minerals to metals

Sustainable operation through design

Green Mining; Beyond the Myth

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Agenda

- **Context**
- Project risk & sustainability
- Risk drivers & framing of design thinking
- Examples
- Conclusions

Context

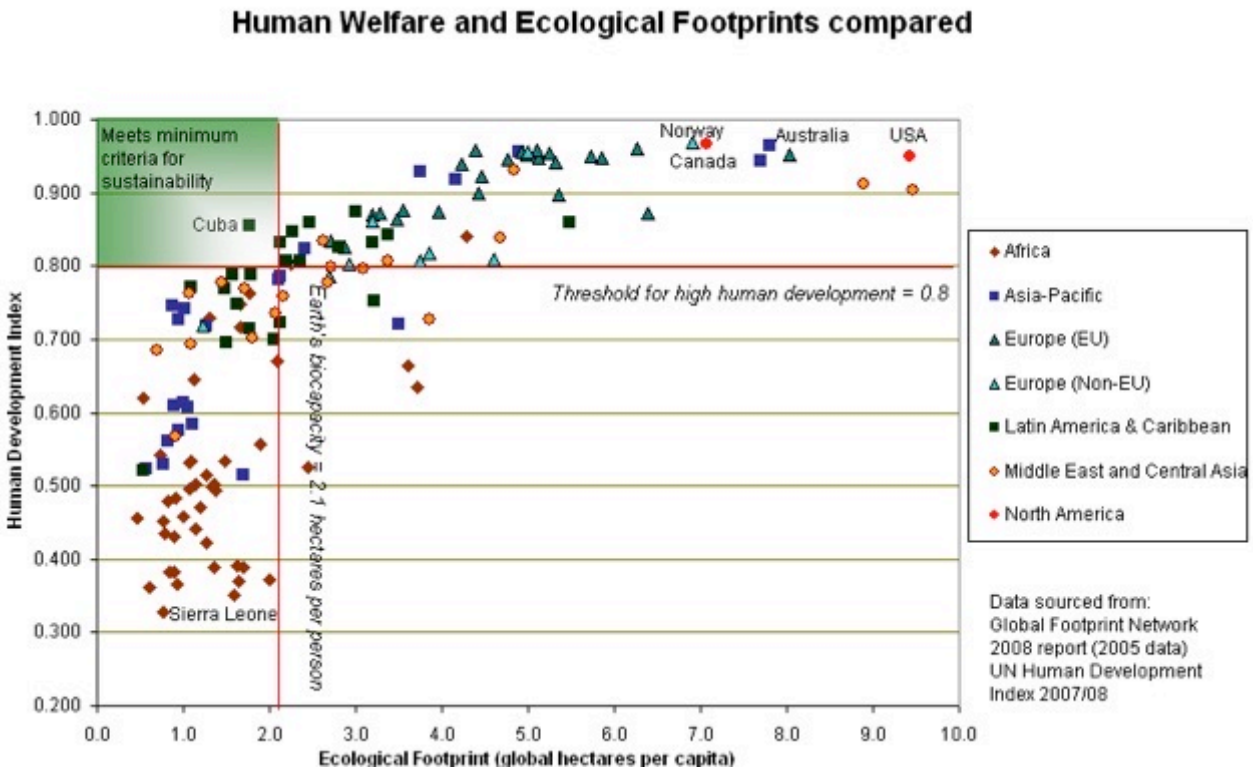
- Sustainability
  - Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

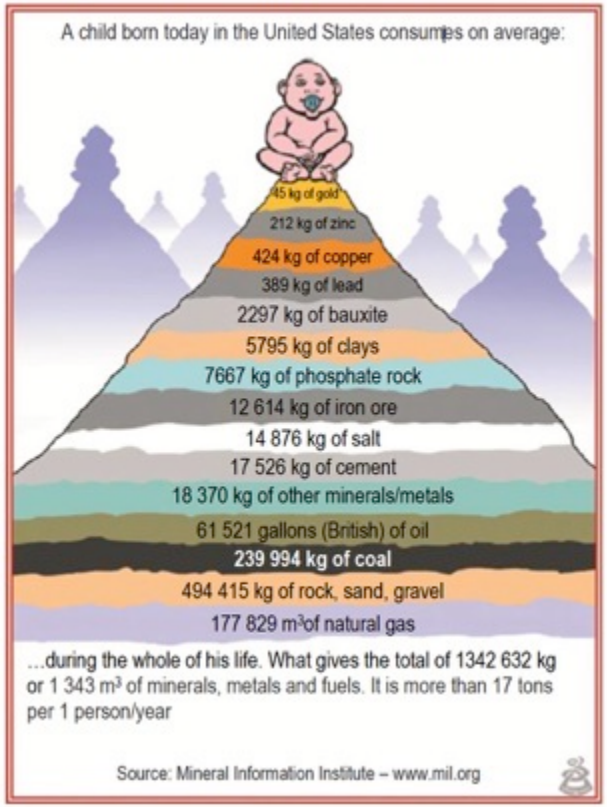
Brundtland

- What is design?
  - It is a decision-making process (often iterative), in which basic science, mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective… subject to a set of constraints

Dept of Mech Eng, University of Nevada

Needs of the Present?





