Systemic Foresight Methodology

Advancements in theory and practice

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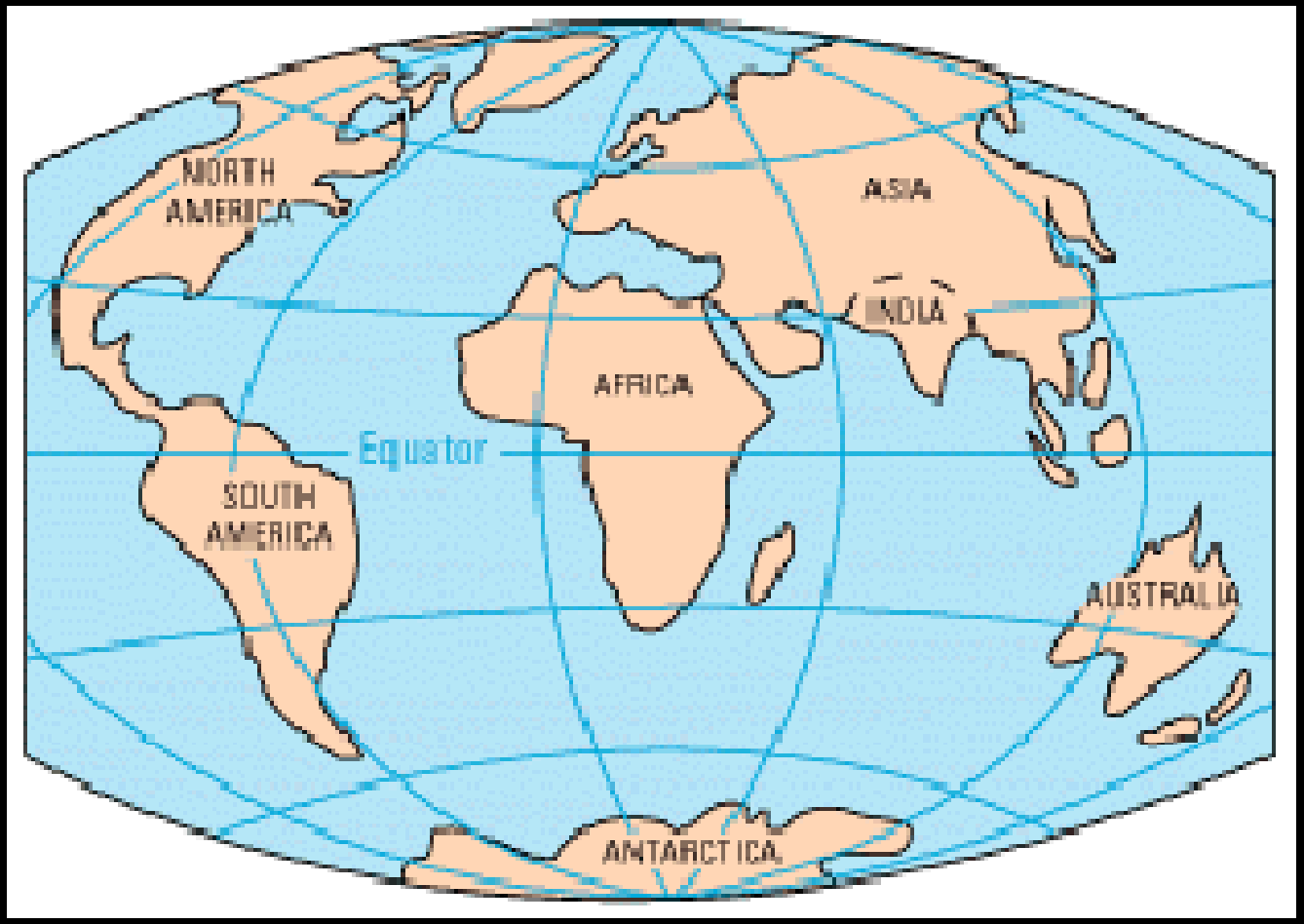

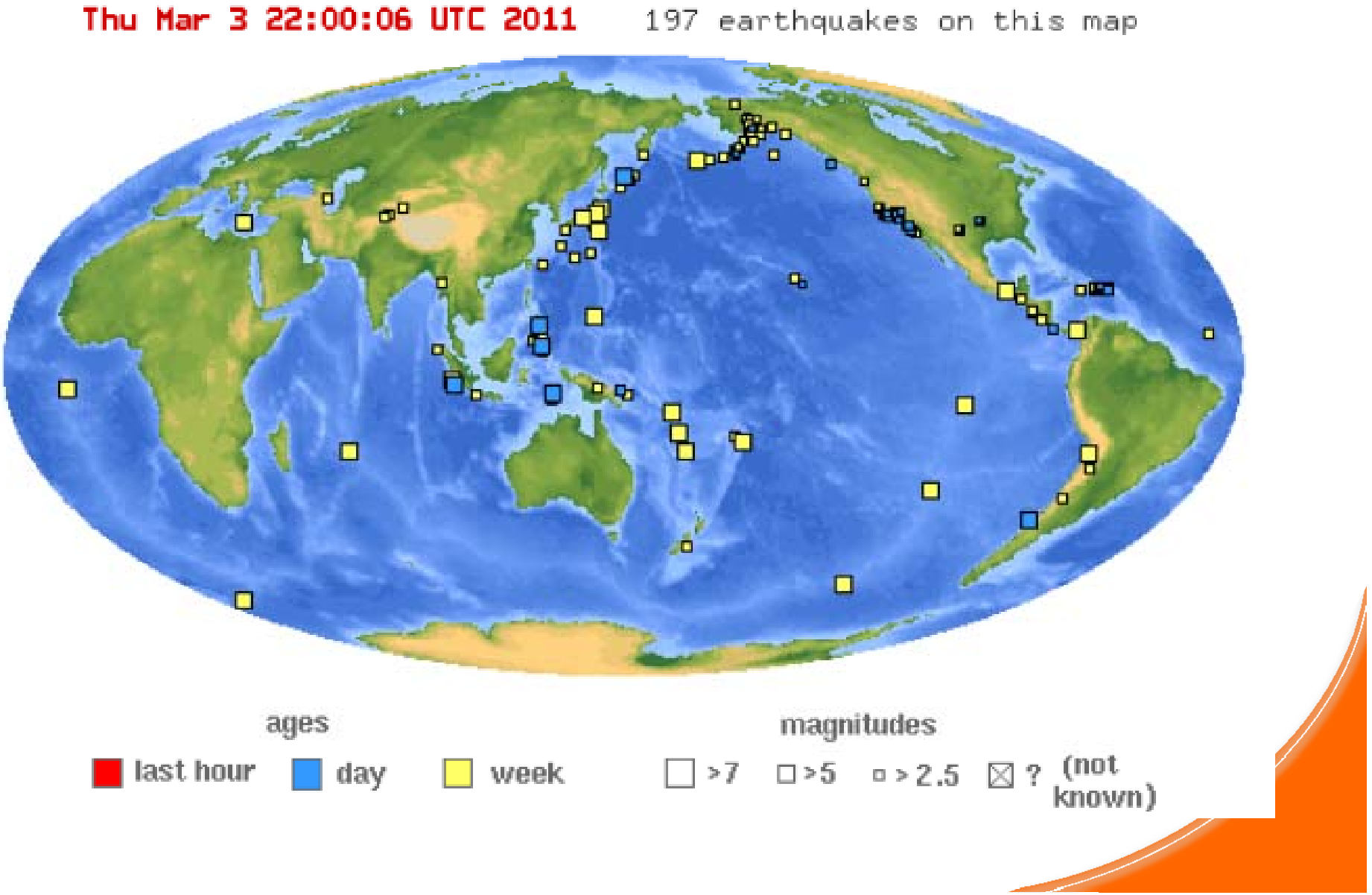
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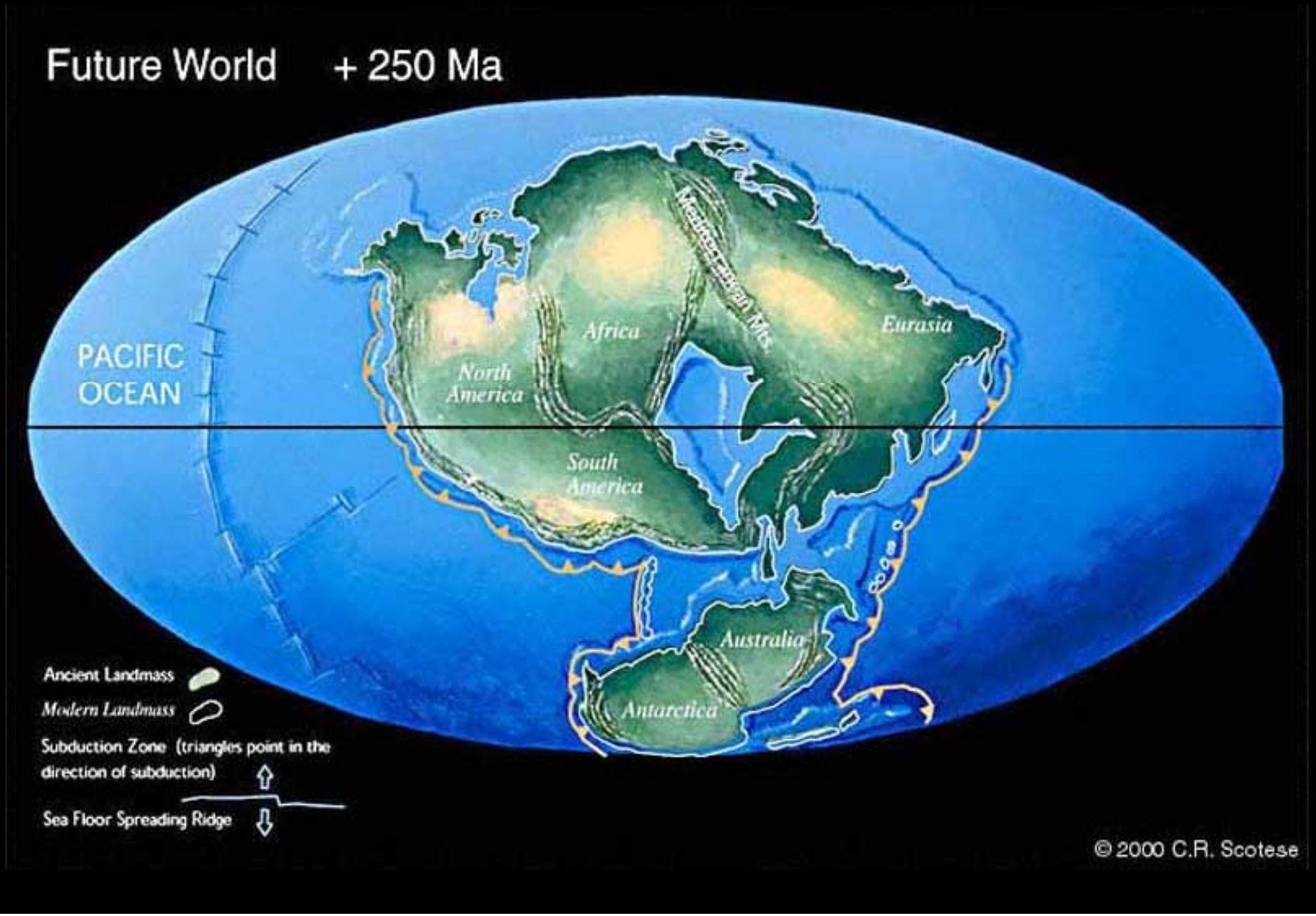
Can you recognise your country?



