



THDC India Ltd.

International Conference on HYDROPOWER AND DAMS DEVELOPMENT FOR WATER AND ENERGY SECURITY – UNDER CHANGING CLIMATE



Central Board of
Irrigation & Power



Indian National Committee
on Large Dams

Organizing and Managing Dam Safety

Przemyslaw (Andy) Zielinski, CANADA





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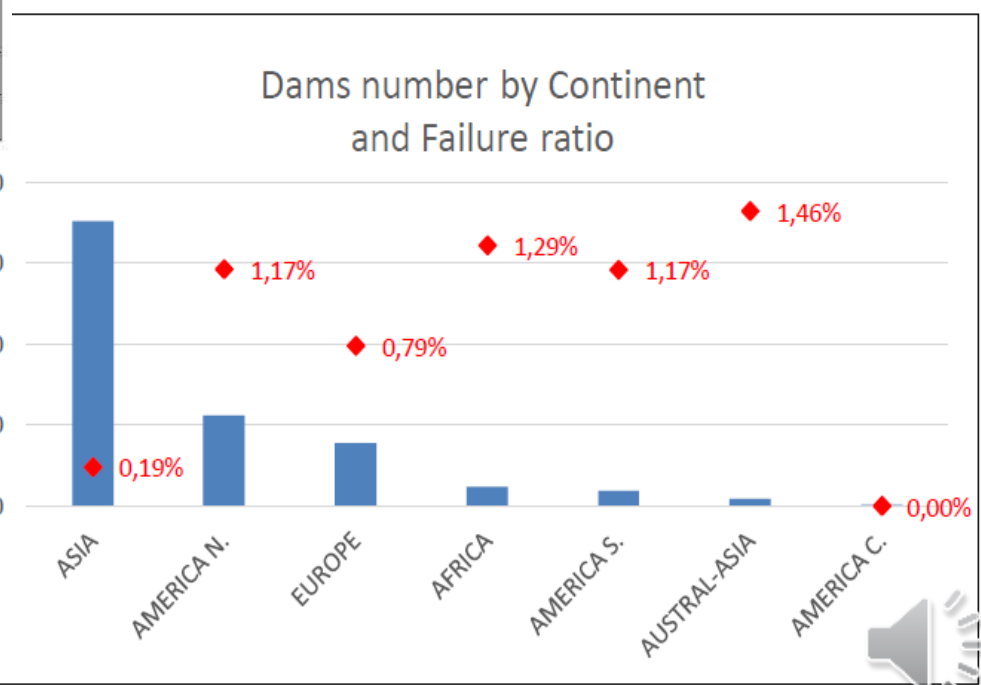


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Some statistics on large dams

	Existing dams	Failed dams	ratio
ASIA	35176	67	0,19%
NORTH AMERICA	11118	130	1,17%
EUROPE	7713	61	0,79%
AFRICA	2330	30	1,29%
SOUTH AMERICA	1887	22	1,17%
AUSTRAL-ASIA	824	12	1,46%
CENTRAL AMERICA	23	0	0,00%
TOTAL	59071	322	0,55%



Source:
ICOLD Bulletin 99 Update:
Statistical analysis of dam failures





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Dam Safety Management Guidance

