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Cumulative Effects Assesment

Good Practices and Options for RoF RA

Presented to the Ring of Fire (RoF) Regional Assessment (RA) Working Group

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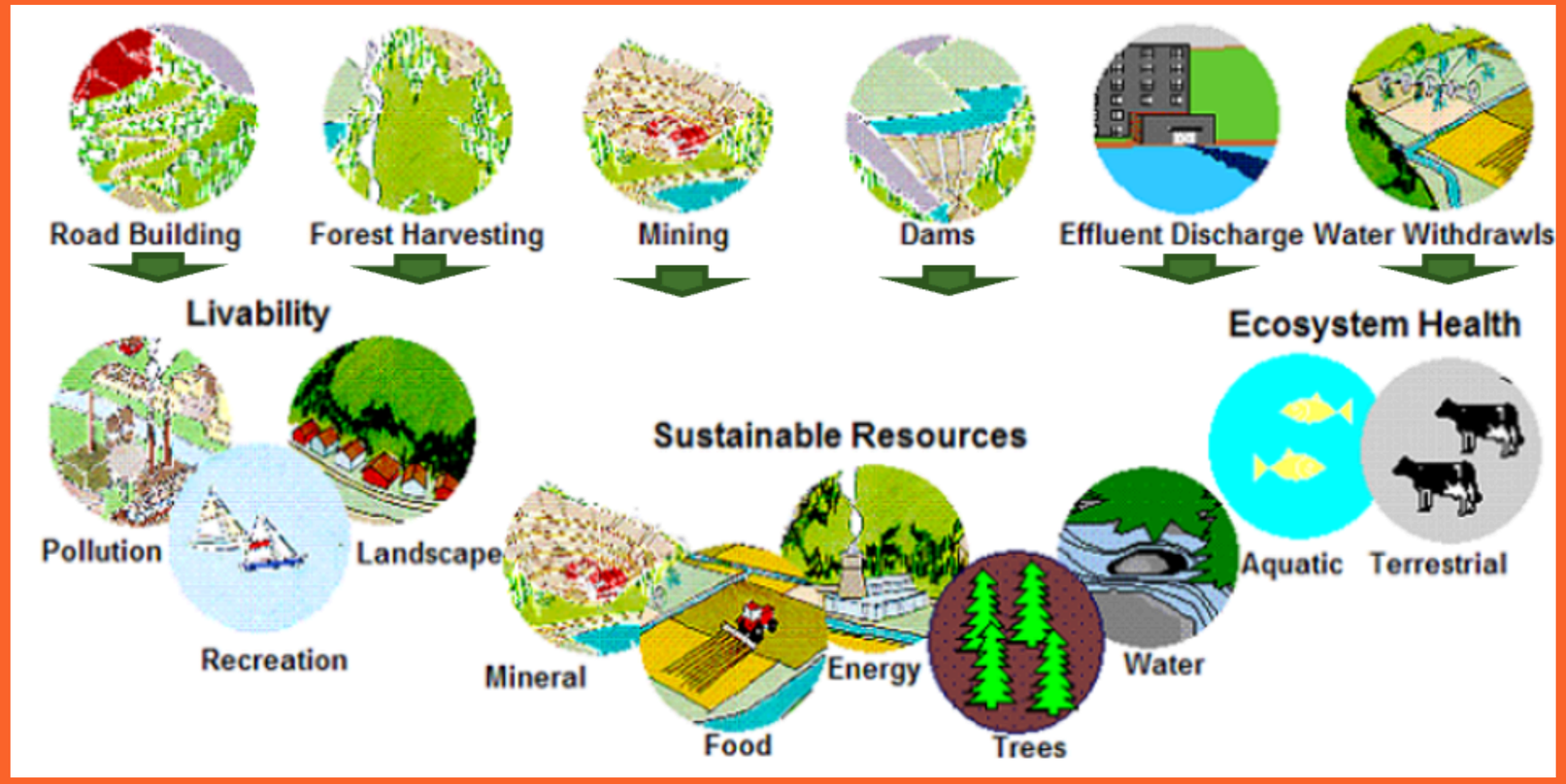
UNIVERSITY OF SASKATCHEWAN

Cumulative effects assessment (CEA) is globally regarded as essential to good impact assessment (IA) because it allows us to estimate the total impact of human-induced and natural disturbances on key aspects of the environment and communities and, therefore, better understand the significance of proposed future developments.

