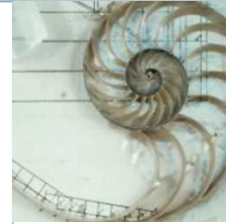




**Anticipating Harm
Coping with Uncertainty and
Ambiguity in a Complex World**



Sandoz 25+
Bonn, November 7, 2011

Ortwin Renn
Stuttgart University and
DIALOGIK gemeinnützige GmbH

Part 1:
Characteristics of Risk

**Complexity, Uncertainty and
Ambiguity**

Three Challenges of Knowledge about Risk

- *Complexity* in assessing causal and temporal relationships

- *Uncertainty*
 - variation among individual targets
 - measurement and inferential errors
 - Interaction with human performance (operator)
 - genuine stochastic relationships
 - system boundaries and ignorance

- *Ambiguity* in interpreting results

Risk and Uncertainty: Conceptual Note I

■ *Linear relationships*

- Plausible connection between cause and effect
- Symmetry between explanation and prediction
- Lack of intervening variables
- Stable context conditions
- Normal distribution of aleatory elements in prediction

■ *Complexity*

- Cause-effect chain requires modeling (not obvious)
- Many intervening variables and changing context conditions
- Explanation ex post possible, prediction often fuzzy
- Resolution by scientific investigations and scrutiny

Risk and Uncertainty: Conceptual Note II

■ *Uncertainty (first order)*

- Complexity cannot be fully resolved
- Combination of aleatory and epistemic uncertainty
- Caused by data imprecision, model limits, and extrapolation methods (confidence intervals)
- Quantitative estimates possible but not fully reliable

■ *Uncertainty (second order)*

- Cause-effect likely but neither proven nor quantifiable
- Genuine stochastic relationships (do they exist?)
- System boundaries (observation limits)
- Non-knowledge (surprises, outliers, idiosyncracies)

Risk and Uncertainty: Conceptual Note III

■ *Implication for uncertainty (first order)*

- Tradeoffs between risk and benefits impossible to calculate, but numerical estimates are helpful
- Need for advanced methods of uncertainty characterization
- Need for **robust** risk management

■ *Implication for uncertainty (second order)*

- Concept of tradeoffs may be misleading
- Need for qualitative characterization of knowledge boundaries
- Focus on vulnerability of risk absorbing systems
- Need for **resilient** risk management

Risk and Ambiguity: Conceptual Note IV

■ *Interpretative ambiguity*

- Not related to factual statements but to interpretation with respect to a value dimension (such as “adverse effect” or “safety”)
- Variation due to different values or priorities on values
- Need for discourse-based management (goal of common understanding)

■ *Normative ambiguity*

- Related to judgment about tolerability or acceptability
- Variation due to legal context, level of aspired safety, security and quality of life, related to value clusters
- Need for discourse-based management (goal of legitimate agreements)

Special Challenge: Systemic Risks

■ Characteristics

- Highly complex
- Second order uncertainty (non-knowledge)
- High interpretative and normative ambiguity
- Open system boundaries (ripple effect)

■ Problems

- Limits of quantification
- Plurality of risk assessment results and uncertainty characterization
- System breakdown possible (essential services interrupted)
- Potential for high social mobilization