DAM SAFETY MANAGEMENT:
Pre Operational Phases
of the Dam Life Cycle

**GESTION DE LA SECURITÉ
DES BARRAGES:**
Phases de Conception, construction et
mise en service

Bulletin 175



DAM SAFETY MANAGEMENT:
Operational phase of the dam life cycle

**GESTION DE LA SÉCURITÉ
des barrages en exploitation**

Bulletin 154





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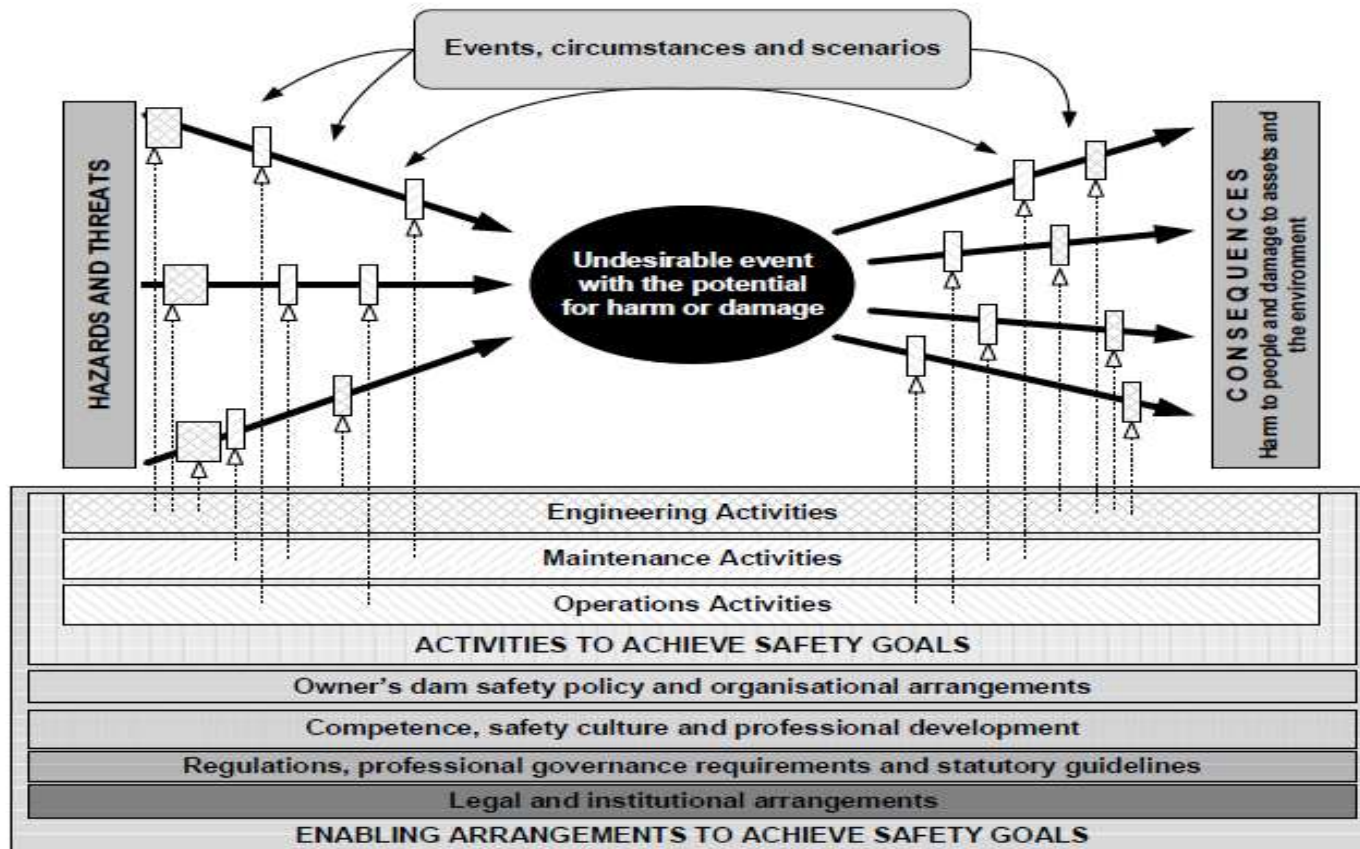


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Dam Safety Management Framework



Source:
ICOLD Bulletin
Dam safety
Guidance
Dam Safety
Concepts,
Principles and
Framework





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Elements of Comprehensive Dam Safety Management



Source:
ICOLD Bulletin Dam safety
Guidance
[Dam Safety Concepts, Principles
and Framework](#)





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Legal and Institutional Arrangements

Designing legal and institutional frameworks for assuring the safety of dams and downstream communities is typically a time consuming and complicated undertaking. The form that the regulation and oversight may take depends on the country characteristics that include:

- the prevailing legal system;
- the administrative arrangements;
- socio-economic context;
- technical characteristics of the portfolio of dams;
- the nature of ownership and financing arrangements;
- the sectoral distribution and hazard profile of the portfolio.

Source:
ICOLD Bulletin
Dam Safety
Guidance
Governance
Considerations





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Legal and Institutional Arrangements

GROUND RULES FOR DEVELOPMENT OF DAM SAFETY REGULATORY FRAMEWORK

1. Regulatory framework and the economic, societal and cultural conditions of the jurisdiction
2. Government's responsibility
3. Maximum level of assurance and the actual level of assurance
4. Regulatory framework must be developed from a range of legal, institutional, technical and financial options (various jurisdictional circumstances, different portfolio characteristics, human and financial resources and population locations and growth..)





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Legal and Institutional Arrangements

GROUND RULES FOR DEVELOPMENT OF DAM SAFETY REGULATORY FRAMEWORK

5. Dam safety regulatory arrangements must be cost-effective.
6. Cost of regulation must be distributed equitably.
7. Regulatory arrangements must be flexible.
8. Design of the regulatory framework evolving with changes in the portfolio and country conditions.





