NanoTechnology Assessment

Exploring Potentials of Nanotechnologies, Avoiding Pitfalls of Ignored Risk Perception

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ITAS at a Glance

- One of more than 20 scientific institutes within the Forschungszentrum Karlsruhe (Research Centre Karlsruhe)
- Largest TA unit within Helmholtz Association (HGF), Germany's largest research organization
- Mission: Comprehensive analysis and evaluation of the development and application of technology and its interrelationship with processes of societal change
- Currently three research areas:
  - Environment and resource management
  - New technologies, innovation processes, technology impacts
  - Knowledge society, knowledge systems, knowledge policy
- Research Group 'TA for Nanotechnologies'
- Operates the TA units of the German (TAB, since 1990) and the European (STOA, since 2005) Parliament
- Member of ETEPS – The Network for European Techno-Economic Policy Support

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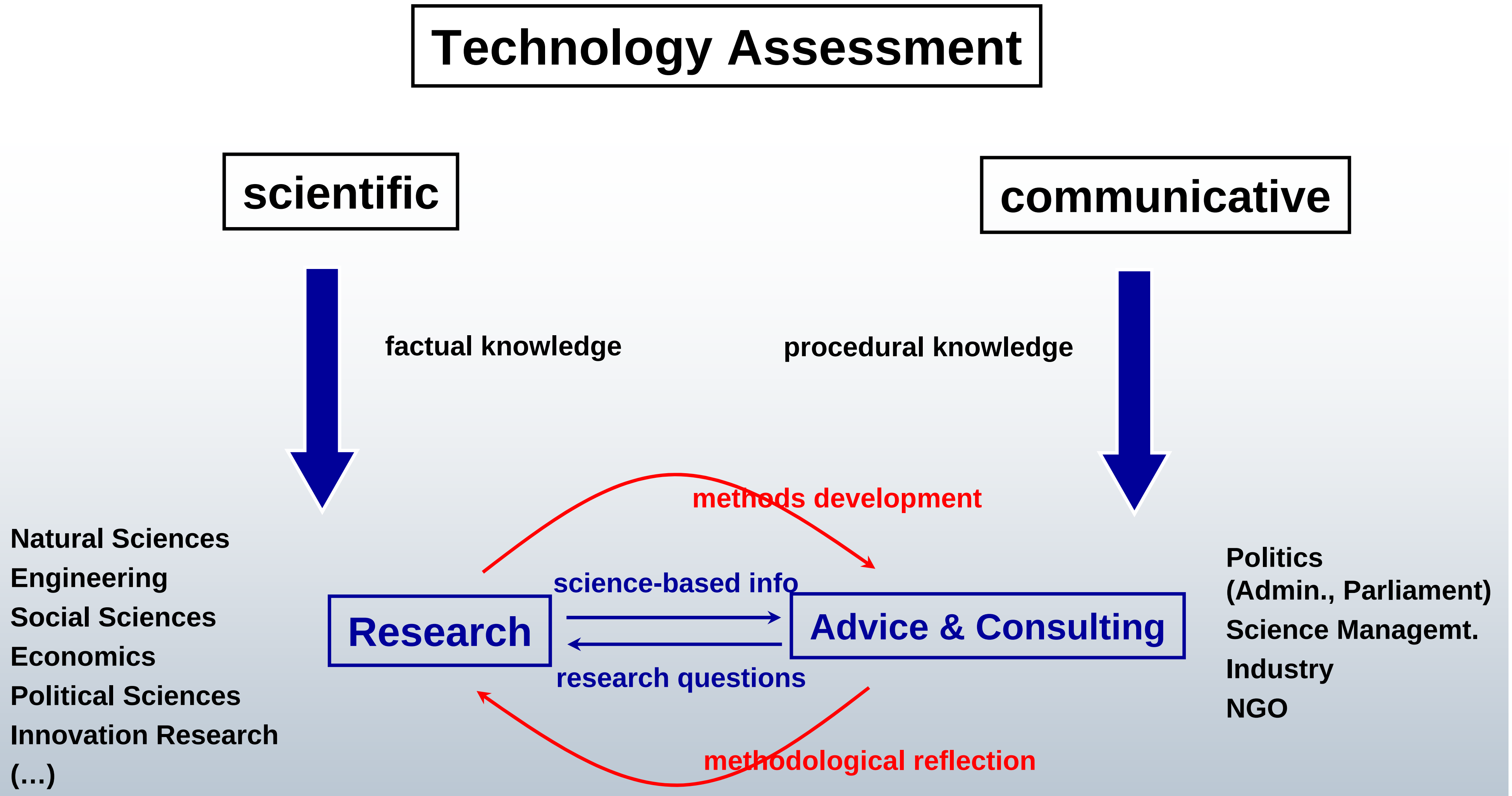
Technology Assessment – The ITAS Perspective



