NUS
National University
of Singapore

# CIBA Safety

1 April 2010

# Outline

- ✓ **Objectives**
1. **Risk Management**
   - o Risk Management Process Flowchart
   - o Risk Assessment Assignments
2. **Safety Management System**
   - o What is SMS?
   - o Safety Audit Requirements
   - o Previous Audit Findings
- ✓ **Updates**

# Objectives

- To raise the awareness and to instill a habitual consideration of safety among every user of the laboratory.
- To promote ‘safety-first’ ethics and practices.
- Continual improvements and reviews on CIBA Safety

1.

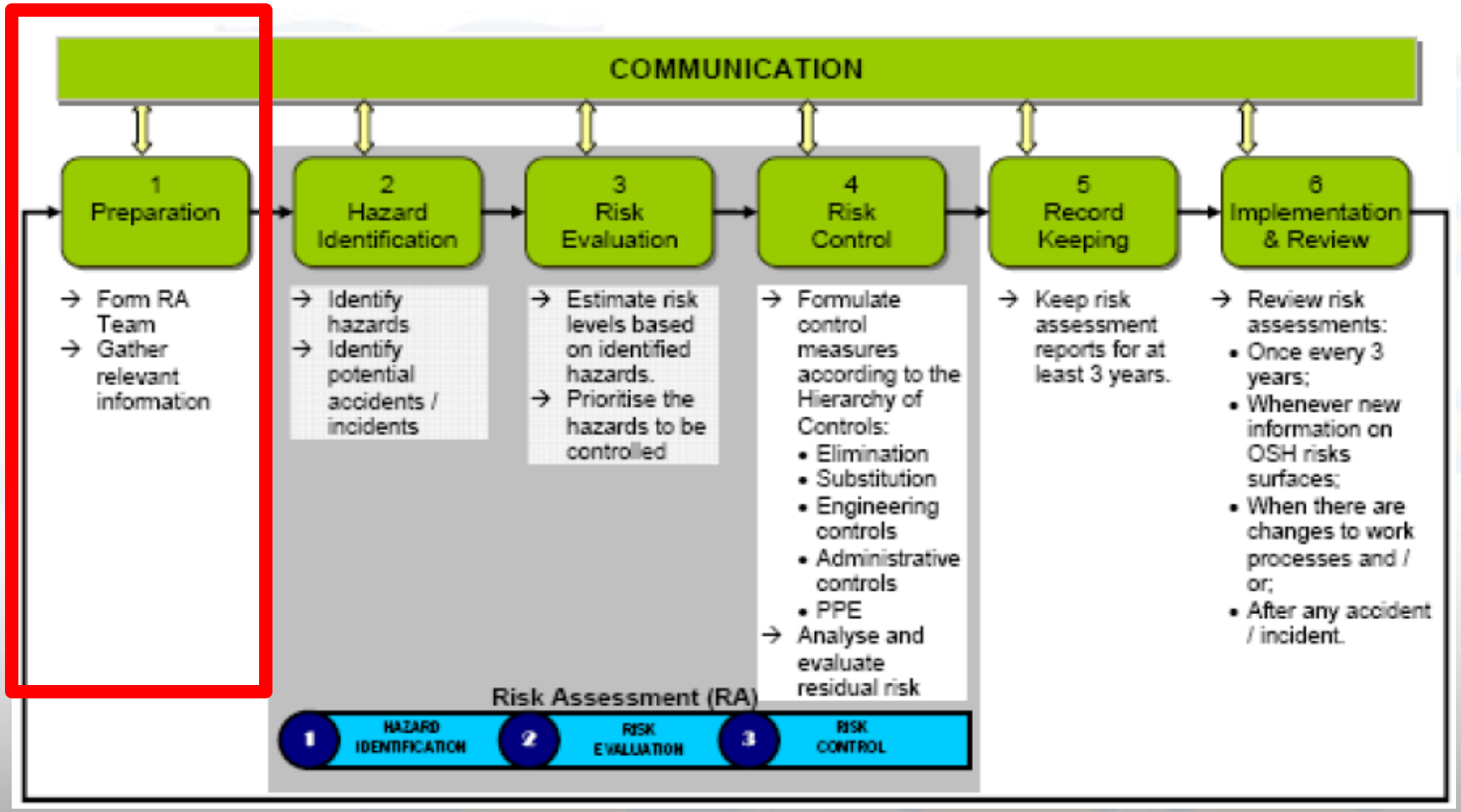
# RISK MANAGEMENT

# Before we starts…

- ❑ Why Risk Assessment?
- ❑ What is Hazard?
- ❑ What is Risk?
- ❑ What is Risk Assessment?
- ❑ What is Risk Management?

✓ RA is a legal requirement under Workplace Safety & Health Act (Risk Management) Regulations 2006

# Risk Management Process Flowchart



# 1. Preparation

- **Form RA team**
  - ✓ Team leader with roles & responsibilities clearly defined
  - ✓ Team leader who is the one competent of the hazards
  - ✓ A team who thorough knowledge of the work to be undertaken
  - ✓ **Never a ONE man show!!**
- **Gather relevant information**
  - ✓ List of chemicals, equipment, machinery, tools used
  - ✓ Manuals
  - ✓ Relevant legislation, codes of practice / specifications
  - ✓ Previous RA
  - ✓ Details of existing risk controls & safe work procedures