Everyone has bad mornings. You wake up late, you stub your toe, you burn the toast...but for a man named Arthur Dent this goes far beyond a bad day. When he learns that a friend of his is actually an alien with advanced knowledge of Earth's impending destruction, he is transported off the Earth seconds before it is exploded to make way for a new hyperspace motorway...

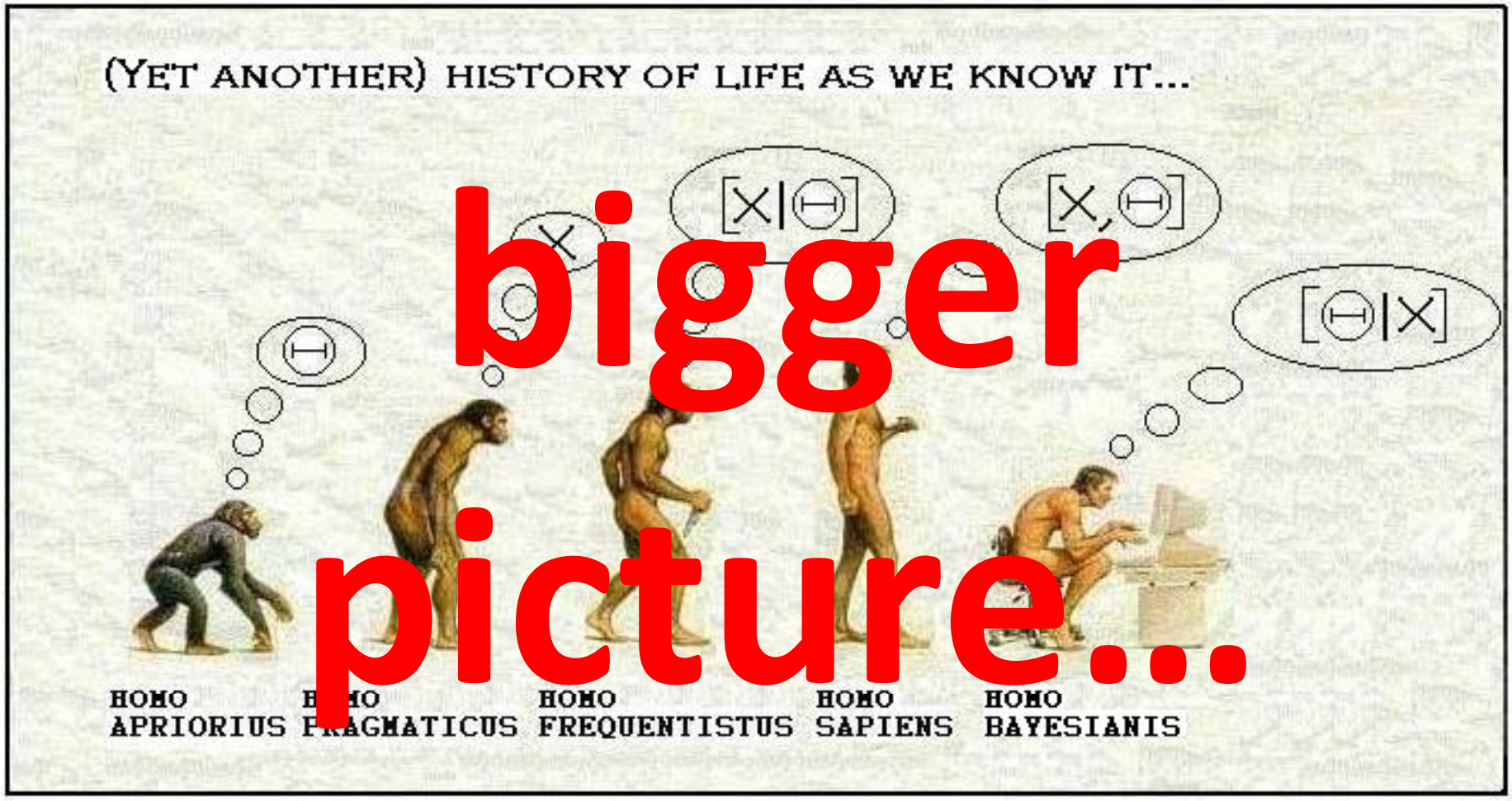
the biggest picture...

Time spans of change

200-year Present	Ideal timeframe for cultures in transition A time with which generations are linked Enough to develop intergenerational biography and dialogue The rise and fall of cultures, empires and entire ecosystems Macro view of history; the panorama of the centuries
100-year Present	Boundary of a single lifetime Long cycles can be distinguished The rise and fall of regions, industries and ecosystems Theories and history and futures begin to flourish
50-year Present	Incorporates some major concerns of a technologically advanced culture Culturally significant period to understand trends and change processes Enough to judge the impacts and implications of existing and new technologies
20-year Present	Cycle of generations for human beings: (Veterans, 1922-1943); (Baby Boomers, 1943-1960); (Generation Xs (1960-1980); The Nexters (1980-2000) Long enough to observe the economics and social impact of strategic R&D activities, e.g. the identification of CFCs scientifically and the sign of the international contract to take precautionary measures (1974-1990)
10-year Present	Sizeable chunk of a human lifetime Long enough to provide insight into dynamic processes Ideal for noting environmental and ecological factors A reasonable horizon for testing new products and services The time it takes to plan and build major infrastructure items
1-year Present	The time it takes planet earth to circle the sun once Cycle of seasons Unit of time measurement for human lives Farming and crop rotation

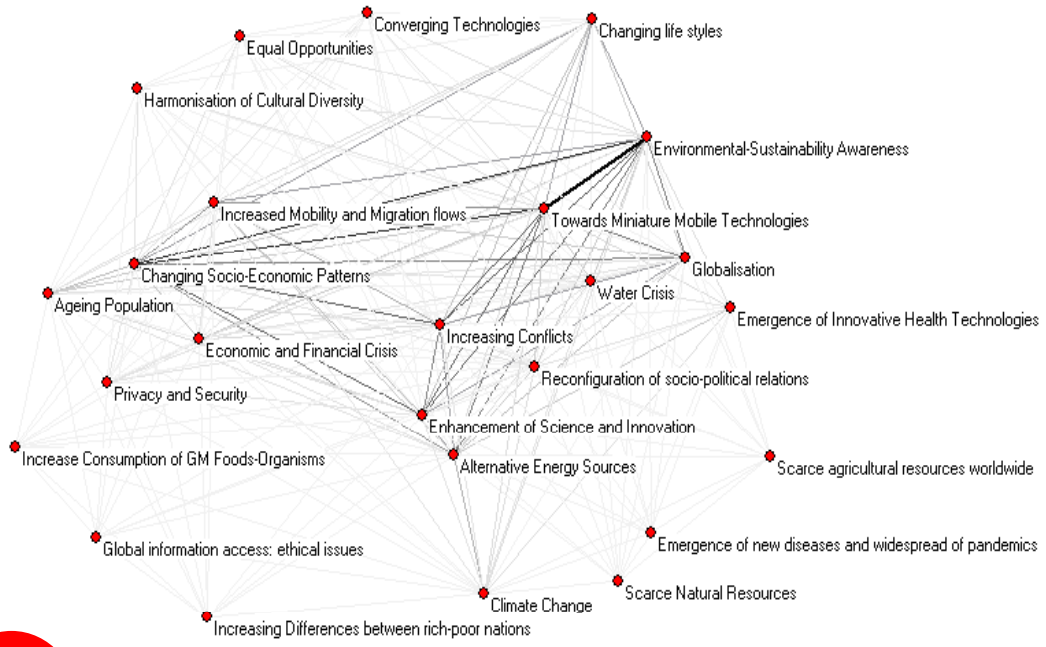
Accelerating change?

Generations Ago	
100,000	Speech
750	Agriculture
500	Writing
400	Libraries
40	Universities
24	Printing
16	Accurate Clocks
5	Telephone
4	Radio
3	Television
2	Computer
1	Internet/e-Mail
0	GPS, CD, WDM



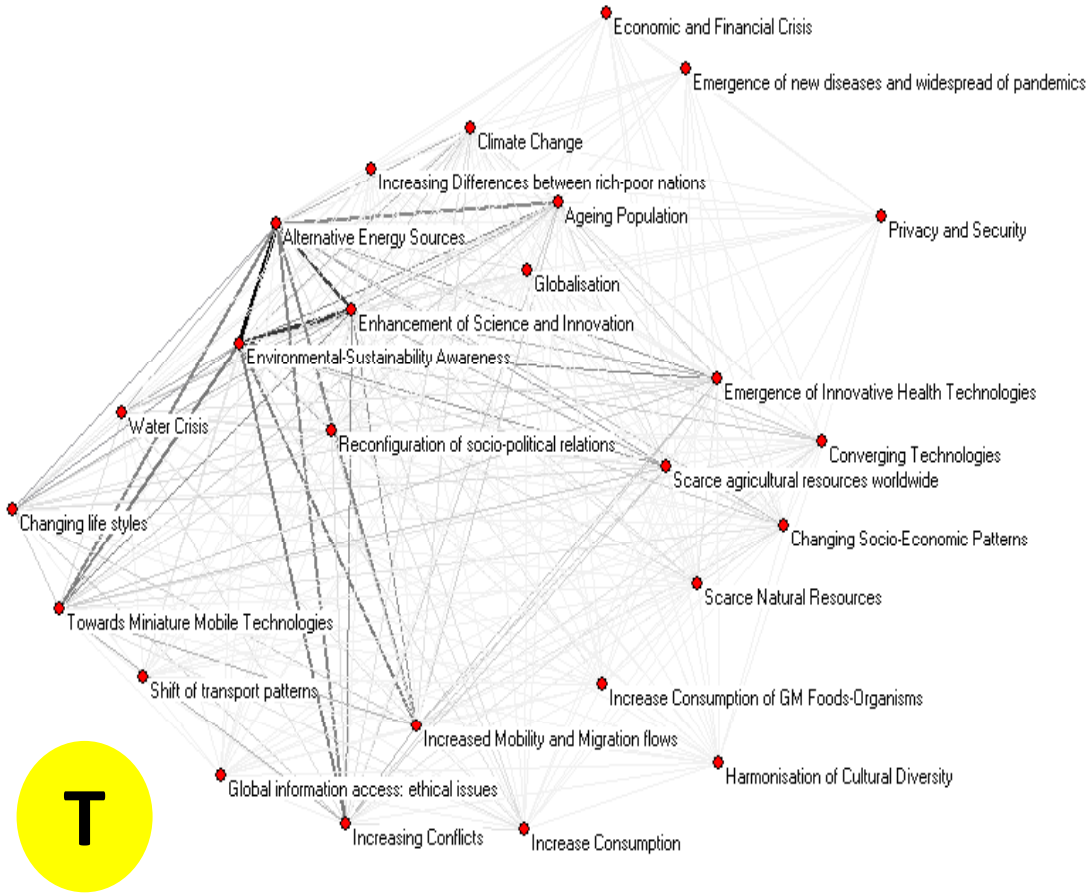
bigger picture...

