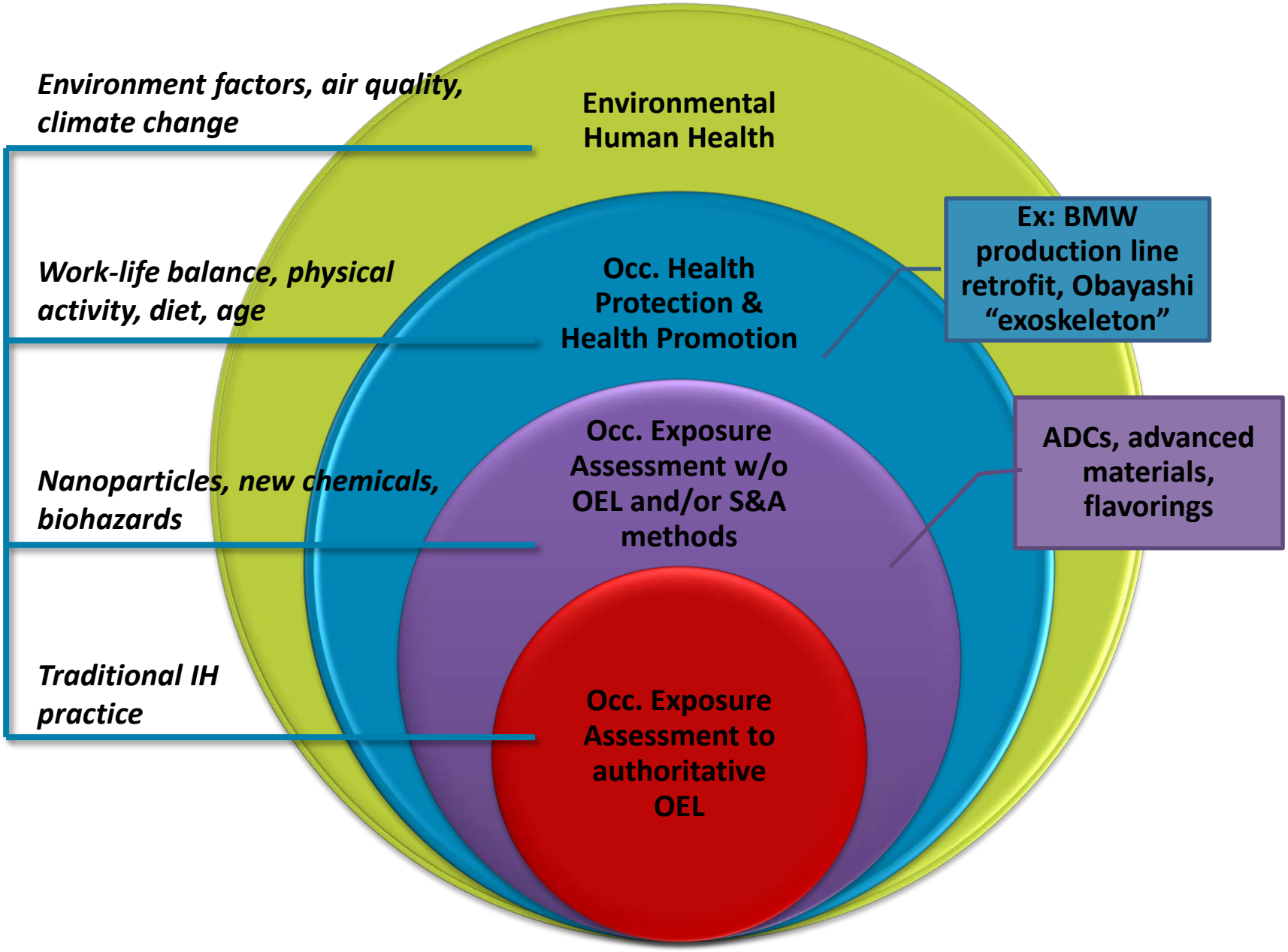
YPSW Section 41st Annual Meeting, Jan 21-22, 2016