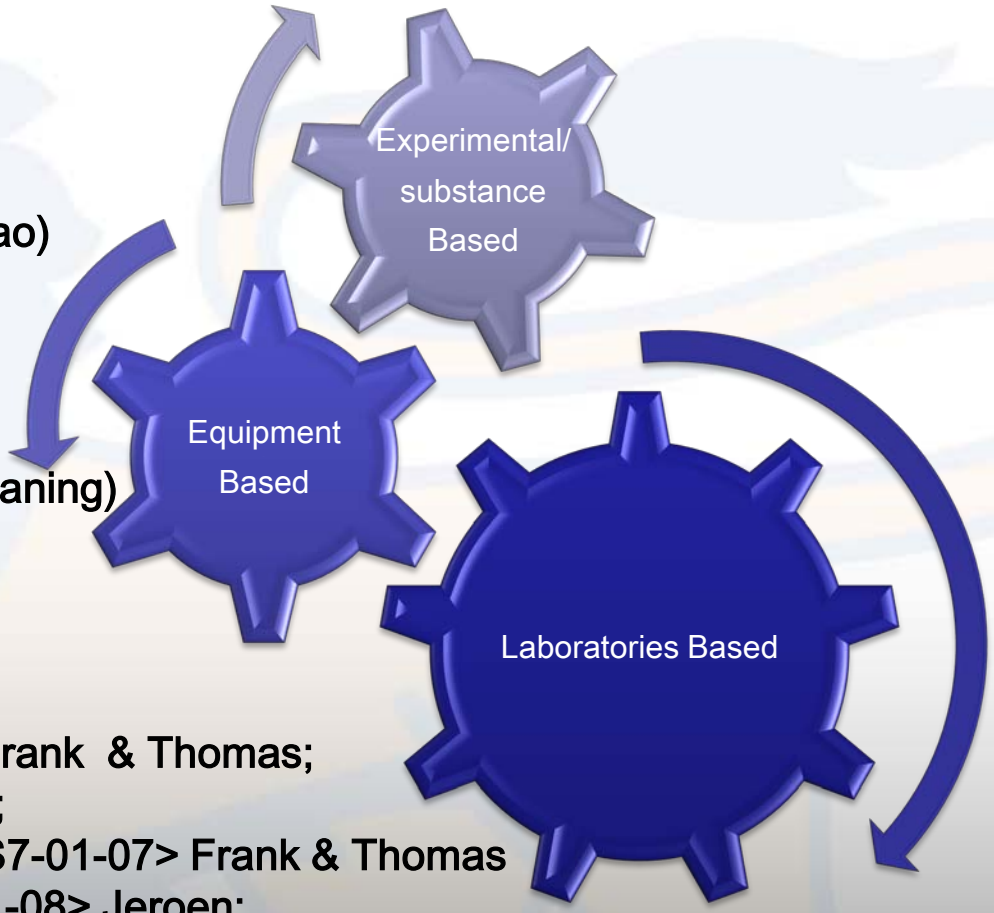
# Roles & Responsibilities

**Principle Investigator (PI)**

- Lab Health & Safety Coordinator
- First Aider
- Research Fellows & Assistants
- Students

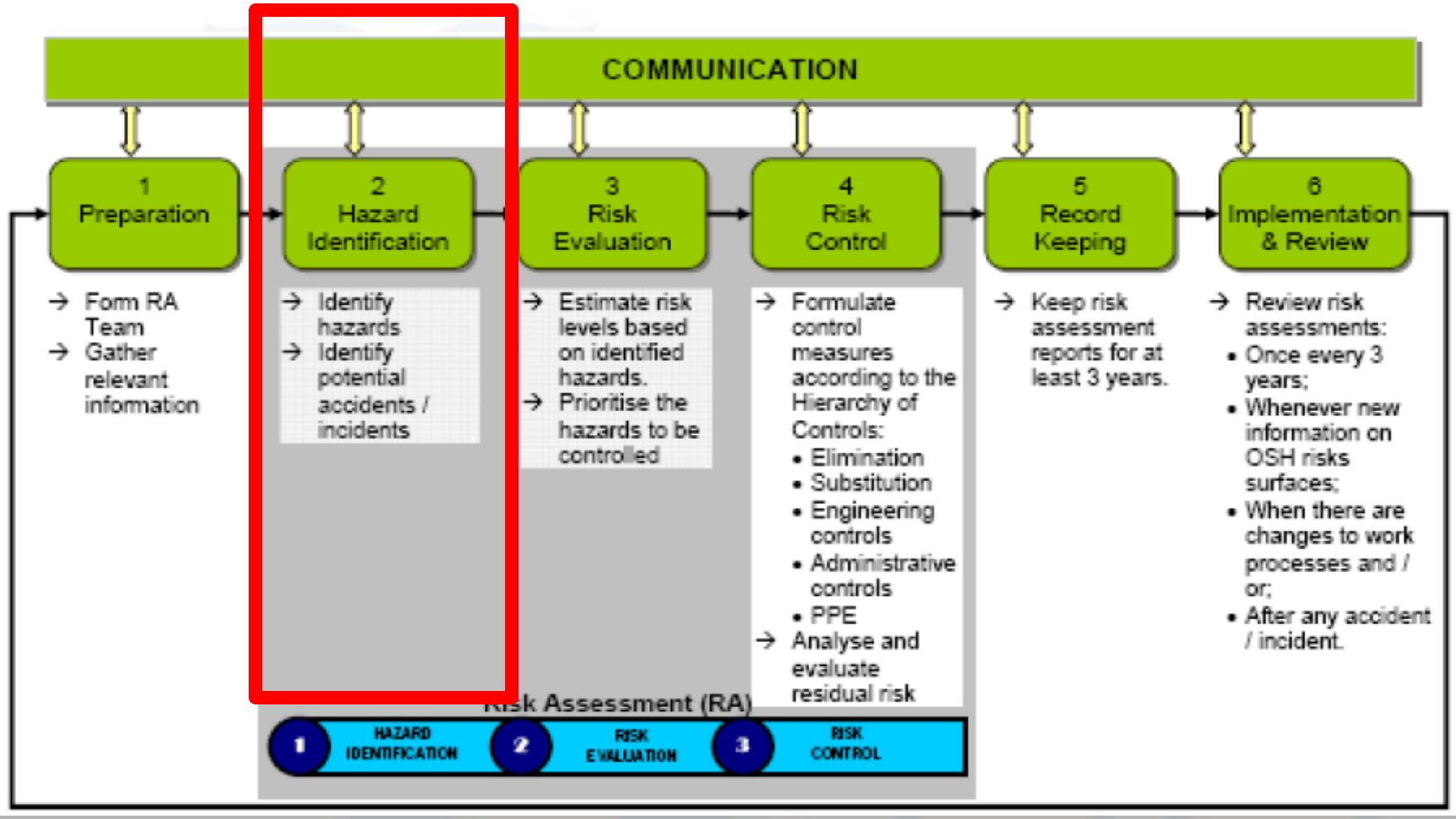
# Roles & Responsibilities

1. 10° proton beam writing line (Shao)
2. Sputter coating machine (Armin)
3. Spincoater (Shao)
4. UV exposure system 248 & 365 nm (Shao)
5. Hot embossing machine (Shao)
6. Plating machine (Shri)
7. Mega-sonic cleaning machine (Armin?)
8. Laser writer (Shri)
9. PDMS casting (Desiccators / plasma cleaning)
10. Polishing Machine (Eejin)
11. Lasers & microscope (Andrew)
12. New beam lines??