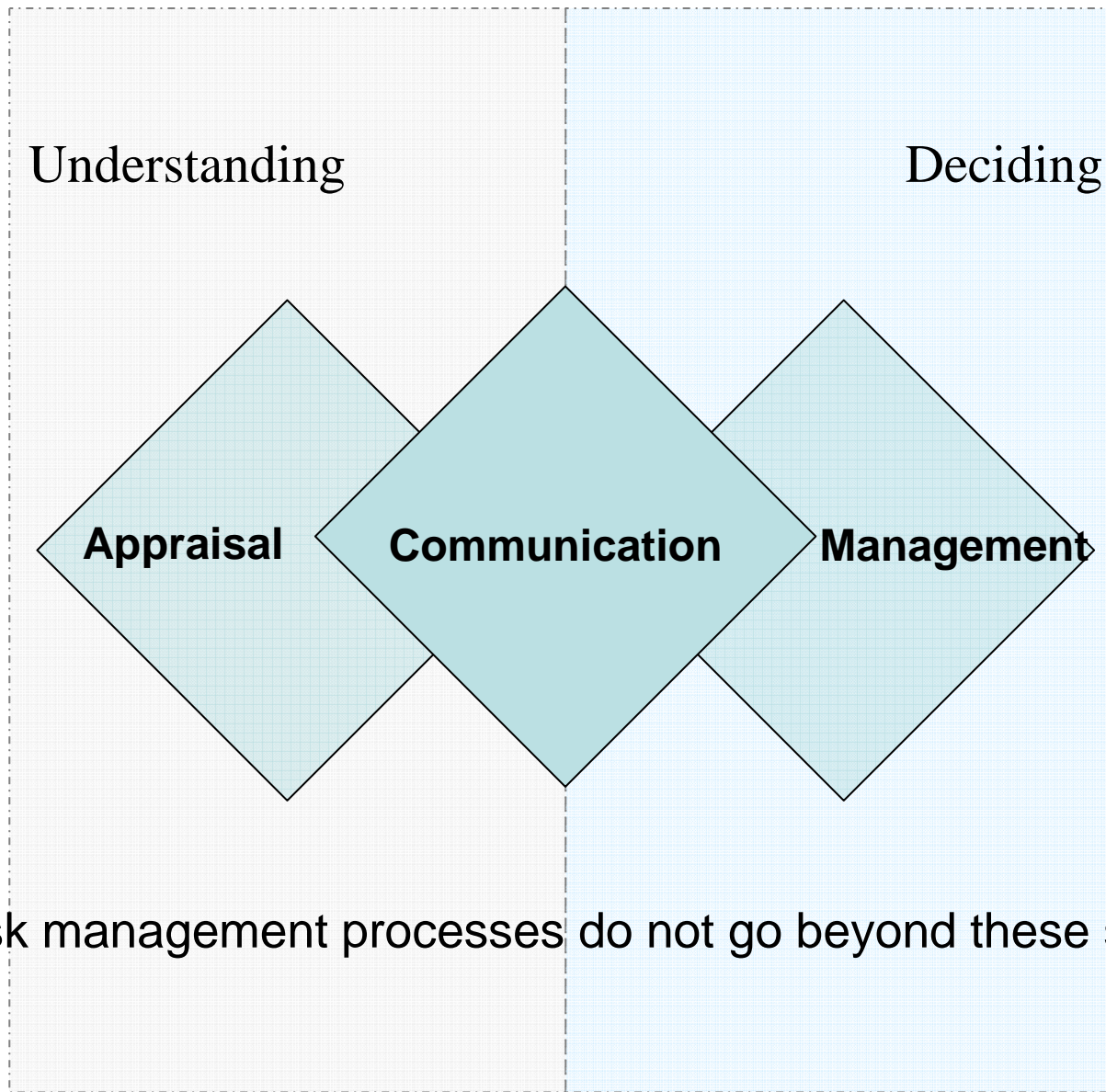
Part 2:

The Basic Fabrics of Risk Governance

**Complexity, Uncertainty and
Ambiguity in:**

Risk Governance

CONVENTIONAL RISK MANAGEMENT



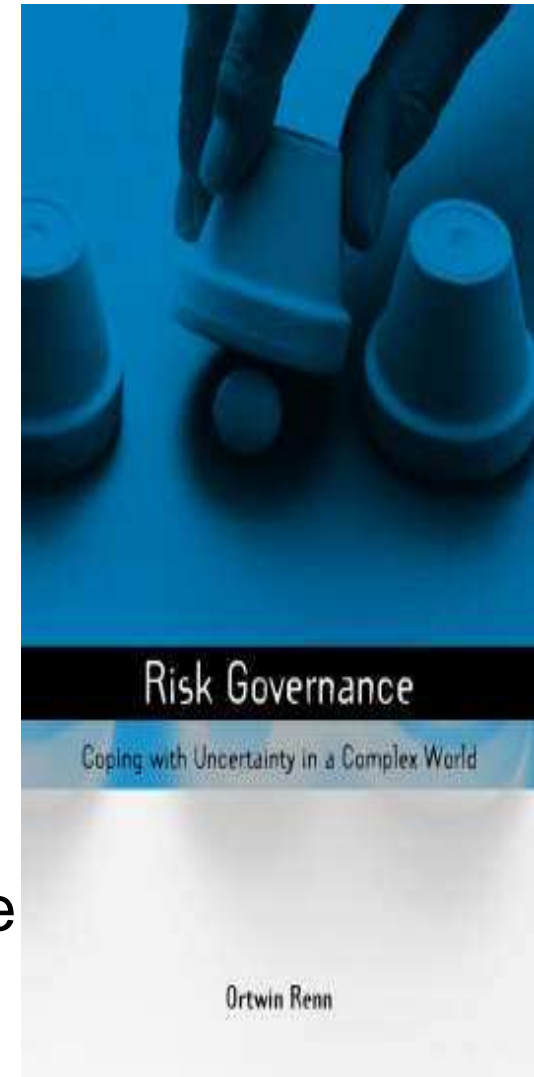
Most risk management processes do not go beyond these steps