BPS2008 – Network Analysis of trends by world regions



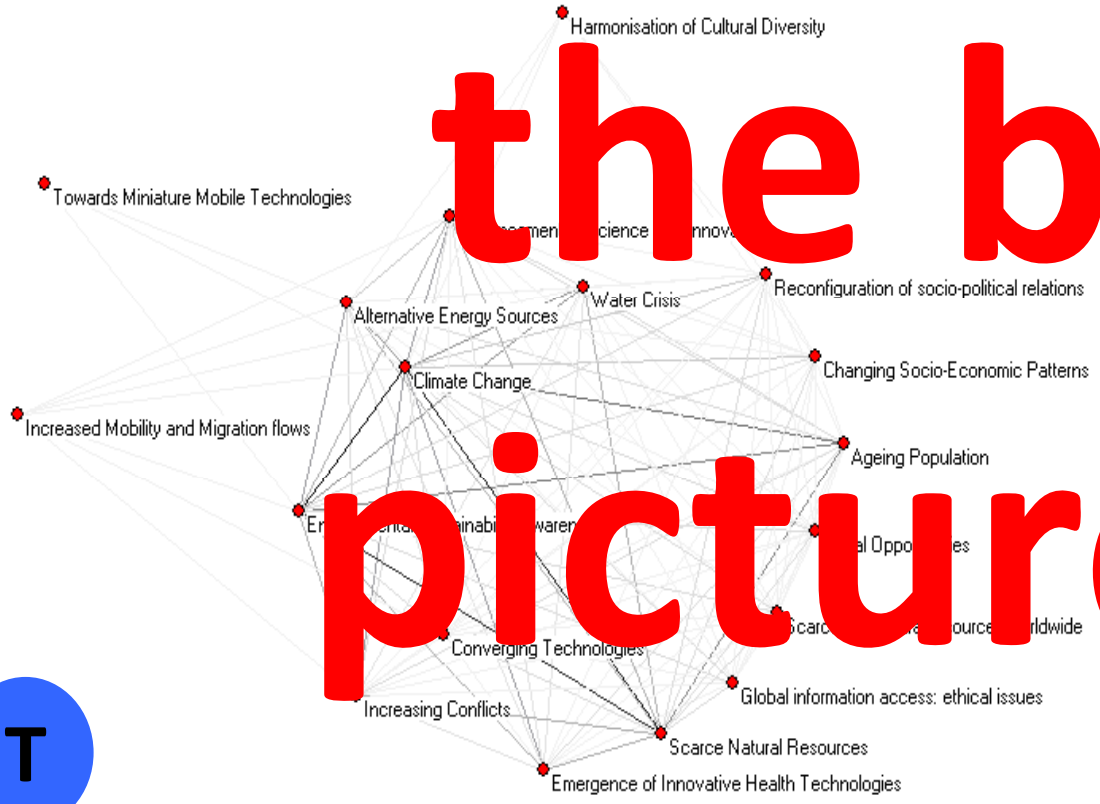
- **2008-2015**
- Environmental and sustainability concerns are shared by all
- Changing socio-economic patterns and environmental and sustainability concerns are tightly linked
- Financial crisis close to the core issues

BPS2008 – Network Analysis of trends by world regions



- **2016-2025**
- The relationship between environmental and sustainability concerns, alternative energy sources, and the role of S&T is emphasised by all
- Ageing population is a more shared concern
- Financial crisis becomes more peripheral for world regions

BPS2008 – Network Analysis of trends by world regions



the big picture...

- **2025 - beyond**
- Climate change is right at the centre and becomes appreciated by all world regions
- More emphasis on the scarcity of natural resources
- No mention of financial crisis, globalisation, and new diseases and pandemics

Foresight – ’50s to ‘90s

- **‘50s:** The principles of trend extrapolation and social indicators, and the methods of expert analysis (e.g. Delphi & cross-impact). First computer simulations become well-known
- **‘60s:** Narrowly focused technology-oriented forecasting activities – the probabilistic assessment of what is likely to happen in the future
- **‘70s:** Change in the understanding of forecasting due to increasing complexity and uncertainty of societies and economies (e.g. unpredicted oil shocks in the ‘70s)
- **‘80s:** Multiple futures thinking, participatory activities, where both processes (i.e. networks, tacit outcomes) and products (i.e. codified outputs) were given emphasis
- **‘90s:** Foresight for **S&T policy making** by government, industry and other organisations

Foresight – 2000s

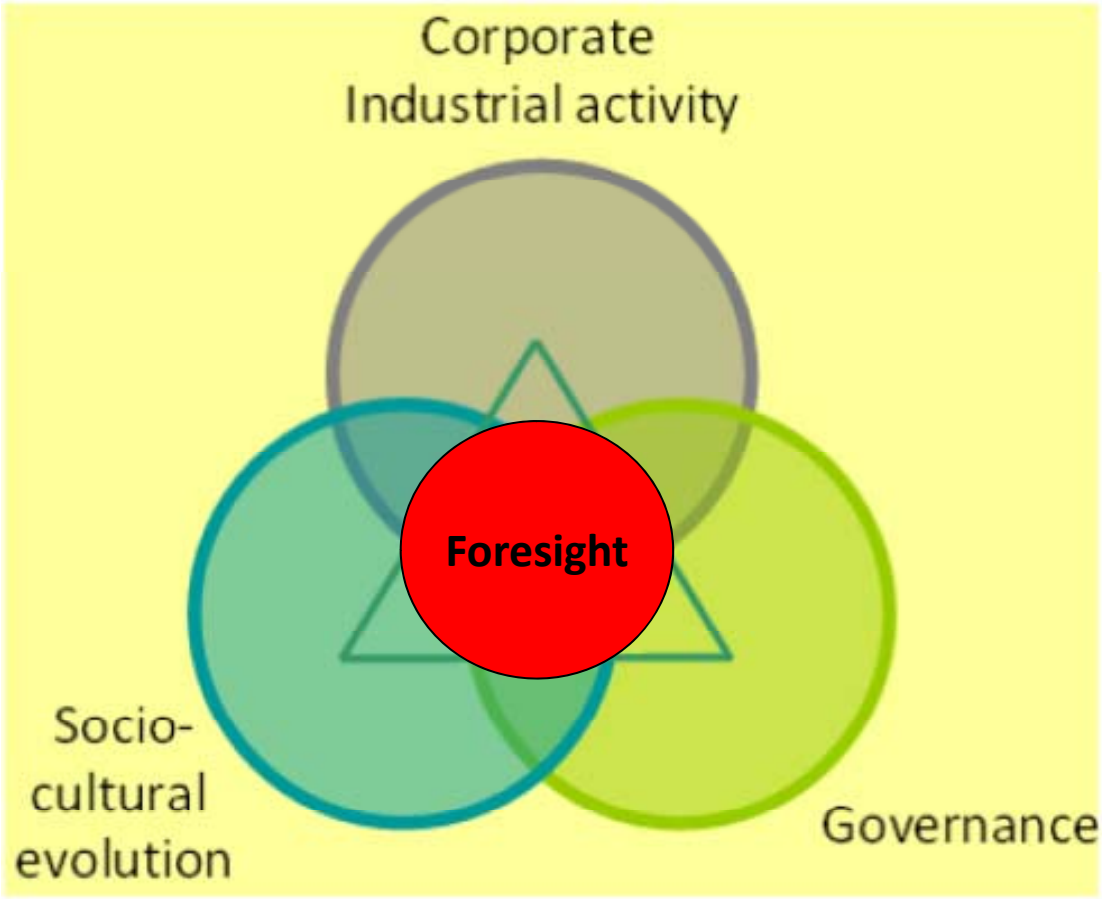
- Change in the S&T dominated appearance with increasing concerns on social aspects due to:
  - **The increasing importance of innovation** (both technological and organisational)
  - **The development of service economies.** Considerable portions of economic activity, employment and output have started taking place in service sectors of the economy
  - **Other developments** including globalisation, changes in demographic structures and in cultural practices, and environmental affairs
  - **Recognition of the close relationship between S&T and society**