CEA allows us to understand how all the things that we build combined with natural forces…

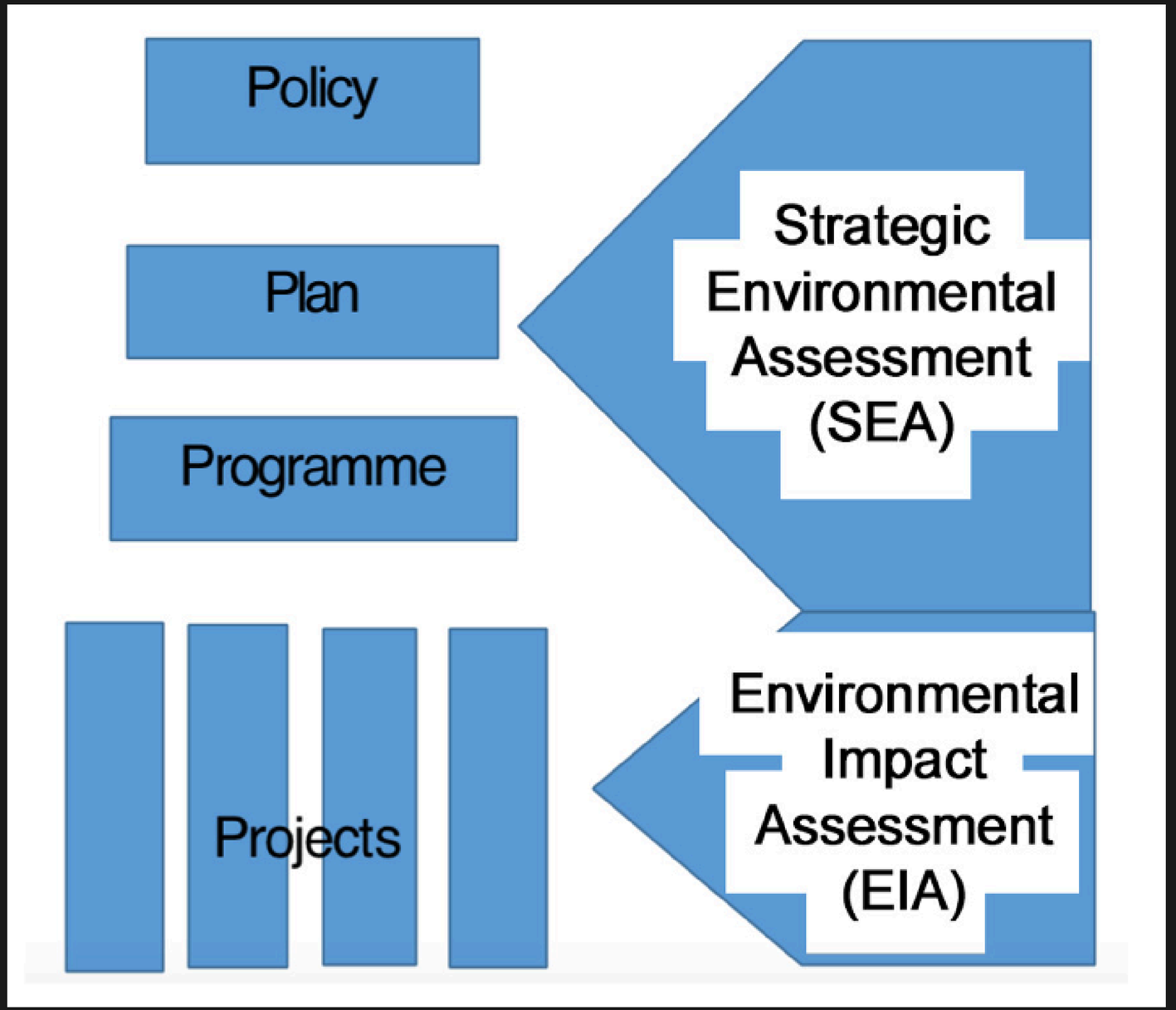


…affect what we care about

Cumulative Effects Assessment

Key Component of Project-Based *and* Strategic IA

All CEAs share the same four universal stages



Let’s explore CEA Methodology

Topics of today’s presentation:

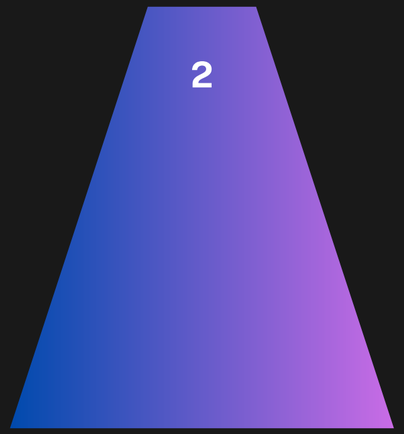
CEA Methodolgy

FOUR UNIVERSAL STAGES

SET UP

“scoping”

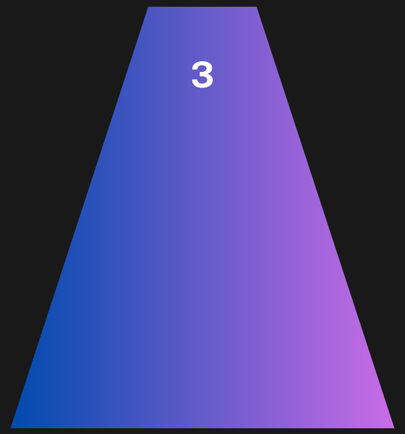
“what/who do we need?”
“what do we care about?”