Need for integration

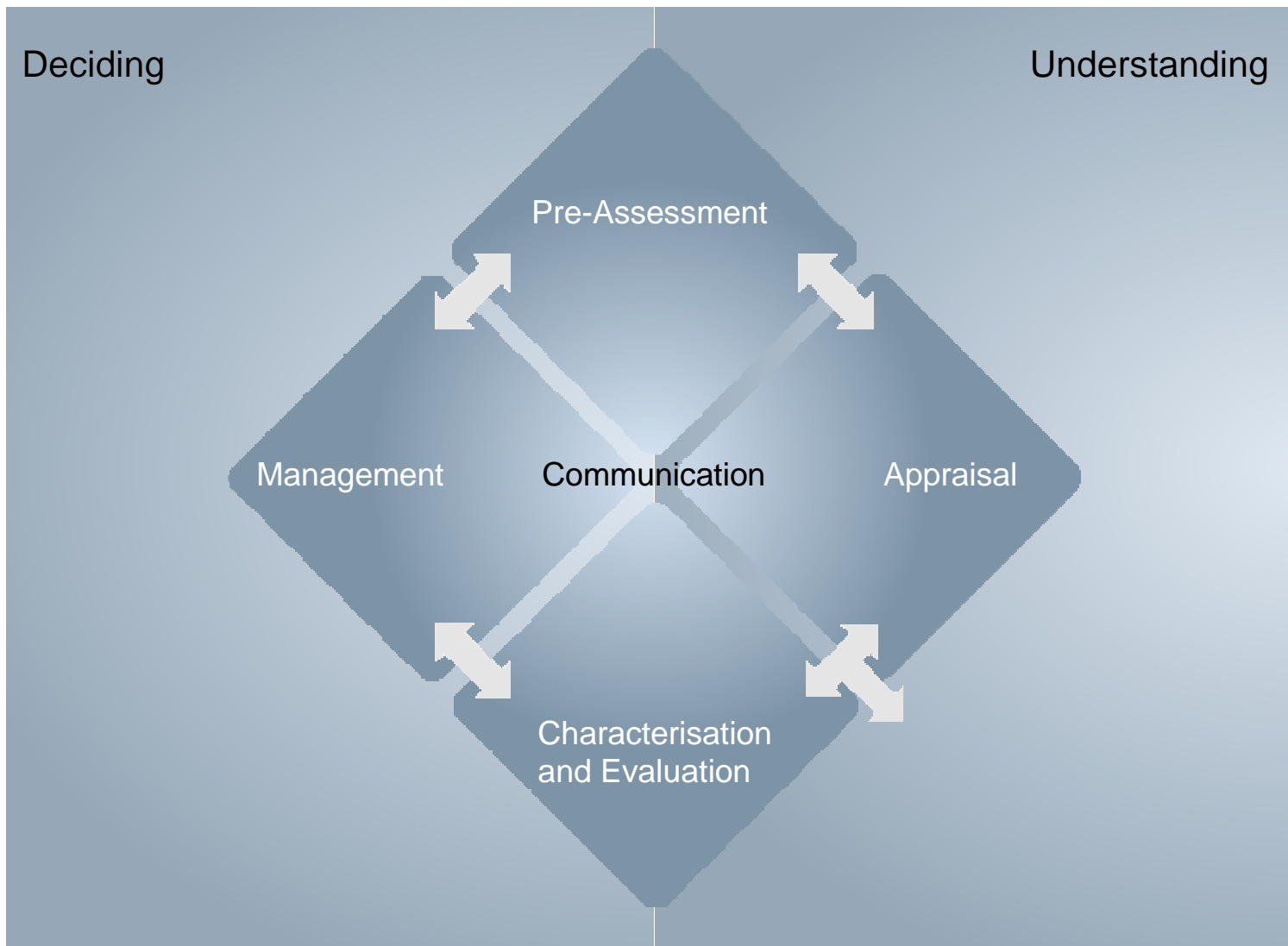
- Concept that links risk assessment with risk perception and social processing of risk
 - Avoiding relativist view of knowledge
 - Including social constructions of risks;
- Concept that links physical and environmental risk analysis with financial, economic and social risk;
 - Explore social amplification pathways
 - Look for cross-fertilization
- Concept that addresses complexity, uncertainty and ambiguity
 - Different guidelines for dealing with mixtures of CUA
 - Emphasis on inclusive governance models capable of providing adequate input to deal with CUA