# *Health Hazard Banding: The Newest Chapter in the Exposure Assessment Strategy Manual*

*Donna S. Heidel, CIH, FAIHA™*
*Industrial Hygiene Practice Leader*

Move Forward with Confidence

BUREAU VERITAS

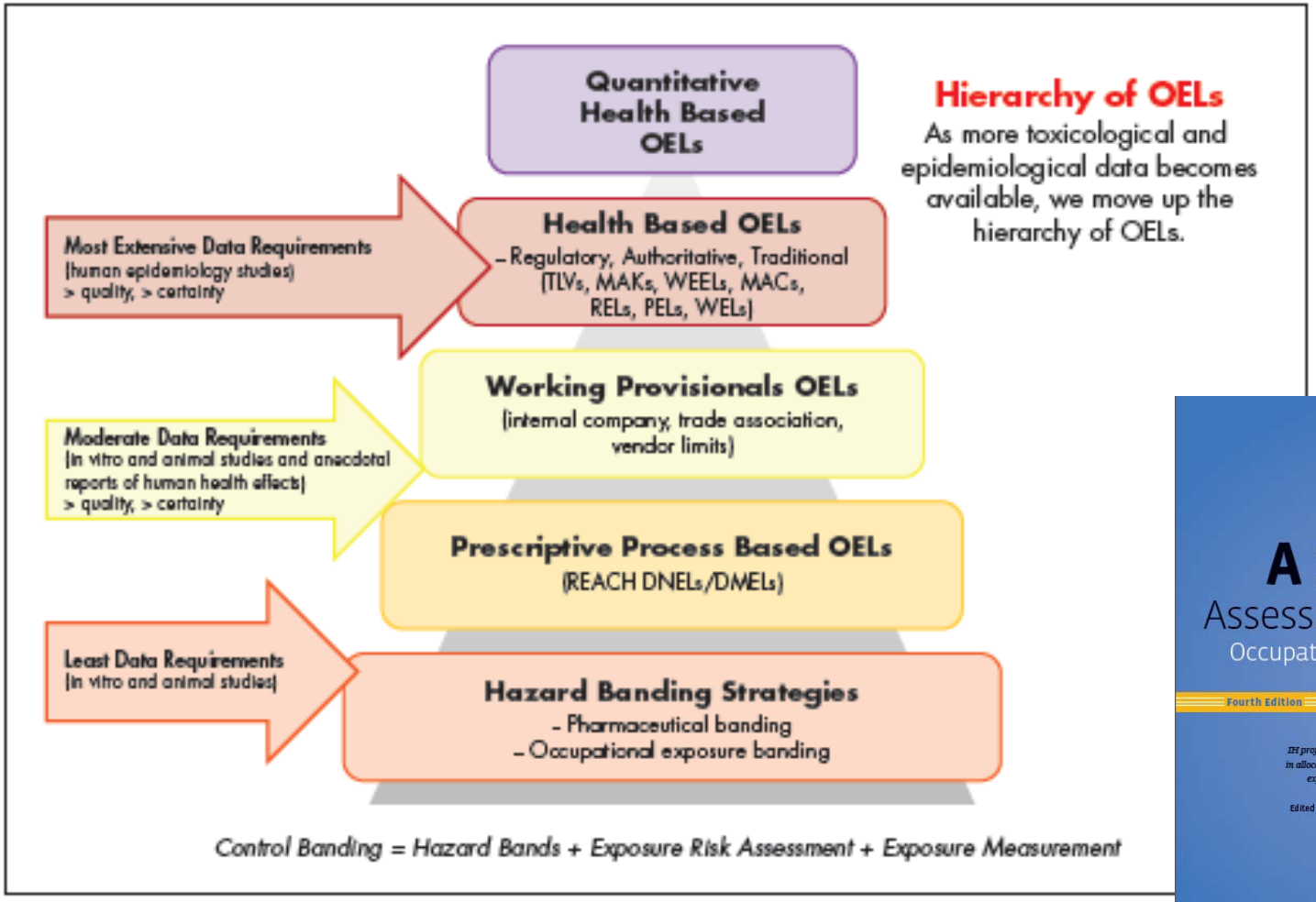


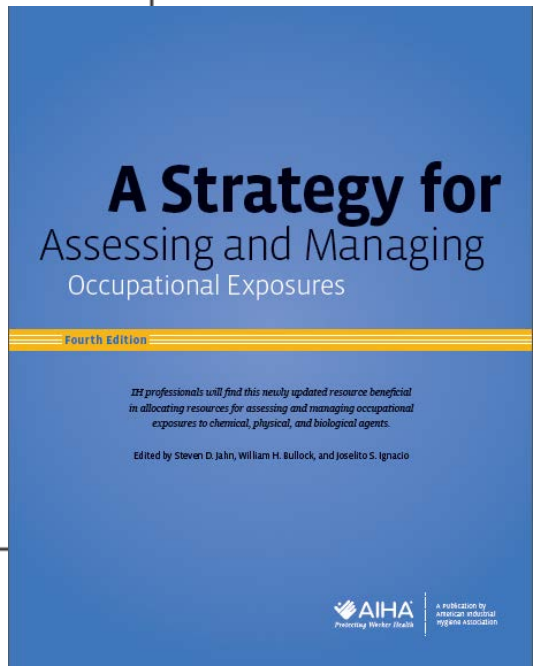

**The World of Occupational Health Risk Evaluation**

# Exposure Guideline Disharmony?

n-Hexane Exposure Guidelines

| Type of Limit | Value (ppm) |
|---|---|
| DNEL – Derived No Effect Level | 4.7 |
| IOELV - Indicative Occupational Exposure Limit Values | 20 |
| TLV® – Threshold Limit Value | 50 |
| AEGL2 – Acute Exposure Guideline Level (2) | 3300 (30-min to 8-hr) |
| IDLH – Immediately Dangerous to Life and Health | 1100 |
| RFC – Inhalation Reference Concentration | 0.2 |

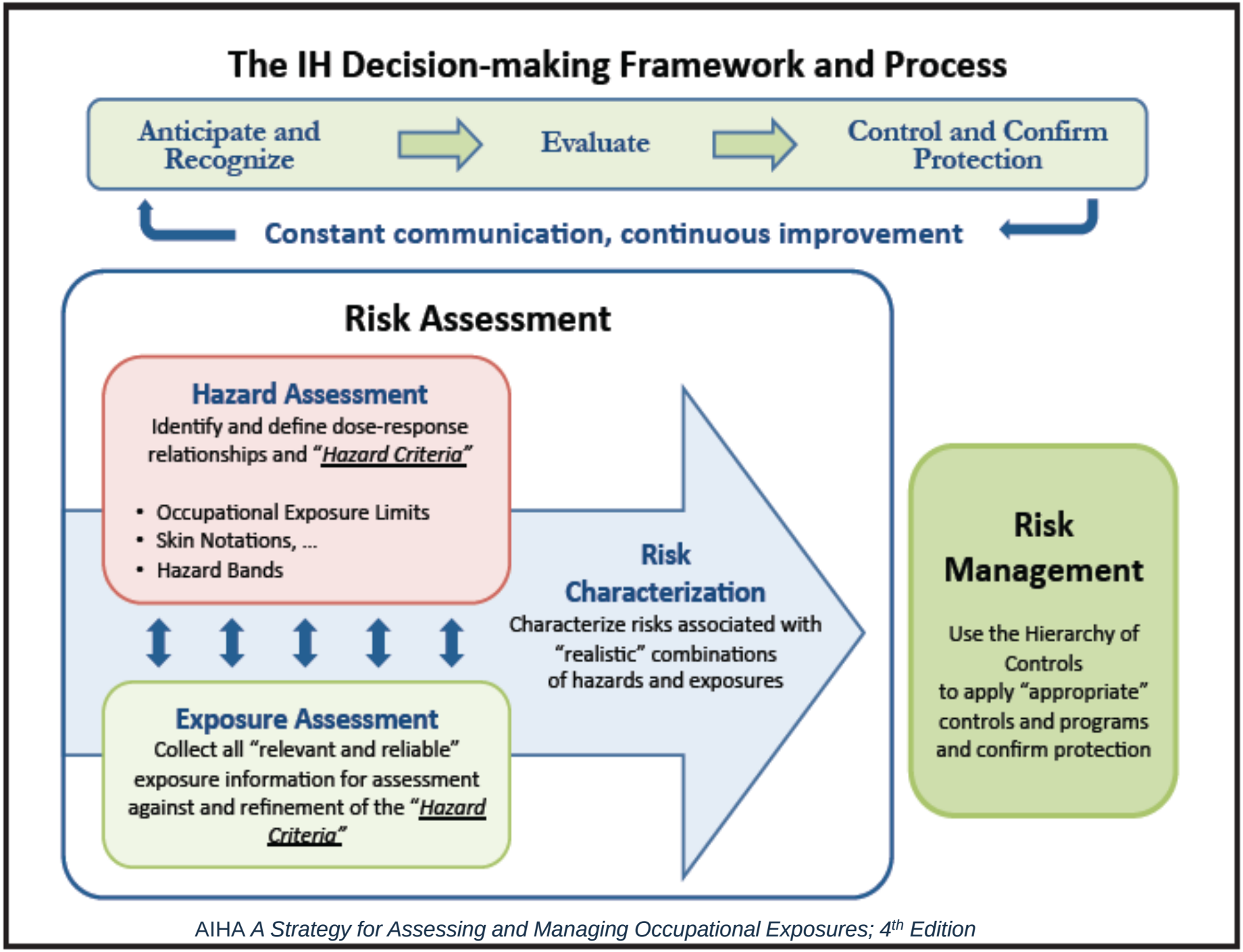

Quantitative Health Based OELs
Hierarchy of OELs
As more toxicological and epidemiological data becomes available, we move up the hierarchy of OELs.
Most Extensive Data Requirements
(human epidemiology studies)
> quality, > certainty
Health Based OELs
– Regulatory, Authoritative, Traditional
(TLVs, MAKs, WEELs, MACs, RELs, PELs, WELs)
Working Provisionals OELs
(internal company, trade association, vendor limits)
Moderate Data Requirements
(in vitro and animal studies and anecdotal reports of human health effects)
> quality, > certainty
Prescriptive Process Based OELs
(REACH DNELs/DMELs)
Least Data Requirements
(in vitro and animal studies)
Hazard Banding Strategies
– Pharmaceutical banding
– Occupational exposure banding
Control Banding = Hazard Bands + Exposure Risk Assessment + Exposure Measurement