CIBA Main lab: S7-01-01, S7-02-01>Frank & Thomas;
CIBA Cleanroom: S7-01-01A> Jeroen;
CIBA Van der Graaf Accelerator lab: S7-01-07> Frank & Thomas
CIBA/ESP Nano fabrication lab: S7-01-08> Jeroen;
CIBA Chemistry lab: S7-01-09> Frank & Jeroen;
CIBA Thermal Processing lab: S7-01-16> Mark
CIBA Optical Materials & Device lab: S11-02-09>Andrew;

# Risk Management Process Flowchart



# 2. Hazard Identification

- ✓ **Most important step!!**
- ✓ **Hazard can ONLY be controlled if they are identified.**
- ✓ **But…**

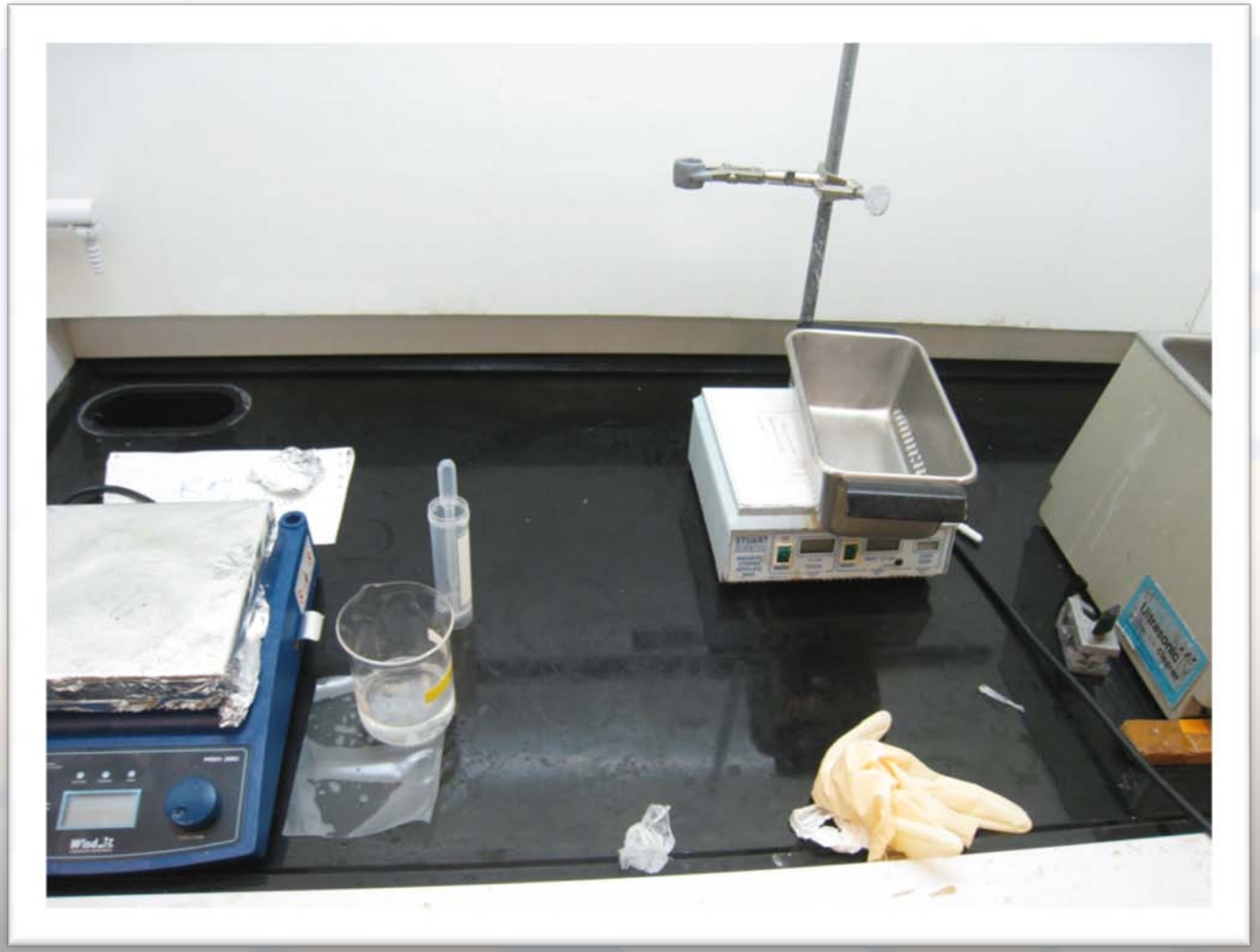
**What to identify?**

- o All the possible types of accidents, incidents and/or ill-health that can occur due to the hazard
- o Should consider:
  Routine/Non-routine Activities
  Normal/Abnormal/Emergency Conditions

# What are the Hazards in a laboratory?

- **Chemicals**
  (Flammability; Toxicity; Irritants…)
- **Biological**
  (Sharps…)
- **Radiation**
  (type of radiation; Lasers…)
- **Mechanical**
  (Sharp Edges; Falling weight…)
- **Physical & Environmental**
  (Weather; Noise; Lighting; Poor housekeeping)
- **Energy**
  (Electrical; Pressure; Fire…)
- **Human Factor**
  (Lack of concentration; Not fit for job; Attitude problem…)

