1.6 Evaluate effectiveness of control measures and refine interventions

Learning Outcome

The learner should be able to evaluate whether physical hazard controls are actually reducing exposure to an acceptable level, identify weaknesses in existing controls, and refine interventions where performance is inadequate.

The key principle is that implementing a control does not automatically mean that the risk has been adequately controlled. Its effectiveness must be verified using evidence.

1. Measuring Control Effectiveness

Control effectiveness means the extent to which a control reduces the identified hazard or worker exposure.

Effectiveness can be evaluated through:

- Exposure monitoring.
- Workplace inspections.
- Equipment testing.
- Maintenance records.
- Incident and near-miss data.
- Worker feedback.
- Health-surveillance findings, where applicable.
- Comparison of performance over time.

For example, installing an acoustic enclosure around a noisy machine is not sufficient by itself. The organisation should verify whether worker noise exposure has actually reduced.

2. Leading and Lagging Indicators

A combination of indicators can provide a more complete picture.

Leading indicators

These measure activities intended to prevent problems, such as:

- Percentage of planned inspections completed.
- Preventive maintenance completion.
- Control testing frequency.
- Percentage of workers trained.
- Number of exposure assessments completed.
- Corrective actions closed on time.

2. Leading and Lagging Indicators

Lagging indicators

These measure outcomes, such as:

- Occupational injuries.
- Reported symptoms.
- Health-surveillance findings.
- Exposure-limit exceedances.
- Equipment-related incidents.
- Occupational disease cases.

A strong management system should not rely only on lagging indicators because waiting for illness or an incident means that control failure may already have occurred.

3. Verification of Engineering Controls

Engineering controls require particular attention because their effectiveness can deteriorate over time.
Examples include:
Noise

- Acoustic enclosure condition.
- Isolation mounts.
- Equipment maintenance.
- Noise measurements.

Vibration

- Tool condition.
- Vibration-damping systems.
- Maintenance and replacement schedules.
- Repeat vibration assessment.

3. Verification of Engineering Controls

Heat

- Ventilation performance.
- Cooling systems.
- Heat shielding.
- Thermal-environment measurements.

Radiation

- Shielding integrity.
- Interlocks.
- Access controls.
- Radiation measurements.

Controls should be inspected, maintained and tested according to their design and risk.

4. Identifying Control Failure

When a control is not performing as expected, the organisation should determine why.
Possible reasons include:

- Poor initial design.
- Incorrect installation.
- Equipment deterioration.
- Inadequate maintenance.
- Incorrect use.
- Changes in production.
- Increased workload.
- Human-factor issues.
- Lack of training.
- Failure to follow procedures.

For example, if a vibration-control system initially reduced exposure but later measurements show increasing exposure, possible causes may include worn equipment, ineffective maintenance or changes in how the tool is being used.
The objective is to identify the underlying cause, rather than simply applying another temporary measure.

5. Refining the Intervention

When controls are underperforming, interventions should be improved using the hierarchy of control.
For example:
Existing situation: High worker exposure to machine noise.
Initial control: Hearing protection.
Evaluation: Exposure remains significant.
Refined intervention:

- Replace noisy equipment where reasonably practicable.
- Improve acoustic enclosure.
- Separate workers from the noise source.
- Improve preventive maintenance.
- Review work scheduling.
- Continue appropriate hearing protection as residual protection.

This demonstrates the movement from temporary or individual protection towards stronger controls at source.

6. Review of Results and Trend Analysis

Control effectiveness should be evaluated over time rather than through a single assessment.

For example:

Assessment	Exposure result	Interpretation
Initial	High	Control improvement required
After engineering control	Reduced	Control appears effective
Six months later	Increasing	Possible deterioration
After maintenance	Reduced again	Control restored

This type of trend analysis can reveal whether the control is:

- Consistently effective.
- Deteriorating.
- Effective only under certain conditions.
- Sensitive to changes in work practices.

7. Practical Case Study – Noise Control

A manufacturing company installs an acoustic enclosure around a high-noise machine.

Initial assessment

Noise exposure is above the relevant criterion.

Intervention

The machine is enclosed and workers are separated from the source where possible.

Verification

Follow-up measurements show that exposure has decreased substantially.

Further evaluation

After several months, noise levels begin increasing.

Investigation

Inspection identifies damaged enclosure panels and deteriorated isolation components.

Refinement

The enclosure is repaired, isolation components are replaced and a preventive maintenance schedule is introduced.

Final verification

Repeat monitoring confirms that exposure has returned to the expected controlled level.

This demonstrates that control effectiveness is an ongoing process, not a one-time decision.

8. When Controls Need to Be Reassessed

Controls should be reviewed when:

- Exposure monitoring shows deterioration.
- An exposure limit is exceeded.
- An incident or near miss occurs.
- Workers report concerns or symptoms.
- Equipment or processes change.
- Production increases.
- New technology is introduced.
- Health-surveillance findings indicate potential occupational effects.
- A control has reached the end of its useful life.

A formal review should also consider whether the selected control remains the most appropriate and proportionate solution.

Critical Evaluation

A common weakness in physical-agent management is assuming that:
"Control implemented = risk controlled."
This is not necessarily true.
A control can fail because of poor design, inadequate maintenance, changing exposure conditions or human factors.
Effective evaluation therefore requires objective evidence, not simply confirmation that a procedure or piece of equipment exists.
The strongest approach is:
Measure → Compare → Investigate → Improve → Re-measure
This creates a continual improvement cycle.

Key Takeaways

- A control is effective only when evidence demonstrates that it is reducing risk as intended.
- Use monitoring, inspections, testing, health information and performance data to verify effectiveness.
- Investigate the underlying reasons for control failure, rather than applying temporary fixes.
- Refine controls using the hierarchy of control wherever possible.
- Continuous improvement follows the cycle: Measure → Evaluate → Improve → Verify.

Thank you