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Legal and Institutional Arrangements

DAM SAFETY GUIDANCE

DAM SAFETY GOVERNANCE CONSIDERATIONS

August 2021

SUSTAINABLE INFRASTRUCTURE SERIES

**Laying
the Foundations**

A Global Analysis of Regulatory Frameworks for the
Safety of Dams and Downstream Communities

WORLD BANK GROUP

Marcus J. Wishart, Satoru Ueda,
John D. Pisanelli, Joanne L. Tingey-Hall,
Kimberly K. Lyon, and Estaban Sij Garcia





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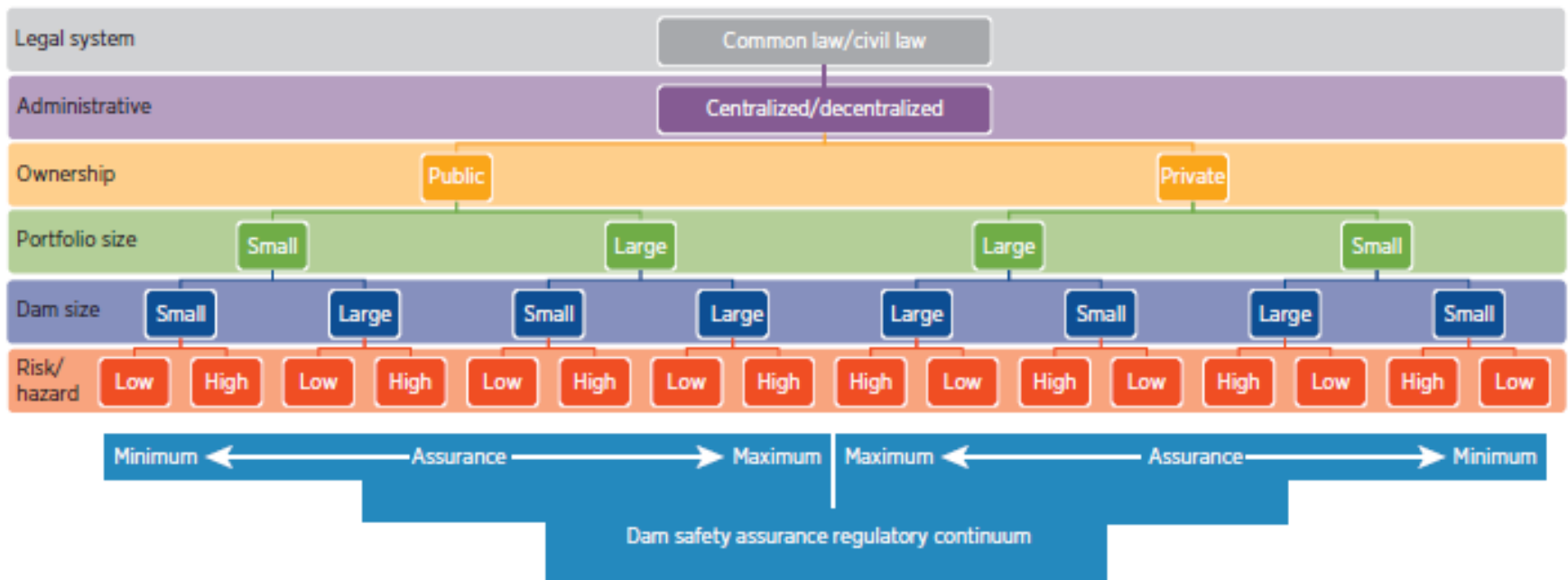
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Legal and Institutional Arrangements

A continuum – the Regulatory Mix for Dam Safety

a continuum of legal and institutional options against which countries can assess their specific needs and requirements



Source: ICOLD Bulletin Dam Safety Guidance: [Governance Considerations](#)





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Dam Safety decision-making: traditional and risk-informed approach

Traditional approach

Traditional methods of dam engineering have always been focused on safety and have resulted in a history of dam designs that have a great record of performance. Safety of dams has been controlled by an engineering standards-based approach, which has developed over many years, initially for the design of new dams, but increasingly applied over the past few decades to assess the safety of existing dams.

In following this approach dam engineers have always been conscious of effects of uncertainty at all stages of analysis and assessment and have taken it into account either intuitively or, indirectly, by following the widely accepted methods of traditional analysis, such as the use of safety factors and conservatism in applying loads and considering plausible scenarios.





