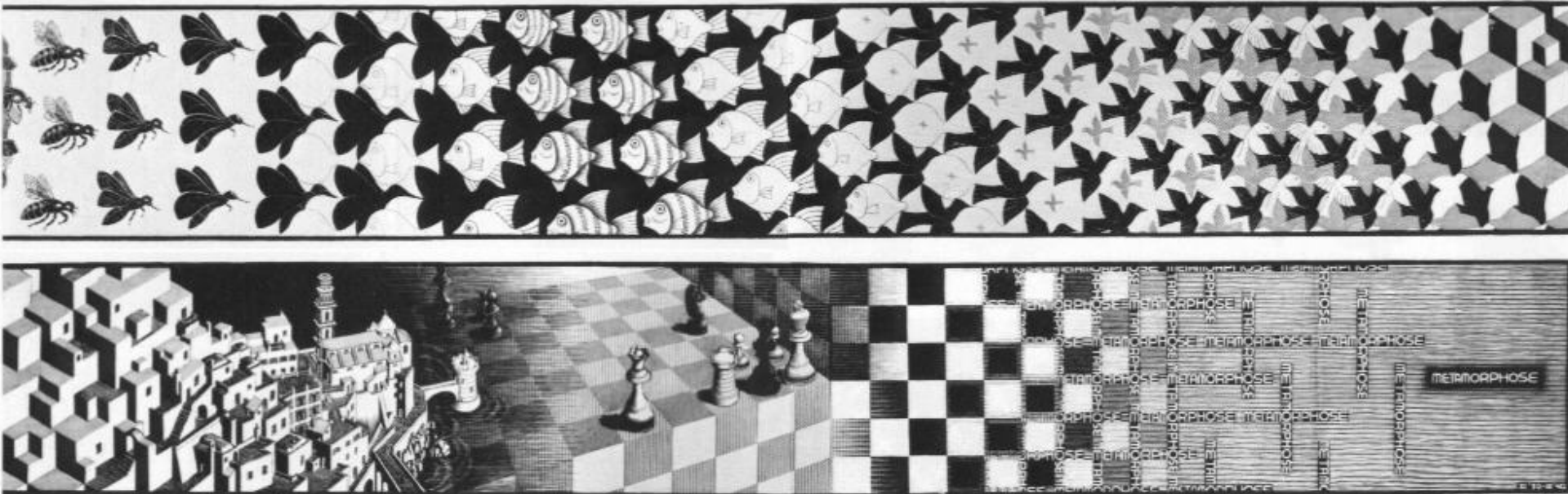# The challenge of addressing Grand Challenges

… and what universities of technology can do

Maurits Cornelis Escher, Metamorphose II (1939-40)

Stefan Kuhlmann
with Arie Rip, University of Twente (UT)
"Universities' Role and Ability to Handle Grand Societal Challenges"
Conference of Rectors and Presidents of European Universities of Technology, Gothenburg, Sweden,
19-20 September 2014

Governing Grand Challenges?

- Orientation towards Grand Challenges (GC) creates a challenge for science, technology, and innovation (STI) policies (Kuhlmann & Rip 2014)

- GC as priorities for R&D and innovation stimulation?

- GC = Manhattan Project or Apollo Project = unambiguous?

- Rather, GC pertain to **heterogeneous** elements and forces, to be mobilised, guided and **integrated**, including **social** innovation

- **GC: open-ended missions, concerning the socio-economic system as a whole, even inducing (or requiring) *system transformation* *(metamorphosis)***

Governing GC – What others say

- Need for concerted action and adaptive programming
  (JIIP Report 2012 to ERAB)

- Foray et al. (ResPol 2012, 1697) suggest that a "*range of existing mission oriented R&D programs can provide useful guidance for the design of new programs aimed at these challenges*".

- *Yet,*
  - Foray et al. (2012) focus on support for R&D support, while the government role should be conceived broader
  - Little or no consideration of role of other actors, especially charitable foundations
  - Focus still on designing to achieve a 'mission'
  - We suggest alternative approaches, such as 'tentative governance', suited to situations where mission is open-ended and will evolve over time.

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Another Grand Challenge

- Building blocks for the governance of GC:
    - GC are heterogeneous
    - Governing GC can require/induce system transformation
    - More broadly defined notion of 'innovation' required
    - Research and innovation systems are evolving and changing themselves (in long-term perspective)
    - 'Tentative governance' needed

- Thus, <u>another Grand Challenge</u>:
  How to modulate research and innovation system changes so that Grand Challenges can be addressed productively?

'Nature' of Grand Challenges?