A Strategy for
Assessing and Managing
Occupational Exposures
Fourth Edition
IH professionals will find this newly updated resource beneficial in allocating resources for assessing and managing occupational exposures to chemical, physical, and biological agents.
Edited by Steven D. Jahn, William H. Bullock, and Joselito S. Ignacio
AIHA

# AIHA Strategic Direction and Content Priorities

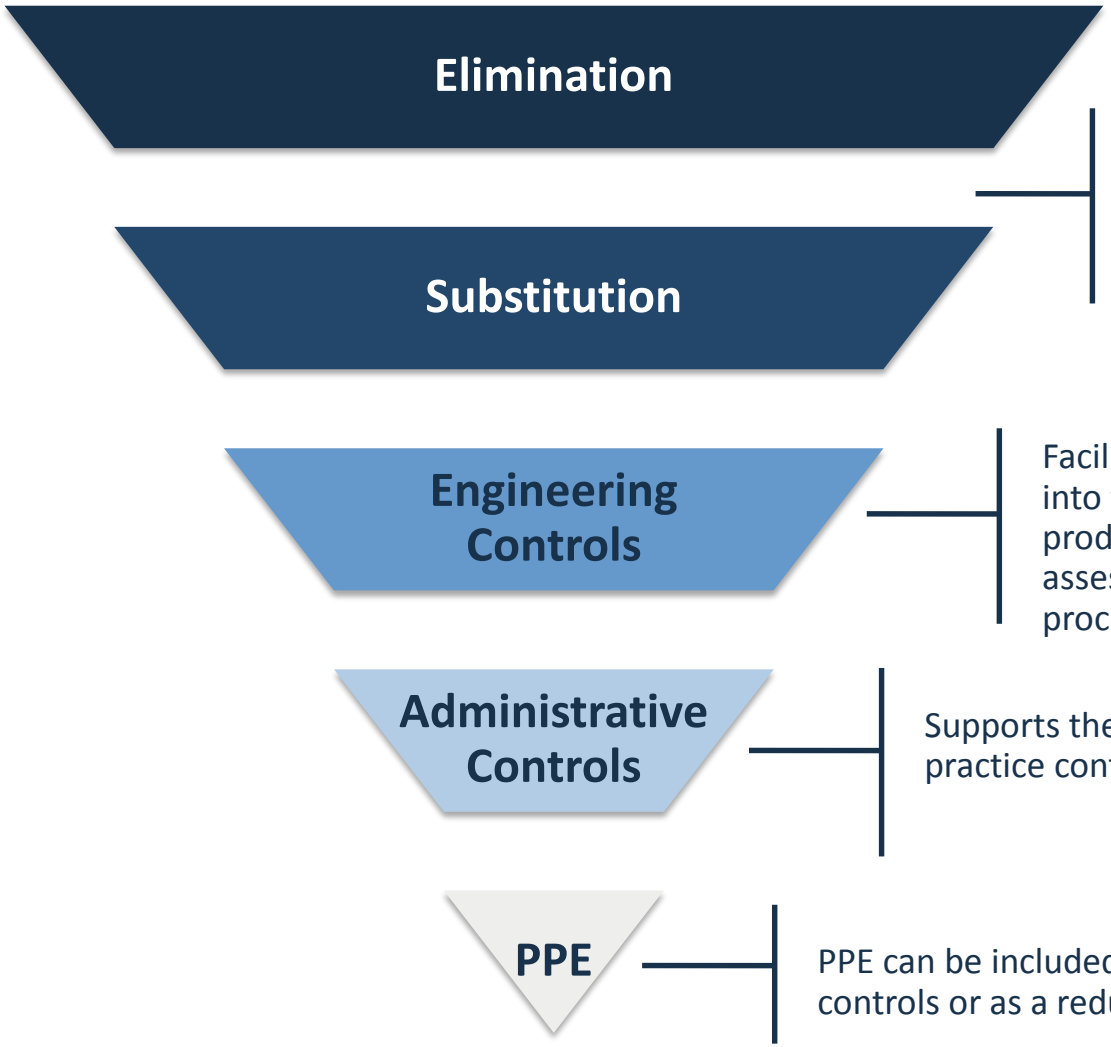
- **Vision:** Elimination of Workplace Illnesses
- **Mission**: Creating Knowledge to Protect Worker Health
- **Content Priorities:**
  - **Exposure Banding/OEL Process**
  - Sensor Technologies
  - Emerging Markets/Global IH/OH Standard of Care
  - **IH Value Strategy/Business Case Development**
  - **Changing Workforce Demographics/Environment**
  - Big Data/Data Management and Interpretation