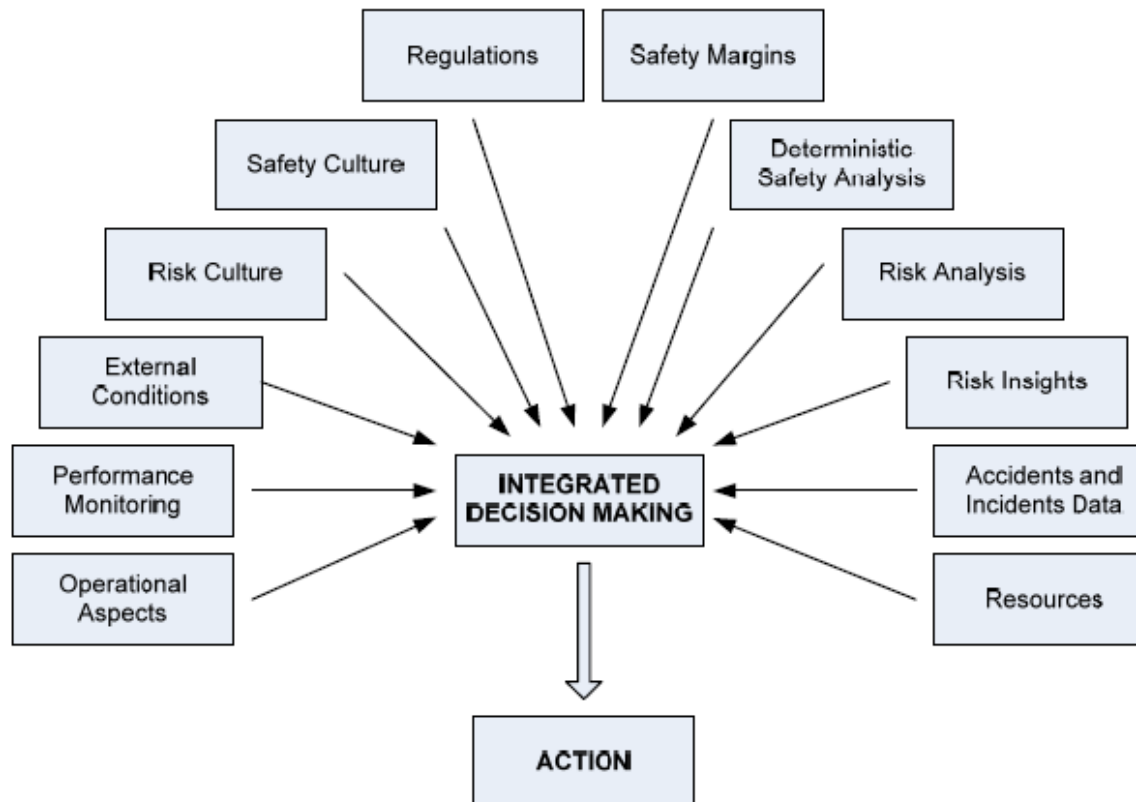
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Dam Safety decision-making: traditional and risk-informed approach

Risk-informed approach to decision-making





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Dam Safety decision-making: traditional and risk-informed approach

Risk-informed approach

- Societies are evolving and their populations are becoming increasingly aware that safety is not an absolute condition, but is a tolerated situation, with various levels of residual risk always present
- The demand by society that risks are identified, assessed, kept under review and properly controlled has resulted in the application of risk assessment over a very wide spectrum of public and private activities which have the potential to affect the welfare and interests of the community
- Societal demands for transparency and accountability cause the increase in the complexity of decision-making for dams and that requires an improved approach for their economical and safe operation, maintenance and overall management.
- The traditional standards-based approach, by itself, is becoming increasingly inadequate to handle a single dam or a portfolio of dams in allocating limited resources for their operation, repair or improvement, in a climate of growing public scrutiny.