- Strategic initiatives required to address a particular GC will depend on its 'nature'

- 'Nature' reflects what relevant actor coalitions consider as 'problem' and key points of leverage

- Definition and articulation of a GC are result of social perception, communication and negotiation

  - GC = inevitable developments, requiring *adaptation* measures
  - GC = influenceable, requiring *mitigation* measures
  - GC = *desirable* development (like better agriculture)
  - GC = *undesirable* development (like clean water shortage)

- *Scenarios* can help to explore, reflect and articulate changes and strategic initiatives

Our take on the 'other Grand Challenge'

- No one-fits-all policy approach

- Go for *tentative policy mixes, also facilitating system changes* where relevant

- Policy mixes can draw on

    - classical priority setting and implementation approaches

    - on transformation in science (systems) or breakthrough innovation

    - demand-side and procurement policies

- ... and will focus on system-oriented strategic interventions, experimental in design, including out-of-the-box approaches, new combinations of actors and alliances.

Existing policy approaches (options and limits)

- *"Business as usual" priority setting procedures*
    - Example Germany: R&D funding body develops thematic programmes (drawing on strategic intelligence-based information, foresight, brainstorming with key stakeholders), launches calls for proposals, organises selection with help of experts … *No transformative orientation!*
    - Example Netherlands: 'Top Sectors' policy with priority-setting delegated to standing panels of stakeholders (selected by government); traditional institutions and programmes have now refer to top-sector policy = *some transformation.*

- Business as usual is *decisionistic*: the problem is seen as one of defining priorities, their implementation and realisation then a matter of creating incentives.

- Actual dynamics are more complex, however.

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Existing policy approaches (options and limits)

- ***Beyond "Business as usual" priority setting procedures***
    - **Public Procurement** (beyond defense and security) to realize public goods; contract relationship, deliverables to be specified – *for some GC difficult!*
    - Technology forcing through **regulation**, as in California Clean Air Act; clean-exhaust motor cars without specifying how to meet requirements – *not applicable to all GC!*
    - Establishing **credibility pressures**, e.g. 'Green Energy'; companies expected to respond – *based on rather diffuse articulation of priorities in society.*
    - In distributed situations, **concertation** – e.g. through road mapping exercises or Joint Technology Initiatives – *can help to articulate GC.*

Existing policy approaches (options and limits)

- ***Concerted policy initiatives***
    - Historical examples: US 'Grand Missions', with 'Green Revolution', next to gov't also strong role of Rockefeller Foundation; UK Wellcome Foundation supporting innovative R&D approaches
    - More recently, e.g. Bill and Melissa Gates Foundation with focus on health in developing countries
    - German Government's 'High Tech Strategy'; 10 'future projects', defined broadly enough to allow for flexibility and inclusion - substantial coordination among many actors, with leading role of gov't
    - European Innovation Partnerships, e.g. on Active and Healthy Ageing, with all actors in innovation cycle, from research to adoption; task of independent mission-driven agency
- Here, gov'ts take responsibility for **'directed facilitation' of variety of actors**

System transformation: a scenario-based approach

- 'Research and Innovation Futures 2030 (RIF)' project (2012-14): landscape of science and innovation is changing within two decades (new sponsors; new roles for intermediary organisations and spaces; science institutions and disciplinary organisation replaced, partly because of new ICT, by new knowledge production communities; request for social innovation; etc.).

- In RIF, a scenario approach allowed to address multi-actor and multi-level complexity of trends, tensions, and transformative change.

- http://www.rif2030.eu/

System transformation: a scenario-based approach

A policy transition scenario

- 2015: Governments address GC in new public management style of specifying objectives, offering resources and monitoring performance.

- Soon clear that unable to meet complexities of GCs this way: also faced with transformations of science, of science in society, and growing importance of new sponsors, while burden of expenditures is heavy.

- In late 2010s UK gov't decides to limit research & innovation expenditure drastically and focus on few priorities only. Gov'ts worldwide follow.

- Public-private set-ups, charitable foundations and some firms join consortia for GC, with participation of few govt's trying to 'orchestrate'. Champions of other GC follow this as model.

- In the 2020s, **addressing GCs had moved from a gov't responsibility to an integral part of the functioning of transformed research and innovation systems.**

Coping with the other Grand Challenge

- Major **public-private initiatives** coping with the transformative potential of a GC need a 'tentative' concept of governance.

- **Tentative governance** is designed, practiced, exercised or evolves as a particularly dynamic process to manage interdependencies and contingencies in a non-finalizing way; rather prudent and preliminary than prescriptive and persistent.

- It creates **spaces of openness, probing and learning** instead of trying to limit options for actors, institutions and processes.

Coping with the other Grand Challenge

- Yet, while tentative governance helps actors to articulate the nature of "their" GC, there is nobody responsible for overall coverage and **coordination with other GCs**.

- Here one could draw on the possibilities of the presently fashionable notion of **Responsible Research and Innovation** (RRI).

- The governance of RRI is still **evolving**, part of its task could be to create spaces to consider the set of GCs to address; see FP7 "Res-AGorA – Governance framework for Responsible Research and Innovation (RRI)" (Walhout & Kuhlmann 2014).