NanoTA at ITAS

Nanotechnology & Society

General TA & Methods
Technology Foresight
Perception & Communication

Nanoscale Materials (Nanoparticles), Toxicology & Risk

Nanotechnology for Energy Applications

Nanotechnology for Biological Applica
Converging Technologies

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Nanotechnology: Challenges for TA

- neither clear definition nor common language
- wide range of approaches, different timescales
- emerging technologies, most activities closer to science than to technologies
- mostly ‘enabling technologies’
- strategies mainly technology-driven
- analytically: a set of different technologies for different applications → no single general assessment

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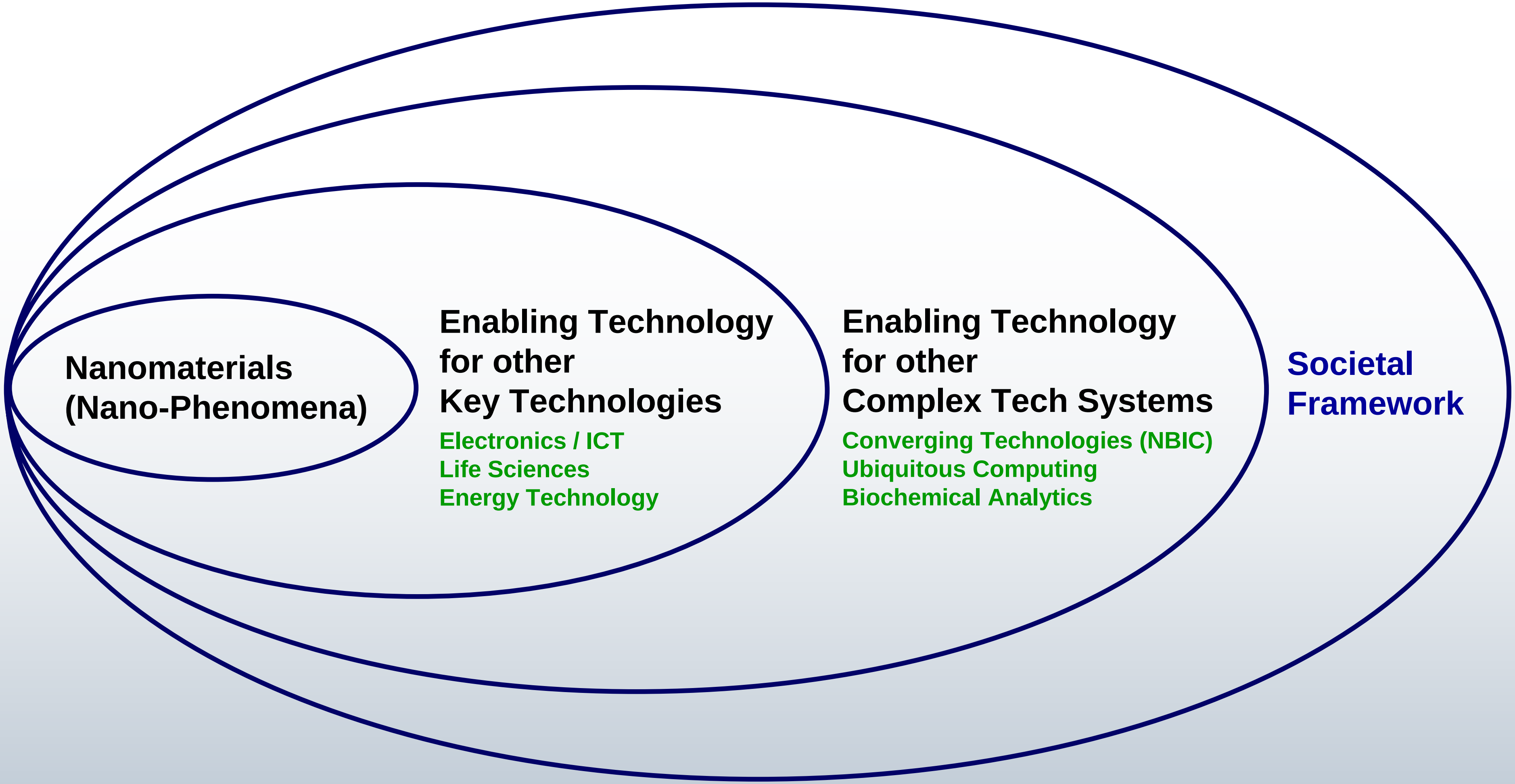
Nanotechnology – Four Layers of Interdependence