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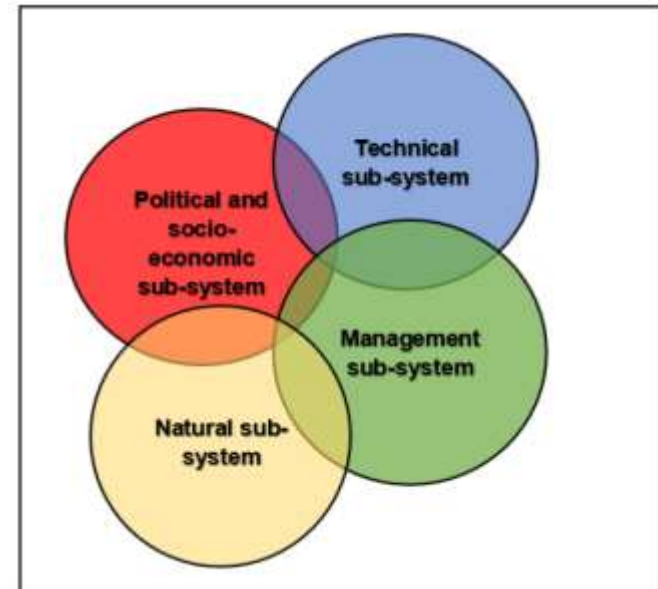
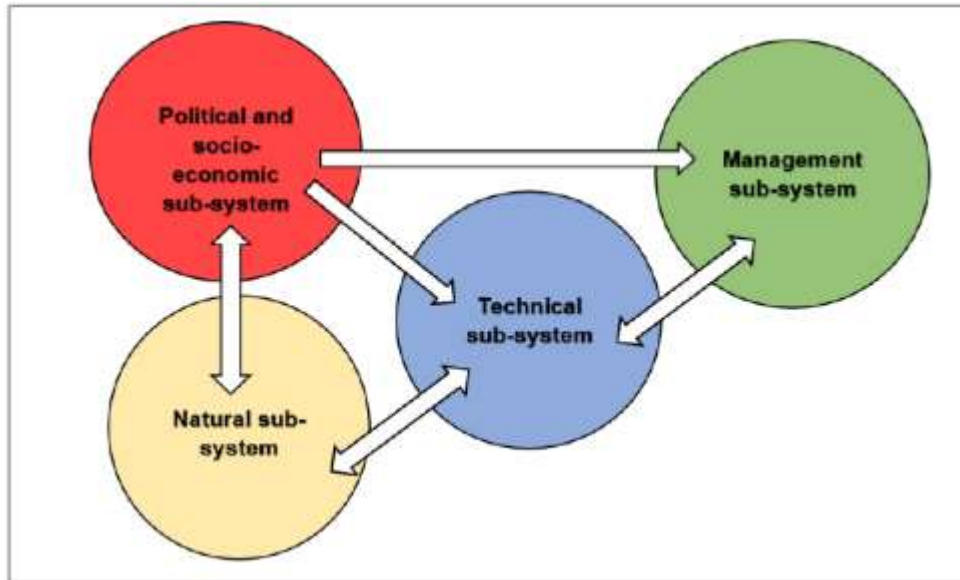
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Dam Safety decision-making: traditional and risk-informed approach

Risk analysis

The methods are still evolving

- Approach based on event and fault trees
- Recognition of dams as complex systems requires different methods





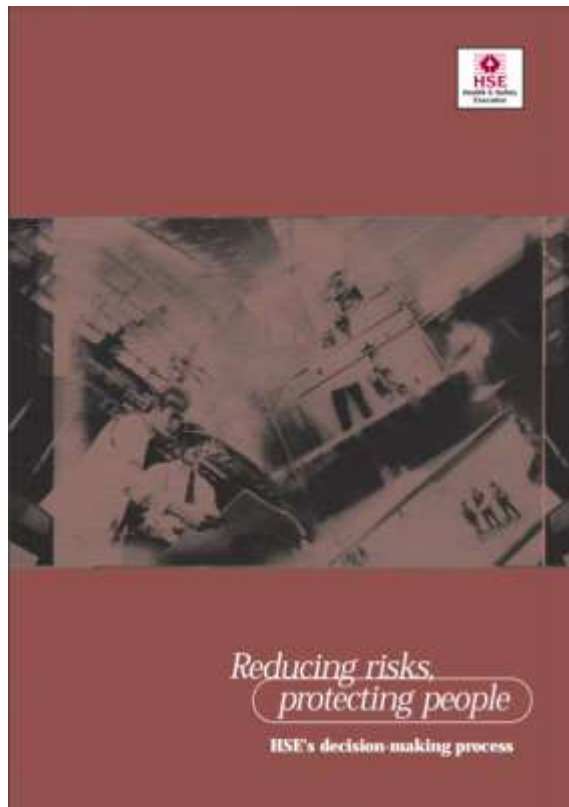
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Dam Safety decision-making: traditional and risk-informed approach

Risk evaluation



Risk tolerability framework developed by U.K. Health and Safety Executive (HSE)

- Australia, United States,
- Not appropriate in countries with civil law legal systems





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Dam Safety decision-making: traditional and risk-informed approach

Risk evaluation

Factors to be taken into account for the development of risk tolerability/acceptability limits

- Legal arrangements for dam safety
- Political aspects of introducing safety criteria that differ from traditional ways of assuring public safety
- Societal expectations
- Cultural traditions
- Economic aspects of safety regulation
- Background natural risk

Transfer of risk evaluation criteria from country to country??





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We are going in the right direction but we are still not there

- ***We expect that any model we are now able to construct will be replaced by more complete ones in the future, and we do not know whether there is any natural end to this process – E.T. Jaynes, 2003***