# Hazard Identification: Exercise 1



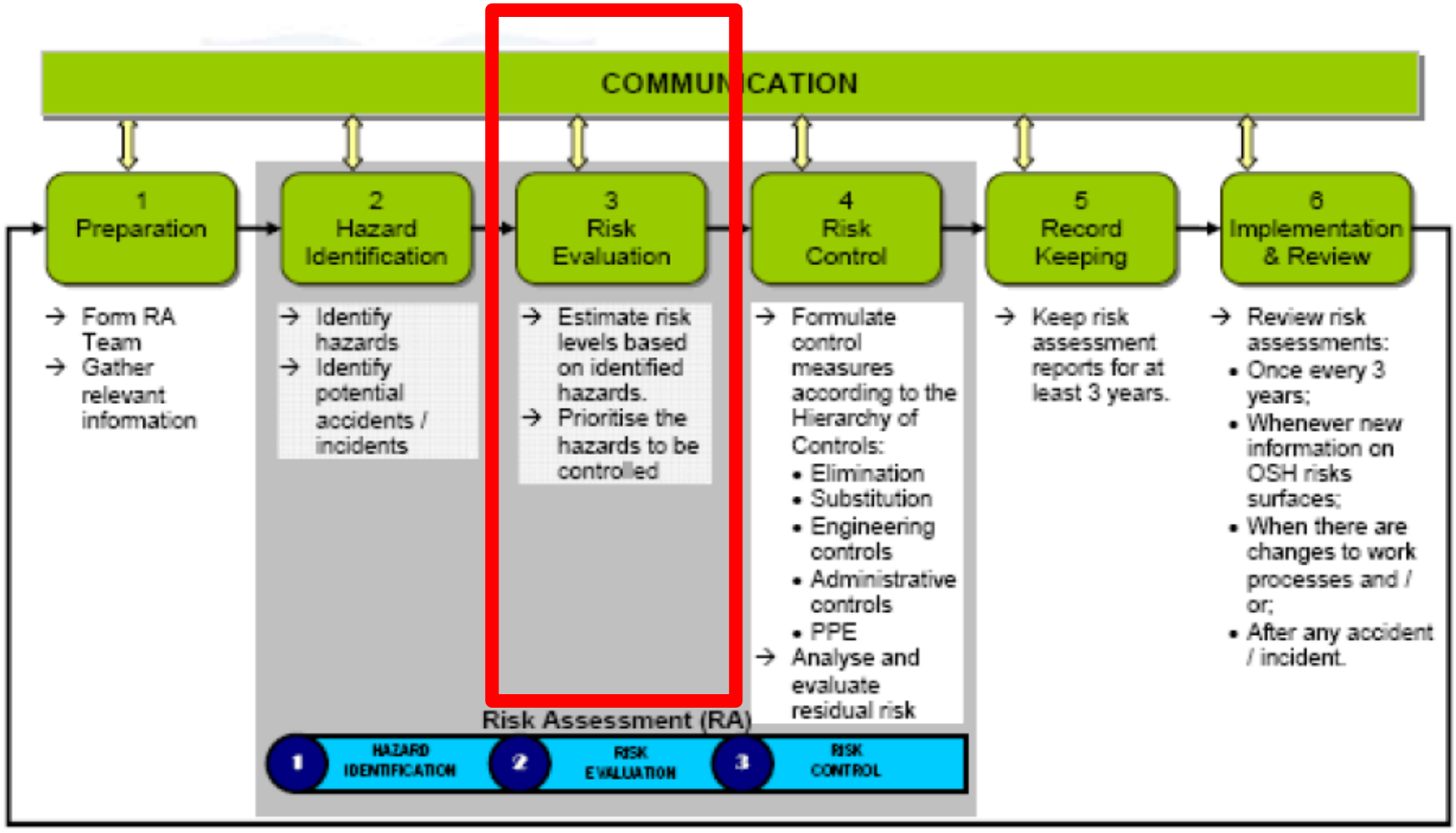
# Hazard Identification: Exercise 2

# Hazard Identification: Exercise 3

# Hazard Identification: Exercise 5

# Hazard Identification: Exercise 4

# Risk Management Process Flowchart



# 3. Risk Evaluation

1. Identifying the existing control measure (e.g. PPE…)
2. Assessing the potential severity
3. Determining the likelihood
4. Assessing the risk level

**Risk = Severity x Probability**

Vary from 1 to 9

< 3 -Acceptable Residual Risk - Low
3,4 -Consider Additional Risk Control - Med
>4 - Additional Risk control Required - High

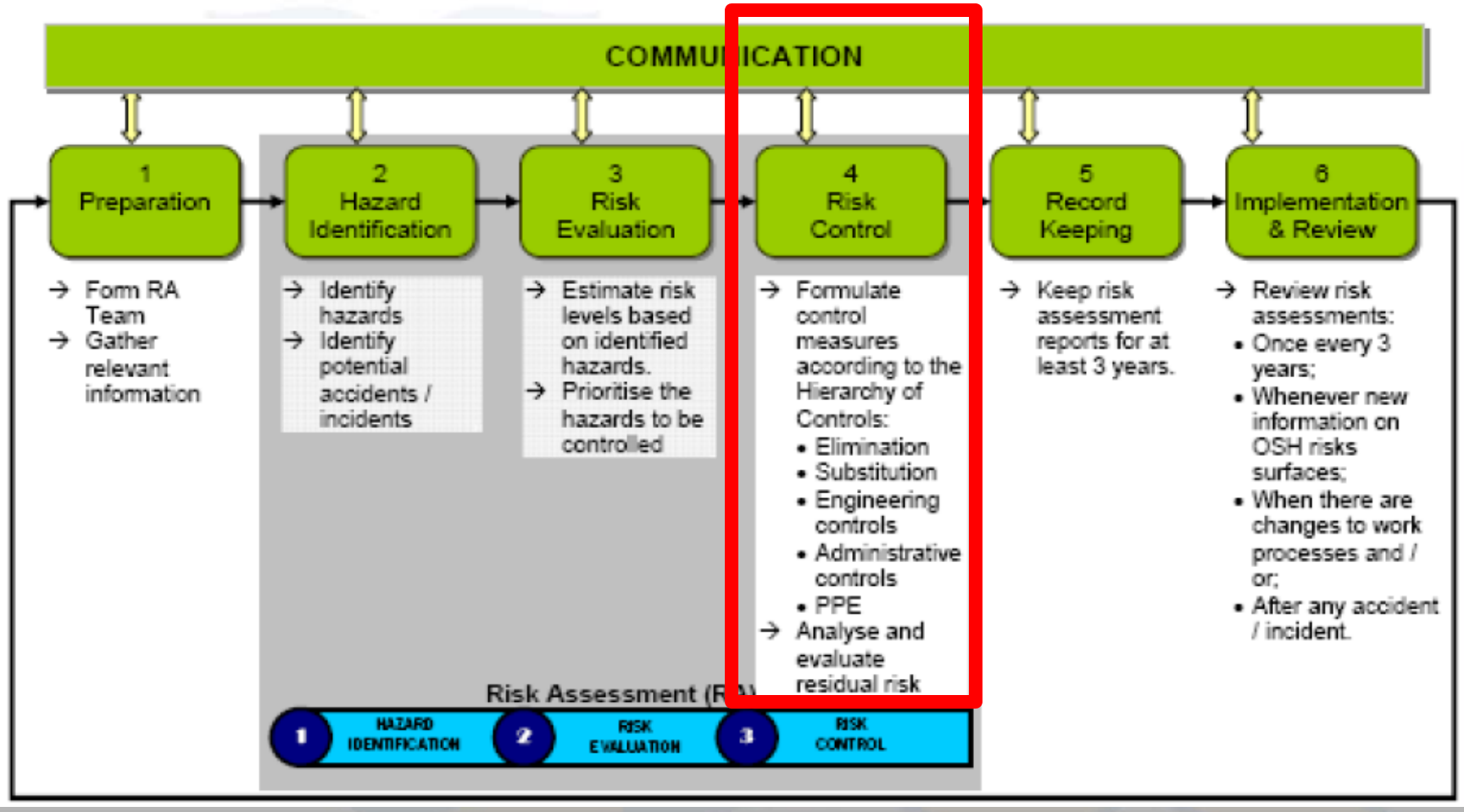
| | | Likelihood | | |
|---|---|---|---|---|
| | | Likely (3) | Possibly (2) | Unlikely (1) |
| Severity | Low (1) | 3 | 2 | 1 |
| | Medium (2) | 6 | 4 | 2 |
| | High (3) | 9 | 6 | 3 |