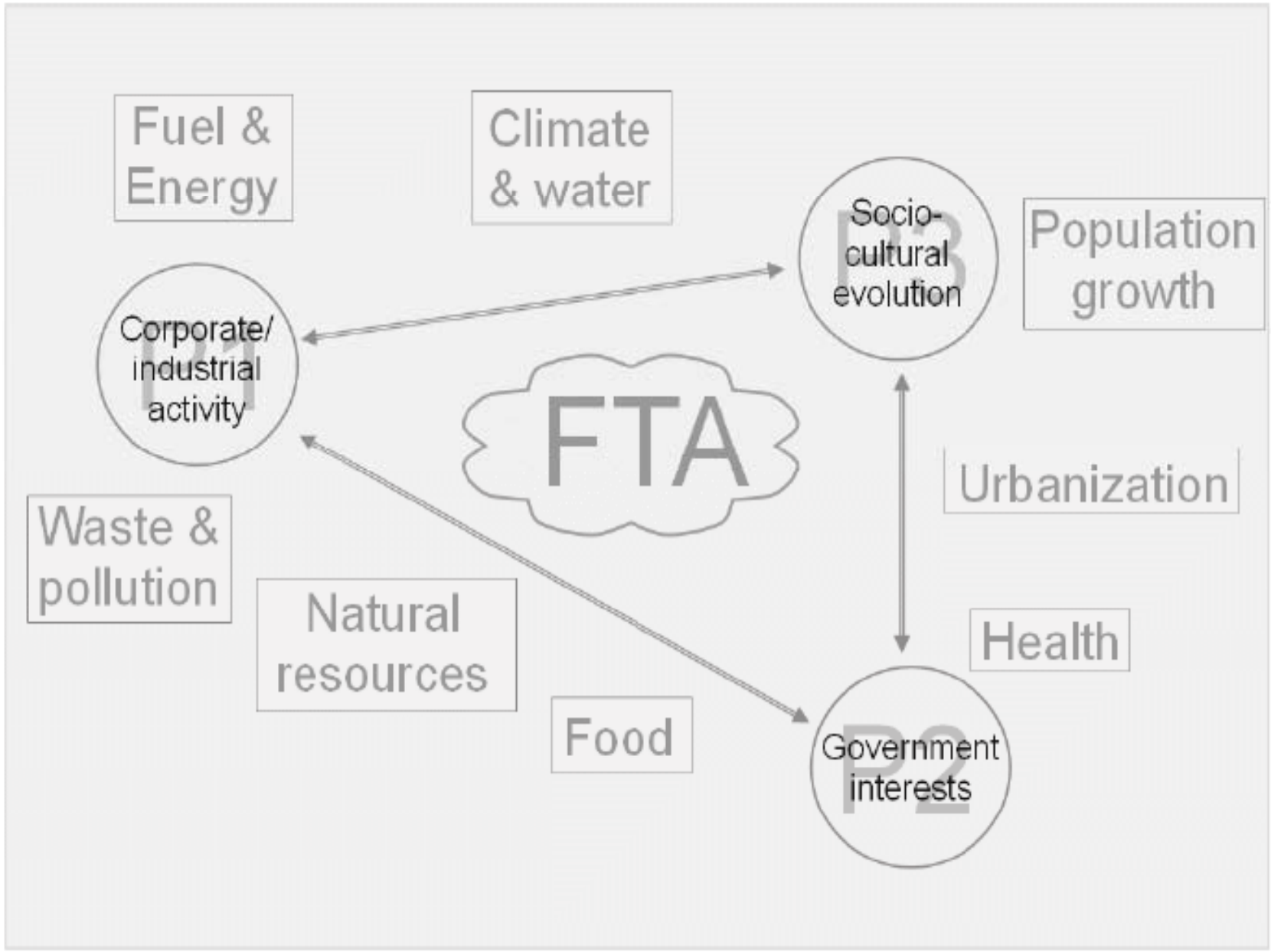

Trends
Drivers
Demand for certain products or services changes and thereby shifts
DAILY NEWS
Weak signals
Wild cards
GENOMES to LIFE
Protect workers and the public
Apply knowledge of microbial functional capabilities
Weak signals
If artificial intelligence is achieved and widely deployed (or if they can reproduce and improve themselves) calls may be made for human rights to be extended to robots. If so, this may be balanced with citizen responsibilities (e.g. voting, paying tax). A push for robots' rights may clash with owners' property rights.

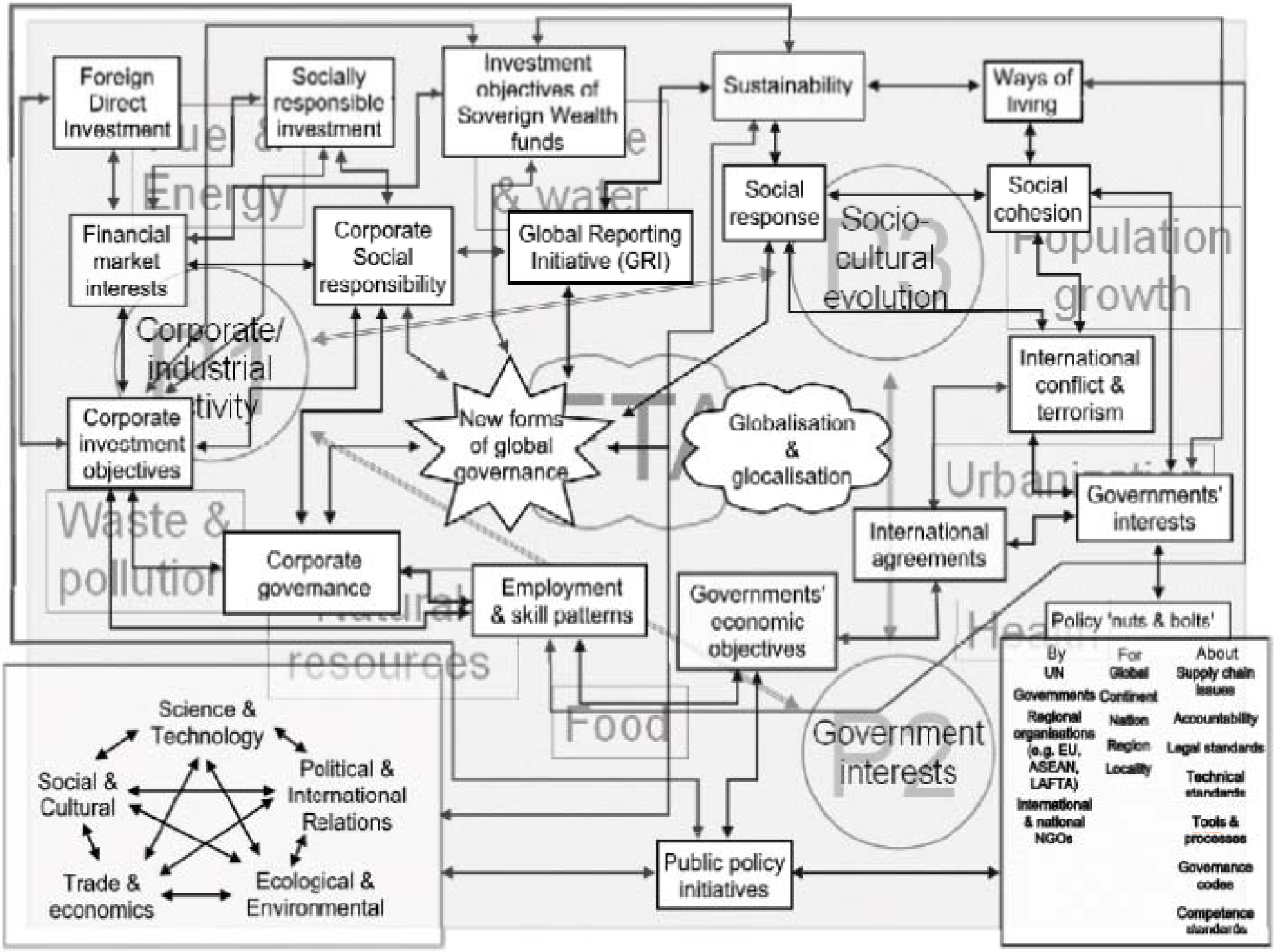
New global context & challenges for Foresight

- Increased financial, trade and investment flows
- Rapid and accelerating technological progress; ICTs, biotechnology, fuel cells, nanotechnologies
- New international regulations and standards on trade, quality, labor, environment, intellectual property rights
- New systems to design, produce, distribute, and manage products and services
- Global value chains and production networks

New Foresight landscape




Fuel & Energy
Climate & water
Socio-cultural evolution
Population growth
Corporate/ industrial activity
FTA
Urbanization
Waste & pollution
Natural resources
Health
Food
Government interests


Foreign Direct Investment
Socially responsible investment
Investment objectives of Soverign Wealth funds
Sustainability
Ways of living
Financial market interests
Corporate Social responsibility
Global Reporting Initiative (GRI)
Social response
Socio-cultural evolution
Social cohesion
Corporate/ industrial activity
Corporate investment objectives
New forms of global governance
Globalisation & glocalisation
International conflict & terrorism
Corporate governance
Employment & skill patterns
International agreements
Governments' interests
Governments' economic objectives
Policy 'nuts & bolts'
Science & Technology
Political & International Relations
Social & Cultural
Trade & economics
Ecological & Environmental
Public policy initiatives
Government interests
By UN Governments Regional organisations (e.g. EU, ASEAN, LAFTA) International & national NGOs
For Global Continent Nation Region Locality
About Supply chain issues Accountability Legal standards Technical standards Tools & processes Governance codes Competence standards

Key requirements for Foresight

- **Understanding**
  - Increasing interrelationships and interdependencies and thus more complex and uncertain situations
  - Introduction of thought experiments for understanding, appreciation and modelling
- **Multi-context focus**
  - Understanding real-life systems and natural settings
  - Long-term focus with intelligence gathering to explore novel ideas and avoid shocks
- **Inclusivity**
  - Participation of all stakeholders on equal terms
  - Involvement troughout whole process
- **Methodological support**
  - Introduction of thought experiments for understanding, appreciation and modelling
  - Integration of best practices, methods and tools

System

- System
  - "*A set of elements connected together which form a whole, this showing the properties which are properties of the whole, rather than properties of its component parts*" (Checkland, 1981, p.4).

- Systems Thinking: Viewing 'events' as a system and/or part of larger systems

Causality

- The effect of one or more system elements on the properties or on the behaviour of the other(s)
- Due to interrelatedness and interdependency between system elements, systems have some characteristics or behavioural patterns that cannot be exhibited by any of its subsets

Holism

- The whole is more than the sum of its parts
- The parts cannot be considered in isolation from the whole
- The behaviour of the system cannot be understood independent from its context

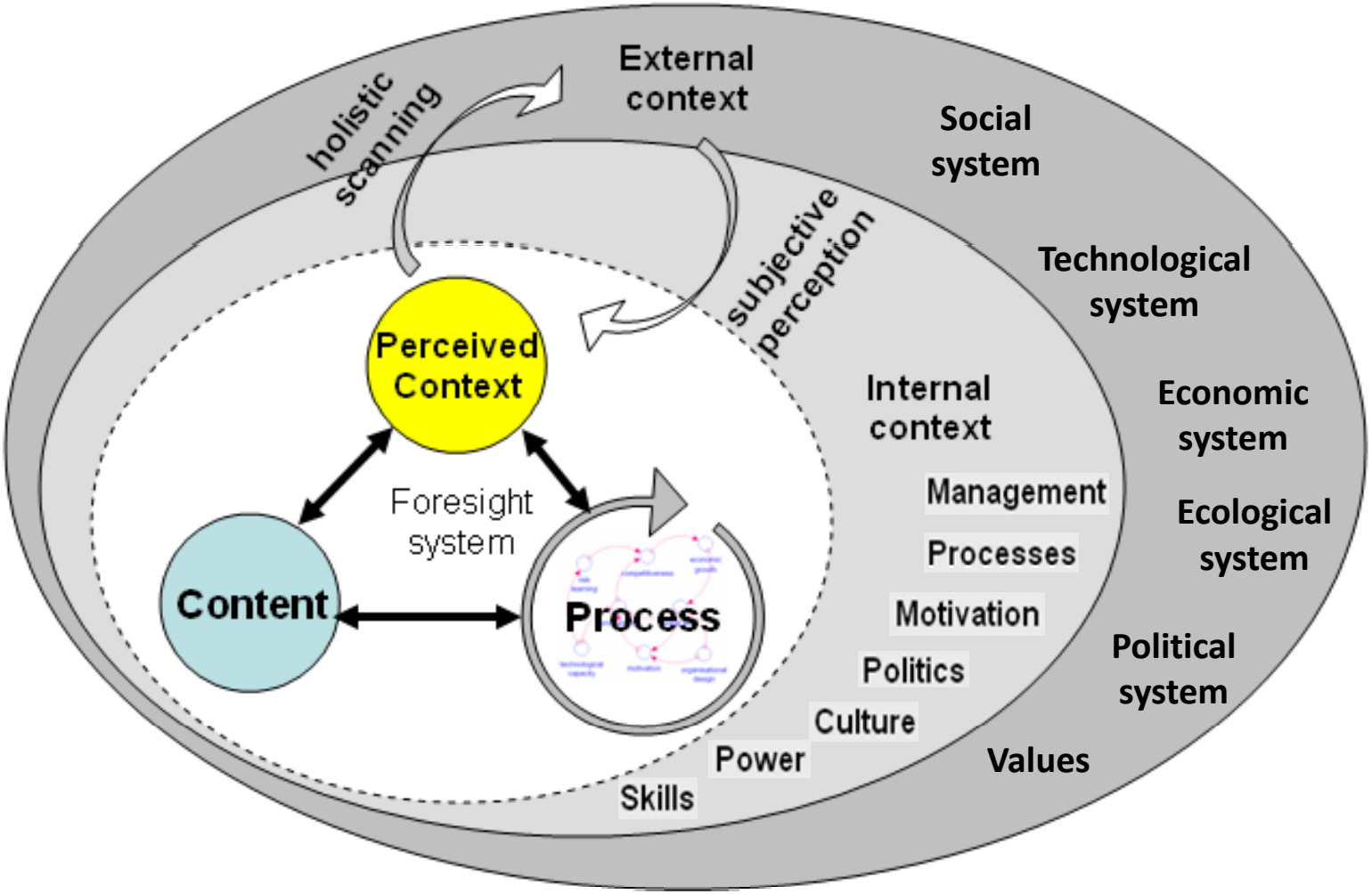
Hierarchy

- The grouping or arrangement of systems according to their higher and lower influence and coverage levels (e.g. upper level systems and sub-systems or nested systems).
- Systems exist as parts of larger wholes, while they themselves provide organisation to their own sub-systems