- **Various paths of interaction between NT and society**
- **Different issues for S&T policy (and TA)**

→ **necessity to link current (research) activities with future potential applications of Nanotechnologies**

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Potential Analyses for Technology Assessment

- Variety of technology forecasts, foresight reports, market studies – general or sectoral – available
- Huge market figures – questionable (methods, timescales, boundaries) but effective (politics, media, …)
- Creating a hype can establish a business – neutral positions are rare

- Since NanoTA deals with emerging enabling technologies, novel methodical approaches are needed:

  a) a tool to link R&D activities with visions for applications

  b) a 'support layer' for the technological interpretation of (political) scenarios including future technology options

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Science & Technology Roadmapping for TA

- Roadmapping methodology can be adapted for TA for emerging enabling technologies
- Traditionally used to gather, structure and communicate information about technologies and products, and to link them to options for the future in companies and industries.
- More recently used as decision aids to design public policies related to research and development (de Laat 2004).
- For NT, a number of roadmaps exists - produced by small groups of experts with a “technology push” perspective - most remain unnoticed or ignored in R&D policies
- Hypothesis: For the acceptance and the relevance of a roadmap, process aspects (design, participants, modes of communication, …) are as important as the technical product (the roadmap) itself.

→ When integrated into a TA process, roadmapping may serve as a powerful tool to provide empirical and structural knowledge and to produce consensus on strategies

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Diffusion: TA adds a broader perspective

- Diffusion / Commercialization are key to success.
- Perspectives often disciplinary (business management, engineering) but commercialization is an complex process.
- Integrated view may offer deeper insights – avoidance of failures, more coherent policies and innovation strategies
- Example: Biases in diffusion research – 'Pro-innovation' and 'Individual-blame' (E.M. Rogers)
- Underestimation of the social dimension of innovation – Need to study ignorance, rejection or discontinuance of innovation, re-invention, anti-diffusion programs
- Failure of innovation is discussed as a problem of the individual rather than from a systemic perspective but systemic failures are targets for political interventions

→ TA provides knowledge on many of these aspects, historical processes (analogies), roles and interplays of actors, …

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Public Attitudes to Nanotechnology

- **Only few empirical studies, isolated. Preliminary results. Trends seem to be similar in U.S. and Europe.**
- **General public does not know very much about nanotech**

  GB 2004: 29% have heard about NT, 19% can give some kind of definition

  D 2004: 30% have heard about NT, 15% can link it to specific developments

  USA 2004: >80 % had heard “little” or “nothing” about NT, most could not correctly answer factual questions about it
- **Majority (~90%) is not interested in NT (or does not care)**