# Example

## Risk Assessment for Laser Alignment

| No | Description/Details of Steps in Activity | Hazards | Possible Accident / Ill Health & Persons-at-Risk | Existing Risk Control | S | L | RL |
|---|---|---|---|---|---|---|---|
| 1 | **Turn on Class IV laser system** | 1) Electrocution | Fatality; Serious injuries | 1) Period check of equipment | 3 | 1 | 3 |
| 2 | **Use laser beam block to block high power beam source** | 1)Eye injury | Permanent eye damage | 1) Laser curtain<br>2) Access controlled<br>3) PPE | 3 | 2 | 6 |
| | | 2)Skin burn | Skin sustain laser burn | 1) Laser curtain<br>2) Access controlled<br>3) PPE | 2 | 2 | 4 |
| 3 | **Perform alignment work at using the lowest power possible** | 1)Eye injury | Permanent eye damage | 1) Laser curtain<br>2) Access controlled<br>3) PPE | 3 | 2 | 6 |
| | | 2)Skin burn | Skin sustain laser burn | 1) Laser curtain<br>2) Access controlled<br>3) PPE | 2 | 2 | 4 |
| 4 | **Turn off Class IV laser system** | 1) Electrocution | Fatality; Serious injuries | 1) Period check of equipment | 3 | 1 | 3 |

# Risk Management Process Flowchart



# 4. Risk Control

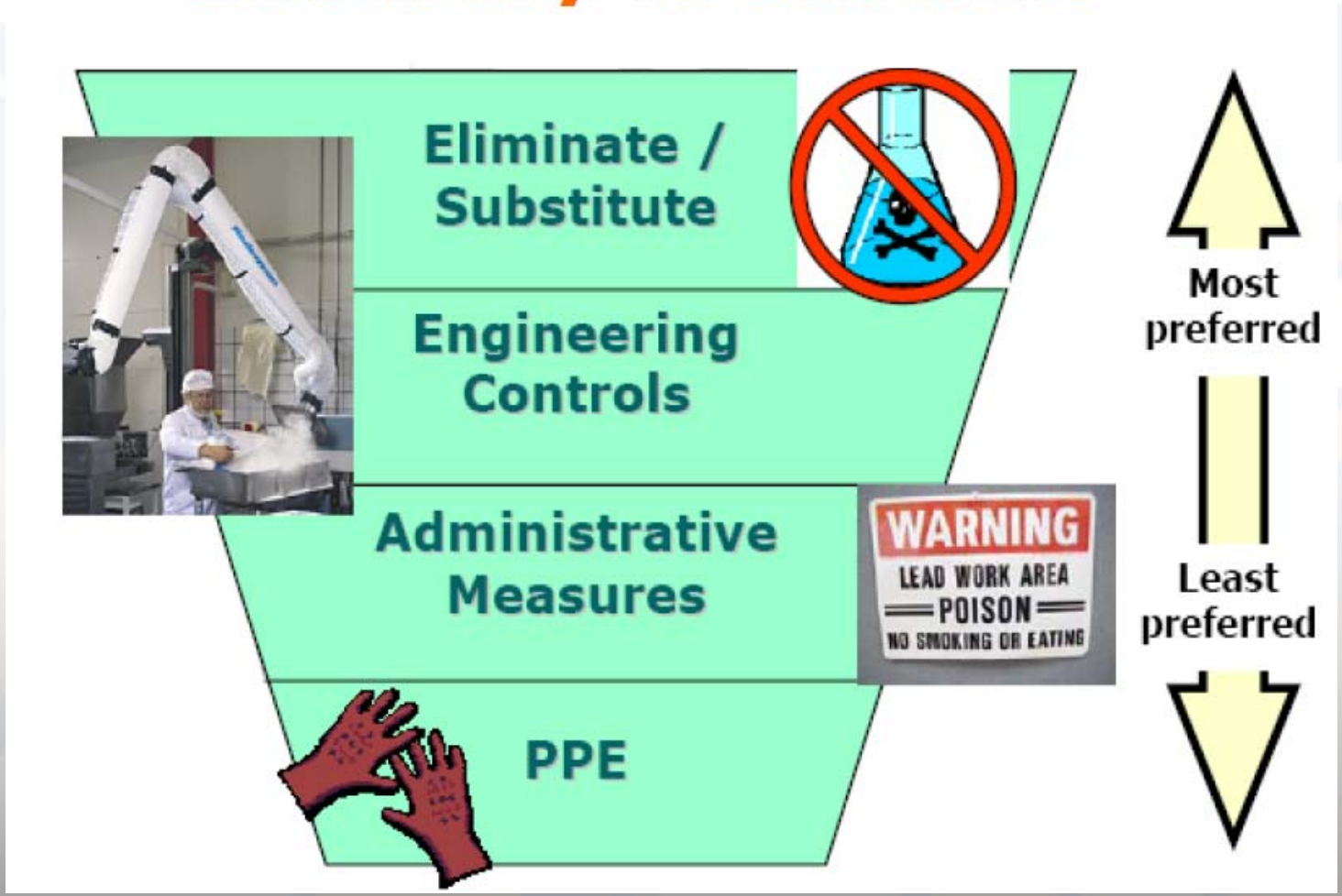
- Based on the risk level, select additional risk control measures to reduce the risk level to an acceptable level

## Acceptability of Risk

| Risk Level | Risk Acceptability | Recommended Actions |
|---|---|---|
| Low Risk <3 | Acceptable | No additional risk control measures may be needed.<br>However, frequent review may be needed to ensure that the risk level assigned is accurate and does not increase over time. |
| Medium Risk 3, 4 | Moderately acceptable | A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as is practicable within a defined time period.<br>Interim risk control measures, such as administrative controls, may be implemented.<br>Management attention is required. |
| High Risk >4 | Not acceptable | High Risk level must be reduced to at least Medium Risk before work commences.<br>There should not be any interim risk control measures and risk control measures should not be overly dependent on personal protective equipment or appliances. If need be, the hazard should be eliminated before work commences.<br>Immediate management intervention is required before work commences. |

# 4. Risk Control

## Hierarchy of Controls



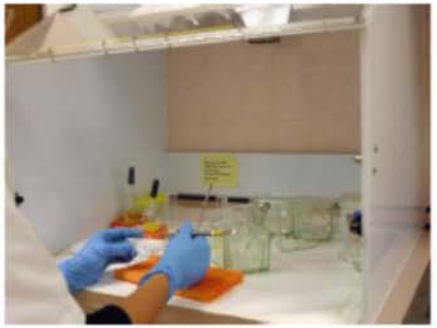
# Elimination/Substitution

- **Replaces the hazardous work process or material with a less hazardous one.**
- **Very effective, especially for hazardous substance.**
  - Replace solvent by water-based solution
  - Use a chemical of higher LD50 or PEL;
  - Micro-scale experiments / Computer simulation;
  - Substitute vapor heating by electric heating;
  - Use electronic control instead of pneumatic one;
  - Use a non-sparking hammer in a flammable atmosphere instead of a steel hammer;
  - Replace Benzene with Toluene;
  - Use a biological agent of lower risk group.