Continuity

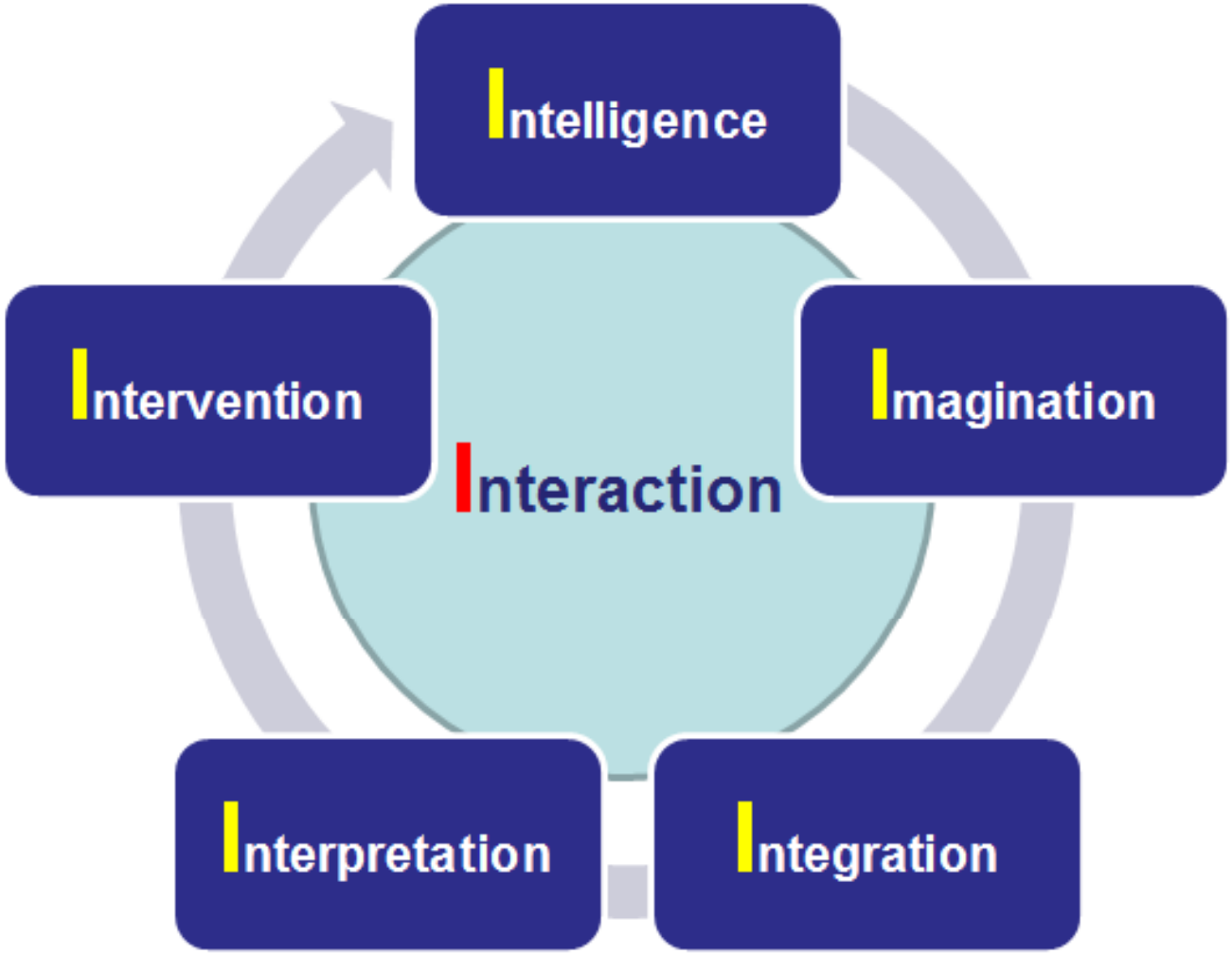
- Systems transform themselves continuously and therefore are dynamic
- This explains an iterative, dynamic and non-linear process
- Two types of continuity (i) Continuity of looped action sequence (ii) The recursion of the looped action sequence in time

Systemic Foresight Methodology: Concept



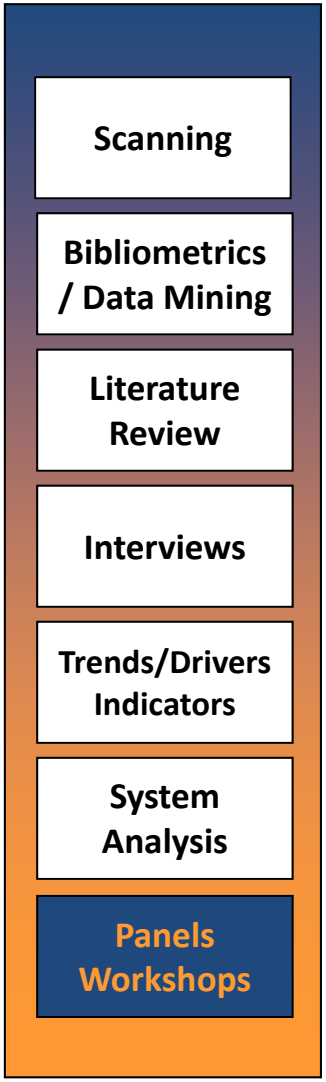

I
Socio
Demography
travel patterns
(business, tourism)
Growth in air travel
Autonomous air travel
more distributed patterns
Technology
IT
Aerotrain
Engines, Aerodynamics
Alt. Fuels
New materials
IT developments / Traffic management
Artificial intelligence
AGRO
Markets / competition
Organisations
Production chains
Business models
Skills
Maintenance
prediction
WTO
standards restrictions
Noise
Safety/ security
Noise levels
Pollution (Airports)
Environment
Env. impact of airports
Transport
Economy
geography
low-cost
Ecological conditions
crises
II
Mapping
Actors
identifying
experts
SWOT
ENVIRONMENT
Systems Approach
Supply-Demand
IV
International collab. / open skies → Global networks
long technology and product development times
Drive time horizon (2030 - 205-)
III
Incremental innovation.
Boeing 707
Airbus 340

Systemic Foresight Methodology: Phases



Intelligence

survey, scan, evidence



Understanding systems spatially, dynamically and historically

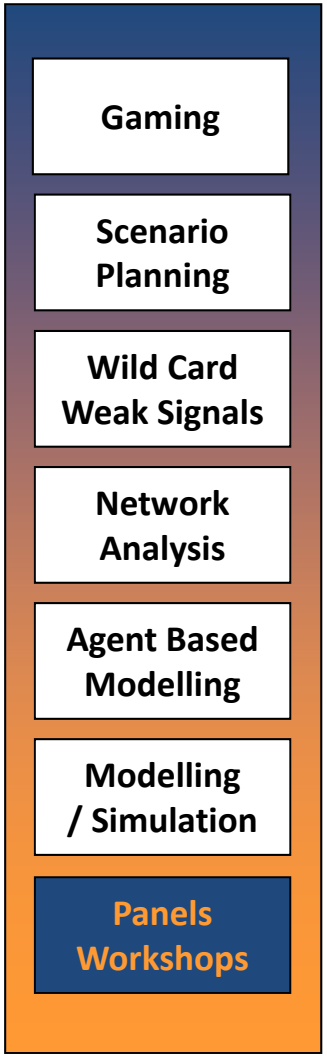
Scanning for Intelligence gathering

- "The systematic examination of potential threats, opportunities and likely future developments which are at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues, as well as persistent problems or trends" (DEFRA, 2002)
- involves analysis of such as Trends, Drivers of Change, Surprises/Shocks, Discontinuities

Selecting the main areas for intervention, the boundaries of the Foresight are drawn and the 'content' of Foresight is built at this phase

Key questions for scanning

- What kind of developments will occur?
- Which ones of them could be beneficial and which ones harmful?
- How soon may these developments occur?
- What might be the first signs that these developments are happening?
- Where and how might the leading indications of impeding change be seen?
- Who is in a position anywhere to observe these indications?
- What is worth to minimise the extent of surprise introduced by these indications?
- Who needs to know about these impending changes?