“what will we measure?”



LOOKING BACK

“retrospective analysis”

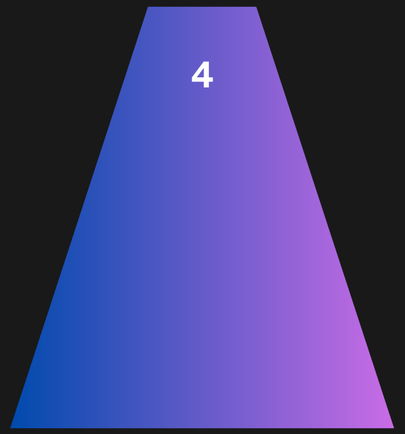
“exporing the past”



LOOKING FORWARD

“prospective analysis”

“exploring the future”



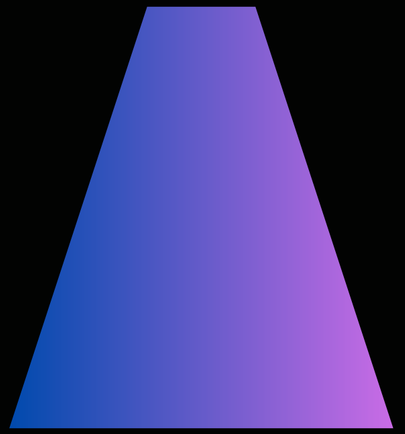
ACTION PLAN

“significance deterimation and management”

“what does it mean?”
“what will we do/monitor?6
“who will follow up and when?”

good practices

1

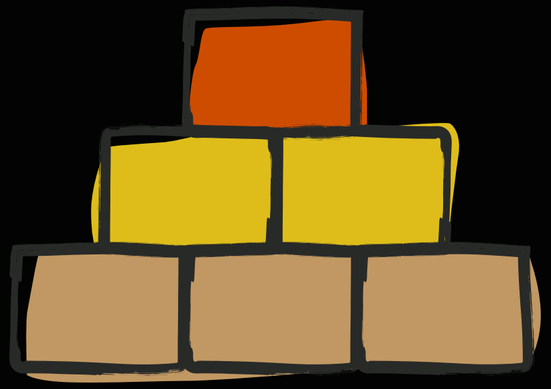


SET UP

“scoping”

“what/who do we need?”
“what do we care about?”
“what will we measure?”