AIHA®
*Protecting Worker Health*




AIHA *A Strategy for Assessing and Managing Occupational Exposures; 4th Edition*

# Enables Hierarchy of Controls



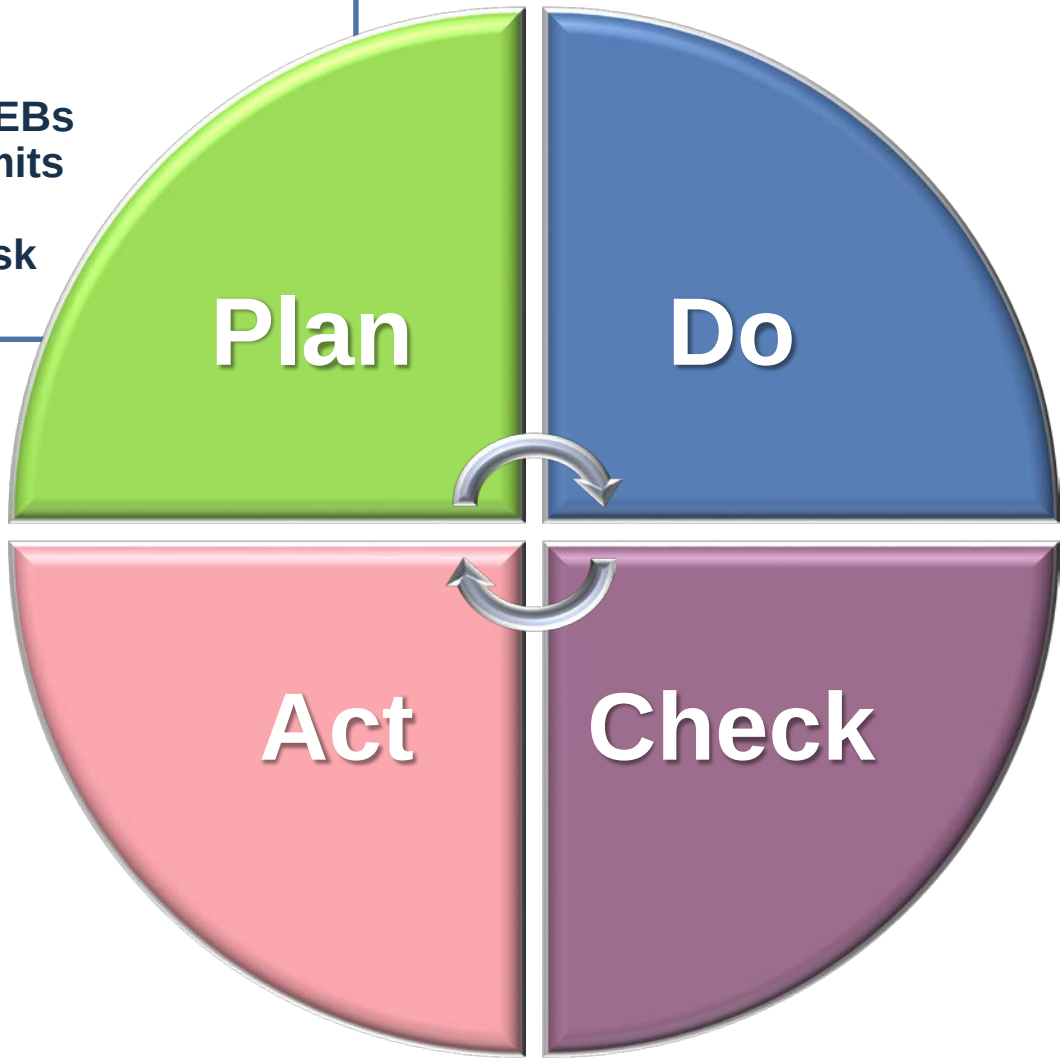
# Management Systems Approach

**Establish OSH policy**

**Allocate resources**

**Identify hazards. OEBs and/or exposure limits**

**Assess potential risk from exposure**



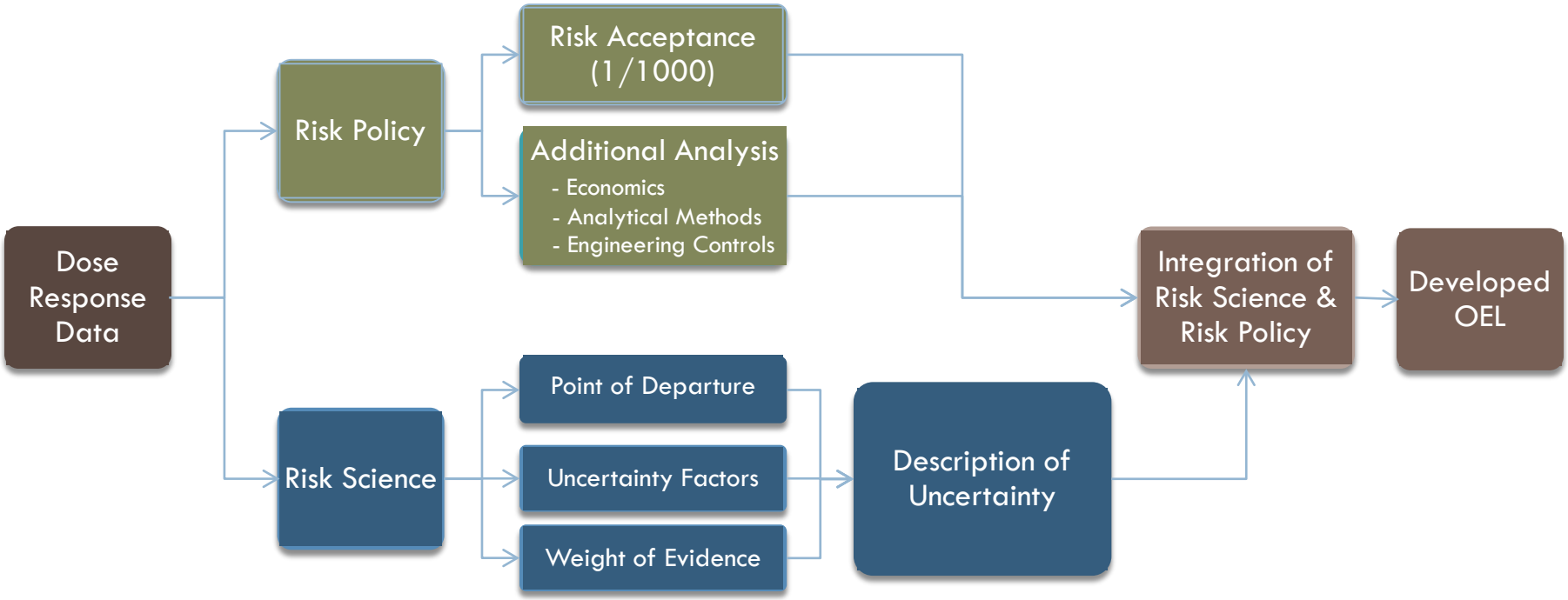
# Plan

- Establish policy
  - Policy addresses chemical agents without authoritative OELs
  - Example:  Columbia University *http://www.ehs.columbia.edu/SafeUseOfChemicals.html*