  EU25 2005: Most interested in medicine (61%), environment (47%), humanities (30%), internet (29%), … – nano 8%.
- **Among those who are interested, argumentation of proponents often perceived as asymmetric:**
  - Developments will bring ‘revolutionary breakthroughs’ but no significant implications are to be expected
  - Benefits are attributed to ‘nano’, related risks are described as problems of application technologies

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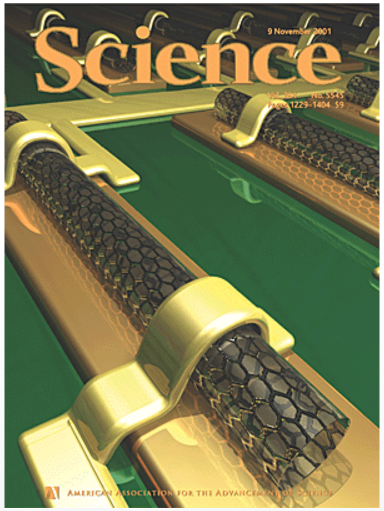
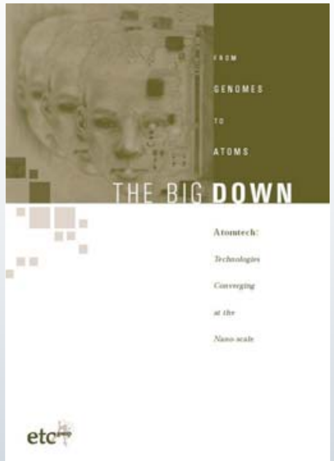
(Popular) Pictures of 'Nanotechnology'

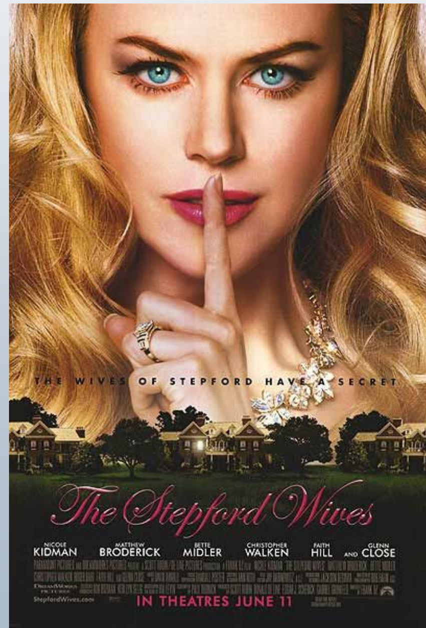


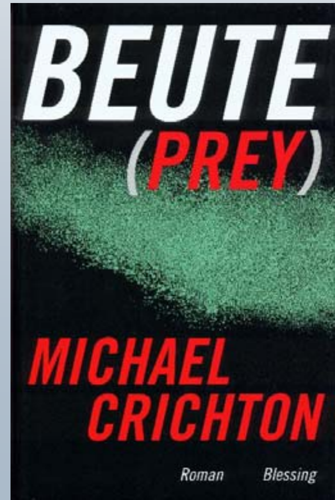

Why the future doesn't need us.

Our most powerful 21st-century technologies – robotics, genetic engineering, and nanotech – are threatening to make humans an endangered species.

By Bill Joy







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Nanotechnology – the Risk Debate(s)

Currently three layers (chronologically):

- Risks of visions: Visions show real consequences regardless of their seriousness
- Risks of unknown material properties at the nanoscale
- Risks of (failed) communication and of public engagement

Impacts of Visions

- Visions (positive and negative) are an important topic in the public communication of NT (‘Bill Joy-Debate’, visualizations in magazines, popular culture: ‘Prey’, ‘Matrix’, …)
- Visions may shape acceptance and further development of this field
- Visions are ambivalent: high potentials often include high risks

→ TA could include a ‘vision assessment’

→ Goal: transparent, knowledge-based discussion about imaginations of the future

→ Vision assessment within a TA process could prevent ‘fear of fears’ and help to avoid damages for the development of S&T and for the culture of democratic decisions

Risks of New Material Properties

- New (surprising and partially still unknown) properties of materials at the nanoscale
- Example: Behaviour of nanoparticles in the human body and the environment – extensive research needs, but already on the market
- NanoToxicology – first results, knowledge still insufficient, challenges for conventional methods of toxicological research
- „new forms of known chemicals“ or „new chemicals because of different chemistry“?

