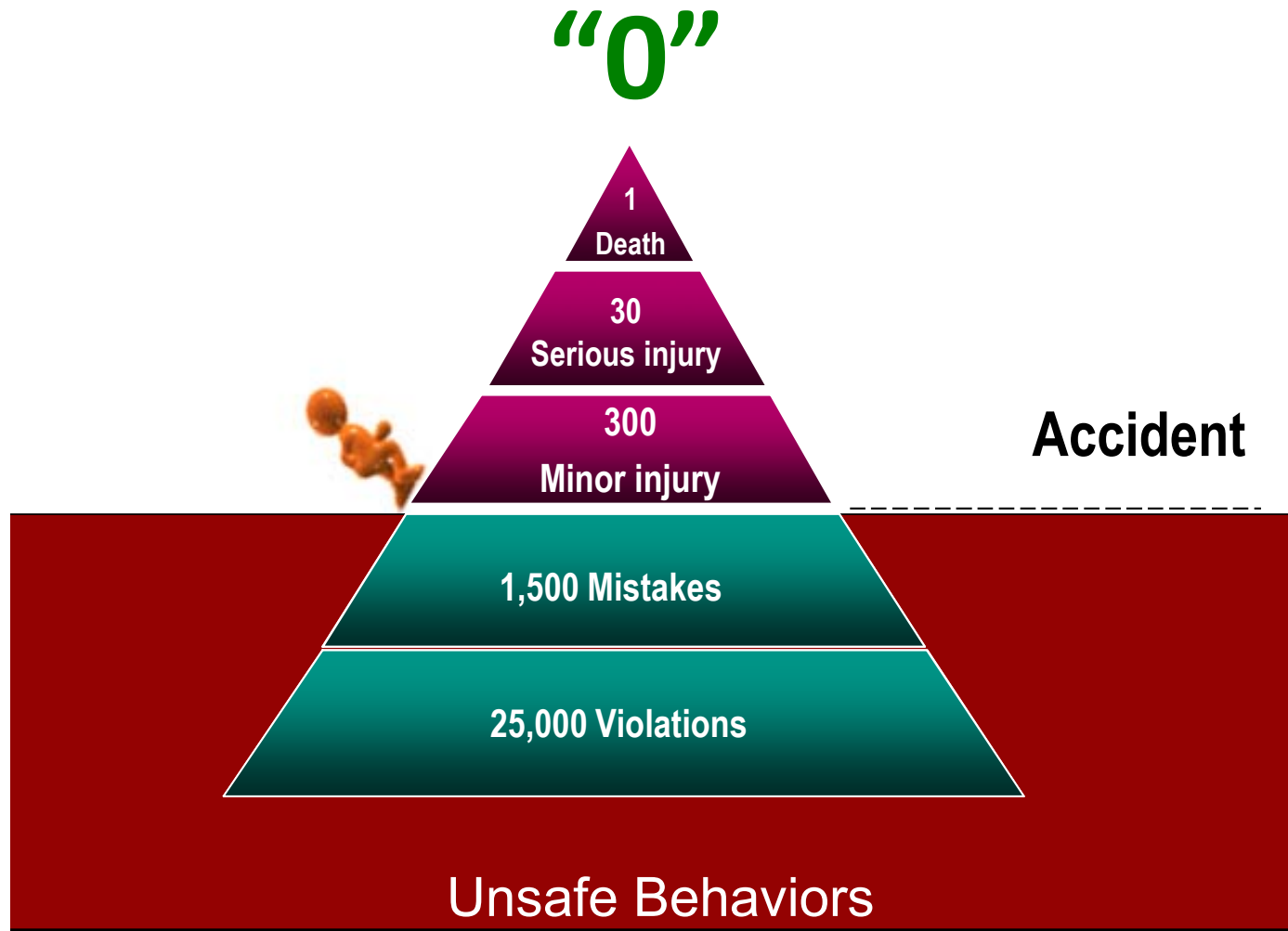
Safety Officer

- Develop and implement accident prevention programs
- Advise management on company policies and governmental regulations
- Evaluate effectiveness of existing safety programs
- Train management in safety observation techniques

Why Have a Plan?