***"…to protect laboratory workers from adverse health effect …regardless of what hazardous substances are used."***

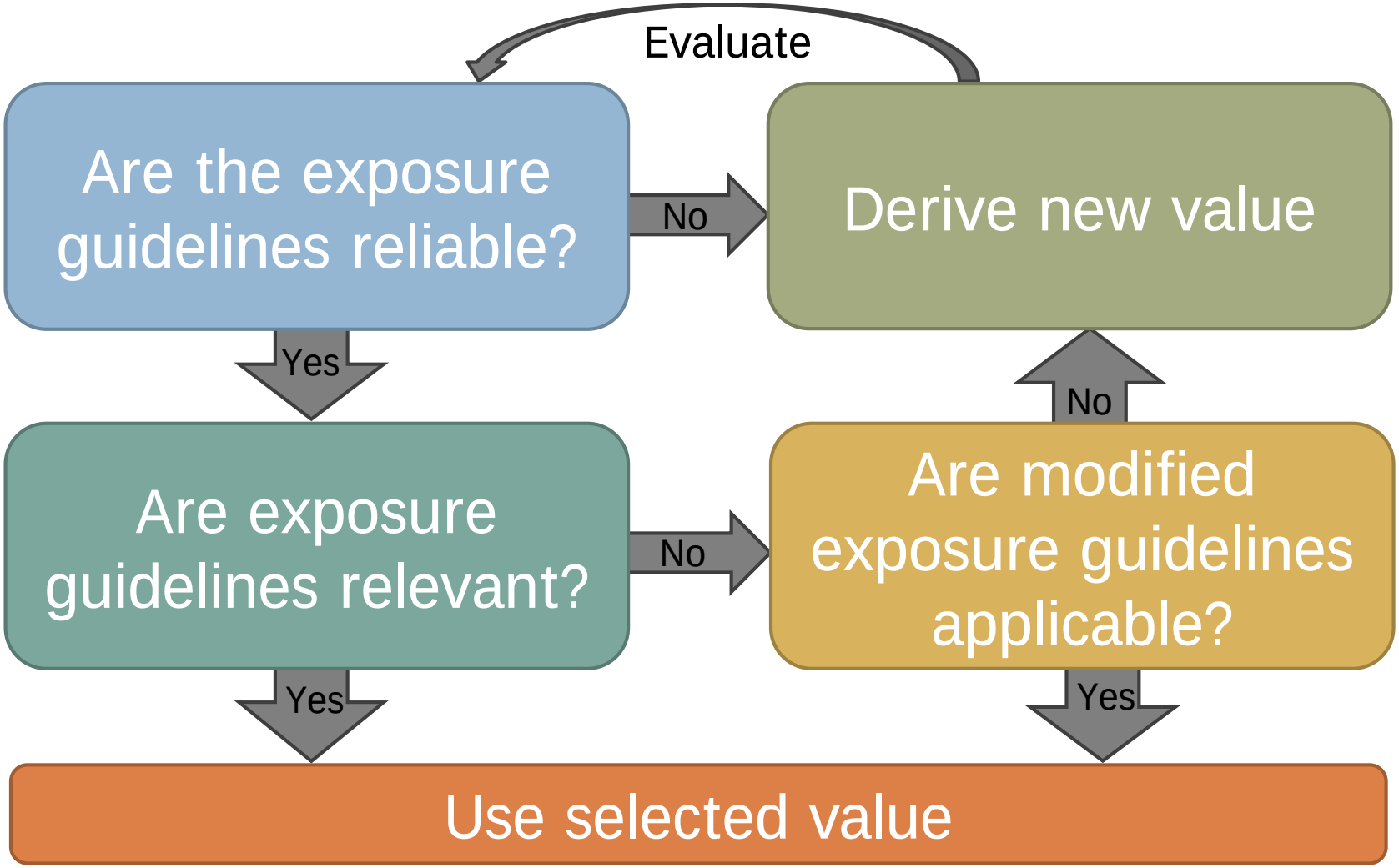
- Allocate resources
  - OEB Tier 1; IH
  - OEB Tiers 2 & 3; IH with specialized expertise, occupational toxicologist
  - Financial resources
- Identify hazards and exposure limits or bands
  - Ex. NIOSH OEB Guidance Document (pending) and AIHA BoK
- Assess potential risk from exposure

# Mapping the Differences in OELs




Andrew Maier, PhD, DABT, CIH

# Need for a Systematic Process




Andrew Maier, PhD, DABT, CIH

# Assessing Potential Exposure Risks

# Selecting the Appropriate Controls

# Management Systems Approach

Establish OSH policy

Allocate resources

Identify hazards and exposure limits

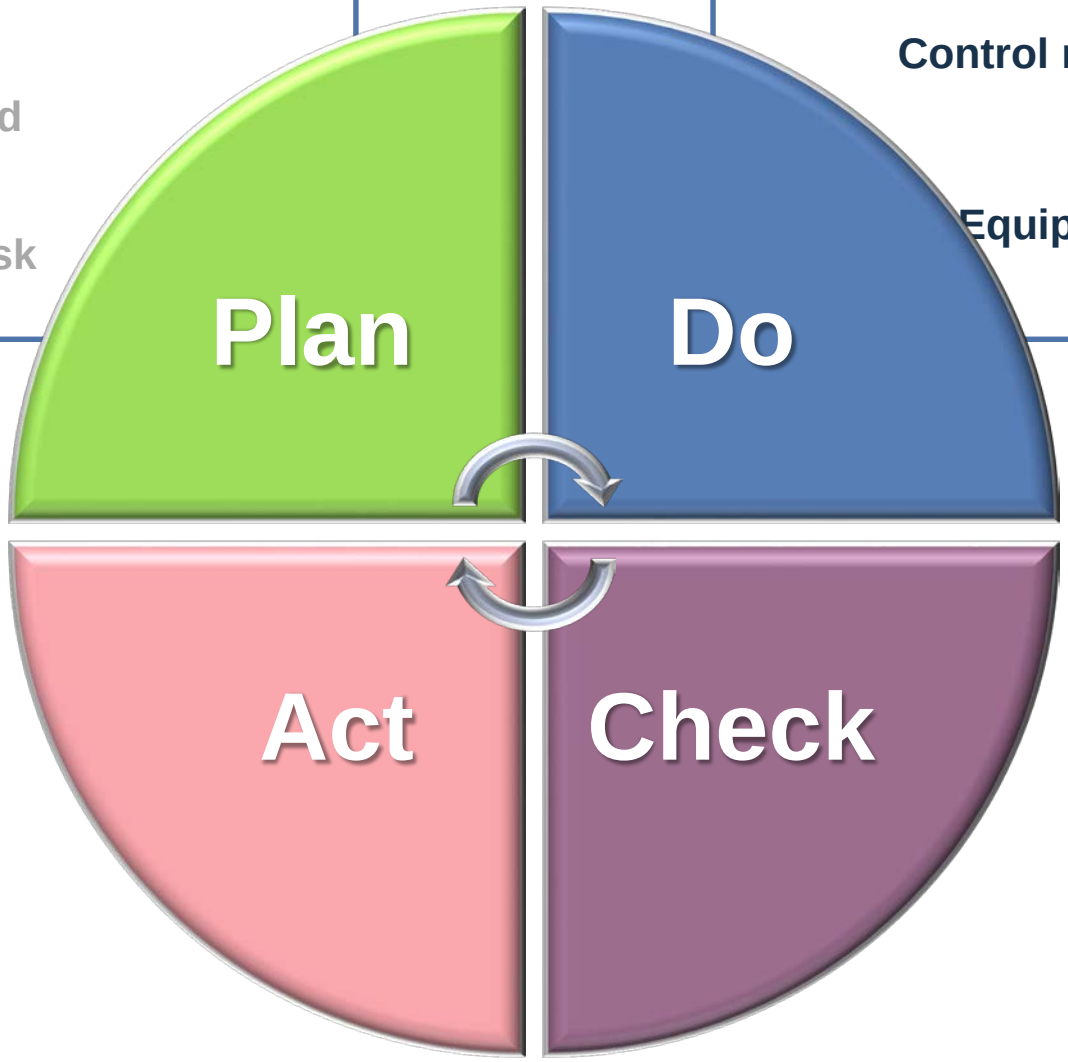
Assess potential risk from exposure

Eliminate and substitute hazards

Control residual exposures

Equipment retrofit

Equipment procurement



# Do

- Eliminate and substitute hazards
  - Tier 1 provides a rapid and defensible method
  - GHS Hazard Categories that prompt “D” and “E” OEBs indicate the potential for irreversible health effects at relatively low doses

| Hazard Class | Hazard Category | | | |
|---|---|---|---|---|
| Acute Toxicity | 1 | 2 | 3 | 4 |
| Skin Corrosion/Irritation | 1A | 1B | 1C | 2 |
| Serious Eye Damage/ Eye Irritation | 1 | 2A | 2B | |
| Respiratory or Skin Sensitization | 1 | | | |
| Germ Cell Mutagenicity | 1A | 1B | 2 | |
| Carcinogenicity | 1A | 1B | 2 | |
| Reproductive Toxicity | 1A | 1B | 2 | Lactation |
| Specific Target Organ Toxicity (STOT) – Repeated Exposure | 1 | 2 | | |