Premises of Risk Governance

1. Both “real” and perceived dimensions of risk are important.
2. All stakeholders should be meaningfully involved as equals.
3. Be process-focused and principled
 - transparent, equitable, effective, efficient and accountable
4. It is based on an inclusive model of integrating governments, private sector, civil society and experts
5. It should be based on best available science and reliable and fair judgment procedures



Risk Governance Process



Part 3:
Implications

**Complexity, Uncertainty and
Ambiguity in:**

Risk Management (Phase 4)

NEED FOR DIFFERENT RISK MANAGEMENT STRATEGIES

- dealing with routine, linear risks
- dealing with *complex* and moderately *uncertain* risks (*first* order uncertainty)
- dealing with highly *uncertain* risks (high degree of *second* order uncertainty)
- dealing with highly *ambiguous* risks (high degree of controversy)
- dealing with imminent dangers or crisis (need for fast responses)

RISK MANAGEMENT STRATEGIES (I): ROUTINE AND COMPLEXITY

■ Linear Risk Management

- Sufficient knowledge of key parameters
- Little complexity, clear causal knowledge
- Standard Assessment sufficient
- Risk-benefit analysis and risk-risk comparisons as basic tool for evaluation

■ Risk-Informed Management

- High complexity of causal risk models
- Low uncertainty or only first order uncertainty
- Expanded risk assessment / need for knowledge management tools
- Emphasis on robust risk management strategies, i.e. risk standards including safety factors and dealing with ranges of impacts
- Emphasis on close monitoring of outcomes

RISK MANAGEMENT STRATEGIES (II): COPING WITH UNCERTAINTY

■ Precaution-Based Management

- High second order uncertainty
- Adverse effects plausible but quantification not reliable
- Limits of knowledge are recognizable
- Characterization of uncertainty by non-statistical means
- Goal of risk management: avoidance of irreversible effects
- Instruments:
 - Negotiation between too little and too much precaution
 - classic: ALARA etc.
 - new: containment, diversification, monitoring; substitution

RISK MANAGEMENT STRATEGIES (III): COPING WITH AMBIGUITY

■ Discourse-Based Management

- High ambiguity
- Goal of risk management:
 - to find common understanding among all stakeholders (interpretative ambiguity)
 - to find legitimate procedures of making collectively binding decisions on acceptability and tolerability (normative ambiguity)
- Instruments:
 - stakeholder involvement
 - public debate
 - risk communication