# Engineering Control

**Engineering controls are physical means that limit the hazard.**

- Biological Safety Cabinet, Local Exhaust ventilation, Fume cupboard, etc
- Centrifuges – safety cups
- Interlocks
- Safety Guards
- Primary barrier to prevent exposure by containment
- Electrical Leakage Circuit Breaker (ELCB)
- Safety Alarms




Special Rack is used

# Administrative Control

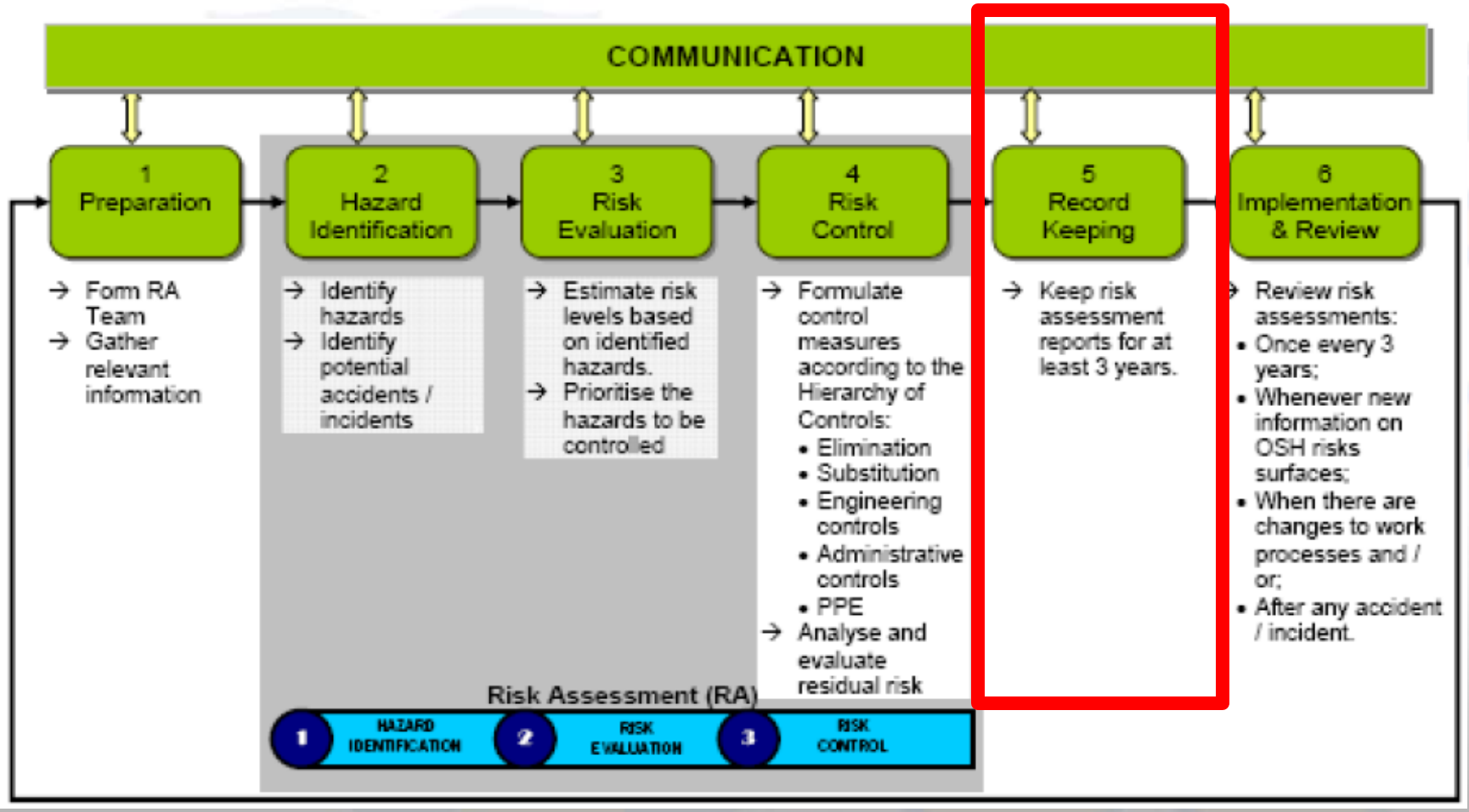
**Administrative controls reduce or eliminate exposure to a hazard by adherence to procedures or instructions.**

- Standard Operating Procedures, signage, etc
- Survey/Wipe tests – verification tests, hygiene monitoring
- Occupational Health – vaccinations/immunizations
- Training and Education
- Labeling
- Inspections and Audits
- Maintenance of Equipment

# Personal Protective Equipment (PPE)

- PPE may be required to reduce the risk of exposure of a staff or student by contact, inhalation or ingestion of an infectious agent, toxic substance, or radioactive material.
- Provide a barrier against hazards to protect laboratory workers from injury risk
- PPE is the last line of defense

# Risk Management Process Flowchart



# 5. Record Keeping

**Records should be concise and include the following information:**

1) Members of the Risk Assessment team,
2) Processed/procedures/tasks/activities involved,
3) Hazard identification and possible accident/ill-health and person at risk,
4) Existing risk control measures,
5) Risk level of each hazard,
6) Recommendation on additional risk control measures,
7) Persons responsible to implement the measures & completion date,
8) Signature, date & designation of persons conducting the Risk Assessment;
9) Signature, date & designation of management approving or endorsing the Risk Assessment.

# Risk Assessment Form

**Experiment-Based Risk Assessment Form**

Name of Department _____ Location of Lab _____

Name of Laboratory _____ Name of PI _____

Name of Researcher/LO _____ Name of Activity/Experiment _____

| No | Description/Details of Steps in Activity | Hazards | Possible Accident / Ill Health & Persons-at-Risk | Existing Risk Control (Mitigation) | Severity | Likelihood (Probability) | Risk Level | Additional Risk Control | Person Responsible | By (Date) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | | | |
| 2 | | | | | | | 0 | | | |
| 3 | | | | | | | 0 | | | |
| 4 | | | | | | | 0 | | | |
| 5 | | | | | | | 0 | | | |
| 6 | | | | | | | 0 | | | |
| 7 | | | | | | | 0 | | | |
| 8 | | | | | | | 0 | | | |
| 9 | | | | | | | 0 | | | |
| 10 | | | | | | | 0 | | | |