# Qualitative Example: dimethyl dicarbonate
## (CAS 4525-33-1)

**Signal word: Danger**

**Acute toxicity via inhalation (Acute Toxicity 2)**

**Corrosive to skin (Skin Corr. 1B)**

**OEB: Band E**

**No authoritative OEL**

**No sampling or analytical method**

**No sensor technology**

**Well within our IH capabilities!**

- ✓ Consider substitution
- ✓ Closed transfers
- ✓ Ventilation known to control exposures to ≤ 0.1 PPM
- ✓ Skin and eye protection, RPE
- ✓ Access to safety shower and eyewash
- ✓ Life cycle assessment; from receipt to ultimate disposal

# Including ALL Chemical Hazards into the Design Process

| Stage | Activities |
|---|---|
| Conceptual Design | Establish IH goals, identify IH hazards and associated regulations and standards. Identify relevant OELs and/or agents of concern. |
| Preliminary Design | Eliminate hazards, if possible. Substitute less hazardous agents / processes, and establish risk minimization targets for remaining hazards (OELs and OEBs). Qualitative exposure assessment; develop control alternatives. |
| Detailed Design | Select controls. Conduct Process Hazard Reviews. |
| Procurement | Develop specifications and include in procurements. Develop test protocols for factory acceptance testing and commissioning. |
| Construction | Construction site safety and contractor safety. |
| Commissioning | Factory acceptance and operational qualification testing. SOPs. Exposure assessments. Mgmt. of residual risks. |
| Start Up and Occupancy | Education. Management of change. Modification of SOPs. |

# Management Systems Approach

Establish OSH policy

Allocate resources

Identify hazards and exposure limits

Assess potential risk from exposure


Eliminate and substitute hazards

Control residual exposures

Equipment retrofit

Equipment procurement

Exposure control verification

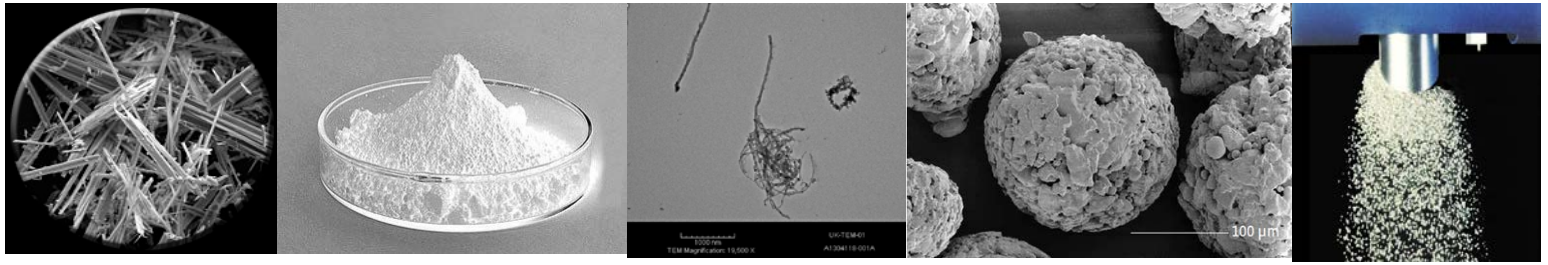
Develop SOPs

Train workers

Health surveillance

# Check

- Exposure control verification
  - Historical data
  - Modeling
  - Surrogates must consider
    - Physical Form
    - Morphology
    - Limit of Detection
    - Particle Size
    - Hygroscopy
    - Flowability




- Exposure control verification using surrogates must replicate the work environment, including work practices and PPE, that the workers will use