Part 4: Complementary Phase

**Implications for Risk
Communication and
Stakeholder Involvement**

RISK COMMUNICATION

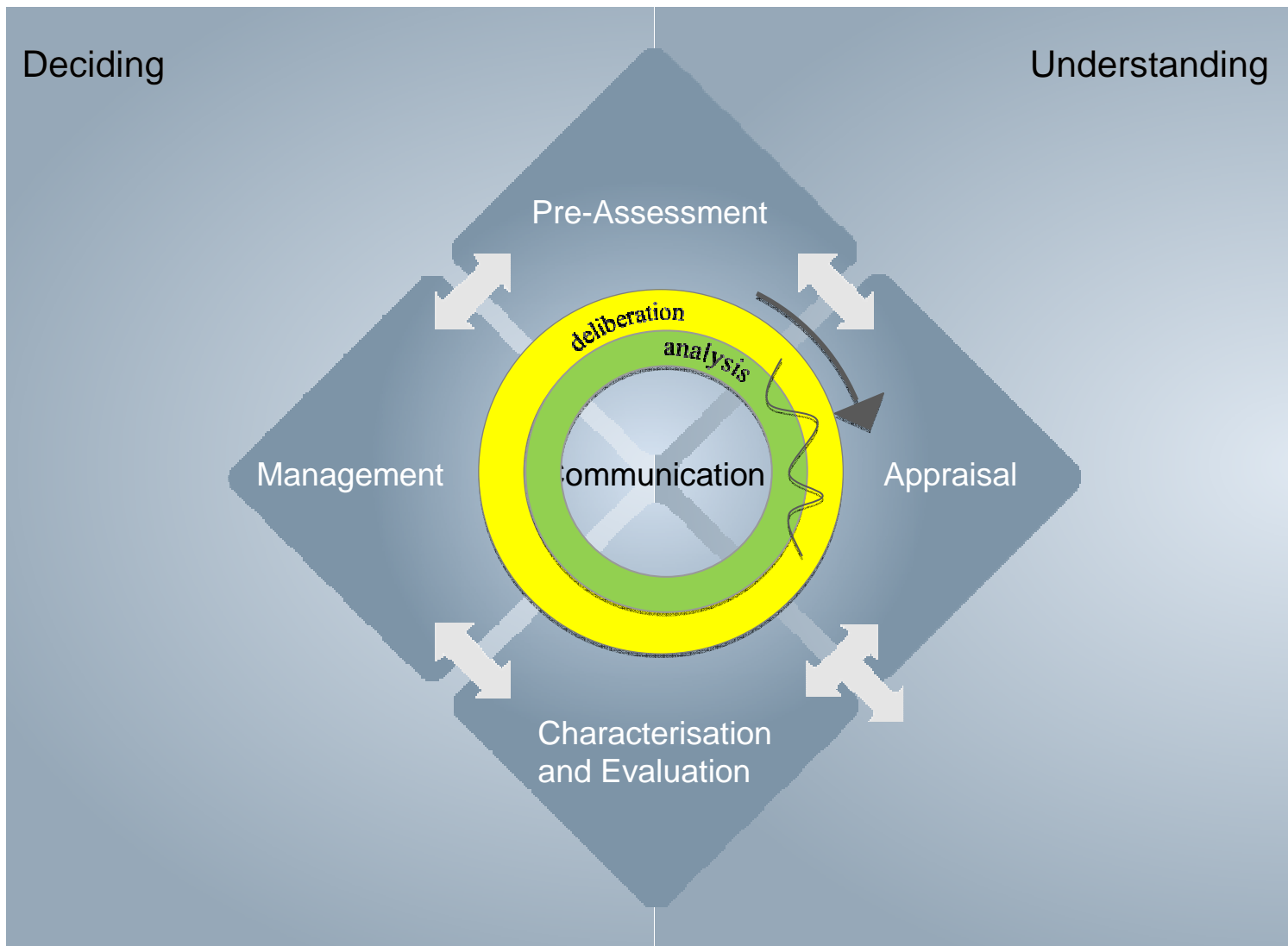
*Risk Communication takes place in all
4 Governance phases*

- **Internally (other agencies, regulatory bodies)**
- **Externally (stakeholders, media, public)**