→ TA knowledge supports development of policy approaches and business strategies

→ Precautionary principle (Call for Moratorium), Regulation, preventive measures? – Balance with innovation policy? – 'Übermaßverbot (prohibition of excess)' as limiting principle

→ Examples: 'Asbestos Experience' as a parallel and warning sign, Positions and roles of (re-)insurance companies

Societal debates about Nanotechnology

- **NT attracted (some) interest from media and civil society groups, but not (yet?) from the public at large**
- **Lack of specificity of NT – open to (misleading) analogies and false generalizations – asymmetric perspectives of proponents – impact on public perception of NT?**
- **Currently, three discourses (of different types) evolve:**

  Unknown material properties and their impact on humans and the environment: Some peculiarities, but in general similar to other chemical risks – 'classic' regulatory policy debates.

  Implications of NT-enabled technologies: IT (privacy, surveillance), medicine (biopolitics, neuroethics), food technology, … – adapted TA.

  NT as another representative of 'risk technologies' in general STS debates: Societal control of science, trust in scientists, lack of influence in decision-making in S&T, …

- **Reflexive science distinguishes here, most researchers, policymakers and the media do not. Will the public?**

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Communication and Public Engagement

- Reluctance of (many) scientists to engage in public debates about benefits, challenges and uncertainties surrounding NT
- Focus on providing information and education – necessary, but not sufficient. Listen to and address public concerns.
- (Risk) Communication is mainly about trust! Balance, honesty, responsiveness. Concede uncertainties. Accept fears of unknown.
- Nanotech is what people think it is.
- Accept and involve the public as a partner, especially in discourses about potentially controversial risk issues

→ TA provides procedural knowledge on risk communication and experiences from public and political debates about other 'risk technologies' (nuclear, genetic, …)

→ TA as a process contributes to societal opinion forming, addresses public concerns, supports public understanding of science and technology

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Summary (1)

- **Innovations can be successful without previously considering their societal impacts, but …**
- **… many innovations failed because societal needs & impacts were not adequately addressed in the development process**
- **TA provides knowledge and methods to avoid mistakes, to reduce uncertainties and support diffusion:**
  - **Needs / Problems:** Identification of societal needs, problems requiring innovation, promising markets, vision assessment
  - **Basic Research:** Strategic decision-making, Strengthen national R&D capacities, Support R&D priority setting, Provide techno-market insights
  - **Applied R&D:** Investigate socio-technical feasibility, Moderate university-industry-government interactions, Coordinate National Innovation System
  - **Product Development & Engineering:** Standards policies, Government as buyer-innovator, Regulatory policy, Environmental impacts
  - **Production & Marketing:** S&T communication, Risk communication & perception, Risk Assessment, Acceptance, LCA, Consumer protection
  - **Incremental R&D:** Sustaining and adapting innovations, Create long term value

Summary (2)

- Public involvement in dialogue and risk evaluation:
  - incorporate views from the general public in decision-making, improve the knowledge base and quality of decisions
  - establish trust and legitimacy, identify issues, mediate and resolve conflicts, reduce risk of rejection
  - educate and inform
- Some issues:
  - don’t confuse stakeholders with ‘the public’
  - the ‘public’ is highly differentiated (background, values, attitudes, …) – broad consensus? – selection, evidence, legitimacy?
  - applications of NT still vague – object of engagement, foresight?
  - controversial among scientists and policymakers – boundaries between positions, recommendations and decisions?

Not consulting the public early may lead NT into a “next GMO crisis” – what forms of engagement could avoid it?

Best practices? Institutional issues? Imaginative approaches?

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Thank You