Imagination

concept model. scenarios, visions

"**Imagination is more than knowledge**" – A. Einstein

Generation of new ideas or concepts, or new associations between existing ideas or concepts

Production of models to promote understanding of systems and situations within the limits of uncertainties

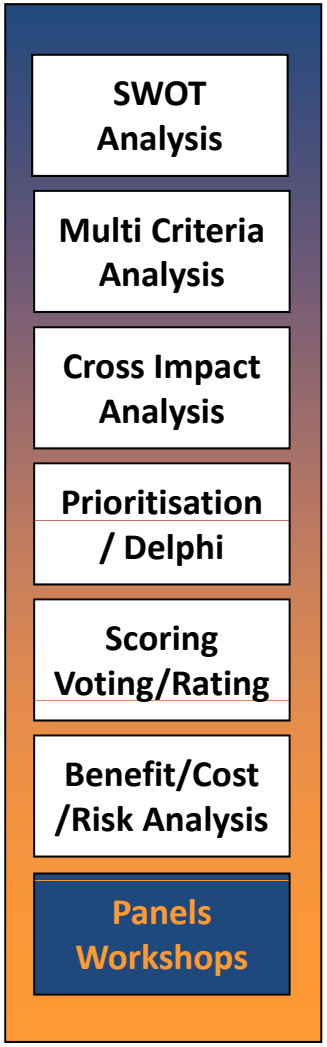
Modelling formalises thought experiments leads to the further development of Foresight process and presentation of the outcome

Jean-Marc Côté's Visions of the Year 2000 (1899)

Hunting by Air

Integration

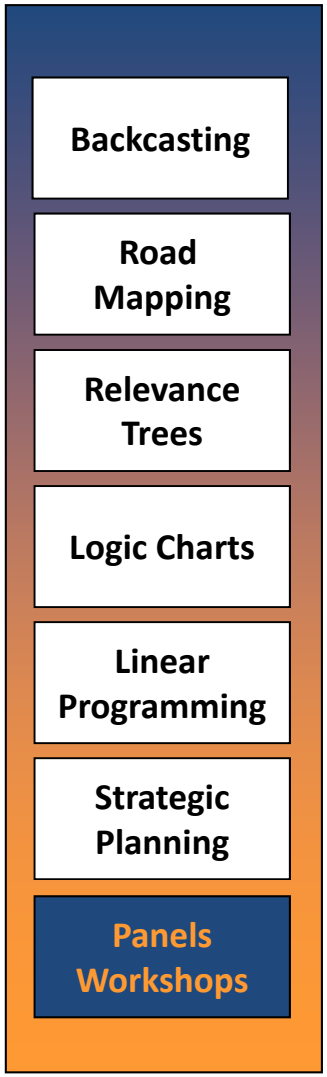
priorities, orders negotiations



- Concerned with the systemic analysis of future alternatives
- The analysis and selection of a desired system is multifaceted as there is a variety of worldviews and expectations to be negotiated.
- For a system to be viable in the long term, the claims of different stakeholders must be considered adequately, and attention must be given to ethical and aesthetic aspects for the pursuit of ideals such as beauty, truth, good and plenty (Ackoff, 1981).
- The end product of this phase is an agreed model of the future

Interpretation

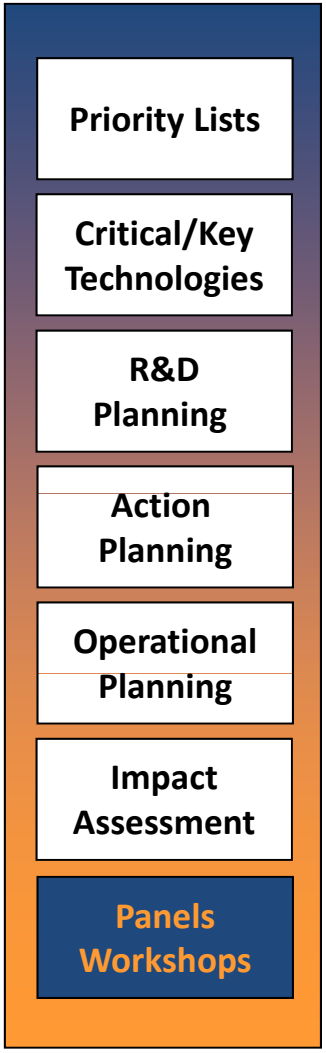
agendas, strategies



- Translates visions into strategies for a successful change programme.
- Conditions for the successful transformation strategies:
  - Assessment (e.g. processing information; developing an understanding of the continuously changing context; and becoming an open learning system)
  - Leadership (e.g. having a context-sensitive leadership; creating capabilities for change; and linking actions with resources)
  - Linking strategic and operational change (e.g. supplying visions, values and directions)
  - Management of human resources (e.g. demonstrating the need for change in people and behaviours)
  - Coherence (e.g. adaptive response to environment; and maintaining competitive advantage)

Intervention

plans, policies, actions



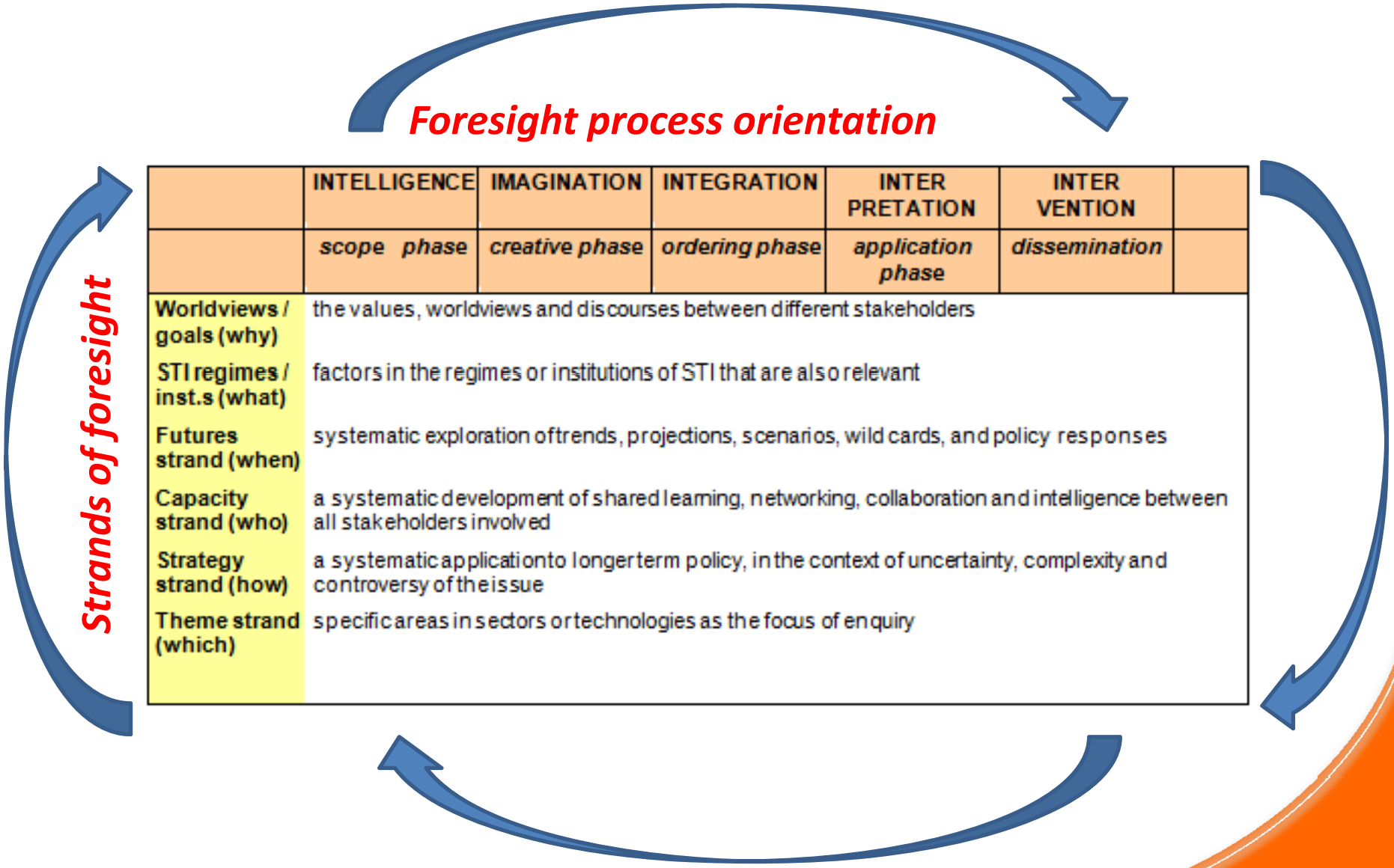
- Any Foresight exercise has to inform policies and actions.
- Foresight suggests actions concerning immediate change actions to implement structural and behavioural transformations.
- Actions for change are determined by considering the following capabilities of the system under investigation:
  - Adapting
  - Influencing and shaping its context
  - Finding a new milieu or modelling itself virtuously in its context
  - Adding value to the viability and development of wider wholes in which it is embedded

Interaction

Interaction

- Shift from ‘government’ to ‘governance’ and thus a new ‘regulatory’ system
  - Inclusiveness and equity through freedom of association and expression, and an organised civil society with full protection of human rights
  - Democratic society influencing, restraining or blocking policy design and implementation
  - Contributions from society, firms, institutions, and associations to enhance public policy within a new normative and legal framework
  - Effectiveness and efficiency in meeting society’s expectations and sustainable use of resources
- The quest for new forms of governance is structured around three pillars: Governance, Socio-cultural evolution & Corporate industrial activity

Systemic Foresight Exercise: Architecture



	INTELLIGENCE	IMAGINATION	INTEGRATION	INTER PRETATION	INTER VENTION	
	scope phase	*creative phase*	*ordering phase*	*application phase*	*dissemination*	
Worldviews / goals (why)	the values, worldviews and discourses between different stakeholders					
STI regimes / inst.s (what)	factors in the regimes or institutions of STI that are also relevant					
Futures strand (when)	systematic exploration of trends, projections, scenarios, wild cards, and policy responses					
Capacity strand (who)	a systematic development of shared learning, networking, collaboration and intelligence between all stakeholders involved					
Strategy strand (how)	a systematic application to longer term policy, in the context of uncertainty, complexity and controversy of the issue					
Theme strand (which)	specific areas in sectors or technologies as the focus of enquiry					

SFM: Methods & Tools

PHASES	INTELLIGENCE	IMAGINATION	INTEGRATION	INTERPRETATION	INTERVENTION
FUNCTIONS	*Scoping / surveying phase*	*Creative phase*	*Ordering phase*	*Strategy phase*	*Action phase*
ACTIVITIES	*Survey, scan, evidence*	*Concept model, visions, scenarios*	*Priorities, analysis, negotiations*	*Agendas, strategies*	*Plans, policies, actions*
Divergent Methods *(more open, creative)*	Horizon scanning	Scenario stories / images	Backcasting	SWOT analysis	R&D planning
	Social Network Analysis	Gaming	Delphi	Strategic planning	Operational research
	Knowledge / research map	Visioning	Success scenarios	Roadmapping	Action planning
	Literature review	Agent –based modelling	Multi-criteria analysis	Cross-impact analysis	Policy impact assessment
Convergent methods *(more specific, quantitative)*	STI policy analysis	Scenario modelling	Risk assessment	Logic framework	Priority lists
	Bibliometric / patent analysis	System dynamics	Cost-benefit analysis	Linear programming	Critical / key technologies

SFM: Example methods

Phases	INTELLIGENCE	IMAGINATION	INTEGRATION	INTERPRETATION	INTERVENTION
Functions	Scoping / surveying phase	Creative phase	Ordering phase	Strategy phase	Action phase
Activities	Survey, scan, evidence	Concept model, visions, scenarios	Priorities, analysis, negotiations	Agendas, strategies	Plans, policies, actions
Divergent Methods (more open, creative)	EHS – Environmental Horizon Scanning	SFV – Societal Future Visions	STH – Six Thinking Hats	FPE – Forward Policy Engagement	RBD – Robust Decision Making
	SOP – State of the Play in the futures field	ISF – Interactive Scenarios Formulation	EPS – Expert Panel Synthesis	FDM – Foresight Decision Models	ARI – Accelerating Radical Innovation
	SFI – State of the Future Index	CSA – Casual Layered Analysis	SBC – Situational Back Casting	CIA – Cross Impact Analysis	THI – Triple Helix Integration
	CTI – Competitive Technical Intelligence	ABM – Agent Based Modelling	CSF – Critical Success Factors	TRM – Technology Road mapping	TIA – Trend Impact Analysis
	STM – Statistical Trend Modelling	SAG – Simulation and Games	RTD – Real Time Delphi	TSA – Technology Sequence Analysis	APM – Action Priority Matrix
Convergent methods (more specific, quantitative)	TDM – Technology Data Mining	GFI – Genius Forecasting and Intuition	CSC – Computerised Scenario Comparisons	FRT – Factor Relevance Trees	CKT – Critical & Key Technologies

Applications of Systemic Foresight

Recent and ongoing applications:

- Higher Education Foresight – UK, TR
- Renewable Energy Foresight – Berlin-Brandenburg
- Science Park Foresight for Ankara University
- Mauritius National Research Foresight Exercise
- Technology Trend Monitoring Methodology for Russia
- Manchester Energy and Security Horizon Scans for the University of Manchester

Manchester Energy

Developing world leading technologies and solutions

- GRIP
- Insularm
- Eco Cities
- Manchester Bobber
- CoEBio3

Horizon Scanning of Energy Research

Focusing on one of the biggest areas of research at The University of Manchester, the Energy Horizon Scanning activity will shortly begin to explore the innovations being developed at the University. Horizon Scanning is 'the systematic examination of potential threats, opportunities and likely future developments which are at the margins of current thinking and planning'[1]. The technique is commonly used in Foresight exercises to uncover emerging issues, and identify future surprises and shocks by looking ahead beyond usual timescales.