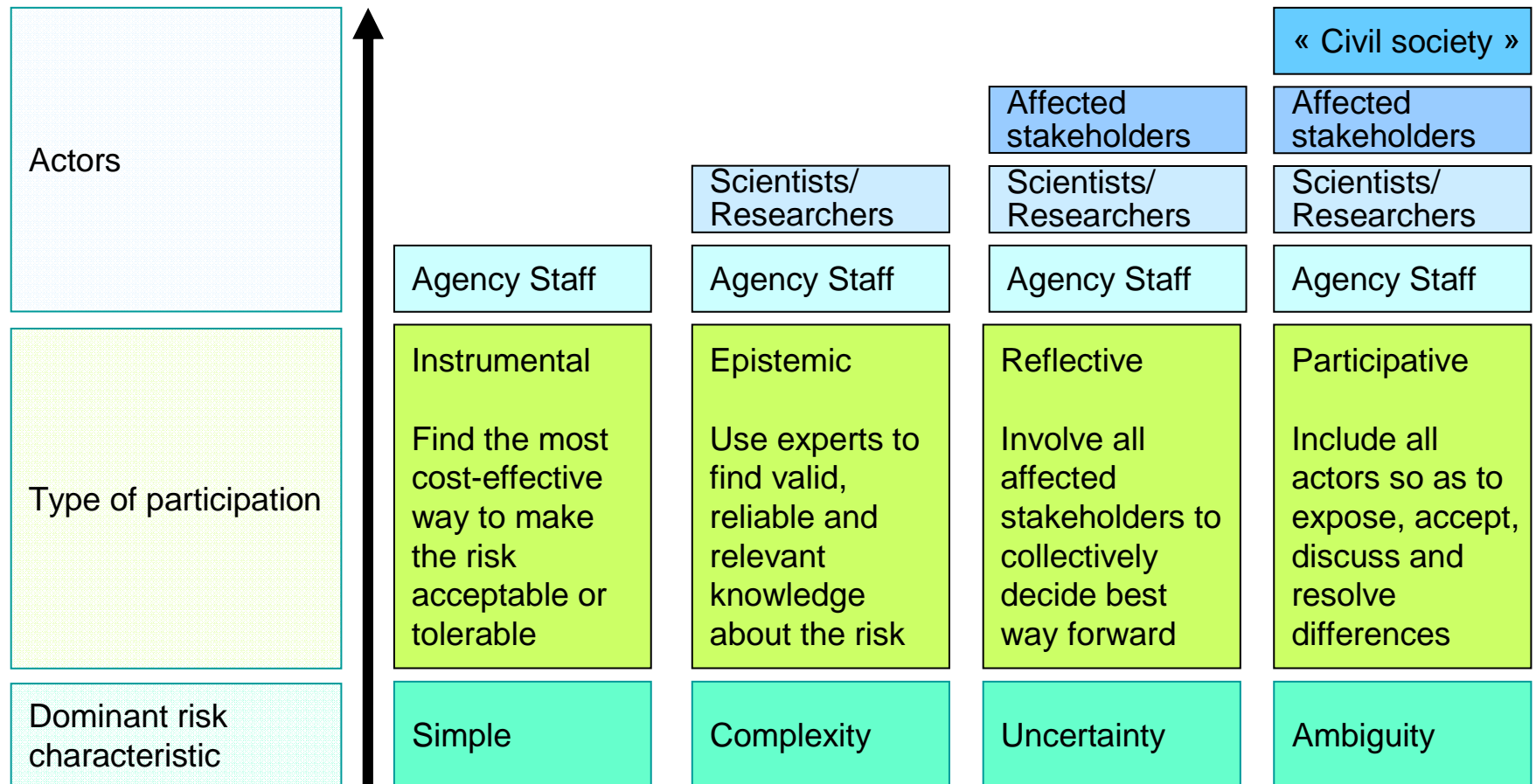
Risk Communication should match risk characteristics

- **Complexity, uncertainty, ambiguity**

Risk Governance Process



STAKEHOLDER INVOLVEMENT



As the level of knowledge changes, so also will the type of participation need to change

Part 5
Conclusions

Lessons for Risk Governance

Conclusions I

■ Problems in handling risk and uncertainty:

- Plural values and knowledge claims
- Oscillation between relativist and positivist perspectives on risk and knowledge
- Expert dissent on degree of complexity, uncertainty and ambiguity
- Low degree of distinction between complexity, uncertainty (first and second order) and ambiguity
- Social amplification and attenuation are attached to handling of complexity, uncertainty and ambiguity
- Inadequate methods to deal with different clusters of complexity, uncertainty and ambiguity

■ Emergence of systemic risk that threaten the provision of essential services and trespass national and sectoral boundaries (ripple effects)

■ Need for an integrated risk governance approach

Conclusions II

- Four risk management regimes should be used to deal with these new risk challenges:
 - linear risk management: standard risk assessments
 - *risk-informed management*: expanded risk assessments; seeking expert consensus and epistemic clarification
 - *precaution-resilience-based management*: negotiated safety level under uncertainty; seeking stakeholder consensus and relying on containment and resilience
 - *discourse-based management*: value-based orientation; seeking more public input and stakeholder involvement for interpretative variability and normative controversy

QUOTE

- “What man desires is not knowledge but certainty.”

Bertrand Russell

- Policy makers cannot produce certainty but can help people to develop coping mechanisms to deal prudently with the necessary uncertainty that is required for societies to progress