Design for sustainability

- Two key questions to consider*:
  1. Am I doing **the right thing**?
  2. Am I doing **the things right**?

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- Assertion:
  - The world needs mining, but…
  - we have to do the 'things right'

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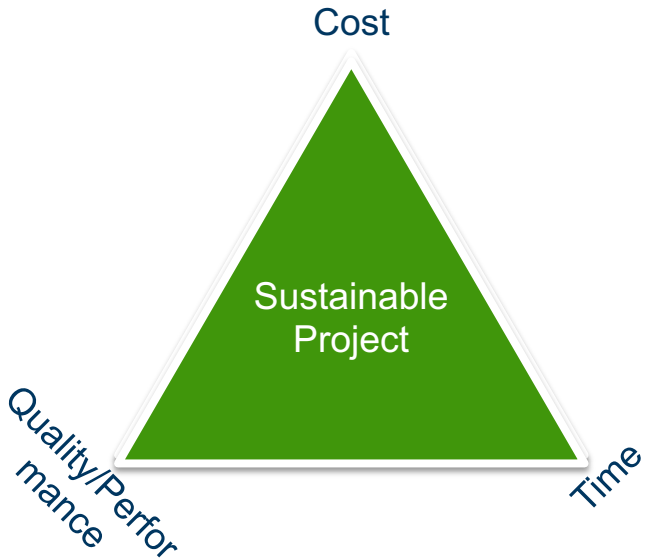
Project Risk

- Possibility or probability that the project will not turn out as planned or desired
  - (Negative) impact on **project objectives**



Sustainability?

- Competing objective?
  - Trade-off's
  - Compromise
- Overarching objective/aim?
  - Cost/Time/Quality cannot overshadow
    - Constraints
    - To be enhanced

(Sustainable) Project Risk

Risk involves two concepts:

- The *likelihood* that some **event** will occur.
- The *impact* **of the event** if it does occur.

It is a joint function of the two

Risk = *f* (likelihood, impact)

Note:
Risk is linked to an event – a person or object therefore cannot be a risk

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Risk and Hazards (risk sources)

- Remember that Hazards...
  - (anything that can cause harm)
- ...is not the same as Risk
  - (likelihood harm will occur and it's severity)

Low Risk

High Risk

The level of risk is determined by the control effectiveness

(Sustainability) Risk Drivers

Low Risk

High Risk

The level of risk is determined by the control effectiveness and the magnitude of the energy

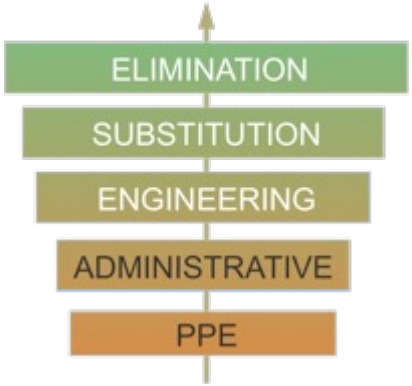
Lowest Risk

(Sustainability) Risk Drivers

- The chance of something happening that will have an impact on your objectives
  - Can be quantified as:

f (**LIKELIHOOD OF EVENT OCCURRING** & **CONSEQUENCE OF EVENT**)

f (control effectiveness)



f (magnitude of "energy")

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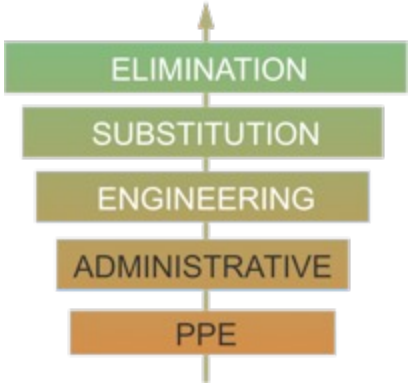
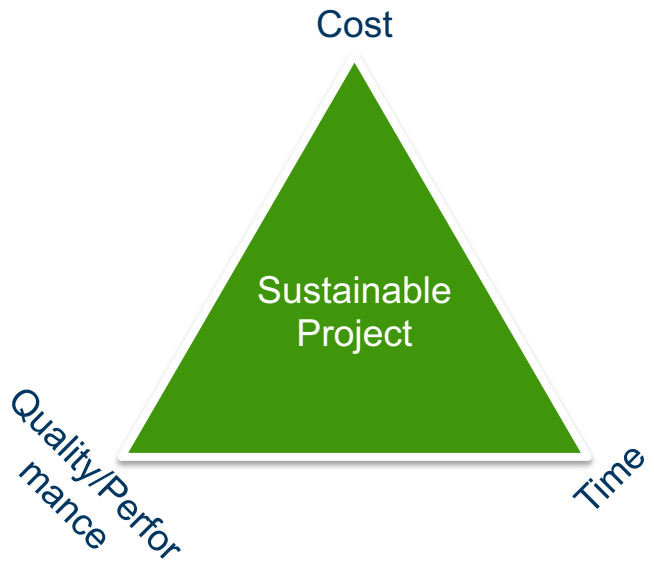
Raw water consumption