Funded by the University EPSRC Knowledge Transfer account, the Horizon Scanning activity will examine the potential to increase the impact of our current research, and will set priorities for the future research and education agenda by proposing a research and innovation strategy. The activity will engage with the energy research community across the University and involve participants from industry and public sector.

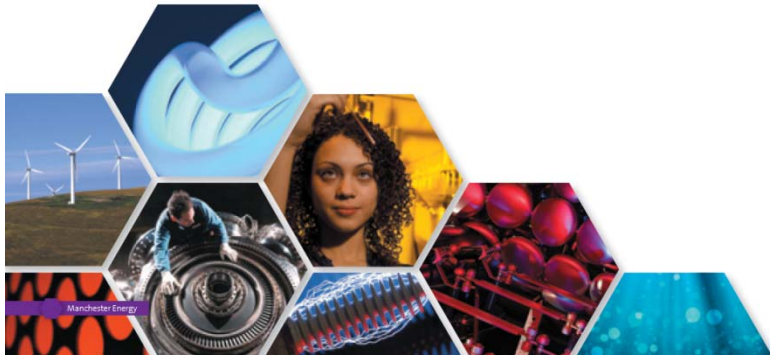
If you would like to find out more about the Horizon Scanning activity, please visit www.energy.manchester.ac.uk

1 http://horizonscanning.defra.gov.uk/default.aspx?menu=menu&module=About

Foresight for Manchester Energy Knowledge Transfer

The Systemic Foresight Methodology is proposed to facilitate the ongoing development of Manchester Energy. It will:

- i) explore future trends and uncertainties;
- ii) connect these to current research activity and capability;
- iii) identify pathways to increase the impact of EPSRC-funded research; and
- iv) inform strategic planning at the School, Faculty and University levels.



Goals of Energy Horizon Scan

The overall Systemic Foresight process will aim to:

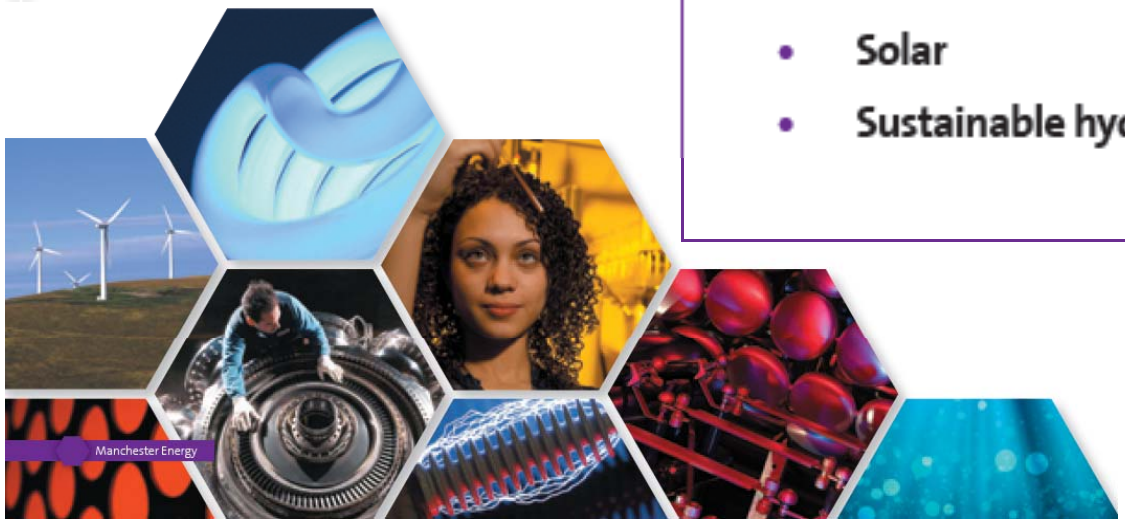
- Promote links between different disciplines, institutions, public and private sectors.
- Inform and involve the research community, industry and policy makers in a priority setting process.
- Increase the impact of current research and propose a research and innovation strategy, action plan and roadmap.

Priority challenge areas

MANCHESTER 1824

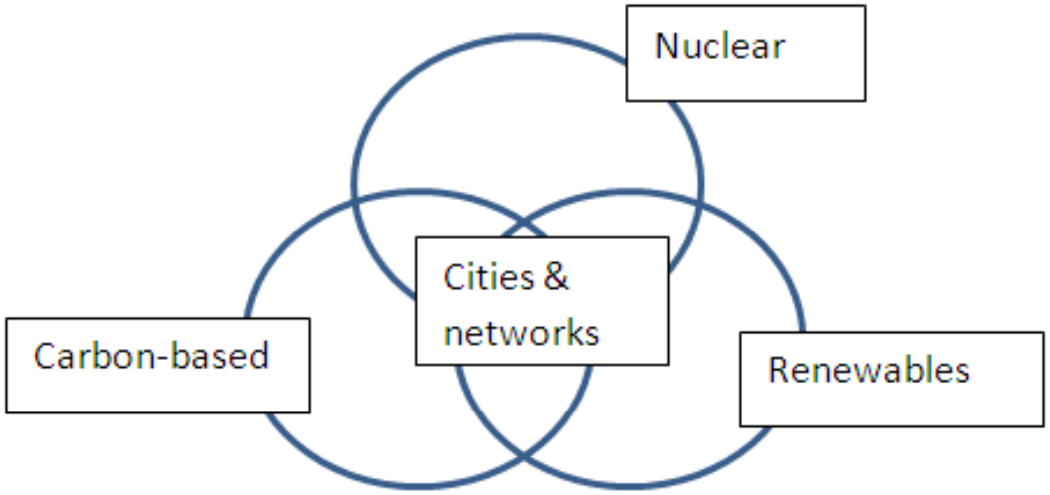
Manchester Energy Challenge Areas:

- Policy and system modelling
- Affordable energy
- Bioenergy
- Cities
- Future electricity networks
- Nuclear
- Offshore renewables
- Solar
- Sustainable hydrocarbons



Organisation of the working groups

Four working groups are established:



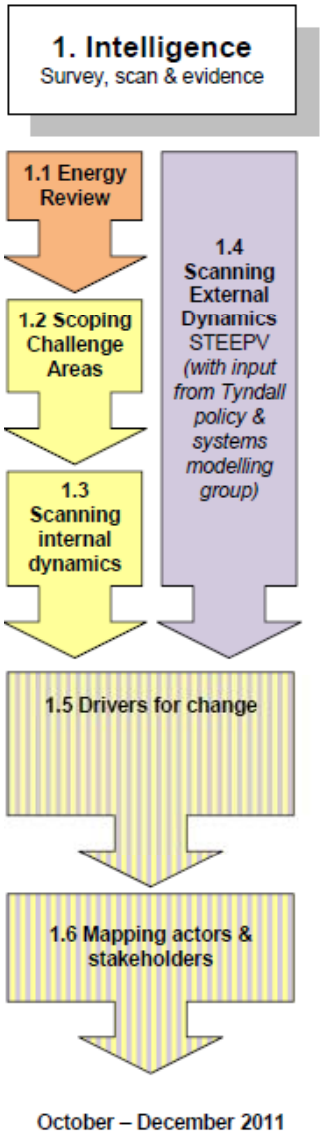
- The Nuclear group will focus on reactor technologies, structural integrity and decommissioning.
- Renewables will focus on Solar, Bioenergy and Offshore Renewables.
- Sustainable Hydrocarbons will be focused by the third group on Carbon-based energies.
- Cities, Affordable Energy and Networks will consider the demand side of energy and will discuss the potentials of this demand to shape energy supply and agenda.

Methodology

The Systemic Foresight Methodology (Saritas, 2006) provides a conceptual framework for the design and implementation of the Foresight exercise for Manchester Energy. The proposed methodology consists of a five-stage process model:

- Intelligence
- Imagination
- Integration
- Interpretation
- Intervention

Phase 1: Intelligence



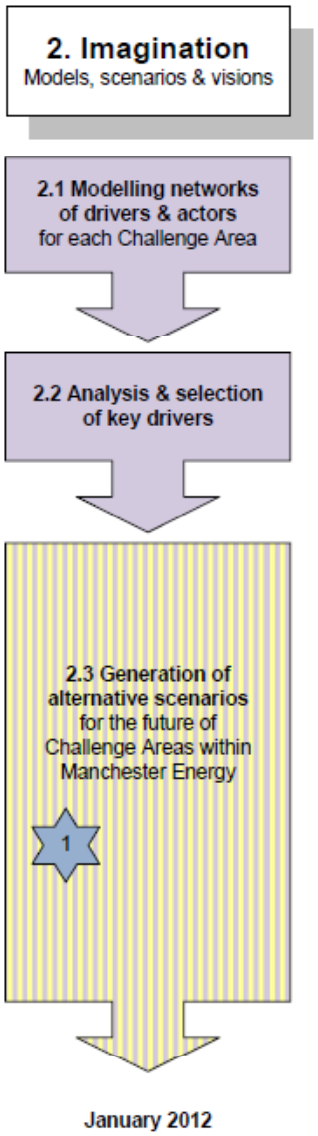
Three main activities:

- **Scoping internal capability**: the Manchester Energy team will produce 4-6 page summaries outlining key academic staff, capabilities, facilities and external stakeholders. This phase will explore how university energy capacity and agenda may shape the energy demand in the future.
- **Horizon Scanning activities**: HS will look at the STEEPV systems and analyse trends, drivers, weak signals, wild cards and discontinuities at global, national and sectoral scales. Looking at the changes in the outer world, this phase will explore at the demand dynamics, which may shape the energy supply agenda.
- **Stakeholder mapping**: This step will look at the key players and stakeholders within the field of Energy. A systematic process will be used to map the actors, their expectations and relationships with each other.