- collaborative
- use Indigenous and western knowledge systems
- reflect regional ecology and context
- use holistic, ambitious valued component selection with documented rationale
- inventory human and natural stressors
- adopt flexible spatial boundaries
- adopt expansive temporal boundaries (ideally past = pre-disturbance, future = project relcamation)



good practices

2

LOOKING BACK

“retrospective analysis”

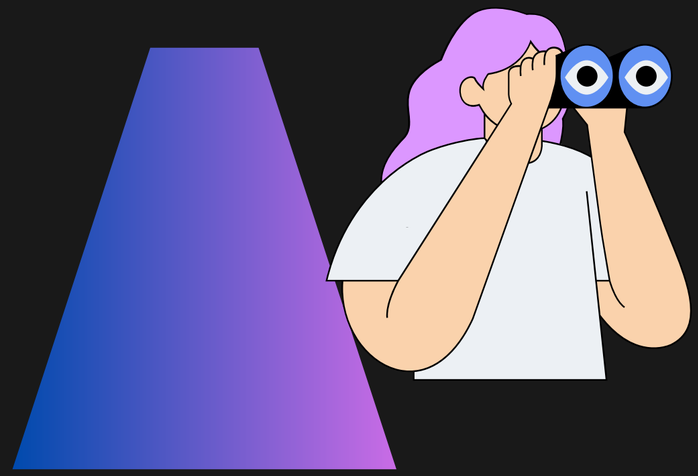
“exporing the past”

- describe current conditions
- describe baseline historical conditions
- explain/model/map/describe the progression of disturbance from past to present
- make links between stressors and valued components or indicators (cause/effect or correlation or lived experiences or storytelling)
- summarize the effects on (changes to) valued components or indicators
- identify thresholds or levels of acceptable change (for use later on)
- be transparent about methods, data sources, modelling assumptions, etc.
- document evidence and communicate uncertainties and confidence levels

good practices

- explore how valued components or indicators may respond to additional stress or disturbance in the future
- use information gathered in the ‘look back’ to inform the ‘look forward’
- adopt scenario exploration or forecasting
- explore a variety of potential future states
- explain/model/map/describe the progression of future disturbances
- summarize the effects on (changes to) valued components or indicators
- be transparent about methods, data sources, modelling assumptions, etc.
- document evidence and communicate uncertainties and confidence levels

3



LOOKING FORWARD

“prospective analysis”

“exploring the future”

good practices

4

- propose mitigations for unwanted cumlulative effects
- propose enhancements for positive cumulative effects
- once mitigations are accounted for, describe the significance of remaining effects
  - consult scienitific thesholds, community limits of change and risk tolerances
  - seek guidance from elders and knowledge keepers and other perspectives
  - use historical baseline conditions to help judge significance
- develop monitoring strategy
- develop adaptive management program (ID decision-making triggers and corrective actions)
- apply precautionary principle as appropriate (risk mitigation)

ACTION PLAN

It may be that a valued component is already in an unhealthy condition or under stress from climate change, thus, any additional disturbance could be considered significant and therefore unacceptable. This is the rationale for adopting a precontact baseline because it tells you how far you are from the resilient natural state.

“significance deterimation and management”

“what does it mean?”
“what will we do/monitor?10
“who will follow up and when?”

CEA Methods and Tools

No shortage!