Conducted By _____

_____

_____

_____

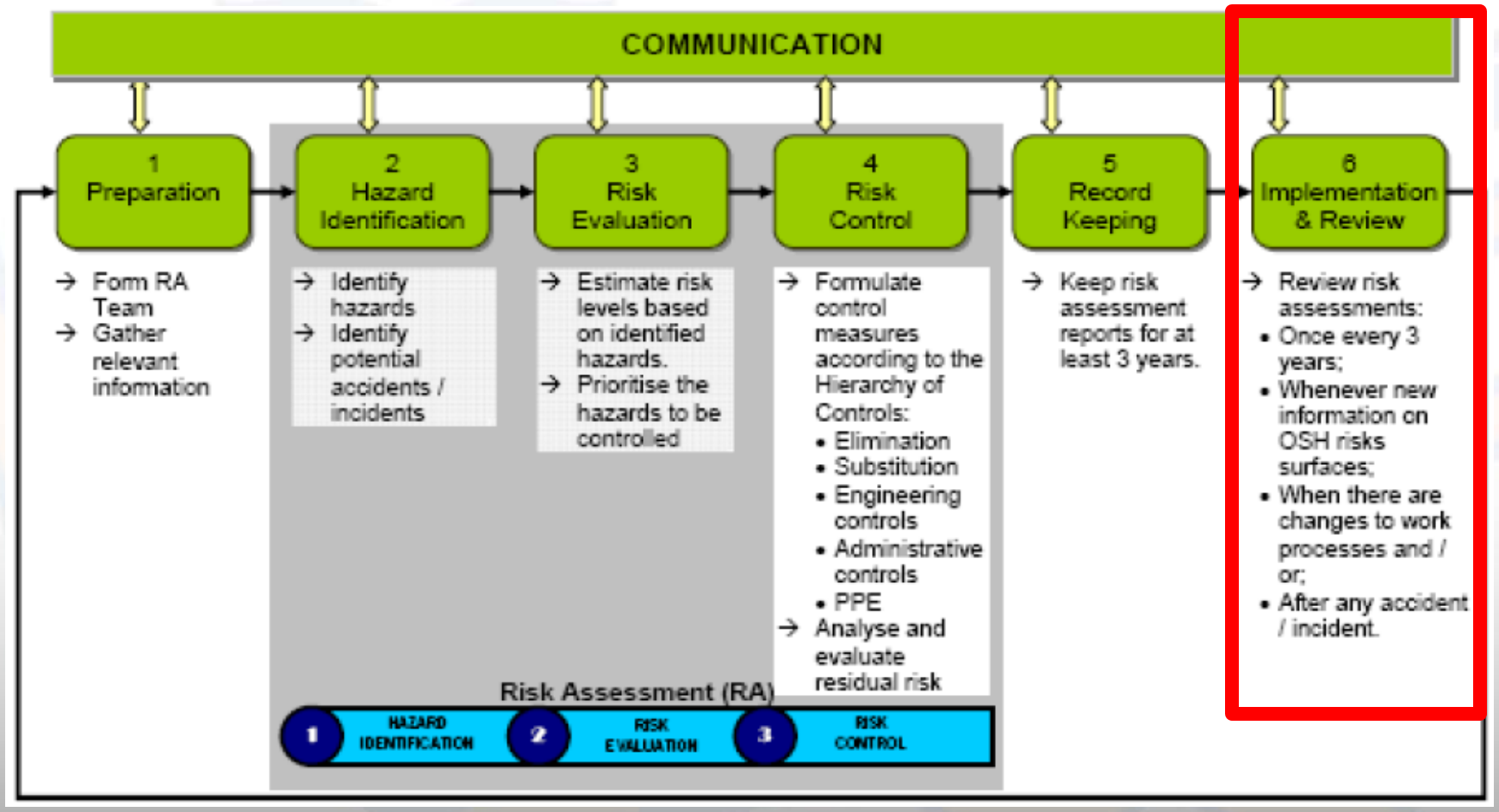
Approved By

Name _____

Signature _____

Approval date _____ Next Revision date _____ (Maximum 3 years)

# Risk Management Process Flowchart



# 6. Implementation & Review

Implementation:

- ✓ RA should be approved and endorsed by PI
- ✓ PI should implement the recommended risk control measures without undue delay, as far as it is practicable
- ✓ Train the affected staff/students

Mandatory Review:

- ✓ Review & Revise once in every 3years
- ✓ After any accident or serious incident occurs
- ✓ When there are changes in the laboratory (Management of Change)

# Management of Change

- New equipment/materials/chemicals/agents
- Parameters are changed
  e.g Δ Equipment setting, Δ concentration/volume of chemicals
- New/revised processes/procedures/working practices are implemented
- New personnel join in / Δ competency
- Labs relocated
- Additional risk control measures are introduced
- Risk control measures are changed/revised

# Risk Assessment Assignment

- Use the RA form: http://www.nus.edu.sg/osh/training/download.htm
- Please submit softcopy (for CIBA website) and hardcopy (endorsed by PI) by **12 April 2010**
- Never a ONE man show!!

2.