ResAGorA
Governance frameworks
for Responsible Research
and Innovation
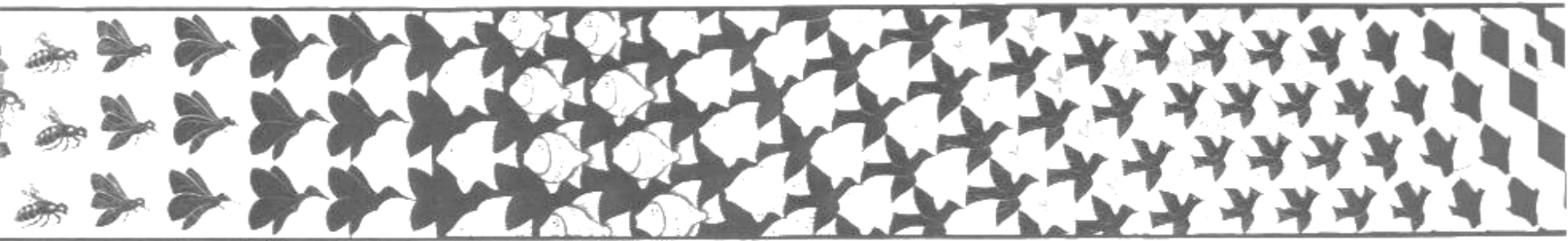
Consequences for universities
(of technology) ?

History of universities (of technology) as change agents

Examples:

- "*École polytechnique*" in France (1794), other "*Grandes Écoles*"
- Technical colleges/universities in Germany (Braunschweig 1745; Karlsruhe 1825; Munich1868; Aachen 1870; Berlin 1879; others)
- *"Royal Academy for the education of civilian engineers, for serving both nation and industry, and of apprentices for trade"* in Delft, NL (1842); Polytechnic School of Delft (1864)
- Land-grant universities in US (1862+) focusing on teaching of practical agriculture, science and engineering (Rutgers; Michigan State; UCLA; Cornell; MIT; more than 100)

- **Dedicated economic and societal missions (e.g. F. List, 1856)**

- **Several universities with strong societal and economic outreach**

Consequences for universities (of technology)

- Europe's universities (of technology) can play an essential and unique role in addressing grand challenges:

  - Increased **funding** of mission-oriented research is important but **not enough** to mobilize their creative potential.

  - They should also *"address a number of strategic issues cutting across their principal missions of educating, performing research, increasing access to knowledge and providing independent expertise to society"* (Foray, ResearchEurope 5, 2014, 7).

  - *"The role of social sciences and humanities is not simply to help science and business reduce public resistance; these disciplines are central parts of the knowledge required to address grand challenges"* (Foray 2014, 7).

Example: Atlas University College

- **Atlas University College – Academy of Technology and Liberal Arts & Sciences,** University of Twente

  - ATLAS offers the only Honours Bachelor's programme in the Netherlands combining Technology with Liberal education.

  - ATLAS: Taking a unique approach to engineering education aspired to educate different kind of engineers and global citizens capable of addressing global challenges and designing solutions in a wide range of social, cultural and political contexts.

  - ATLAS selects students who are driven by technology, but are also socially engaged.

    http://www.utwente.nl/en/education/bachelor/programmes/atlas-university-college/

Example: DesignLab, Univ. of Twente

- DesignLab is a creative and cross-disciplinary 'ecosystem' connecting science and society through design. (http://www.utwente.nl/designlab/)

- Faculty and students from all fields work together with companies and governments on societal design challenges of our times, inspired by novel scientific insights.

- Talents from engineering, natural science, social science and the humanities join forces to take on the *wicked problems* of tomorrow's world, using their creativity to bring science to design for society.

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Example: TUM's Munich Center for Technology in Society (MCTS)

MCTS focuses on interface between sciences, technology and society from three perspectives

- **Science & Technology Studies**: Social science and humanities – philosophers, historians, sociologists, political scientists and psychologists – investigate social dimensions of science and technology <u>together</u> with engineers, natural scientists, and physicians.

- **Ethics & Responsibility**: Ethics experts specialized in business, medicine, environment and technology analyze research and technical innovations.

- **Media & Science**: Communication and media experts and museum educators investigate ways to promote dialogue between the world of research and society at large.

- http://www.mcts.tum.de/en/about-mcts/

Governance tasks for universities (of technology)

- GC-oriented universities should foster **interdisciplinary collaboration** (also between techn. and social sciences) …

- … with room for problem-oriented exploration, experimentation, and critical reflection in research and education about the contribution of technological innovation to meet societal challenges.

- This includes the **study of the "governability"** and options for the management of innovation.

- **Education** (under-grad, grad, post-grad): <u>Design</u> orientation and <u>entrepreneurial</u> spirit has to be fostered.

Governance tasks for universities (of technology)

- **University leadership** needed: committed to societal challenges, experimental, tentative, entrepreneurial.

- Inter-institutional **strategic partnerships** between (technical) universities and with other partners in society and industry will strengthen research and innovation.

- **Universities (of technology) and their networks should make their voices heard in society, politics and policy-making
– as avant-garde institutions of knowledge-based responses to GC .**

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