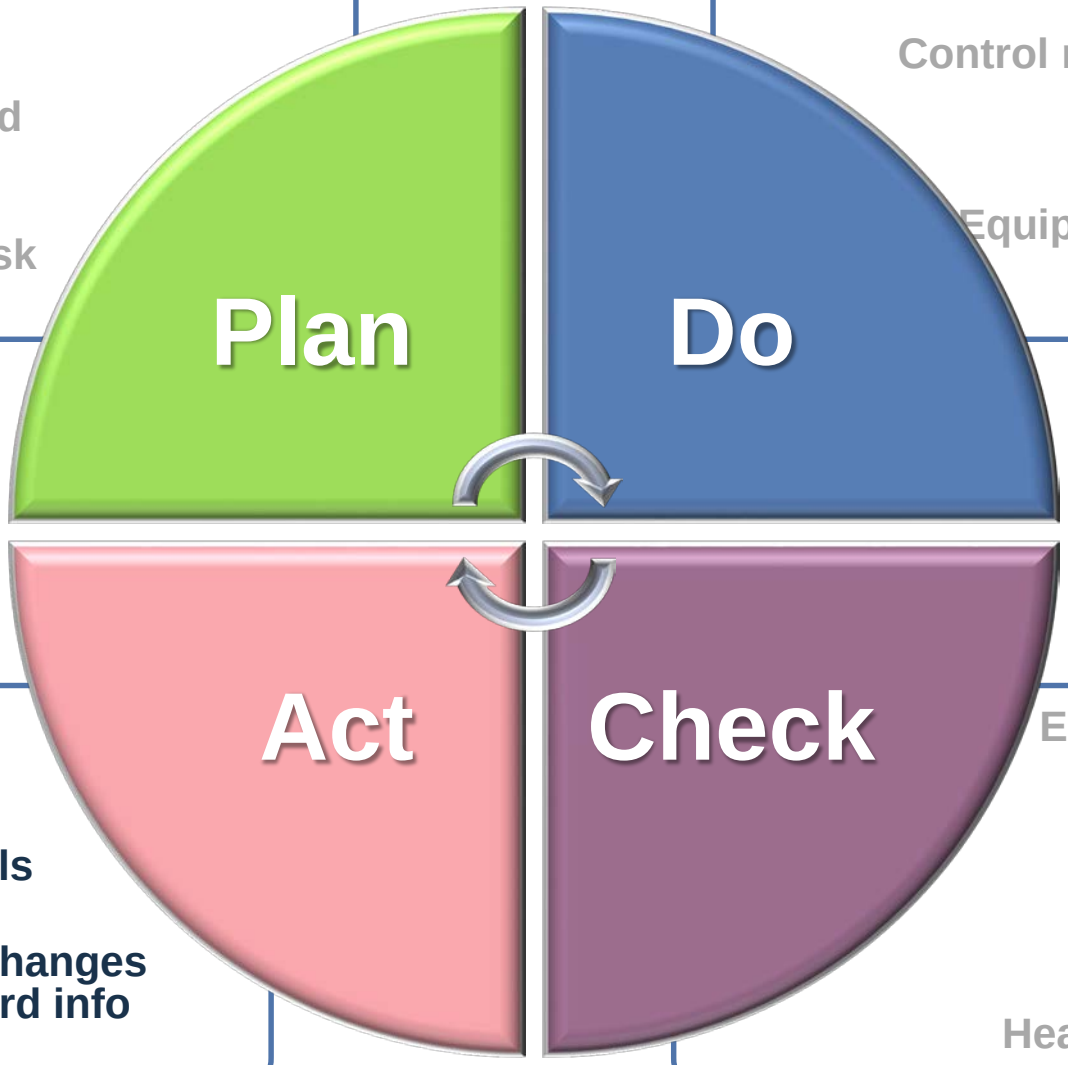
# Management Systems Approach

Establish OSH policy

Allocate resources

Identify hazards and exposure limits

Assess potential risk from exposure




Eliminate and substitute hazards

Control residual exposures

Equipment retrofit

Equipment procurement

**Assess ongoing effectiveness**

**Supplement controls**

**Make appropriate changes based on new hazard info**

Exposure control verification

Develop SOPs

Train workers

Health surveillance

# Act

- Make appropriate changes based on new hazard info
- Recent examples
  - Pesticides
  - Fumigants
  - Carbon nanotubes and nanofibers
  - Nano silver
  - Beryllium
  - Silica
  - Flavorings

# Business Value of Worker Health

- Estimated costs of $250B*/year
  - The medical costs associated with occupational disease and injury: $67B
  - Productivity costs $183B, including current and future lost earnings and fringe benefits

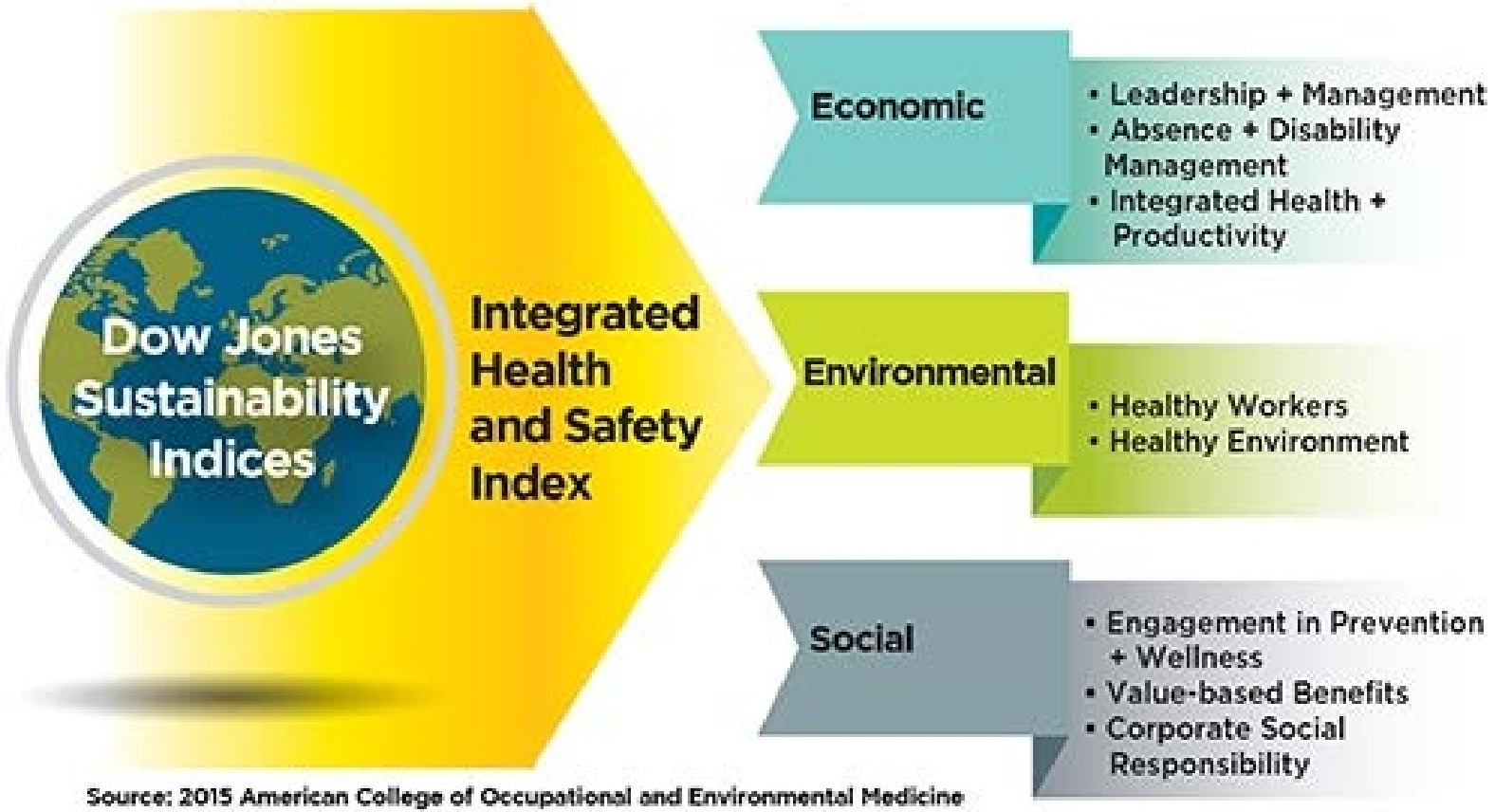
*Leigh, J. P. (2011), Economic Burden of Occupational Injury and Illness in the United States. Milbank Quarterly, 89: 728–772.

- An Integrated Health and Safety Index has been proposed
  - Translates the impact of employer health and safety programs into business value for the investment community