- Designed to Protect
 - Personnel
 - Environment
 - Public
 - Operation and Equipment
- Government Regulations
 - OSHA
 - EPA
 - State/Local
- Public/Private Requirements

Zero Incident/Accident Safety Programs



Source: Fang, 2017

Typical Safety Programs

- Personal Protective Equipment (PPE):
FIRST LINE OF DEFENSE
 - Proper use
 - Employee training
 - Enforcement
 - Dusty Operations
 - Unknown hazards
 - Hazardous waste operations and
Emergency Response
- PPE: Rubber gloves, Rubber Insulated work boots, Safety Hard Hat, Reflective Vest, Long sleeve shirts, Eye glasses



Typical Safety Programs

- Hazard communication program
 - Written program development and implementation
 - Chemical Inventory
 - Communicate safe work methods for:
 - Jobs-Specific activities
 - Non-routine tasks
 - Labeling requirements
 - MSDS
 - Employee training (contractors)
- Machine guarding
 - Make sure that machine guarding is:
 - Replaced and tested for proper function when removed for maintenance
 - Review electrical and mechanical interlocks to see if they work properly

Typical Safety Programs

- Job Hazard Analysis
 - Select activities with highest risk
 - Break activity into individual components
 - Identify potential hazards in each component
 - Develop procedures to eliminate/reduce hazard
- Equipment Repair
 - Inspect and repair and/or replaced defective parts
- Lockout/Tagout
 - Make sure that lockout/tagout procedures are established
 - Employees trained
- Others
 - Confined-space entry
 - Excavation
 - Heavy equipment

Environmental Protection

- Environmental projection requirements:
- Environmental Hazard Assessment
 - Prior to beginning work on a project, an environmental hazard assessment will have be performed.
 - Upon completion, if any issues require clarification by federal, regional or municipal environmental legislation, the appropriate governing authorities will be contacted.
- Owner/Client Requirements
 - Owner/client environmental requirements or concerns must be addressed prior to beginning work on any project.
 - Environmental requirements will be discussed during the pre-job meeting.
- Site-Specific Environmental Protection Plan (EPP)
 - Environmentally-sensitive projects will require the development of a site-specific EPP.

Environmental Protection

- Site-Specific Environmental Protection Plan (EPP) will address the following issues:
 - Identification of all aspects of the environment that may be at risk due to ongoing operations at the site.
 - Control measures to be instituted to protect the environment from harm.
 - Issuance of any permits or licences required.
 - Shipping, handling and storage of environmentally hazardous products.
 - Watercourse siltation control procedure(s).
 - Spill containment procedure(s).
 - Emergency response plan including personnel, equipment and emergency contact numbers.

Environmental Protection Practices

- Air Quality: reasonable effort has to be made to reduce the release of air contaminants generated by equipment or project work processes into public or work areas, such as:
 - Nuisance odours generated from sources such as thaw fires or asphalt plants.
 - Dust generated from traffic on haul roads.
 - Hazardous particulate generated from concrete finishing and grinding processes.
 - Excessive exhaust from internal combustion engines.
- Noise
 - Wherever possible, the project shall schedule project operations so that local noise bylaws are not violated.

Environmental Protection Practices

- Soil Conservation: all project personnel shall be informed of site requirements and guidelines for:
 - Rights of way
 - Soil disturbances
 - Stock piling
 - Low ground pressure tires or tracks, and
 - Project restoration
- Groundwater:
 - The project has to ensure all hazardous spills are promptly contained and cleaned up to reduce potential harm to groundwater.
- Water Discharge from the Project:
 - The project shall institute procedures to prevent turbid water discharges and sediments from escaping the site.
 - The project will ensure water quality meets the standards for discharge to storm sewers.

References:

- *Griffith A & Howarth T. 2000. Construction health & safety management. Pearson Education Limited.*
- *Kunju Ahmad. 2000. Developing a safety performance measurement tool (SPMT) for construction sites. Loughborough University thesis. UK.*
- *Heberle D. 1998. Construction safety manual. McGraw Hill. USA.*
- *Davies V.J. Tomasin K. 1990. Construction safety handbook. Thomas Telford, London.*
- *Fang D. 2017. Safety and Health: The Challenge in construction. Presentation, Addis Ababa, Ethiopia.*