Every stage of the CEA process is assisted by methods and tools

All of them provide you with information… *not answers*

Selection depends on valued components, time & resources and what you want to know

Method/Tool	Examples
Adaptive management	Experimentation; incremental adjustments to environmental policies, procedures or management prescriptions during follow-up
Analogs	Case studies, look-alikes; lessons or experiences from elsewhere
Checklists	Simple; descriptive; questionnaire
Consultation	Interviews; focus groups; public surveys; stakeholder forums; town hall meetings
Decision-focused checklists	Multi-criteria decision making (MCDM); Multiattribute utility measurement (MAUM); decision analysis (DA); scaling, rating or ranking; weighting
Environmental sampling	eDNA; water, air, soil, sediment, environmental surface sampling
Environmental surveys	Census; monitoring; tracking
Expert opinion	Professional judgment; Delphi technique; adaptive environmental assessment; simulation modelling
Laboratory testing and scale models	Water and air quality analysis; soil composition; hydrological flows; contamination and toxicity testing (heavy metals)
Literature reviews	Systematic reviews; environmental scans
Matrices	Simple; stepped; scoring; Petersen matrix
Mapping	Cultural/community mapping; structural spatial mapping; ecosystem service and hotspot mapping; habitat mapping; disturbance mapping; system mapping (e.g. cluster mapping, causal loop mapping)
Monitoring	Radiotelemetry; field studies of analogs; drone surveys; ground-based photo monitoring
Networks, Network Analysis	Impact trees; chains
Geographic Information Systems (GIS) (overlay mapping)	ARCGIS; QGIS; ARCGIS Story Maps
Photographs and Photomontages	Historical photography (comparisons); air photo analysis; aerial surveys or drone mapping; repeat photography;
Qualitative modelling	Grounded theory; qualitative simulation; heuristic models; conceptual models; ethnography; phenomenology
Quantitative modelling (mechanistic models; deterministic models; stochastic models; statistical models)	Media; ecosystem; visual; archaeological; systems analysis; Monte Carlo simulations
Remote sensing (active, passive)	Cameras; radar; LiDAR (from aircraft), satellite imagery
Risk assessment	Hazard identification; ecological risk assessment; exposure assessment; consequence analysis
Scenarios	Basic scenario analysis; strategic management scenarios
Storytelling, Lived Experiences, Testimony	Indigenous narrative; environmental storytelling; sharing circles
Trauma-informed enquiry	Environmental scan of the environmental and social context; attention to trauma triggers; actions to minimize harm and promote well-being
Trend extrapolation	Forecasting; back casting

RoF RA CEA Methodology

Indigenous-Centered

“Upholding [and centring] Indigenous methodologies is about Indigenous cultural sustainability” (Kovach 2021)

- **based on relationships, attention to the way the work is done**
- **reflects Indigenous beliefs, ethics, rootedness in land & place, experiential knowledge**
- **respects Indigenous Natural Law**
- **adherence to OCAP by contributors**
- **avoid ‘sciencization’ of Indigenous Knowledge, taking it out of cultural place-based context and separated from the Knowlegde holder (Carlson et al. 2025)**

RoF RA CEA Methodology

Impactful

What DO you want to know? What investigations will be most impactful now and in the future?

- **Laws and regulations require project proponents to focus on certain issues (e.g. fish and fish habitat, aquatic species, migratory birds). Seek a regional perspective on these to increase the usefulness of the RA to project decisions**
- **Issues beyond the scope of single projects: food security, climate security, water security**
- **Sustainability of key regional ecosystem services (e.g. carbon storage in muskeg, freshwater hydrology, nature-based recreation)** Mitchell et al. (2021)

- **Cumulative effects on treaty and inherent rights, especially concerning land management, hunting, fishing and trapping but also culture, identity, wellbeing, ceremonies, customs, governance, trade, transmission of stories, language, knowledge, medicine, sites, places, trails, etc.**
  - **CHANGES TO ACCESS - preclusion of ability to practice treaty rights**
  - **CHANGES TO TRADITIONAL LAND USE OPPORTUNITY - net land base accessible to community to preserve 'way of life' (preferred lands, waters, food sources are important)**