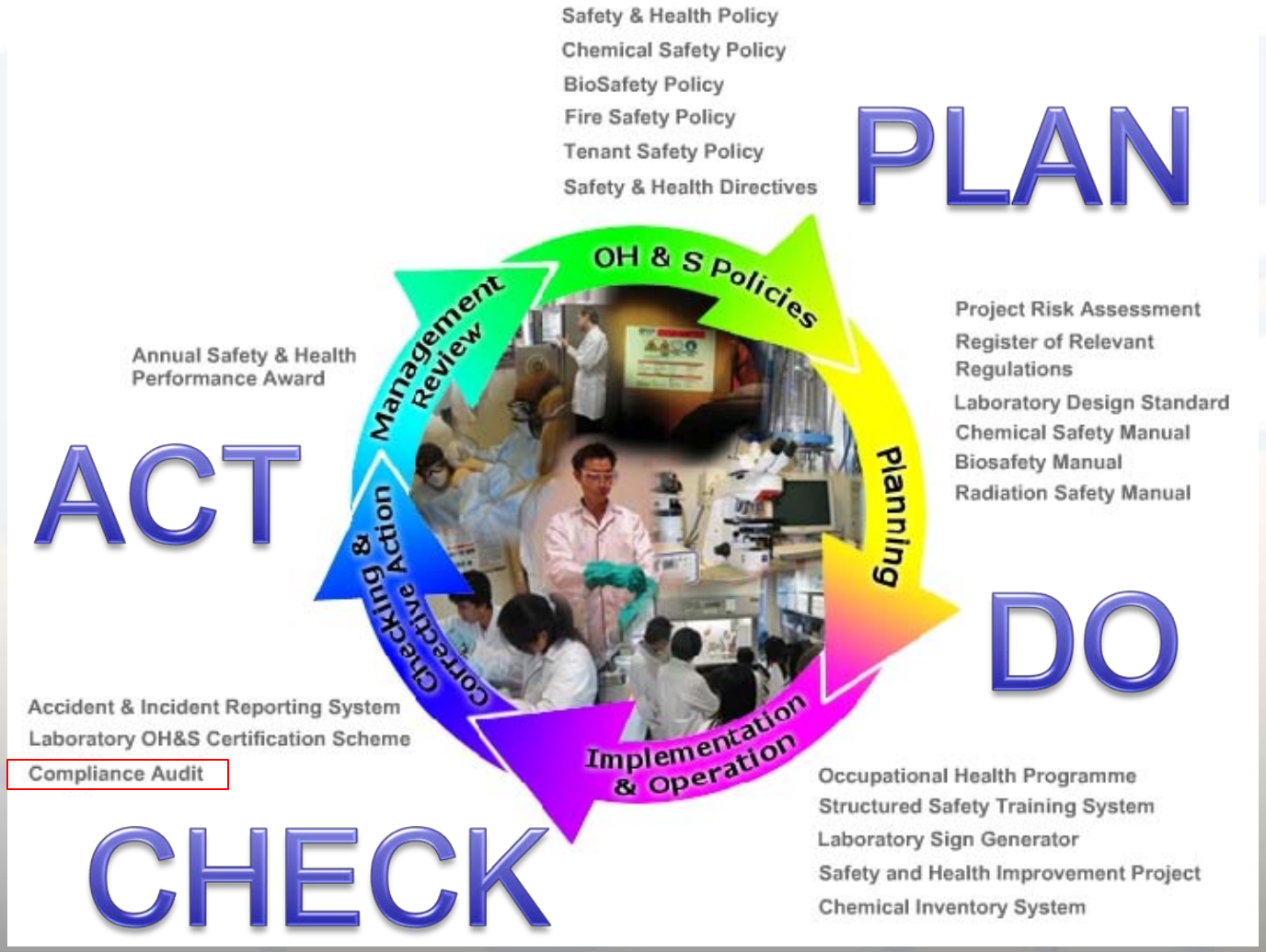
# SAFETY MANAGEMENT SYSTEM

# What is Safety Management System?

SMS has been defined as:
...a businesslike approach to safety.
It is a systematic, explicit and comprehensive process for managing safety risks.
As with all management systems, a safety management system provides for goal setting, planning, and measuring performance.
A safety management system is woven into the fabric of an organization. It becomes part of the culture, the way people do their jobs.

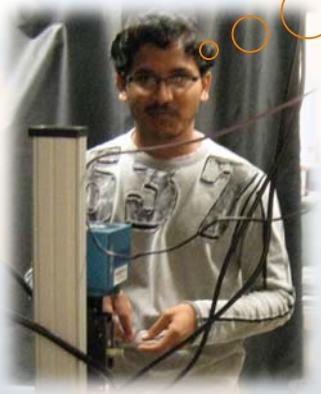
…adapted from wikipedia

# What is Safety Management System?



# Safety Audit

- User's mindset….





- Auditor
  - ✓ helps us to improve
  - ✓ makes sure our existing controls are effective

# Safety Audit Requirements

1. General Requirements
2. Commitment to OH & S system
3. Resource Roles & Responsibilities
4. Planning – Hazard Identification, RA, Controls
5. Legal & other requirements
6. Competence, Training & Awareness
7. Communication, Participation & Consultation
8. Objectives & Programmes
9. Documentation & Control
10. Operational Control
11. Emergency Preparedness & Response
12. Performance Measurement & Monitoring
13. Incident Investigation & Preventive Action
14. Internal Audit

# Safety Audit Requirements

1. General Requirements
   - ❑ Evidence of maintenance of implemented system
   - ❑ Previous audit report, follow actions and closure of findings
2. Commitment to OH&S system
   - ❑ Policy documents- changes
   - ❑ Continual Improvement
3. Resource, Roles and Responsibilities
   - ❑ Defined R&R
   - ❑ Availability of resources
4. Planning – Hazard Identification, RA, Control
   - ❑ Evidence of proper RA
   - ❑ Review of documents

# Safety Audit Requirements

5. Legal & other requirements
   - ❑ Legal register , Licence– identify applicable requirements
   - ❑ Communication of requirements to all
6. Competence, training & awareness
   - ❑ Orientation training, records, check list
   - ❑ Evidence of attendance & certificates
   - ❑ Effectiveness of training
7. Communication, participation & consultation
   - ❑ External/Internal communication, updates
   - ❑ New legal requirements
8. Objectives & Programme(s)
   - ❑ Participation in OSHE, Faculty, department, CIBA safety activities

# Safety Audit Requirements

9. Documentation & Control
   - RA, SOP, Inventory records, maintenance records
10. Operational Control
   - Verified lab practices
   - Available of PPE, etc
11. Emergency preparedness & response
   - First Aid Box, First Aider
12. Performance Measurement & Monitoring
   - Effectiveness of controls
   - Evaluation of compliance
13. Incident Investigation & Preventive action
   - Procedure, reports & follow-ups
14. Internal Audit

3.

# UPDATES

# 10 Things You Need to Know About *Safety* in NUS

- ✓ Familiarize yourself with NUS Policies and SOPs
  Develop lab specific SOPs and safety procedures
  http://www.nus.edu.sg/osh/policies.htm
- ✓ Do Risk Assessment for all research grant based projects and submit to OSHE for approval. Risk assessment form is available at:
  http://www.nus.edu.sg/osh/programmes/ra_submission.htm
- ✓ Review and implement SOP on laboratory commissioning
  http://www.nus.edu.sg/osh/sop.htm
- ✓ Send RA/RF/LO for relevant in-house trainings (i.e. biological safety, chemical safety, fire safety and radiation safety)
  https://wws.nus.edu.sg/staff/ohr/training/trgdirectory/CY08dir_worksafety.htm
- ✓ Mandatory vaccination for Life Science research: Hepatitis B (Blood Work), Tetanus (Animal Work)
  http://www.nus.edu.sg/osh/programmes/occup_health/intro.htm
- ✓ Put up lab sign at the door of laboratory
  https://wws.nus.edu.sg/osh/labsign/default.aspx
- ✓ Ensure first aid box is available
  http://www.nus.edu.sg/osh/manuals/cat/firstaid.pdf
- ✓ Ensure PF&M quantities within the permissible limit
  https://wws.nus.edu.sg/osh/resources/fms.htm
- ✓ Report all Accidents and Incidents to OSHE via AIRS
  http://nus.edu.sg/osh/airs.htm
- ✓ Contact Faculty Safety and Health Officers for more information
  http://www.nus.edu.sg/osh/aboutus/staff.htm

*Emergency Information*

*OSHE (during office hours): 6516 6863* *Campus Security (after office hours): 6874 1616*

# To-do-list:

- ✓ Updates on Management of change :
  New equipments/experiments
- ✓ Review and implement Risk Assessments on laboratory commissioning
- ✓ Review and implement SOPs on laboratory commissioning
- ✓ Safety trainings are recommended for related staffs/students:
  By OSHE: Biological, chemical, radiation, non-radiation, fire, first aid etc…
  * Online registrations available at
  http://www.nus.edu.sg/osh/training/schedule2010.htm
- ✓ Be Familiarize yourself and students with NUS & Department's Policies (just before safety audit)
  http://www.nus.edu.sg/osh/policies.htm
  http://www.physics.nus.edu.sg/corporate/safety/safetypolicy.html