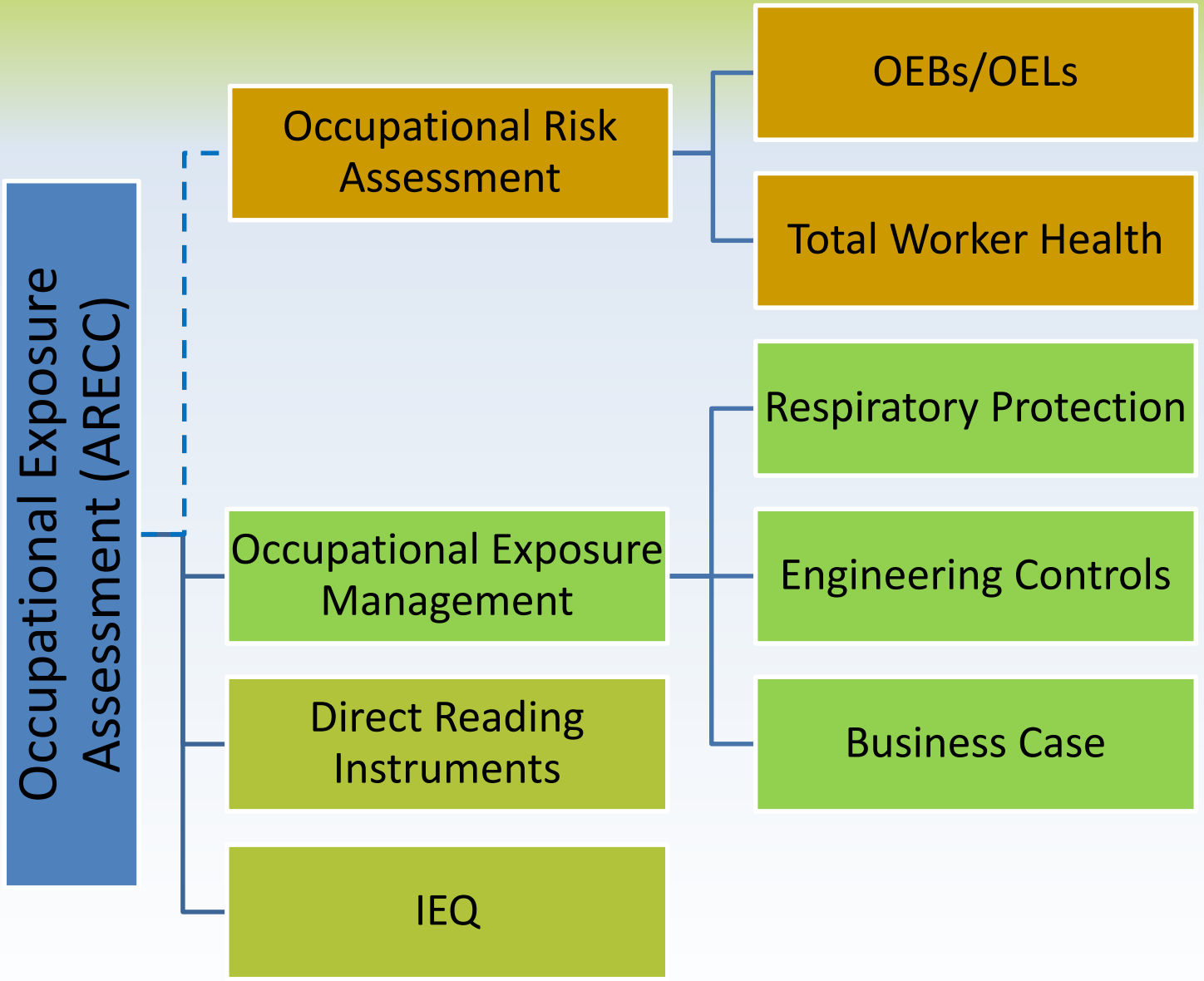
*Ultimately, the value of a company can be seen as the health of its workforce*

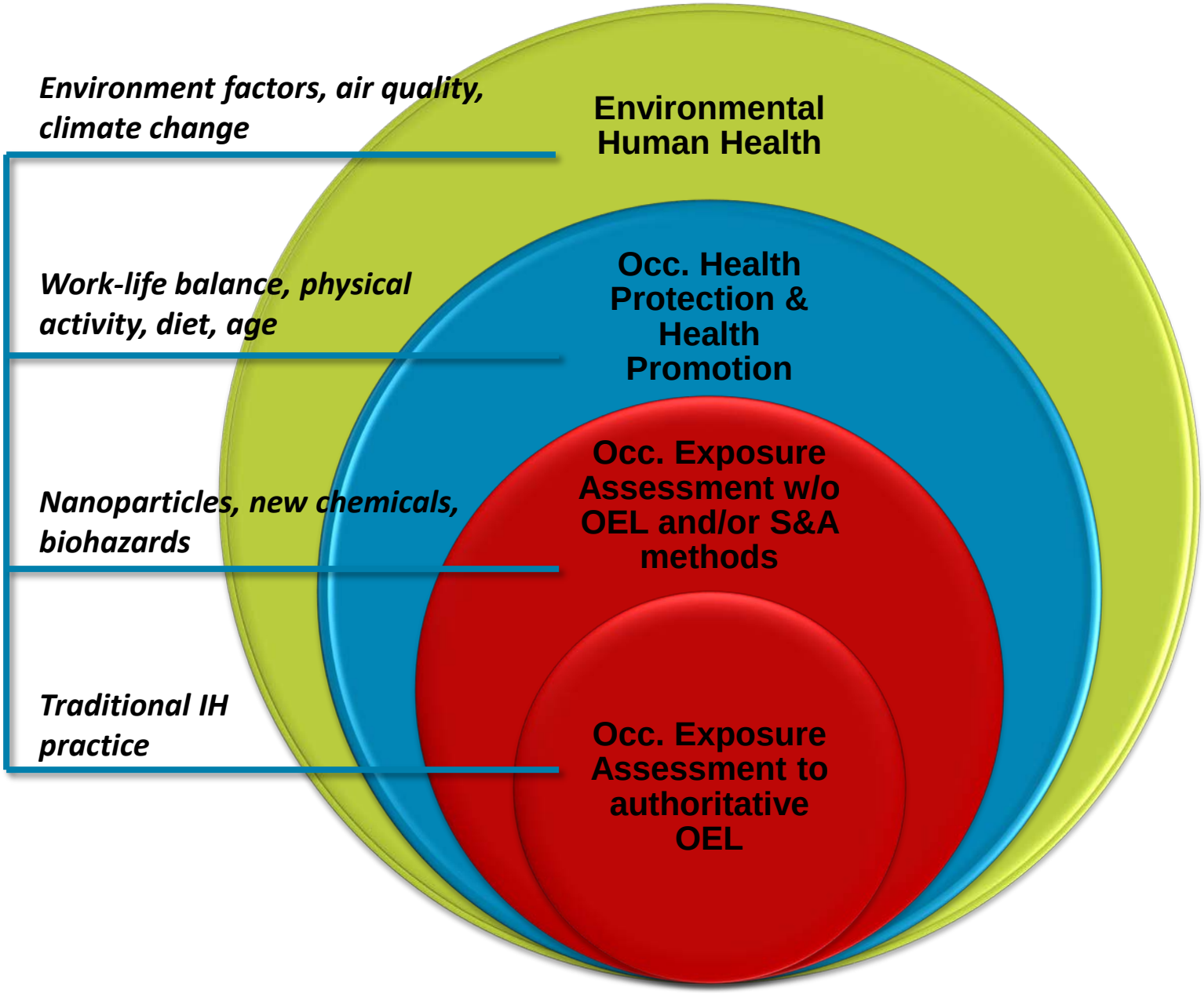
*Dr. Robert McLellan, co-author of Integrated Health and Safety model*

# Integrated Health and Safety Index




Source: 2015 American College of Occupational and Environmental Medicine


Occupational Exposure Assessment (ARECC)
Occupational Risk Assessment
OEBs/OELs
Total Worker Health
Occupational Exposure Management
Respiratory Protection
Engineering Controls
Business Case
Direct Reading Instruments
IEQ

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