Expected outputs:

- A review of energy sector futures which will identify key drivers of change with impacts on research, education and the Energy sector in 5, 10 and 20 year horizons.
- A compendium of internal capability include mapping of academics and external stakeholders.
- A list of key players with the analysis of potential synergies and conflicts between them.

Phase 2: Imagination



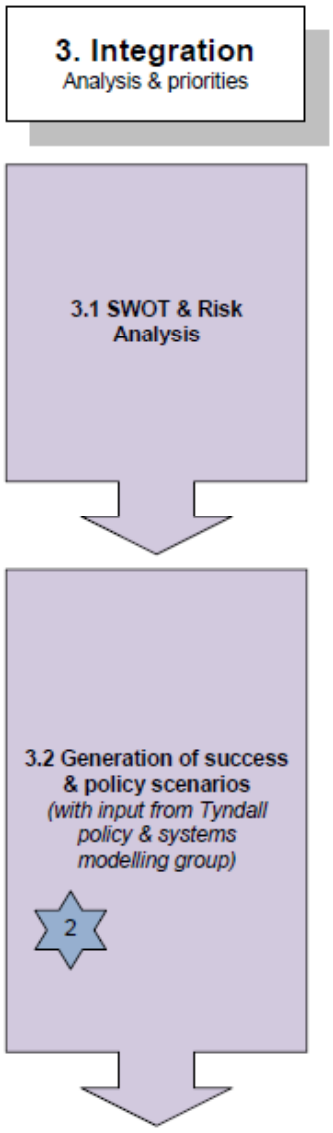
Covers a scenario development process through workshops. Network analysis and modelling approaches will be used as supplementary tools. The main activities of this phase will be:

- Identification and review of existing Energy scenarios from accountable sources.
- Identifying a range of drivers of change and modelling networks of drivers to determine the key drivers of change and central issues.
- Analysis and selection of key drivers of change, which have high potentials to shape the future energy supply and demand.
- Alternative scenarios for the future of energy, which will be generated using the cross-fertilisation of the key drivers

Deliverables from this phase will be:

- Scenario reports (max. 5 pages each) outlining the key drivers and four scenarios; and
- Scenario workshop with all Challenge Area leaders and external experts.

Phase 3: Integration



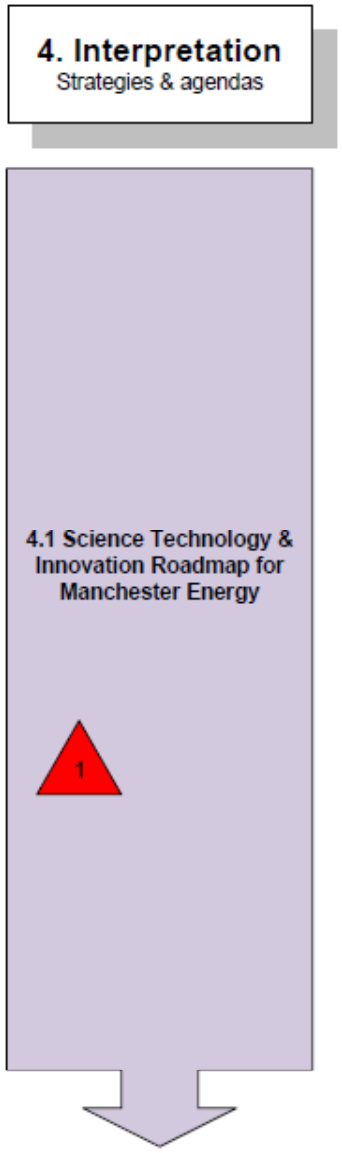
Key questions: “where and how far Manchester can influence these scenarios?”. Work will establish how different research teams working on solutions for the energy sector might increase the impact of current research and plan successful activities in future. The main activities of this phase are:

- SWOT & Risk analysis. Analysis will be conducted for each scenario. Common strengths and opportunities in all scenarios will constitute the backbone of the success/policy scenario, while common weaknesses and threats will be addressed with policy interventions.
- Success scenario. This involves the formulation of a visionary scenario, which may remain robust under the alternative scenarios outlined.
- Extended scenarios reports for each Energy team, outlining what scenario is chosen by the researchers for what reasons.

Deliverable from this phase will be:

- A visionary policy scenario for Energy at Manchester.

Phase 4: Interpretation

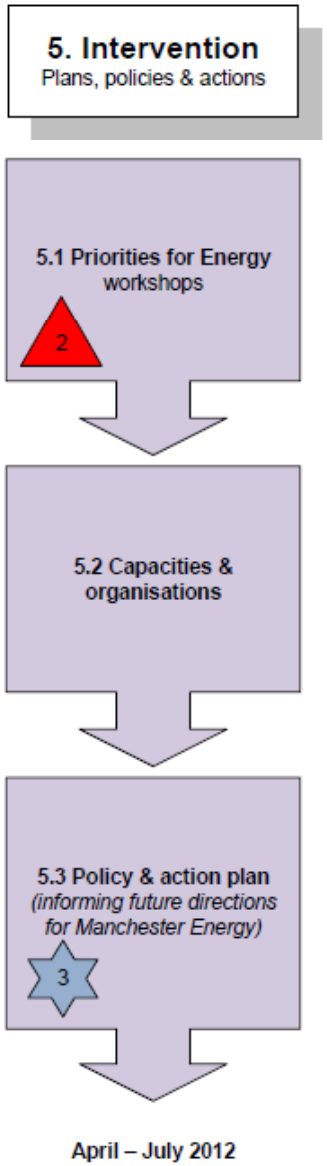


This phase will develop a Science, Technology and Innovation Roadmap to bring together goals and objectives with policies, programmes, actors and milestones. The roadmap will portray the relationships between research, development and innovation needs on the demand side and capacities on the supply side.

Deliverable from this phase will be:

- A roadmap for Manchester Energy and, as well as a summary commenting on common issues and key dates in pursuing the different paths of future research for each of the Challenge Areas.
- An nearly completed interim version of this roadmap will be presented during the Manchester Energy week commencing May 14, 2012 for further consultation and dissemination shortly afterwards.

Phase 5: Intervention



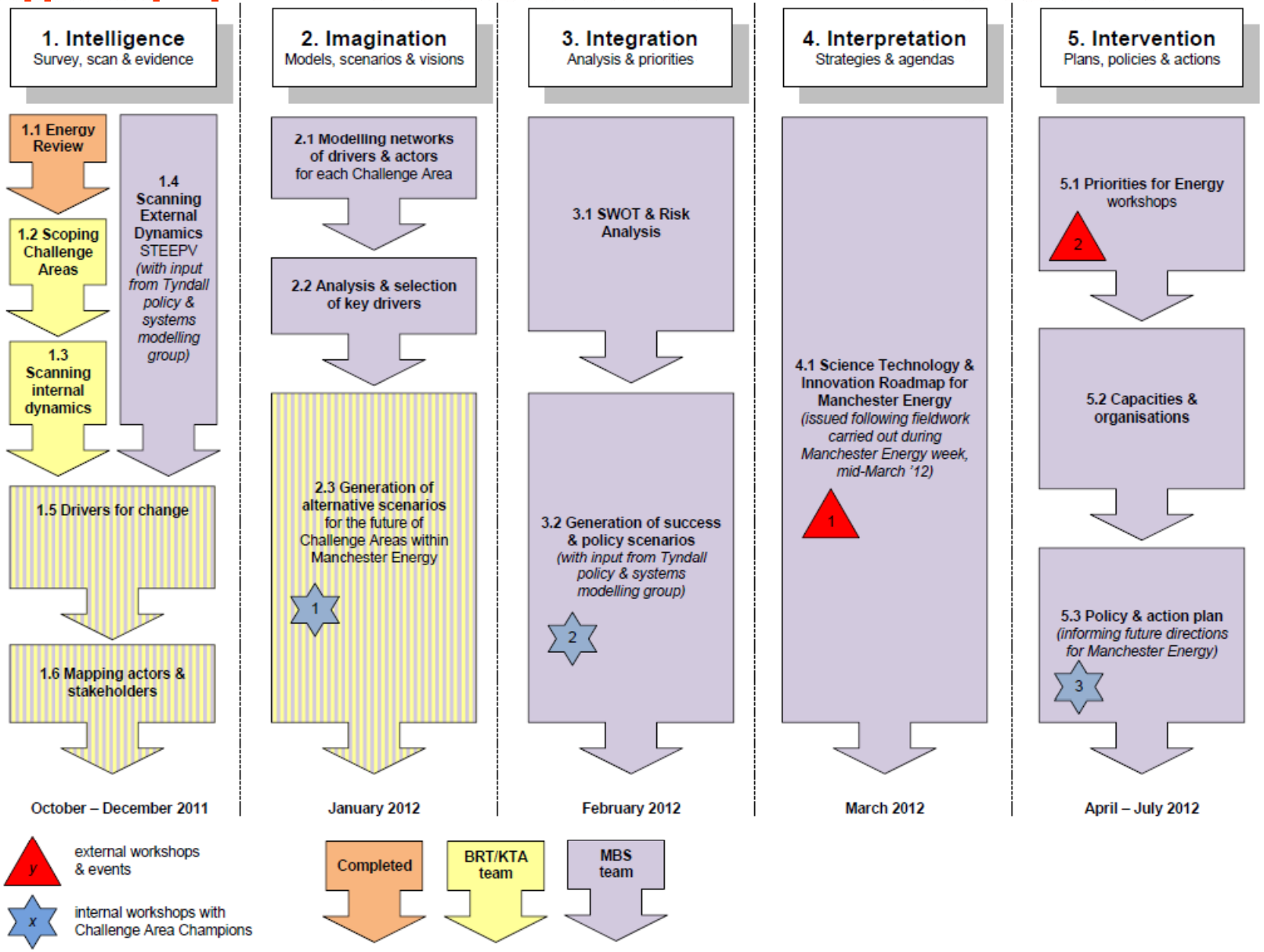
Phase 5 will take futures and strategy strands from the earlier phases and will involve a structured assembly and analysis of priorities, policies, and actions.

The main activities of this phase are:

- Priorities for Energy at Manchester will be identified. This will involve a survey to consult the wider research, development and innovation community. Survey results will be discussed in a workshop.
- Preparation of action plans for each Challenge Area identifying the inter-connections between visions, cross-cutting themes and capacities, supported with quantitative targets where possible.
- A capacity building programme to mobilise the research, development and innovation community.

A final report will be produced to represent the results of the Energy Foresight exercise in a most useful and effective way.

Energy Foresight: Overall Methodology



Some conclusions for SFM

Systemic & inter-connected problems
- call for –

Systemic & inter-connected solutions ***("development pathways")***
-based on –

Systemic analysis, methods, tools
- supported by -

Systemic theory & cognitive framework
- implemented with –

Systemic information / intelligence systems

End of presentation.

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