- Cannot eliminate
- Cannot substitute using aquifer water
- Tailings belt filter + dry deposition
- Measure all take-off's + water balance
- Daily reporting
- Future upgrade WWTW
  - Water positive



Local capex procurement



- 1210mt of steel to be facricated and erected in <10 months
- Understand local capacity
- Build into contracts

Rehabilitation of sensitive vegetation

- Rehabilitation expert advising team
  - topsoil handling
  - bulbs/plants
- Search and rescue of Species of Conservation Concern
- Mulching of vegetation
- Search and rescue of bulbs
- Propagation of species at offsite nursery
- Built topsoil handling into project schedule and detailed mine planning
  - Embed in contracts

Commencement of early rehabilitation

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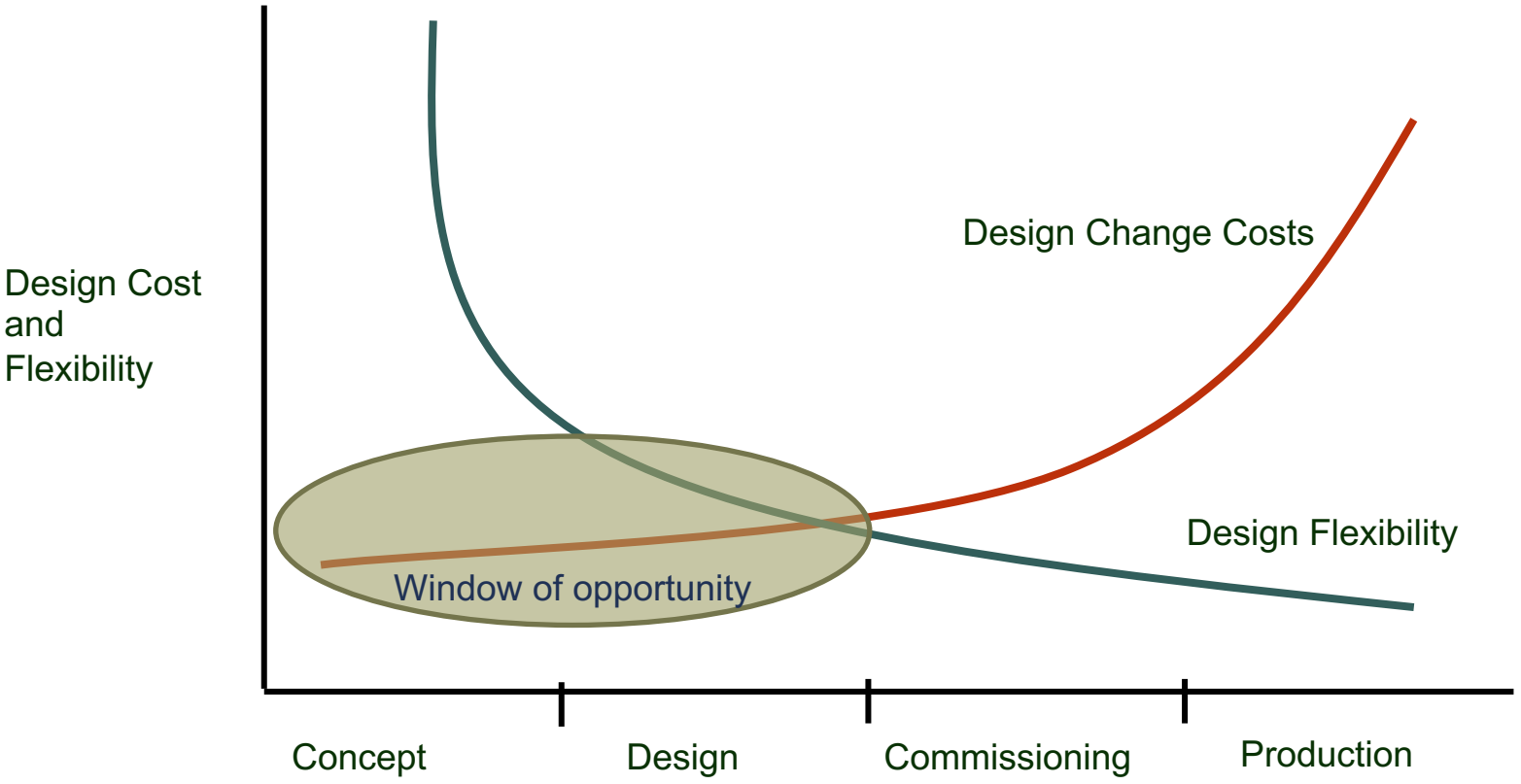
Design Phase vs Change Cost & Flexibility



Conclusions

- Sustainability should be the overarching aim of the design, not a design constraint or a competing objective
- Consider early in the design process
- Understand the ‘driving force’/energy + how to lose control
  - Design & implement engineering controls, not just policies/rules
  - Embed in procurement processes
- Failure is not an option – we have to do the ‘things right’
  - The more we do the ‘things right’, the more mining will become the ‘right thing’

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