RoF RA CEA Methodology

Evidentiary Basis for Claims of Cumulative Effects

Blakley, et al. 2026, *forthcoming*

Evidence Maturity Ladder

- Evidence Maturity Level 1 - Inventory of disturbances
- Evidence Maturity Level 2 - Demonstration of connections and pathways among stressors and receptors
- Evidence Maturity Level 3 - Empirical monitoring and experiential evidence
- Evidence Maturity Level 4 - Source attribution

RoF RA CEA Methodology

RAWG Assessment Priorities

Empahsis on community well-being, cultural and spiritual wellbeing, social and economic equity, healthy environmental relationships. Numerous priorities identified.

Next steps:

- Measure each directly?
  Or assign indicators for each?
- Decide what you want to know, what you want to track in the future
- Select appropriate method or tool
- Gather data

There are many RA examples in Canada to look to:

Sample of socio-cultural components evaluated in RAs

Land dispossession and tenure	Wellbeing and health
Community economic diversification	Archaeological resources
Cultural Identity	Traditional activities
Economic prosperity	Community knowledge
Outdoor recreation	Food security
Historic/heritage resources	Land access
Regional demographics	Education and training
Regional and community change	Employment contracting
Community infrastructure and services	Quality of life

Some method options: Demographic analysis, health and economic statistics, community census (door-to-door), interviews, surveys, sharing circles, artworks, community based mapping, story maps, photography and video capture (drones), etc.

RoF RA CEA Methodology

Specific methodoptions:

To be well together (community well-being)

- e.g. Food security

e.g. Blakely and Heckbert (2026, forthcoming) recently developed a generic agent based model (netlogo version 6.4.0) - measures changes to regional food security using indicators for food availability, access, utilization and stability
(based on RoF region/data)

Cultural and spiritual well-being

- e.g. Cultural vitality and traditional practices, including traditional food and medicine
- e.g. Continued way of life and exercising Aboriginal and Treaty rights

e.g. Wilson (CE Analytic Ltd.) has developed:

Land dispossession index
Seasonal protein round index
Ceremonial medicinal plants index
Tenure dispossesion index
Etc.

Social and economic equity

- e.g. Access to land and resources

(Indicies are proprietary & copyright protected but adaptable to RoF)

RoF RA CEA Methodology

Healthy Environment Relationships

- water and river systems, flows
- wildlife and wildlife habitat
- peatlands
- forest ecosystems, plants
- climate change adaptation
- biodiversity
- air quality

Some useful disturbance metrics for assessing biophysical cumulative effects:

Spatial Extent of Alteration

- Percent disturbed area
- Total disturbed area (ha or km2) (broken out by sector)
- Patch size distribution
- Core Area (ha or km2) (intact core area of total habitat area)

Fragmentation

- Linear Disturbance Density
- Edge Density or Perimeter Area Ratio
- # or density of river/stream crossings
- Fish Passage Assessment
- Flood frequency
- Habitat Connectivity (wildlife movement corridors)
- Wetland Interruption by Footprint

Proximity for Overlap

- Zone of Influence (stressors on VCs)
- Stressor Overlap (access loss, etc.)

Habitat and Population

- Native Species Integrity Index
- Predator-Prey Relationships
- Forest Demography analysis
- Habitat Suitability Degradation
- Rate of Extirpation

How has all of this changed from past to present?

How will all of this change from now into the future under different development scenarios that incorporate all stressors (roads, mines, climate change, and much more)

What is the meaning or signficance of the anticipated changes?

What can be done now to prevent unwanted changes and enhance changes we want?

What will be done to track and manage changes over time?

Plan for ongoing, collaborative regional environmental governance?

Thank you!

For more information about cumulative effects assessment methdology please visit jillblakley.ca

or:

2025 Special Issue of *Environmental Management* on cumulative effects assessment and management state-of-the-art
https://link.springer.com/collections/dfcdahgecc

Cited Works

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